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(54) **LED SIGNAL LAMP**

(57) An LED signal lamp which includes at least one white LED illumination unit, and at least one light filter each is provided in a light path of each of the white LED illumination unit for filtering at least one portion of light beams of the white LED illumination unit to provide non-white light beams of a predetermined color. Thus colored signal lamp is provided via white LED illumination units, the light efficiency is enhanced, the structure is simple, and the manufacturing costs are low.

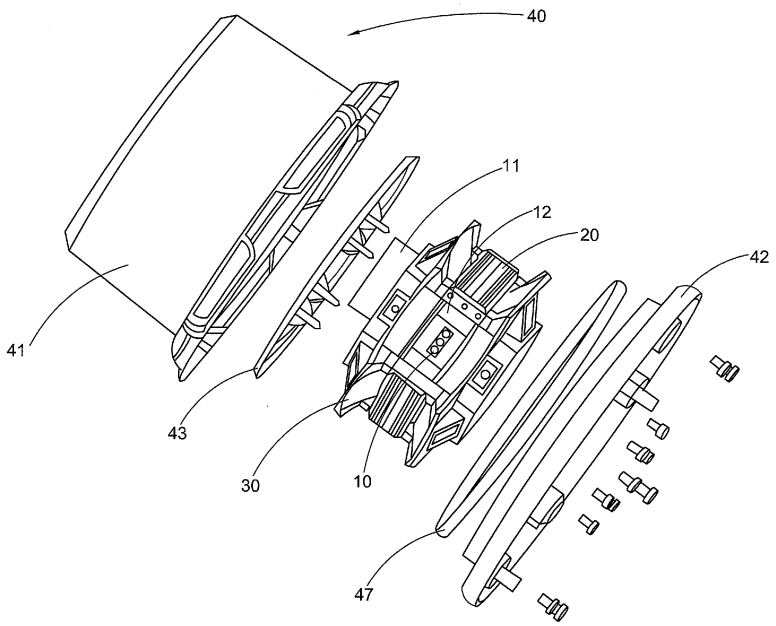

FIG. 1

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Description

FIELD OF INVENTION

[0001] The present invention relates to a signal lamp, and more particularly to a signal lamp which uses one or more white LEDs as a light source.

DESCRIPTION OF RELATED ARTS

[0002] A signal lamp such as an emergency vehicle lighting and a pharos generally give an alarm or send a signal to people by colorful lights. For example, a vehicle of the policemen or firemen generally uses an emergency vehicle lighting with red and blue lightings which follow each other in rotation or just uses red lighting. The lighting used during an emergency construction may be yellow warning lamps. An ambulance is generally provided with blue signal lamps. In order to enhance the warning effect, the vehicle of the policemen can be provided with flashing lighting. More specifically, a spinning mirror which is powered by an electric motor is provided around a bulb for creating rotating beams of light, or a flash light circuit is provided in a chip of the lamp, so that the lamps appeared to flash when viewed.

[0003] Recently, LED lighting becomes a new light source besides the incandescent lamps, the fluorescent lamps, and the gas discharge lamps. The LED lighting has many advantages in comparison with other lighting sources, such as its low voltage, long lifespan, small volume, light weight, fast response, no radiation, no pollution, and durable in bad working conditions. Therefore, the development of LED lighting as the light source of the signal lamps has become a new trend.

[0004] A signal lamp is generally identified by its colorful light and a warming effect can be performed by the colorful light. For example, a conventional LED signal lamp may use a red chip, a blue chip, or a yellow chip which is encapsulated in a transparent housing for producing corresponding red light, blue light, or yellow light. However, the current industry has focused on the development of white LEDs and little research is made on the red chips, blue chips, and the yellow chips. In other words, a white LED has been developed to have a relatively high effective luminous flux and the value is still increasing. However, the effective luminous flux of these colored chips still remains at a relatively low level, and it is not efficient to use colored chips to provide colored lightings.

[0005] In addition, the current research has mainly focused on increasing the luminous flux of the LED chips, the physical structure of the LED lamp has not been modified for reducing the light loss. In other words, the current research seldom optimizes the structure of the LED lamp to reduce the blind illumination areas so as to gather light beams and increase the light efficiency of the LED lamps.

SUMMARY OF THE PRESENT INVENTION

[0006] The main object of the present invention is to provide an LED signal lamp which uses white LEDs as its light source, wherein a light path of the light source with white LEDs is provided with a light filter arranged for filtering at least a portion of light beams of the white LEDs into non-white light beams, so that white LEDs can be used for forming non-white signal lamps.

[0007] Another object of the present invention is to provide an LED signal lamp which comprises a plurality of rows of successively arranged white LEDs and a plurality of corresponding rows of light filters, so that the plurality of rows of white LEDs is capable of providing evenly distributed light beams.

[0008] Another object of the present invention is to provide an LED signal lamp, wherein each light filter is provided in front of corresponding white LED illumination unit at a position that the light filter is capable of condensing light beams of the white LED illumination unit, so that a light condensing effect is provided. Simultaneously, the light filter is also a filtering lens which is arranged for filtering the white light beams of the white LED illumination unit to yield colored light beams. In other words, the light filter is provided with two functions: light condensing and light filtering functions.

[0009] Another object of the present invention is to provide an LED signal lamp, wherein each white LED illumination unit is provided with a light filter and a light reflecting surface which are arranged for collecting the light beams, so that light intensity is enhanced in comparison with a signal lamp with colored LED illumination units.

[0010] Another object of the present invention is to provide an LED signal lamp, in comparison with a conventional art in which colored chips are provided for providing a light source and a transparent housing is provided for meeting the requirement of a high luminous flux so as to reduce the attenuation, the LED signal lamp of the present invention can be provided with a colored housing corresponding to the predetermined color of the colored chip, so that the light beams projected from the white LED illumination unit pass through a colored light distributor (colored housing) to provide colored light beams of relatively high purity. In addition, the colored housing itself can perform a decoration and warning effect.

[0011] Another object of the present invention is to provide an LED signal lamp, in comparison with a conventional art in which colored chips such as yellow chips are provided for providing a light source, the attenuation will be about 50% in thirty minutes, there is a rare attenuation for the white LEDs when the white LEDs are employed to used as light source of the LED signal lamp of the present invention, so that the LED signal lamp of the present invention is capable of obtaining a relatively high light intensity.

[0012] Another object of the present invention is to provide an LED signal lamp, wherein white LED illumination units are introduced for replacing the colored LED illumi-

nation units such as red LED illumination units, blue LED illumination units, and yellow LED illumination units, the structure is simple, the manufacturing process is easy, and the manufacturing costs are low.

[0013] Additional advantages and features of the invention will become apparent from the description which follows, and may be realized by means of the instrumentalities and combinations particular point out in the appended claims.

[0014] According to the present invention, the foregoing and other objects and advantages are attained by an LED signal lamp comprising at least one white LED illumination unit, and at least one light filter each is provided in a light path of each of the white LED illumination unit for filtering at least one portion of light beams of the white LED illumination unit to provide non-white light beams of a predetermined color.

[0015] According to an embodiment of the present invention, the light filter is provided at a position in the light path of each of the white LED illumination unit allowing the light filter to perform a light condensing effect, wherein the light filer is capable of performing both a light filtering effect and the light condensing effect.

[0016] According to an embodiment of the present invention, the light filter comprises a lens which is capable of condensing light beams.

[0017] According to an embodiment of the present invention, the LED signal lamp further comprises at least one light reflecting surface for reflecting another portion of light beams of the corresponding white LED illumination unit.

[0018] According to an embodiment of the present invention, the another portion of light beams of the white LED illumination unit reflected by the light reflecting surface and the portion of the light beams of the white LED illumination unit filtered by the light fitter project in a same direction, so that a light condensing effect is provided.

[0019] According to an embodiment of the present invention, the light reflecting surface is a structure selected from a group consisting of a first structure and a second structure, wherein in the first structure, each of the white LED illumination units is provided with a light reflecting device, wherein the light reflecting surface is an inner surface of the light reflecting device, wherein in the second structure, each of the white LED illumination units is provided with a heat dissipating device, wherein the light reflecting surface is an inner surface of the heat dissipating device.

[0020] According to an embodiment of the present invention, the LED signal lamp further comprises a housing which includes a light distributor allowing light beams of predetermined color to pass through.

[0021] According to an embodiment of the present invention, the light distributor is further used for distributing a direction of the light beams.

[0022] According to an embodiment of the present invention, at least one mounting element is provided for mounting the each of the light filters and the corresponding heat dissipating device and the light distributor in position.

[0023] According to an embodiment of the present invention, the predetermined color is selected from a group consisting of red, blue, yellow, green, and purple.

[0024] According to an embodiment of the present invention, the light filter is selected from a group consisting of a convex lens and a Fresnel lens which is capable of providing light filtering effect.

[0025] According to an embodiment of the present invention, the light filter is selected from a group consisting of a vehicle emergency lighting, a warning lamp, a pharos, a ship navigation lighting, and a building aero obstruction lighting.

[0026] According to an embodiment of the present invention, the LED signal lamp comprises a plurality of the white LED illumination units, wherein the plurality of white LED illumination units are arranged to form a plurality of rows of white LED illumination units, wherein lines of the plurality of rows of white LED illumination units are intersected to form a polygonal shape, wherein each row of white LED illumination units comprises one or more the white LED illumination units.

[0027] According to an embodiment of the present invention, the LED signal lamp further comprises a control module arranged for selectively turn on and turn off the plurality rows of white LED illumination units so as to provide a predetermined signal lighting pattern of the LED signal lamp.

[0028] According to an embodiment of the present invention, the control module selectively clockwise and counterclockwise turn on the plurality of rows of white LED illumination units to provide a flashing lighting effect.

[0029] According to an embodiment of the present invention, the control module controls to have at least one row of white LED illuminating units of the plurality of rows of white LED illuminating units being turned on so as to keep a signal lighting of the LED signal lamp being not interrupted.

[0030] According to an embodiment of the present invention, the control module control the operation of the plurality of rows of white LED illumination units to provide an illumination of an angle range selectively from a group consisting of 30°, 45°, 60°, 90°, 120°, and 180°.

[0031] The present invention further provides a method of manufacturing an LED signal lamp comprising the following steps.

[0032] (a)Project white light beams via at least one white LED illumination unit.

[0033] (b)Filter at least one portion of the white beams to harvest non-white light beams.

[0034] The present invention further provides an LED signal lamp comprising at least one LED illumination unit, and at least one light processer each is provided in a light path of each of the white LED illumination unit for condensing at least one portion of light beams of the white LED illumination unit before the light beams project to outside.

[0035] According to an embodiment of the present invention, the LED signal lamp further comprises at least one light reflecting surface for reflecting another portion of light beams of the corresponding white LED illumination unit, wherein the another portion of light beams of the white LED illumination unit reflected by the light reflecting surface and the portion of the light beams of the white LED illumination unit filtered by the light fitter project in a same direction.

[0036] According to an embodiment of the present invention, the LED illumination unit is a white LED illumination unit, wherein the light processer is further provided with a light filtering effect for filtering the at least one portion of light beams of the white LED illumination unit to provide non-white light beams of a predetermined color.

[0037] According to an embodiment of the present invention, the light processer is selected from a group consisting of a convex lens and a Fresnel lens which is capable of providing a light filtering effect, wherein the light filter is provided at a position in the light path of each of the white LED illumination unit allowing the light filter to provide a light condensing effect, wherein the light filer is capable of performing both a light filtering effect and the light condensing effect.

[0038] According to an embodiment of the present invention, the light processer is selected from a group consisting of a convex lens and a Fresnel lens which is capable of providing a light filtering effect, wherein the LED illumination unit is selected from a group consisting of a white LED illumination unit, a yellow LED illumination unit, a red LED illumination unit, a blue LED illumination unit, a green LED illumination unit and a purple LED illumination unit.

[0039] According to an embodiment of the present invention, the plurality of white LED illumination units are arranged to form a plurality of rows of white LED illumination units, wherein lines of the plurality of rows of white LED illumination units are intersected to form a polygonal shape so as to provide a radial illumination.

[0040] According to an embodiment of the present invention, the lines of the plurality of rows of white LED illumination units are intersected to form a regular polygonal shape.

[0041] According to an embodiment of the present invention, the predetermined color is selected from a group consisting of red, blue, yellow, green, and purple.

[0042] According to an embodiment of the present invention, the light reflecting surface is a structure selected from a group consisting of a first structure and a second structure, wherein in the first structure, each of the white LED illumination units is provided with a light reflecting device, wherein the light reflecting surface is an inner surface of the light reflecting device, wherein in the second structure, each of the white LED illumination units is provided with a heat dissipating device, wherein the light reflecting surface is an inner surface of the heat dissipating device.

[0043] According to an embodiment of the present invention, the LED signal lamp further comprises a housing which includes a light distributor allowing light beams of predetermined color to pass through and to be evenly distributed.

[0044] The LED signal lamp of the present invention may employ an LED member which is specially packaged to provide light beams of a predetermined color other than white. Therefore, according to another aspect of the present invention, the present invention provides an LED signal lamp comprising: at least one LED member serving as a light source, wherein each of the LED members comprises at least one white LED illumination unit, wherein the white LED illumination unit is packaged in the corresponding LED member in such a manner that light beams projecting out from the LED member are light beams of a predetermined color other than white, so that the LED signal lamp is capable of providing desired colored light beams.

[0045] According to an embodiment of the present invention, each of the white LED illumination unit is provided with a transparent package member which has a color filtering effect, wherein white light beams emitting from the white LED illumination unit are filtered by the corresponding colored transparent package member so as to harvest light beams of the predetermined color.

[0046] According to an embodiment of the present invention, the LED signal lamp further comprises at least one light condenser and at least one light reflector, wherein the light condenser is provided at a position in a light path of the LED member in such a manner that the light condenser is capable of providing a light condensing effect, wherein a portion of the light beams projecting out from the LED members is reflected by the light reflector, wherein another portion of the light beams projecting out from the LED members is condensed by the light condenser, wherein both of the first and second portion of the light beams projecting out from the LED members are collected to substantially project along a same direction, so that a light collecting effect is provided.

[0047] Still further objects and advantages will become apparent from a consideration of the ensuing description and drawings.

[0048] These and other objectives, features, and advantages of the present invention will become apparent from the following detailed description, the accompanying drawings, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0049]

Fig. 1 is an exploded view of an LED signal lamp according a first preferred embodiment of the present invention.

Fig. 2 is a schematic view illustrating the outer appearance of the LED signal lamp according to the above preferred embodiment of the present inven-

tion.

Fig. 3 is a sectional view of the LED signal lamp according to the above preferred embodiment of the present invention.

Fig. 4 is a schematic view illustrating an internal structure of the LED signal lamp according to the above preferred embodiment of the present invention.

Fig. 5 is a sectional view of the LED signal lamp illustrating the lighting beams from the white LED illumination units being collected and filtered into light beams with desired color according to the above preferred embodiment of the present invention.

Fig. 6A is an enlarged partial view of an LED signal lamp according to a second preferred embodiment of the present invention.

Fig. 6B is an enlarged partial view of an LED signal lamp according to an alternative mode of the second preferred embodiment of the present invention.

Fig. 7 is an exploded view of an LED signal lamp according a third preferred embodiment of the present invention.

Fig. 8 is a schematic view illustrating the outer appearance of the LED signal lamp according to the above third preferred embodiment of the present invention.

Fig. 9 is a sectional view of the LED signal lamp according to the above third preferred embodiment of the present invention.

Fig. 10 is a schematic view illustrating an internal structure of the LED signal lamp according to the above third preferred embodiment of the present invention.

Fig. 11 is a sectional view of the LED signal lamp illustrating the lighting beams from the white LED illumination units being collected and filtered into light beams with desired color according to the above preferred embodiment of the present invention.

Fig. 12 is an enlarged partial view of an LED signal lamp according to a fourth preferred embodiment of the present invention.

Fig. 13 is an enlarged partial view of an LED signal lamp according to an alternative mode of the above fourth preferred embodiment of the present invention.

Fig. 14 is a perspective view of an LED signal lamp according to a fifth preferred embodiment of the present invention.

Fig. 15 is a schematic view illustrating the internal structure of the LED signal lamp according to the above preferred embodiment of the present invention.

Fig. 16 is a schematic view illustrating the LED member of LED signal lamp according to the above preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0050] The following description is disclosed to enable any person skilled in the art to make and use the present invention. Preferred embodiments are provided in the following description only as examples and modifications will be apparent to those skilled in the art. The general principles defined in the following description would be applied to other embodiments, alternatives, modifications, equivalents, and applications without departing from the spirit and scope of the present invention.

[0051] Referring to Figs. 1 to 5 of the drawings, an LED signal lamp according to a first preferred embodiment of the present invention is illustrated. The LED signal lamp according to this preferred embodiment of the present invention can be embodied as an emergency vehicle lighting (a warning lamp) which comprises a plurality of light sources and a plurality of light filters **20** respectively provided in light paths of the light sources.

[0052] According to the present invention, the plurality of light sources can be embodied as a plurality of white LED illumination units **10.** The plurality of white LED illumination units **10,** which is accessible in the market, can be pubic-sold white LED illumination units of single chip type or multichip type. The plurality of light filters **20** is respectively provided in light paths of the plurality of white LED illumination units **10.** For example, each of the plurality of light filters **20** is provided at one side of each of the plurality of white LED illumination units **10** so as to filter at least a portion of white light beams of each white LED illumination unit **10** into light beams which are not white colored, so that a non-white colored signal lamp is formed. According to this preferred embodiment, the plurality of light filters **20** can filter at least a portion of the light beams of the plurality of white LED illumination units **10** respectively to obtain single colored light beams such as red, blue, green, yellow, and purple light beams, so that red, blue, green, yellow, or purple LED signal lamps can be provided. As an example, the plurality of light filters **20** of this preferred embodiment filters at least a portion of the light beams of the plurality of white LED illumination units **10** respectively to obtain red or yellow warning lamps.

[0053] The principle of the colored signal lamp of the

present invention is to filter the light beams of the plurality of white LED illumination units **10** so as to obtain colored signal lighting. High quality light source of white LED illumination units is easy to obtain from the market. In comparison with the conventional art in which colored LED illumination units are directly used as the light source, the LED lamp of the present invention is easier to obtain a relatively high light intensity while the costs are low. For example, a white LED illumination unit with a luminous flux about **150**lm is easy to obtain in the market, when the light beams of the white LED illumination unit is filtered to provide colored light beams via the light filter **20,** the obtained colored light beams still has a light intensity which is significantly larger than a light intensity of a conventional signal lamp which uses colored LED chips as the light source. For example, in the yellow warning lamp of the present invention, the light beams may be filtered by the light filter **20** to obtain yellow light beams which is about **60%** of the total light beams of the yellow warning lamp, the obtained luminous flux of the yellow beams is about **90**lm which is stiller significantly higher than the luminous flux of the public-sold yellow LED illumination unit which is about **50~60**lm.

[0054] The terms "filter, filtered, and filtering" of the present invention are referred to a process in which the light beams of the white LED illumination units **10** are respectively processed by the plurality of light filters **20** to obtain light beams of a single predetermined color which is not white colored. The predetermined color may be red, blue, green, yellow and the like.

[0055] Since each white LED illumination units **10** which can be accessed from the market already has a relatively high luminous flux, and the research on the white LED illumination units is still going on, thus the luminous flux of the white LED illumination units **10** can be further increased. However, little research is made on the colored LED illumination units and the luminous flux of the colored LED illumination units still maintains a relatively low level. Therefore, when the white LED illumination units are used as light source of colored light signal lamp, the white LED illumination units of high luminous flux are easy to obtain from the market, so that the manufacturing process is easy.

[0056] It is worth mentioning that the LED signal lamp of the present invention can comprise at least two arrows of white LED illumination units **10.** For example, the LED signal lamp may comprises three rows, four rows, six rows, eight rows, or twelve rows of the white LED illumination units **10.** Each row of the white LED illumination units **10** may comprise one or more white LED illumination units **10.** Therefore, the plurality of rows of white LED illumination units are successively arranged in such a manner that the lines of the plurality of rows of white LED illumination units **10** may be intersected with each other to form an equilateral triangular shape, a square shape, a regular hexagonal shape, a regular octagonal shape, a regular dodecagonal shape, or other regular polygonal shapes. It is worth mentioning that the plurality of white LED illumination units **10** may not be arranged to form a regular polygonal shape so as to provide a LED signal lamp which provides a lighting of a circular section shape rather than a circular radial lighting. The present invention is not limited in this aspect, and the shapes may be varied according to different actual requirements.

[0057] It is thus can be seen that when the number of the rows of the plurality of the white LED illumination units **10** increases, the light beams of the white LED illumination units **10** will become more evenly and radially distributed. The brighter light beams and the darker light beams will overlap with each other to the utmost extent so that a **360°** angled evenly distributed lighting is provided. Therefore, the signal lamp of the present invention can be an LED signal lamp with radial lighting. The term "radial lighting" refers to a pattern of lighting in which the light beams radially project from the light source and are arranged circumferentially. Preferably, the white LED illumination units are arranged to provide **360°** light beams. Alternatively, one or more rows of the white LED illumination units **10** of the plurality of rows of the white LED illumination units **10** may be eliminated according to actual requirements so that one or several directions of the signal lamp is not provided with lighting. In other words, the LED signal lamp of the present invention can provide circular sector shaped or semicircular shaped lighting, such as a lighting of a range of **180°** or **270°.**

[0058] It is worth mentioning that the plurality of light filters **20** corresponding to the white LED illumination units **10** can filter the light beams of the white LED illumination units to obtain different colored light beams. For example, three rows of six rows of the white LED illumination units **10** are provided with red light filters **20,** and the other three rows of six rows of the white LED illumination units **10** are provided with blue light filters **20.** The LED signal lamp may be further provided with a control center **11** which selectively turns on the six rows of white LED illumination units **10** so as to selectively provide red lighting, blue lighting, and red and blue lightings which follow each other in rotation. In this example, the housing of the LED lamp can be a transparent housing.

[0059] In this preferred embodiment, as an example, the warning lamp comprises six rows of the white LED illumination units **10.** Each row comprises three white LED illumination units **10.** Each of the three white LED illumination units **10** is provided with a light filter **20** in a light path thereof for filtering at least a portion of light beams of the white LED illumination unit **10** so as to obtain yellow lighting, so that a yellow warning lamp is provided.

[0060] It is thus can be seen that in the above example of the yellow warning lamp, the control center **11** selectively turns on or turn off the white LED illumination units **10,** or turns on the white LED illumination units **10** at a predetermined time interval so as to provide a yellow flash lighting, thus addition view impact effect is provided to enhance the warning effect.

[0061] The plurality of light filters **20** is respectively provided at a suitable position adjacent to the plurality of

white LED illumination units **10.** Preferably, in this preferred embodiment, the plurality of light filters **20** are innovatively designed to perform a light condensing effect. In other words, each light filter **20** is capable of collecting light beams of the corresponding white LED illumination unit **10** while simultaneously is capable of filtering the light beams so as to obtain non-white light beams.

[0062] In other words, the light filters **20** of the present invention not only perform a light filtering effect but also perform a light condensing effect. It is worth mentioning that after the light condensing process, the effective luminous flux reaching to the desired areas is increased, so that the light intensity of the LED lamp is enhanced.

[0063] Each of the light filters **20** can be a lens which can provide a light condensing effect, such as a convex lens. Accordingly, as an example, each of the light filters **20** can be a Fresnel lens which has a light filtering function, so that the light beams of each white LED illumination unit **10** are collected and focused via the Fresnel lens and are further filtered to provide light beams of predetermined color rather than white. The processed light beams project substantially in parallel directions, so that light efficiency is increased, the predetermined areas, where the light beams reach to, can have a relatively high luminous flux.

[0064] Each of the light filters **20** is provided at a suitable position in front of corresponding white LED illumination unit **10.** A shape and size of each light filter **20** can be varied according to requirements so as to obtain a maximum light condensing effect. Obvious brighter spots can also be eliminated. In this example, each light filter **20** is provided with at least one mounting element **21,** so that each light filter **20** is fit to a suitable position in the light path of the white LED illumination unit **10** via the mounting element **21.** For example, each light filter **20** can be mounted with the corresponding mounting element **21** via screws. In addition, the LED signal lamp is further provided with a plurality of heat dissipating devices **12.** The mounting element **21** is provided between the heat dissipating device **12** and the light filter **20** so as to connect the heat dissipating device **12** with the light filter **20.** The installation of the light filters **20** can be achieved by other methods as long as the light filters **20** are capable of providing light condensing and light filtering effect. Each heat dissipating device **12** comprises a metal heat dissipating panel **121** and a plurality of heat dissipating fins **122** connected to the heat dissipating panel **121.** The heat dissipating panel **121** and the plurality of heat dissipating fins **122** can be made of metal materials. Referring to Fig. 3 of the drawings, each white LED illumination unit **10** is mounted on the corresponding heat dissipating panel **121.**

[0065] As shown in Fig. 3 of the drawings, it is worth mentioning that each white LED illumination unit **10** is provided in a receiving chamber **31** defined by a light reflecting surface **30.** The light reflecting surface **30** and the light filter **20** cooperate to gather light beams of each white LED illumination unit **10.** The light reflecting surface **30** may provide a bar type parabolic surface, so that the light beams reflected by the light reflecting surface **30** and the light beams gathered by the light filter **20** are collected to form light beams projecting to parallel directions, as shown in Fig.3, a gap may be formed between the light reflecting surface **30** and the light filter **20** in such a manner that a portion of the light beams passes through the gap to reach the light reflecting surface **30** and is reflected by the light reflecting surface **30** without processing by the light filter.

[0066] Each light reflecting surface **30** may be an inner surface of a light reflecting device, as shown in Fig. 3, the light reflecting surface can be parabolic cured surface. The shape can be optimized to obtain a desired reflecting effect according to the requirements, so that the light reflecting surface **30** can cooperate with the light filter **20** (Fresnel lens) to obtain a desired best light condensing effect.

[0067] It is worth mentioning that when the white LED illumination units **10** are able to provide an enough light illumination, the light reflecting surface **30** can only be used for reflecting the light beams without performing the light condensing effect.

[0068] Referring to Fig. 5 of the drawings, when one of the white LED illumination units **10** is in operation to produce white light beams, a portion of white beams, which passes through the corresponding light filter **20** (Fresnel lens), is gathered by corresponding light filter **20** (Fresnel lens) and filtered to obtain single colored light beams, as shown in the drawings, the light beams, which are radially projected from each white LED illumination unit **10** serving as a light source center, reach to S**1** zone which is defined between each white LED light illumination unit **10** and corresponding light filter **20** (Fresnel lens). And then, the light beams reach to S**2** zone in which the light beams have passed through the corresponding light filter **20** (Fresnel lens), so that the radial white light beams are gathered and directed to form parallelly projecting light beams and the white light beams are filtered to provide colored light beams rather than white light beams.

[0069] It is worth mentioning that the LED signal lamp according to this preferred embodiment of the present invention further comprises a housing **40** which comprises a light distributor **41** which filters all of the light beams of the white LED illumination units **10** to harvest light beams of desired color. In other words, the portion of light beams, which passes through the gap between each light filter **20** and light reflecting surface **30** and reflected by the light reflecting surface **30,** is filtered into non-white light beams after passing through the light distributor **41.** In other words, the light filter **20** and the light distributor **41** are capable of filtering the white light beams of the corresponding white LED illumination unit **10** to obtain non-white light beams with a same color.

[0070] It is worth mentioning that the light distributor **41** not only performs the light filtering function, but also optimize the distribution of the light output. In other words,

the light beams from all of the light illumination units **10** are evenly distributed to desired areas via the light distributor **41.**

[0071] Referring to Fig. 5 of the drawings, the light beams reaching to S**3** zone which are reflected by the light reflecting surface **30** are preferably directed to project in a direction the same of the direction of light beams which have passed through the light filter **20,** so that the light intensity of light beams reaching to the desired areas is enhanced, the light beams which have been reflected by the light reflecting surface **30** are processed by the light distributor **41** to form desired colored light beams.

[0072] As an example of the above warning lamp, the light distributor **41** is a yellow lens, so that the portion of light beams, which does not pass through the light filter **20** but is reflected by the light reflecting surface **30,** is filtered by the yellow lens. Simultaneously, the main portion of light beams of each white LED illumination unit **10** is filtered by the light filter **20,** so that a yellow warning lamp is provided. In addition, the warning lamp can be directly provided with a yellow light distributor. In comparison with a conventional art which has yellow LEDs as a light source and a transparent housing, the warning lamp of the present invention is provided with a colored effect for enhancing the warning effect. It is worth mentioning that the light distributor **41** of the present invention can be directly used as an outer housing of the LED signal lamp of the present invention.

[0073] In the LED signal lamp which is embodied as a warning lamp of the present invention, the housing **40** is provided with a base **42.** A chamber is defined by the light distributor **41** and the base **42.** The plurality of white LED illumination units **10,** and the corresponding plurality of light filters **20** and other necessary components are installed in the chamber. A top portion of the housing **40** can be further provided with a decoration housing **43** for adding decoration effect to the LED signal lamp so as to enhance the aesthetic appearance. The housing **40** also comprises a necessary electric wire **44** which is electrically connected to the control center **11** for offering power supply so as to control the operation of the LED signal lamp. The electric wire **44** passes through a sealing panel **45** and is retained in position by sealing glues **46.** The light distributor **41** is sealedly connected via a sealing ring **47.**

[0074] Referring to Figs. 6A and 6B of the drawings, an LED signal lamp according to a second preferred embodiment of the present invention is illustrated. The LED signal lamp of this preferred embodiment has a structure similar to the structure of the above first preferred embodiment. In this preferred embodiment, the light reflecting surface **30**A is an inner surface of the heat dissipating device **12**A. In other words, the inner surface of the heat dissipating device **12**A is also provided with light reflecting effect, so that the light condensing effect is provided via the cooperation of each light filter **20** and the inner surface of the heat dissipating device **12**A, and thus the light beams of each white LED illumination unit are directed to parallel directions. A light filtering housing **50**A is also connected to each light reflecting surface **30**A for allowing light beams with predetermined color passing therethough. In other words, the light filtering housing **50**A, which has a similar function with the light distributor **41** of the above preferred embodiment, is directly coupled with each corresponding light reflecting surface **30**A to define a sealed receiving chamber **31**A.

[0075] Accordingly, the present invention provides an LED signal lamp which comprises one or more light illumination arrangements each comprising a white LED illumination unit **10,** a light filter **20,** and having a light reflecting surface **30.** The white LED illumination unit **10** provide white light beams which are filtered by the corresponding the light filter **20** and undergo a light condensing process via the light filter **20** and the light reflecting surface **30,** so that colored signal light beams with high illuminating efficiency are provided. These light illumination arrangements can be arranged to provide radially projecting colored light beams so as to provide a radial signal lighting.

[0076] The present invention provides a method of manufacturing an LED signal amp which comprises the following steps.

(a)Project white light beams via at least one white LED illumination unit **10.**

(b)Filter at least one portion of the white beams to harvest non-white light beams.

[0077] The step (a) may further comprise a step (a.**1**) of: Arrange a plurality of white LED illumination units **10** into a plurality of rows of white LED illumination units **10** in such a manner that the lines of the plurality of rows of white LED illumination units **10** are intersected to form a polygonal shape so as to provide a radial illumination.

[0078] In the step (a.**1**), each row of the white LED illumination units **10** comprises one or more white LED illumination units **10.**

[0079] In the step (a.**1**), the lines of the plurality of rows of white LED illumination units **10** are intersected to form a polygonal shape such as an equilateral triangular shape, a square shape, a regular hexagonal shape, a regular octagonal shape, and a regular dodecagonal shape.

[0080] The step (b) may comprise a step (b.**1**) of providing a light filter **20** in a light path of each of the white LED illumination units **10,** wherein light beams passing through the light filter **20** is filtered to harvest light beams with a predetermined single color.

[0081] In the step (b.**1**), the light filter can be a Fresnel lens with light filtering effect. The Fresnel lanes may be provided at a location which is capable of condensing light beams so that the light filter **20** performs both light filtering and light condensing effects.

[0082] In the step (b.**1**), the predetermined color can be red, blue, yellow, green, or purple.

[0083] The method may further comprises a step (c) of reflecting another portion of the white light beams via a light reflecting surface **30** in such a manner that the reflected white light beams project in a direction substantially the same as a direction of the light beams which pass through the light filter **20.**

[0084] In the step (c), the light reflecting surface can be a parabolic surface of a light reflecting device or an inner surface of a heat dissipating device **12.**

[0085] The method may further comprises a step (d) of processing the light beams via a light distributor **41** of a housing **40,** wherein the light distributor **41** is an outer lens of a predetermined color, so that the resulted colored light beams are evenly distributed, and the color of the light beams is also enhanced.

[0086] The LED signal lamp manufactured by the above method may be a warning lamp (a vehicle emergency lighting), a pharos, a ship navigation lighting, a building aero obstruction lighting, or the like.

[0087] Referring to Figs. 7 to 11 of the drawings, an LED signal lamp according to a third preferred embodiment of the present invention is illustrated. The LED signal lamp according to this preferred embodiment of the present invention can be embodied as an emergency vehicle lighting (a warning lamp) which comprises a plurality of light sources and a plurality of light processers **20**B respectively provided in light paths of each of the light sources.

[0088] According to the present invention, the plurality of light sources can be embodied as a plurality of white LED illumination units **10**B. The plurality of white LED illumination units **10**B, which is accessible in the market, can be pubic-sold white LED illumination units of single chip type or multichip type. The plurality of light processers **20**B is respectively provided in light paths of the plurality of white LED illumination units **10**B. For example, each of the plurality of light processers **20**B is provided at one side of each of the plurality of white LED illumination units **10**B so as to filter at least a portion of white light beams of each white LED illumination unit **10**B into light beams which are not white colored, so that a non-white colored signal lamp is formed. According to this preferred embodiment, the plurality of light processers **20**B can filter at least a portion of the light beams of the plurality of white LED illumination units **10**B respectively to obtain single colored light beams such as red, blue, green, yellow, and purple light beams, so that red, blue, green, yellow, or purple LED signal lamps can be provided. As an example, the plurality of light processers **20**B of this preferred embodiment filters at least a portion of the light beams of the plurality of white LED illumination units **10**B respectively to obtain red or yellow warning lamps.

[0089] The principle of the colored signal lamp of the present invention is to filter the light beams of the plurality of white LED illumination units **10**B so as to obtain colored signal lighting. High quality light source of white LED illumination units is easy to obtain from the market. In comparison with the conventional art in which colored LED illumination units are directly used as the light source, the LED lamp of the present invention is easier to obtain a relatively high light intensity while the costs are low. For example, a white LED illumination unit with a luminous flux about **150**lm is easy to obtain in the market, when the light beams of the white LED illumination unit is filtered to provide colored light beams via the light processer **20**B, the obtained colored light beams still has a light intensity which is significantly larger than a light intensity of a conventional signal lamp which uses colored LED chips as the light source. For example, in the yellow warning lamp of the present invention, the light beams may be filtered by the light processer **20**B to obtain yellow light beams which is about **60%** of the total light beams of the yellow warning lamp, the obtained luminous flux of the yellow beams is about **90**lm which is stiller significantly higher than the luminous flux of the public-sold yellow LED illumination unit which is about **50~60**lm.

[0090] The terms "filter, filtered, and filtering" of the present invention are referred to a process in which the light beams of the white LED illumination units **10**B are respectively processed by the plurality of light processers **20**B to obtain light beams of a single predetermined color which is not white colored. The predetermined color may be red, blue, green, yellow and the like.

[0091] Since each white LED illumination units **10**B which can be accessed from the market already has a relatively high luminous flux, and the research on the white LED illumination units is still going on, thus the luminous flux of the white LED illumination units **10**B can be further increased. However, little research is made on the colored LED illumination units and the luminous flux of the colored LED illumination units still maintains a relatively low value. Therefore, when the white LED illumination units are used as light source of colored light signal lamp, the white LED illumination units of high luminous flux are easy to obtain from the market, so that the manufacturing process is easy.

[0092] It is worth mentioning that the LED signal lamp of the present invention can comprise at least two arrows of white LED illumination units **10**B. For example, the LED signal lamp may comprise three rows, four rows, six rows, eight rows, or twelve rows of the white LED illumination units **10**B. Each row of the white LED illumination units **10**B may comprise one or more white LED illumination units **10**B. Therefore, the plurality of rows of white LED illumination units are successively arranged in such a manner that the lines of the plurality of rows of white LED illumination units **10**B may be intersected with each other to form an equilateral triangular shape, a square shape, a regular hexagonal shape, a regular octagonal shape, a regular dodecagonal shape, or other regular polygonal shapes. It is worth mentioning that the plurality of white LED illumination units **10**B may not be arranged to form a regular polygonal shape so as to provide a LED signal lamp which provides a lighting of a circular section shape rather than a circular radial lighting. The present

invention is not limited in this aspect, and the shapes may be varied according to different actual requirements.

[0093] It is thus can be seen that when the number of the rows of the plurality of the white LED illumination units **10**B increases, the light beams of the white LED illumination units **10**B will become more evenly and radially distributed. The brighter light beams and the darker light beams will overlap with each other to the utmost extent so that a **360°** angled even lighting is provided. Therefore, the signal lamp of the present invention can be an LED signal lamp with radial lighting. The term "radial lighting" refers to a pattern of lighting in which the light beams radially project from the light source and are arranged circumferentially. Preferably, the white LED illumination units are arranged to provide **360°** light beams. Alternatively, one or more rows of the white LED illumination units **10**B of the plurality of rows of the white LED illumination units **10**B may be eliminated according to actual requirements so that one or several directions of the signal lamp is not provided with lighting. In other words, the LED signal lamp of the present invention can provide circular sector shaped or semicircular shaped lighting, such as a lighting of a range of **180°** or **270°.**

[0094] It is worth mentioning that the plurality of light processers **20**B corresponding to the white LED illumination units **10**B can filter the light beams of the white LED illumination units to obtain different colored light beams. For example, three rows of six rows of the white LED illumination units **10**B are provided with red light processers **20**B, and the other three rows of six rows of the white LED illumination units **10**B are provided with blue light processers **20**B. The LED signal lamp may be further provided with a control center **11**B which selectively turns on the six rows of white LED illumination units **10**B so as to selectively provide red lighting, blue lighting, and red and blue lightings which follow each other in rotation. In this example, the housing of the LED lamp can be a transparent housing.

[0095] In this preferred embodiment, as an example, the warning lamp comprises six rows of the white LED illumination units **10**B. Each row comprises three white LED illumination units **10**B. Each of the three white LED illumination units **10**B is provided with a light processer **20**B in a light path thereof for filtering at least a portion of light beams of the white LED illumination unit **10**B so as to obtain yellow lighting, so that a yellow warning lamp is provided.

[0096] It is thus can be seen that in the above example of the yellow warning lamp, the control center **11** selectively turns on or turn off the white LED illumination units **10**B, or turns on the white LED illumination units **10**B at a predetermined time interval so as to provide a yellow flash lighting, thus addition view impact effect is provided to enhance the warning effect.

[0097] The plurality of light processers **20**B is respectively provided at a suitable position adjacent to the plurality of white LED illumination units **10**B. Preferably, in this preferred embodiment, the plurality of light processers **20**B is innovatively designed to perform a light condensing effect. In other words, each light processer **20**B is capable of collecting light beams of the corresponding white LED illumination unit **10**B while simultaneously is capable of filtering the light beams so as to obtain non-white light beams.

[0098] In other words, the light processers **20**B of the present invention not only perform a light filtering effect but also perform a light condensing effect. It is worth mentioning that after the light condensing process, the effective luminous flux reaching to the desired areas is increased, so that the light intensity of the LED lamp is enhanced.

[0099] Each of the light processers **20**B can be a lens which can perform light condensing effect, such as a convex lens. Accordingly, as an example, each of the light processers **20**B can be a Fresnel lens which has light filtering function, so that the light beams of each white LED illumination unit **10**B are collected and focused via the Fresnel lens and are further filtered to provide light beams of a predetermined color rather than white. The processed light beams project substantially in parallel directions, so that light efficiency is increased, the predetermined areas which the light beams reach to have a relatively high luminous flux.

[0100] Each of the light processers **20**B is provided at a suitable position in front of corresponding white LED illumination unit **10**B. A shape and size of each light processer **20**B can be varied according to requirements so as to obtain a maximum light condensing effect. Obvious brighter spots can also be eliminated. In this example, each light processer **20**B is provided with at least one mounting element **21**B, so that each light processer **20**B is fit to a suitable position in the light path of the white LED illumination unit **10**B via the mounting element **21**B. For example, each light processer **20**B can be mounted with the corresponding mounting element **21B** via screws. In addition, the LED signal lamp is further provided with a plurality of heat dissipating devices **12**B. The mounting element **21**B is provided between the heat dissipating device **12** and the light processer **20**B so as to connect the heat dissipating device **12**B with the light processer **20**B. The installation of the light processers **20**B can be achieved by other methods as long as the light processers **20**B are capable of providing light condensing and light filtering effect. Each heat dissipating device **12**B comprises a metal heat dissipating panel **121**B and a plurality of heat dissipating fins **122**B connected to the heat dissipating panel **121**B. The heat dissipating panel **121**B and the plurality of heat dissipating fins **122**B can be made of metal materials. Referring to Fig. **10**B of the drawings, each white LED illumination unit **10**B is mounted on the corresponding heat dissipating panel **121.**

[0101] As shown in Fig. **10**B of the drawings, it is worth mentioning that each white LED illumination unit **10**B is provided in a receiving chamber **31**B defined by a light reflecting surface **30**B. The light reflecting surface **30**B

and the light processer **20**B cooperate to gather light beams of each white LED illumination unit **10**B. The light reflecting surface **30**B may provide a bar type parabolic surface, so that the light beams reflected by the light reflecting surface **30**B and the light beams gathered by the light processer **20**B are collected to form light beams projecting to parallel directions, as shown in Fig. **10**B, a gap may be formed between the light reflecting surface **30**B and the light processer **20**B in such a manner that a portion of the light beams passes through the gap to reach the light reflecting surface **30**B and is reflected by the light reflecting surface **30**B without processing by the light processer.

[0102] Each light reflecting surface **30**B may be an inner surface of a light reflecting device, as shown in Fig. **10**B, the light reflecting surface can be parabolic cured surface. The shape can be optimized to obtain a desired reflecting effect according to the requirements, so that the light reflecting surface **30**B can cooperate with the light processer 20B (Fresnel lens) to obtain a desired best light condensing effect.

[0103] It is worth mentioning that when the white LED illumination units **10**B are able to provide an enough light illumination, the light reflecting surface **30**B can only be used for reflecting the light beams without performing the light condensing effect.

[0104] Referring to Fig. 11 of the drawings, when one of the white LED illumination units **10**B is in operation to produce white light beams, a portion of white beams, which passes through the corresponding light processer **20**B (Fresnel lens), is gathered by corresponding light processer **20**B (Fresnel lens) and filtered to obtain single colored light beams, as shown in the drawings, the light beams, which are radially projected from each white LED illumination unit **10**B serving as a light source center, reach to S**1** zone which is defined between each white LED light illumination unit **10**B and corresponding light processer **20**B (Fresnel lens). And then, the light beams reach to S**2** zone in which the light beams have passed through the corresponding light processer **20**B (Fresnel lens), so that the radial white light beams are gathered and directed to form parallelly projecting light beams and the white light beams are filtered to provide colored light beams rather than white light beams.

[0105] It is worth mentioning that the LED signal lamp according to this preferred embodiment of the present invention further comprises a housing **40**B which comprises a light distributor **41**B which filters all of the light beams of the white LED illumination units **10**B to harvest light beams of desired color. In other words, the portion of light beams, which passes through the gap between each light processer **20**B and light reflecting surface **30**B and reflected by the light reflecting surface **30**B, is filtered into non-white light beams after passing through the light distributor **41**B. In other words, the light processer **20**B and the light distributor **41**B are capable of filtering the white light beams of the corresponding white LED illumination unit **10**B to obtain non-white light beams with a same color.

[0106] It is worth mentioning that the light distributor **41**B not only performs the light filtering function, but also optimize the distribution of the light output. In other words, the light beams from all of the light illumination units **10B** are evenly distributed to desired areas via the light distributor **41**B.

[0107] Referring to Fig. 11 of the drawings, the light beams reaching to S**3** zone which are reflected by the light reflecting surface **30**B are preferably directed to project in a direction the same of the direction of light beams which have passed through the light processer **20**B, so that the light intensity of light beams reaching to the desired is enhanced, the light beams which have been reflected by the light reflecting surface **30**B are processed by the light distributor **41**B to form desired colored light beams.

[0108] As an example of the above warning lamp, the light distributor **41**B is a yellow lens, so that the portion of light beams, which does not pass through the light processer **20**B but is reflected by the light reflecting surface **30**B, is filtered by the yellow lens. Simultaneously, the main portion of light beams of each white LED illumination unit **10**B is filtered by the light processer **20**B, so that a yellow warning lamp is provided. In addition, the warning lamp can be directly provided with a yellow light distributor. In comparison with a conventional art which has yellow LEDs as a light source and a transparent housing, the warning lamp of the present invention is provided with a colored effect for enhancing the warning effect. It is worth mentioning that the light distributor **41**B of the present invention can be directly used as an outer housing of the LED signal lamp of the present invention.

[0109] In the LED signal lamp which is embodied as a warning lamp of the present invention, the housing **40**B is provided with a base **42**B. A chamber is defined by the light distributor **41**B and the base **42**B. The plurality of white LED illumination units **10**B, and the corresponding plurality of light processers **20**B and other necessary components are installed in the chamber. A top portion of the housing **40**B can be further provided with a decoration housing **43**B for adding decoration effect to the LED signal lamp so as to enhance the aesthetic appearance. The housing **40**B also comprises a necessary electric wire **44**B which is electrically connected to the control center **11**B for offering power supply so as to control the operation of the LED signal lamp. The electric wire **44**B passes through a sealing panel **45**B and is retained in position by sealing glues **46**B. The light distributor **41**B is sealedly connected via a sealing ring **47**B.

[0110] Accordingly, the present invention provides an LED signal lamp which comprises one or more light illumination arrangements each comprising a white LED illumination unit **10**B, a light processer **20**B, and a light reflecting surface **30**B. The white LED illumination unit **10**B provide white light beams which are filtered by the corresponding the light processer **20**B and undergo a light condensing process via the light processer **20**B and

the light reflecting surface **30**B, so that colored signal light beams with high illuminating efficiency are provided. These light illumination arrangements can be arranged to provide radially projecting colored light beams so as to provide a radial signal lighting.

[0111] It is worth mentioning that the light processor of this preferred embodiment can be a light condensing device. The LED signal lamp may comprise at least one LED illumination unit and at least one light processor provided in a light path of the LED illumination unit for filtering at least a portion of light beams of the corresponding LED illumination unit before the light beams project to outside.

[0112] It is still worth mentioning that when the light process of the present invention is a light condensing device, the LED illumination unit may be embodied as a colored LED illumination unit so that the light processer of the present invention may not need to perform the light filtering step to yield the colored light beams.

[0113] When the LED illumination units are white LED illumination units, the light processer is further provided with light filtering effect so as to filter the white light beams of the white LED illumination units to harvest non-white light beams of a predetermined color.

[0114] When the light processer is a light filter, the present invention provides a method of manufacturing an LED signal amp which comprises the following steps.

[0115] (a')Project white light beams via at least one white LED illumination unit 10B.

[0116] (b')Filter at least one portion of the white beams to harvest non-white light beams.

[0117] The step (a) may further comprise a step (a.**1**) of: Arrange a plurality of white LED illumination units **10**B into a plurality of rows of white LED illumination units **10**B in such a manner that the lines of the plurality of rows of white LED illumination units **10**B are intersected to form a polygonal shape so as to provide a radial illumination.

[0118] In the step (a.**1**'), each row of the white LED illumination units **10**B comprises one or more white LED illumination units **10**B.

[0119] In the step (a.**1**'), the lines of the plurality of rows of white LED illumination units **10**B are intersected to form a polygonal shape such as an equilateral triangular shape, a square shape, a regular hexagonal shape, a regular octagonal shape, and a regular dodecagonal shape.

[0120] The step (b') may comprise a step (b.**1**) of providing a light processer **20**B in a light path of each of the white LED illumination units **10**B, wherein light beams passing through the light processer **20**B is filtered to harvest light beams with a predetermined single color.

[0121] In the step (b.**1**'), the light processer can be a Fresnel lens with light filtering effect. The Fresnel lanes may be provided at a location which is capable of condensing light beams so that the light processer **20**B performs both light filtering and light condensing effects.

[0122] In the step (b.**1**'), the predetermined color can be red, blue, yellow, green, or purple.

[0123] The method may further comprises a step (c) of reflecting another portion of the white light beams via a light reflecting surface **30**B in such a manner that the reflected white light beams project in a direction substantially the same as a direction of the light beams which pass through the light processer **20**B.

[0124] In the step (c'), the light reflecting surface can be a parabolic surface of a light reflecting device or an inner surface of a heat dissipating device **12**B.

[0125] The method may further comprises a step (d') of processing the light beams via a light distributor **41**B of a housing **40**B, wherein the light distributor **41**B is an outer lens of a predetermined color, so that the resulted colored light beams are evenly distributed, and the color of the light beams is also enhanced.

[0126] The LED signal lamp manufactured by the above method may be a warning lamp (a vehicle emergency lighting), a pharos, a ship navigation lighting, a building aero obstruction lighting, or the like.

[0127] Referring to Fig. 12 of the drawings, an LED signal lamp according to a fourth preferred embodiment of the present invention is illustrated. The LED signal lamp comprises six rows of white LED illumination units **10**C each row comprising one or more white LED illumination units **10**C. A corresponding light filter **20**C is provided in a light path of each white LED illumination unit **10**C. The six rows of white LED illumination units **10**C are successively arranged in such a manner that the lines of the six rows of white LED illumination units **10**C are intersected to from a regular hexagonal shape.

[0128] According to this preferred embodiment, the LED signal lamp may further comprises a control module **60**C selectively control the operation of each row of the white LED illumination units **10**C so as to provide a predetermined pattern of the light beams of the LED signal lamp. In other words, varied lighting effects can be provided by turning on some of the six rows of white LED illumination units **10**C while simultaneously turning off some of the six rows of white LED illumination units **10**C.

[0129] In a specific example, the six rows of white LED illumination units **10**C are turned on to flash one by one so that a rotation flash pattern is provided. More specifically, the six rows of white LED illumination units **10**C comprises a first row of white LED illumination units **101**C, a second row of white LED illumination units **102**C, a third row of white LED illumination units **103**C, a fourth row of white LED illumination units **104**C, a fifth row of white LED illumination units **105**C, and a six row of white LED illumination units **106**C. The control module **60**C can turn on the first row of white LED illumination units **101**C to provide light illumination with light beams which are filtered to provide light beams of desired color, so that signal light beams are provided. Then, the control module **60**C turn on the second row of white LED illumination units **102**C or the sixth row of white LED illumination units **106**C which is adjacent to the first row of white LED illumination units **101**C while simultaneously turn off the first row of white LED illumination units **101**C. The operations can be repeated to provide a counterclock-

wise or clockwise rotation flash signal lighting. It is worth mentioning that the control module **60**C can keep at least one row of white LED illumination units be in the operation state, so that the lighting of the LED signal lamp is not interrupted. The control module **60**C may turn on two adjacent rows of white LED illumination units. For example, the first and second rows of white LED illumination units **101**C and **102**C are firstly turned on for provide a **120°** light illumination, and then the third and fourth rows of white LED illumination units **103**C and **104**C are turned on, and then the fifth and sixth rows of white LED illumination units **105**C and **106**C are turned on, and the above steps can be repeated. It is worth mentioning that the control module may selectively and successively provide a signal light illumination of a predetermined angel range which is **30°, 45°, 60°, 90°, 120°, 180°,** or the like.

[0130] It is thus can be seen that the varied signal light illumination patterns can be provide via controlling the sequence of the lighting of different rows of white LED illumination units besides the above mentioned clockwise or counterclockwise rotation flashing light illumination. For example, one row of the white LED illumination units can be continually turned on or turned off for several times to provide predetermined warning message. As another example, the first and fourth rows of white LED illumination units **101**C and **104**C are turned on for providing an illumination and then turned off, the second and fifth rows of white LED illumination units **102**C and **105**C are then turned on for providing an illumination and then turned off, the third and sixth rows of white LED illumination units **103**C and **106**C are then turned on for providing an illumination and then turned off, the above operations can be repeated so that a different lighting pattern is formed. As yet another example, the first row of white LED illumination units **101**C is turned on and maintained for providing the illumination, the second and sixth rows of white LED illumination units **102**C and **106**C are then turned on, and then turn on the third and fifth rows of white LED illumination units **103**C and **105**C while keeping the above first, second, and sixth rows of white LED illumination units **101**C, **102**C, and **106**C are also turned on, and then turn on the fourth row of white LED illumination units **104**C, finally turn off all rows of white LED illumination units, the above operation steps can be repeated so that another lighting pattern is provided. In other words, varied lighting patterns can be provided through the operation of the white LED illumination units **10**C under the control of the control module.

[0131] Referring to Fig. 13 of the drawings, an alternative mode of the above preferred embodiment of the present invention is illustrated, the control module **60**C may turn on the first, second, and third rows of white LED illumination units **101**C, **102**C, and **103**C to provide a substantially **180°** angled light illumination, and then the first, second, and third rows of white LED illumination units **101**C, **102**C, and **103**C are turned off and the fourth, fifth, and sixth rows of white LED illumination units **104**C, **105**C, and **106**C are turned on for provide anther substantially **180°** angled light illumination. In other words, the control module **60** may turn on or turn off several rows of white LED illumination units. It is worth mentioning that the light beams of conventional colored illumination units may provide dark areas in the overlapping areas of the light beams. However, when the first, second, and third rows of white LED illumination units **101**C, **102**C, and **103**C used for providing the light illumination, more specifically, when the first and second rows of white LED illumination units **101**C and **102**C are turned on and the light beams of the first and second rows of white LED illumination units **101**C and **102**C are respectively filtered and collected by the corresponding light filters **20**C, therein is no relatively dark areas in the overlapping light illumination zone. Similarly, when the second and third rows of white LED illumination units **102**C and **103**C are turned on and the light beams of the second, and third rows of white LED illumination units **102**C, and **103**C are respectively filtered and collected by the corresponding light filters **20**C, therein is no relatively dark areas in the overlapping light illumination zone. Therefore, the entire light source of the first, second, and third rows of white LED illumination units **101**C, **102**C and **103**C provide an evenly distributed light illumination with a relatively high light intensity.

[0132] Referring to Figs. 14 to 16 of the drawings, an LED signal lamp according to a fifth preferred embodiment of the present invention is illustrated. The LED signal lamp comprises an LED light source which comprises one or more LED members **100.** The LED signal lamp may further comprise a lamp housing **200** for receiving the one or more LED members **100.** The light beams projecting out from each of the LED members **100** are the desired light beams of a predetermined color, so that the desired colored LED signal lamp of the present invention is provided. The lamp housing **200** may have a same structure with the housing **40** of the LED signal lamp according to the above preferred embodiment.

[0133] More specifically, each of the LED members **100** is encapsulated with a white LED illumination unit **110.** After the encapsulation or package, the white light beams emitting from each of the LED members **100** is filtered to harvest desired colored light beams. Accordingly, a package member **120** of each of the LED members **100** is provided with a color filtering effect, so that the white light beams passing through the package member **120** can be filtered so as to provide desired light beams of a predetermined color.

[0134] In other words, regarding each of the LED members **100,** which is may be provided with a supporting frame, one or more wires, one or more heat dissipating members, or coated with a fluorescence layer, when after the white LED illumination unit **110** is encapsulated to provide the LED member **100,** the light beams projecting out from the LED member **100** become colored light beams of a predetermined color. The material of the package member **120** can be epoxy resin, glass material, silicone material, polycarbonate, polymethyl methacr-

ylate, and so on. However, in comparison with the conventional art, the package member **120** of the present invention is provided with color filtering effect. In other words, each the LED member **100** of the present invention employs a white LED illumination unit **110** as a light source to provide colored light beams when the white LED illumination unit **110** is encapsulated in the package member **120,** the conventional art cannot anticipate that effect.

[0135] It is worth mentioning that the LED signal lamp of the present invention also may have a similar structure as the LED signal lamp of the above preferred embodiment of the present invention. More specifically, each of the LED members **100** comprises at least one white LED illumination unit **110,** and the LED signal lamp further comprises at least one light condenser **130** in the light path of the LED illumination unit **110.** The light condenser **130** is provided at a position with respect to the LED member **100** in such a manner that one or more of the light condenser **130** can be creatively designed to perform a light condensing effect. In other words, each of the light condenser **130** can be used to condensing the light beams projecting out from the LED members **100.**

[0136] It is worth mentioning that since the light beams projecting out from the LED members **100** are desired light beams of a predetermined color, so that the light condenser **130** is different from the above light filter **20,** for the light condenser **130** only performs the light condensing effect without need to filter the white light beams.

[0137] It is worth mentioning that each of the light condensers **130** can be a lens which can provide a light condensing effect, such as a convex lens. Accordingly, as an example, each of the light condensers **130** can be a Fresnel lens, so that the light beams of each LED member **100** are collected and focused, so as to project substantially in parallel directions, so that the light efficiency is increased. The predetermined areas, where the light beams reach to, can have a relatively high luminous flux. Accordingly, each of the LED members **100** may be provided with one light condenser **130.** Alternatively, a plurality of light condensers **130** is formed into an integral structure for condensing light beams emitting from the plurality of LED members **100.**

[0138] Similarly, each of the white illumination unit **110** of the LED member **100** is provided within a receiving cavity defined by a light reflector **140.** The light reflector **140,** together with the light condenser **130,** collects and condenses the light beams emitting from the white illumination unit **110** of the LED member **100.** The light beams reflected by the light reflector **140** and the light beams passing through the light condenser **130** are condensed so as to substantially project along parallel directions. Accordingly, the light reflector **140** may be spacedly aligned with the light condenser **130** so that a gap may be formed therebetween allowing a portion of light beams to pass therethrough so as to reach the light reflector **140** and finally be reflected on the light reflector **140.** The light condenser **130** does not perform a light condensing effect for this portion of light beams passing through the gap between the light condenser **130** and the light reflector **140.**

[0139] Therefore, the introduction of the LED members **100** of this preferred embodiment is able to provide colored light beams of a desired predetermined color. When a plurality of LED members **100** is arranged in a plurality of rows each comprising one or more of the LED members **100,** LED signal lamps which can provide an illumination to areas of different angle ranges or of different shapes can be provided.

[0140] One skilled in the art will understand that the embodiment of the present invention as shown in the drawings and described above is exemplary only and not intended to be limiting.

[0141] It will thus be seen that the objects of the present invention have been fully and effectively accomplished. The embodiments have been shown and described for the purposes of illustrating the functional and structural principles of the present invention and is subject to change without departure from such principles. Therefore, this invention includes all modifications encompassed within the spirit and scope of the following claims.

Claims

1. An LED signal lamp, comprising:

at least one white LED illumination unit, and
at least one light filter each is provided in a light path of each of said white LED illumination unit for filtering at least one portion of light beams of said white LED illumination unit to provide non-white light beams of a predetermined color.

2. The LED signal lamp, as recited in claim 1, wherein said light filter is provided at a position in said light path of each of said white LED illumination unit allowing said light filter to perform a light condensing function, wherein said light filer is capable of providing both a light filtering effect and a light condensing effect.

3. The LED signal lamp, as recited in claim 2, wherein said light filter comprises a lens which is capable of condensing light beams.

4. The LED signal lamp, as recited in claim 1, 2 or 3, wherein said LED signal lamp is further provided with at least one light reflecting surface for reflecting another portion of light beams of said corresponding white LED illumination unit.

5. The LED signal lamp, as recited in claim 4, wherein said another portion of light beams of said white LED illumination unit reflected by said light reflecting surface and said portion of said light beams of said white

LED illumination unit filtered by said light fitter project in a same direction, so that a light condensing effect is provided.

6. The LED signal lamp, as recited in claim 5, wherein said light reflecting surface is a structure selected from a group consisting of a first structure and a second structure, wherein in said first structure, each of said white LED illumination units is provided with a light reflecting device, wherein said light reflecting surface is an inner surface of said light reflecting device, wherein in said second structure, each of said white LED illumination units is provided with a heat dissipating device, wherein said light reflecting surface is an inner surface of said heat dissipating device.

7. The LED signal lamp, as recited in claim 6, wherein said LED signal lamp further comprises a housing which includes a light distributor allowing light beams of predetermined color to pass through.

8. The LED signal lamp, as recited in claim 7, wherein said light distributor is further used for distributing a direction of said light beams.

9. The LED signal lamp, as recited in claim 8, wherein at least one mounting element is provided for mounting said each of said light filters and said corresponding heat dissipating device and said light distributor in position.

10. The LED signal lamp, as recited in claim 6, wherein said predetermined color is selected from a group consisting of red, blue, yellow, green, and purple.

11. The LED signal lamp, as recited in claim 6, wherein said light filter is selected from a group consisting of a convex lens and a Fresnel lens which is capable of providing light filtering effect.

12. The LED signal lamp, as recited in claim 11, wherein said light filter is selected from a group consisting of a vehicle emergency lighting, a warning lamp, a pharos, a ship navigation lighting, and a building aero obstruction lighting.

13. The LED signal lamp, as recited in claim 1, 2 or 3, wherein said LED signal lamp comprises a plurality of said white LED illumination units, wherein said plurality of white LED illumination units are arranged to form a plurality of rows of white LED illumination units, wherein lines of said plurality of rows of white LED illumination units are intersected to form a polygonal shape, wherein each row of white LED illumination units comprises one or more said white LED illumination units.

14. The LED signal lamp, as recited in claim 13, wherein said LED signal lamp further comprises a control module arranged for selectively turn on and turn off said plurality rows of white LED illumination units so as to provide a predetermined signal lighting pattern of said LED signal lamp.

15. The LED signal lamp, as recited in claim 14, wherein said control module selectively clockwise and counterclockwise turn on said plurality of rows of white LED illumination units to provide a flashing lighting effect.

16. The LED signal lamp, as recited in claim 13, wherein said control module controls to have at least one row of white LED illuminating units of said plurality of rows of white LED illuminating units being turned on so as to keep a signal lighting of said LED signal lamp being not interrupted.

17. The LED signal lamp, as recited in claim 13, wherein said control module control the operation of said plurality of rows of white LED illumination units to provide an illumination of an angle range selectively from a group consisting of 30°, 45°, 60°, 90°, 120°, and 180°.

18. A method of manufacturing an LED signal lamp, comprising the following steps:

(a) projecting white light beams via at least one white LED illumination unit; and
(b) filtering at least one portion of the white beams to harvest non-white light beams.

19. The method, as recited in claim 18, wherein the step (b) further comprises a step (b.1): providing a light filter in a light path of each of said white LED illumination units, wherein light beams passing through said light filter is filtered to harvest light beams with a predetermined single color.

20. The method, as recited in claim 19, wherein in the step (b.1), said light filter is a Fresnel lens which is capable of providing a light filtering effect, wherein said Fresnel lanes is provided at a location which is capable of condensing light beams.

21. The method, as recited in claim 20, wherein said predetermined color is selected from a group consisting of red, blue, yellow, green, and purple.

22. The method, as recited in claim 21, wherein the method further comprises a step (c): reflecting another portion of said white light beams via a light reflecting surface.

23. The method, as recited in claim 22, wherein said

another portion of said white light beams which is reflected by said light reflecting surface projects in a direction substantially the same as a direction of light beams which have passed through said light filter.

24. The method, as recited in one of claims from claims 18-23, wherein the method further comprises a step (d): processing said light beams via a light distributor of a housing, wherein said light distributor is an outer lens of a predetermined color, so that resulted colored light beams are evenly distributed, and a color of said light beams is also enhanced.

25. The method, as recited in claim 24, wherein said light distributor is further arranged for adjusting a direction of said light beams.

26. An LED signal lamp, comprising: at least one LED member serving as a light source, wherein each of said LED members comprises at least one white LED illumination unit, wherein said white LED illumination unit is packaged in the corresponding LED member in such a manner that light beams projecting out from said LED member are light beams of a predetermined color other than white, so that said LED signal lamp is capable of providing desired colored light beams.

27. The LED signal lamp, as recited in claim 26, wherein each of said white LED illumination unit is provided with a transparent package member which has a color filtering effect, wherein white light beams emitting from said white LED illumination unit are filtered by said corresponding colored transparent package member so as to harvest light beams of said predetermined color.

28. The LED signal lamp, as recited in claim 27, further comprising at least one light condenser and at least one light reflector, wherein said light condenser is provided at a position in a light path of said LED member in such a manner that said light condenser is capable of providing a light condensing effect, wherein a portion of said light beams projecting out from said LED members is reflected by said light reflector, wherein another portion of said light beams projecting out from said LED members is condensed by said light condenser, wherein both of said first and second portion of said light beams projecting out from said LED members are collected to substantially project along a same direction, so that a light collecting effect is provided.

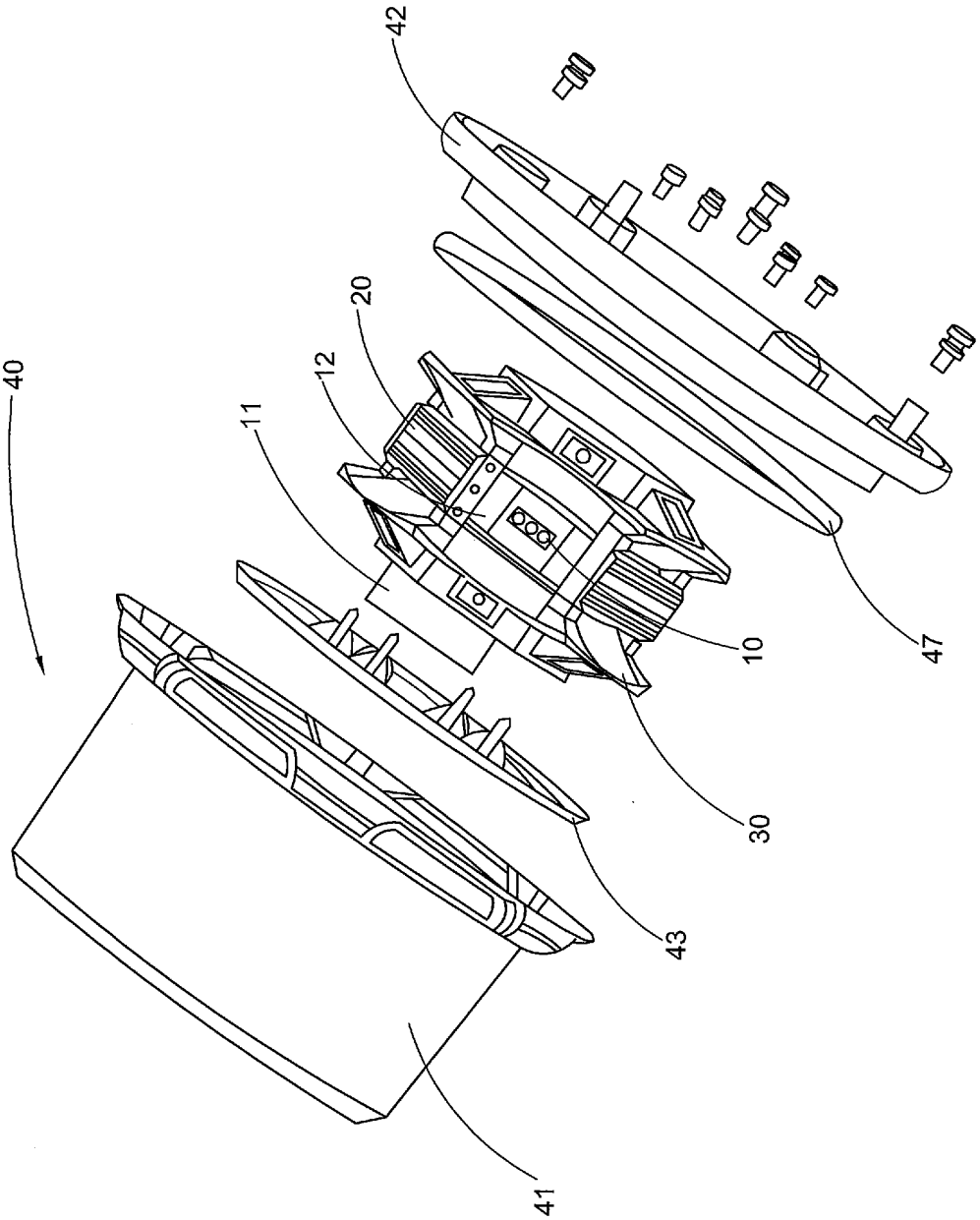


FIG. 1

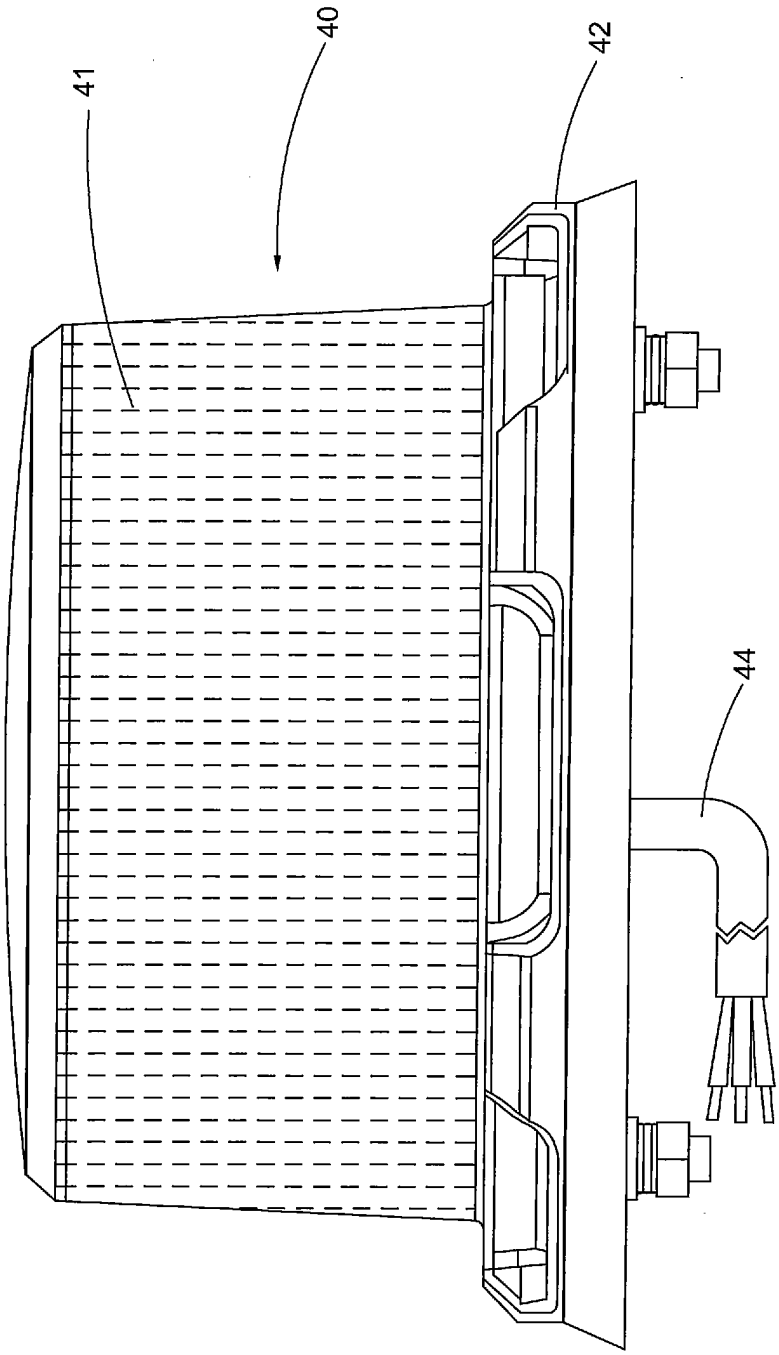


FIG. 2

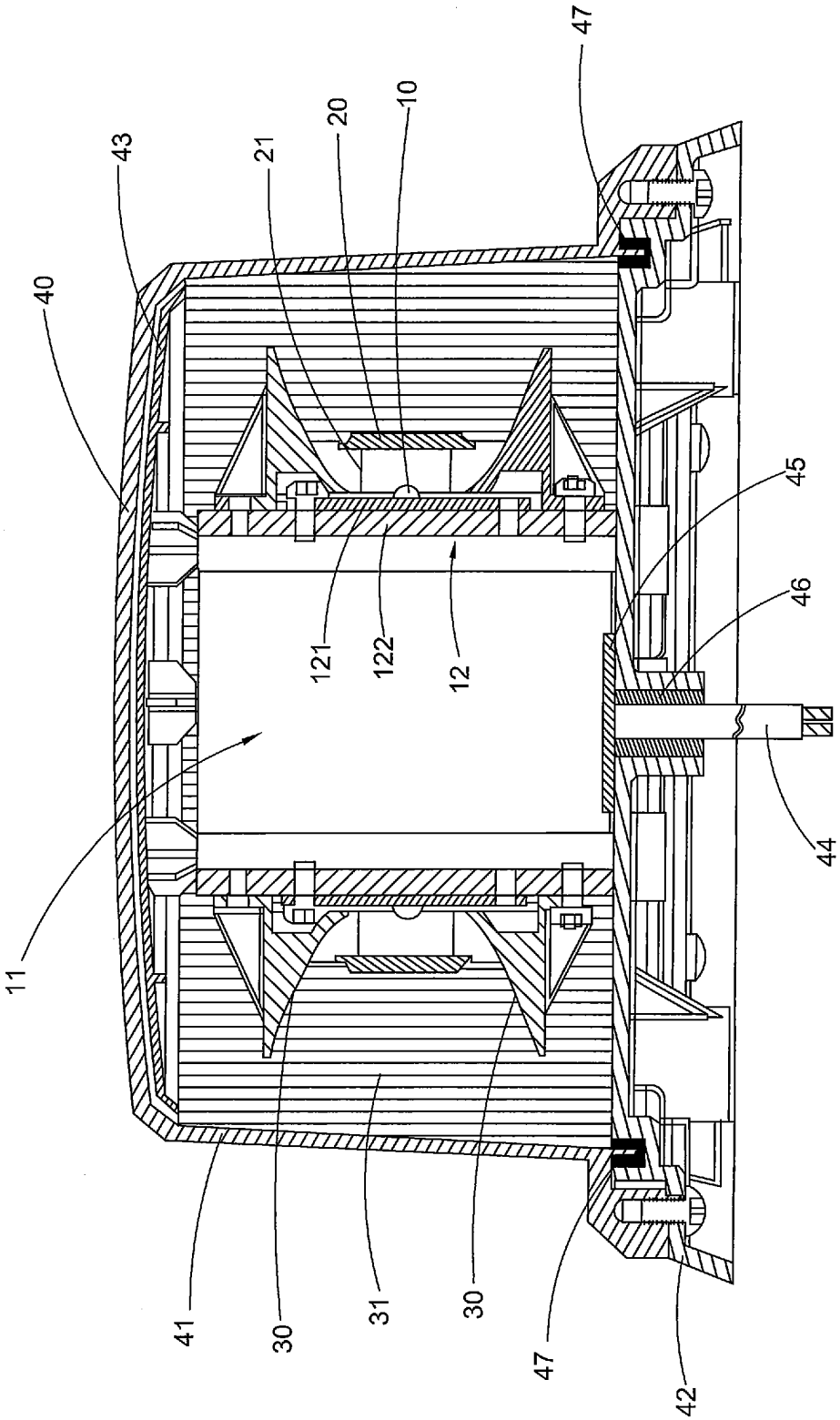


FIG. 3

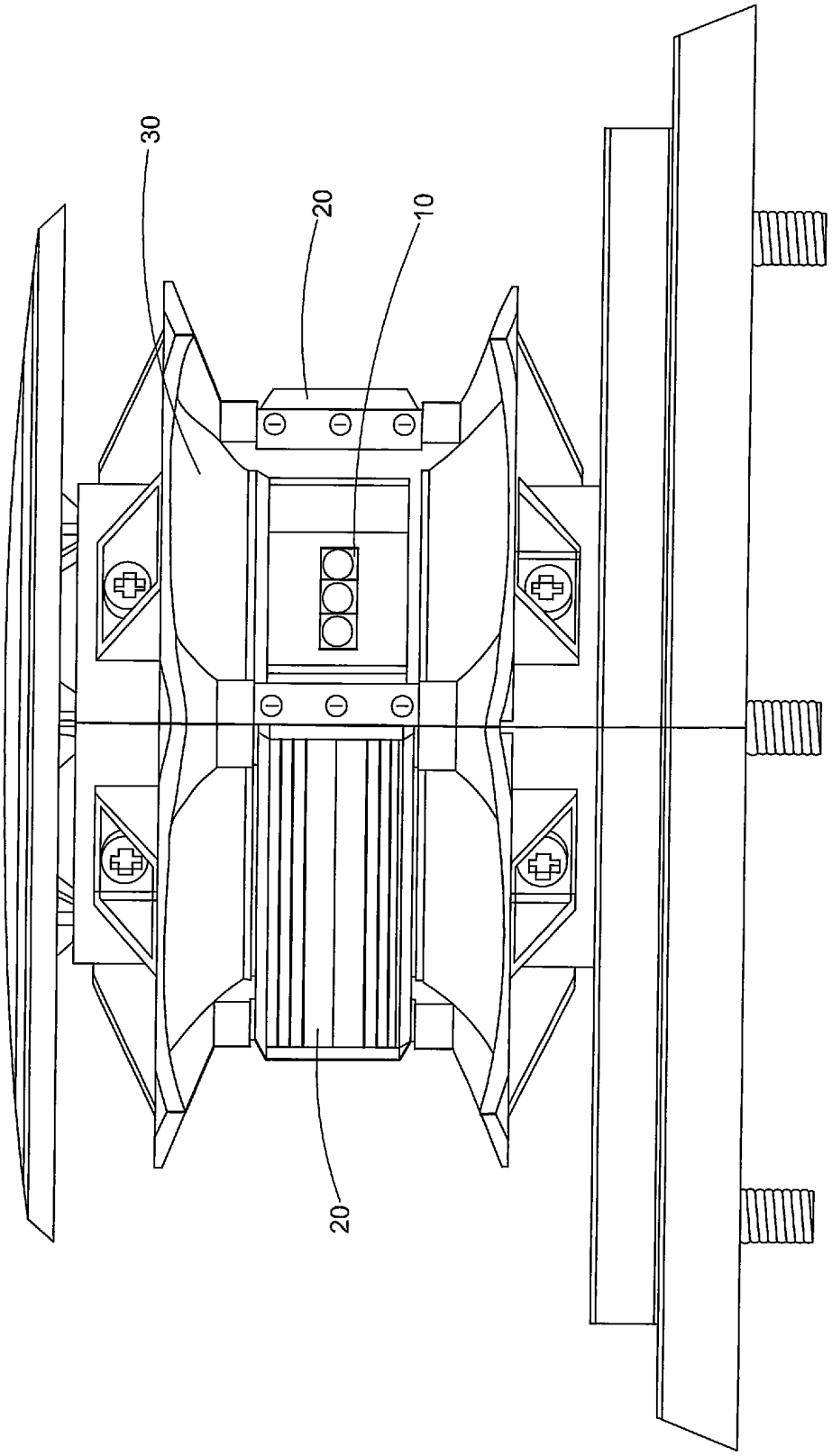


FIG. 4

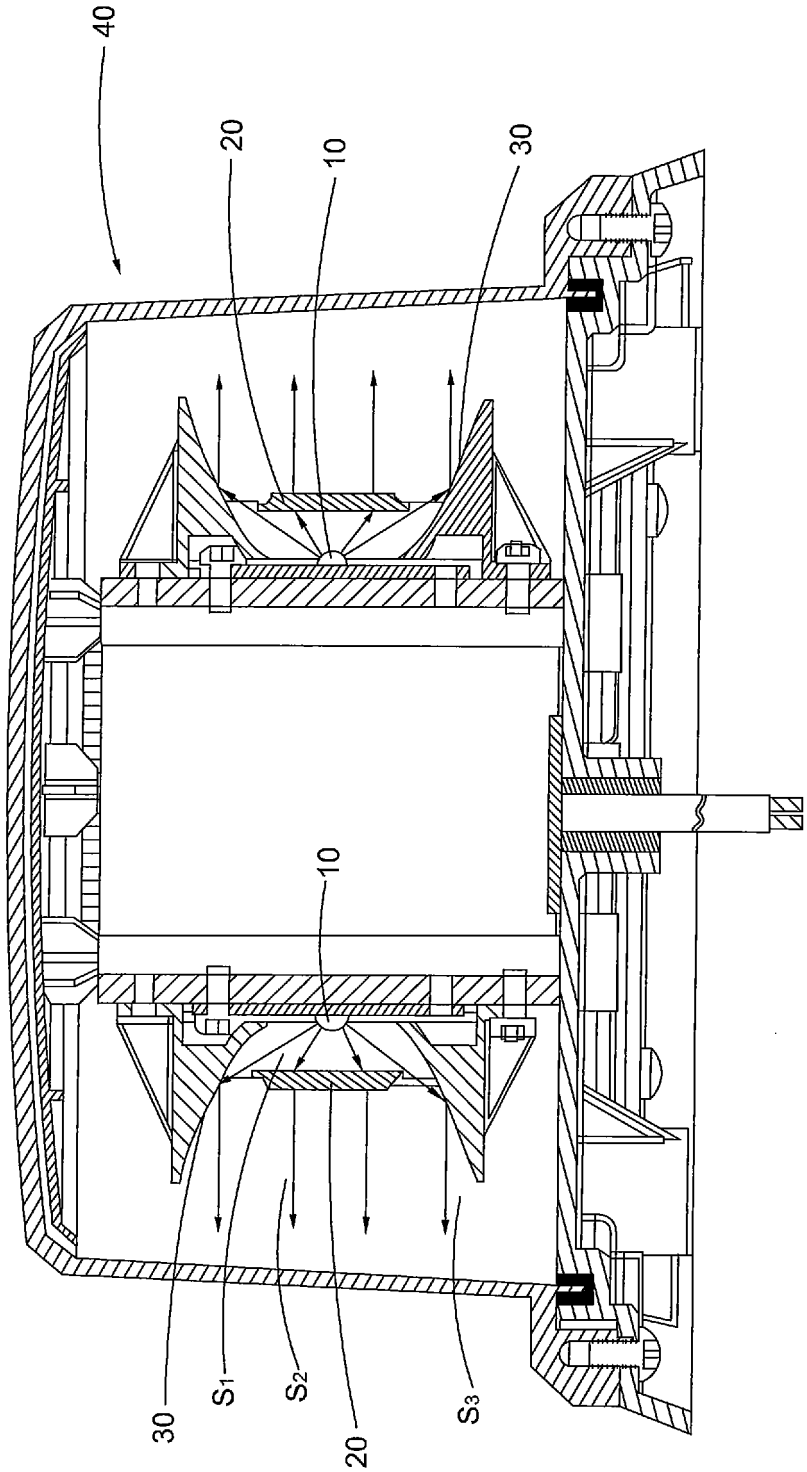


FIG. 5

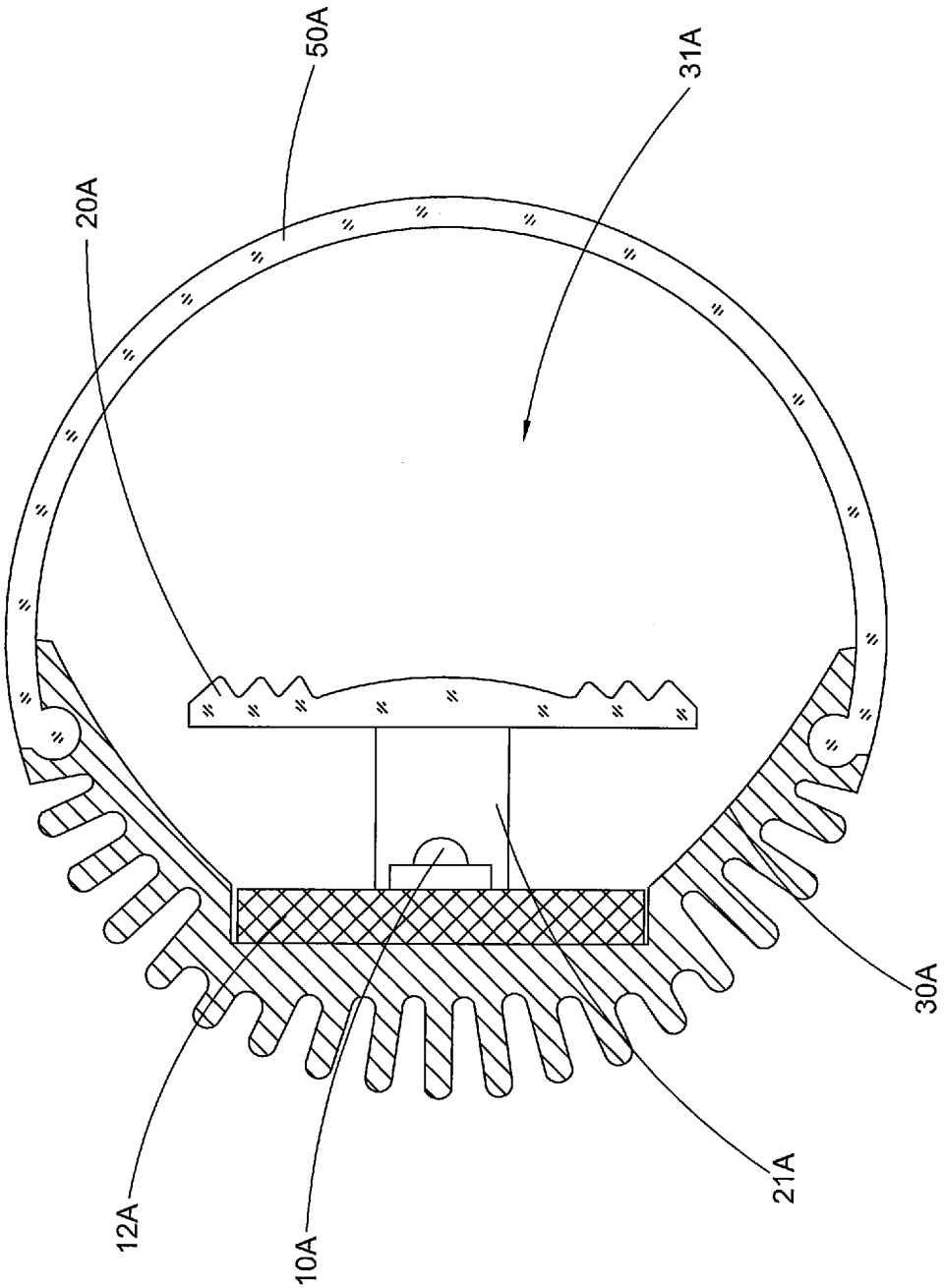


FIG. 6A

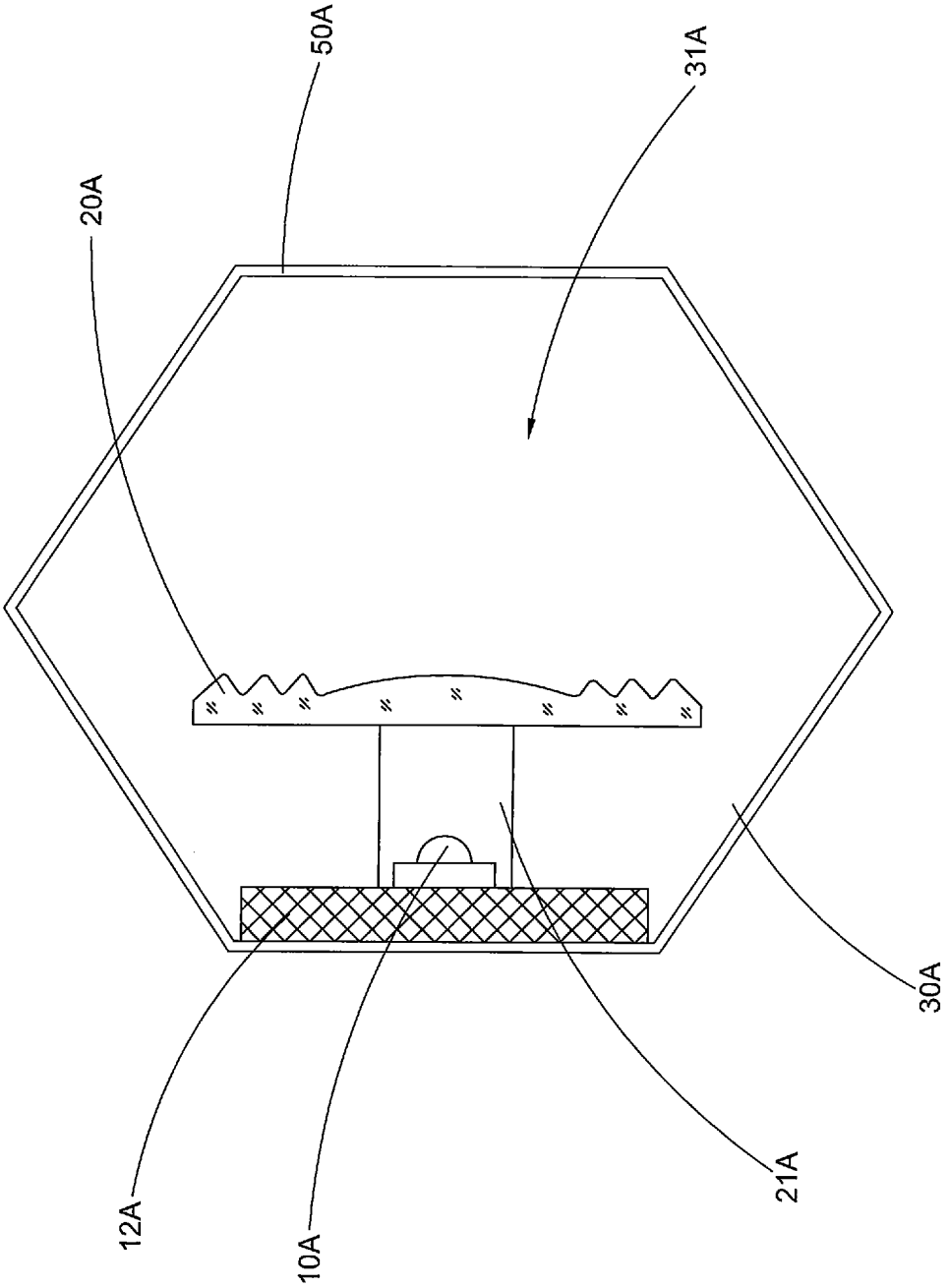


FIG. 6B

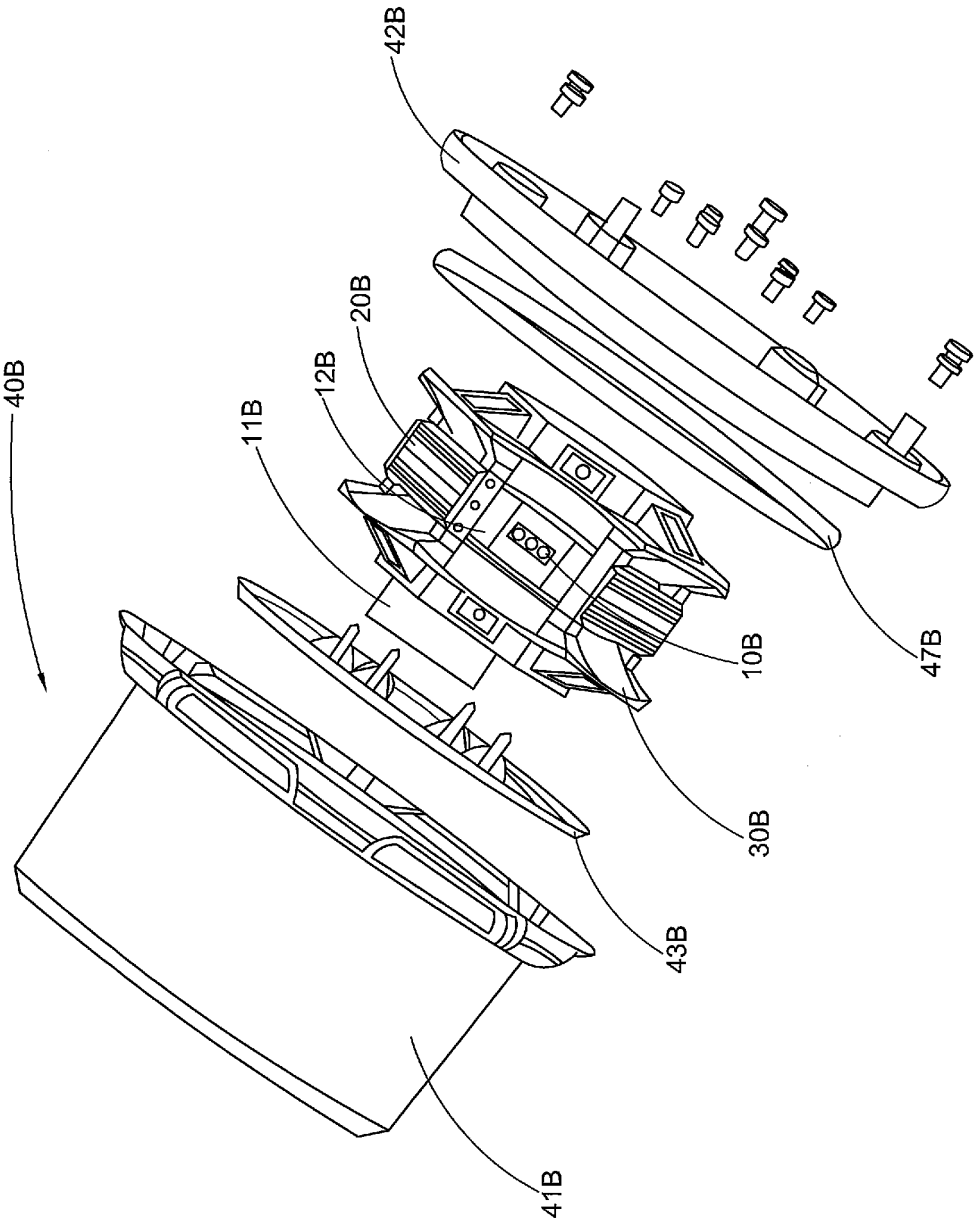


FIG. 7

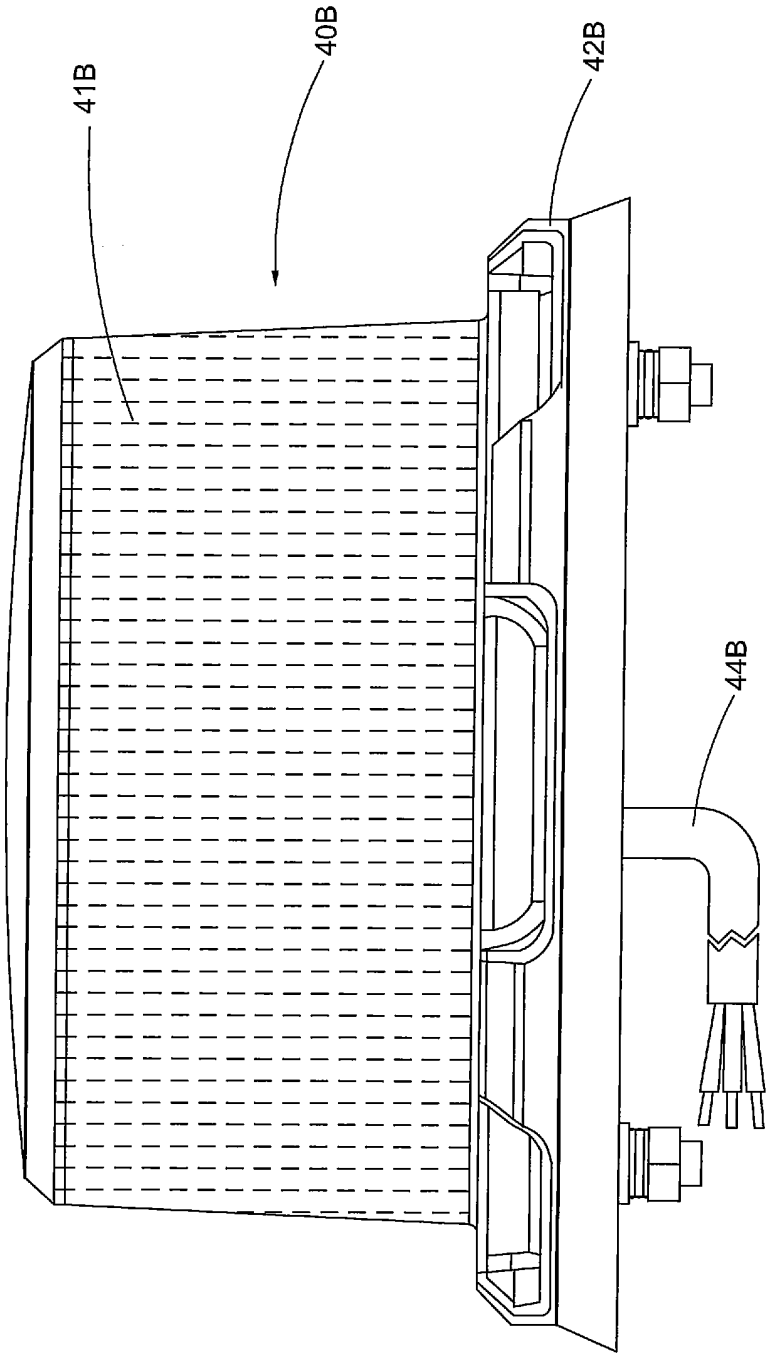
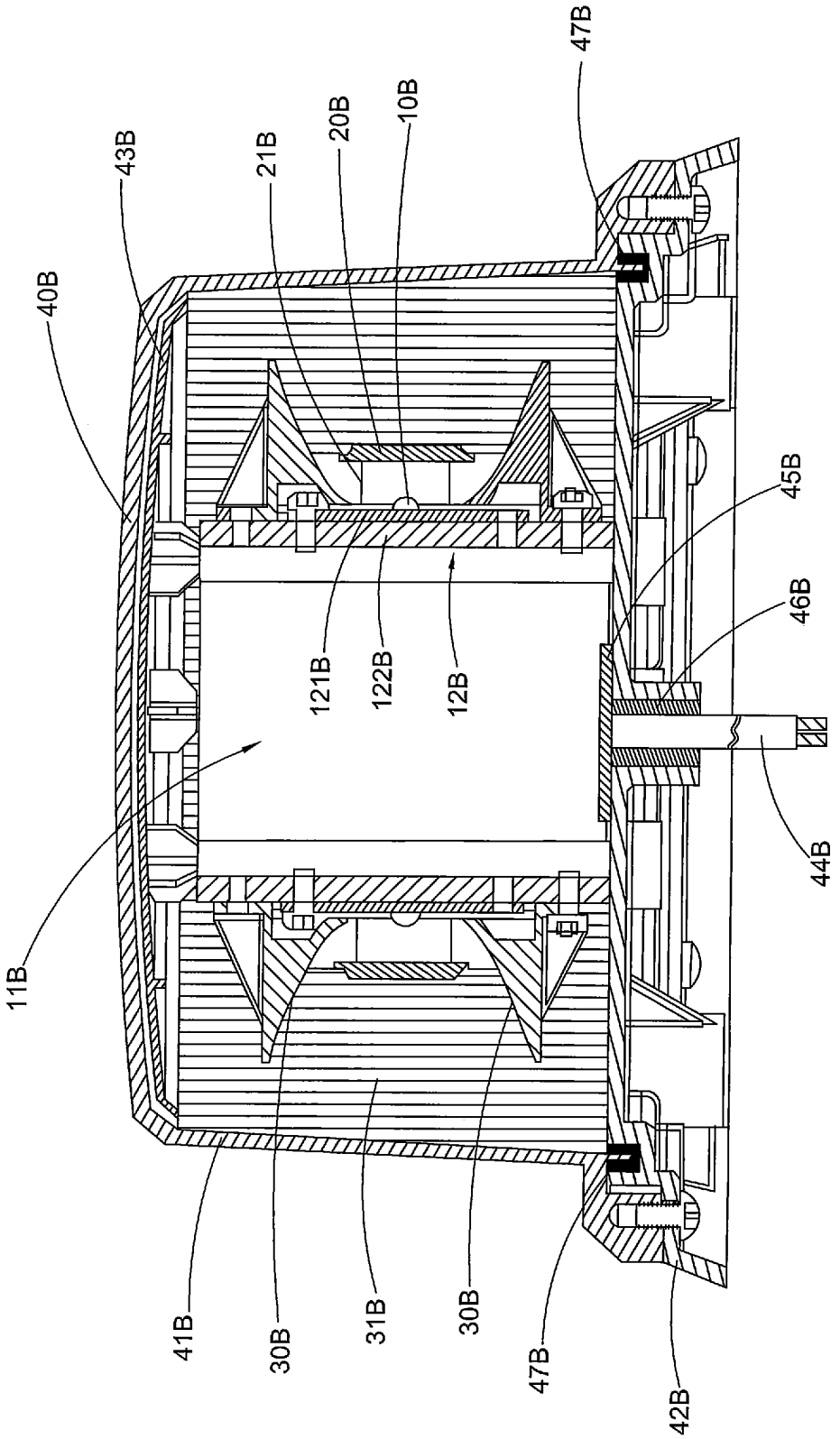


FIG. 8


47B
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47B
42B

FIG. 9

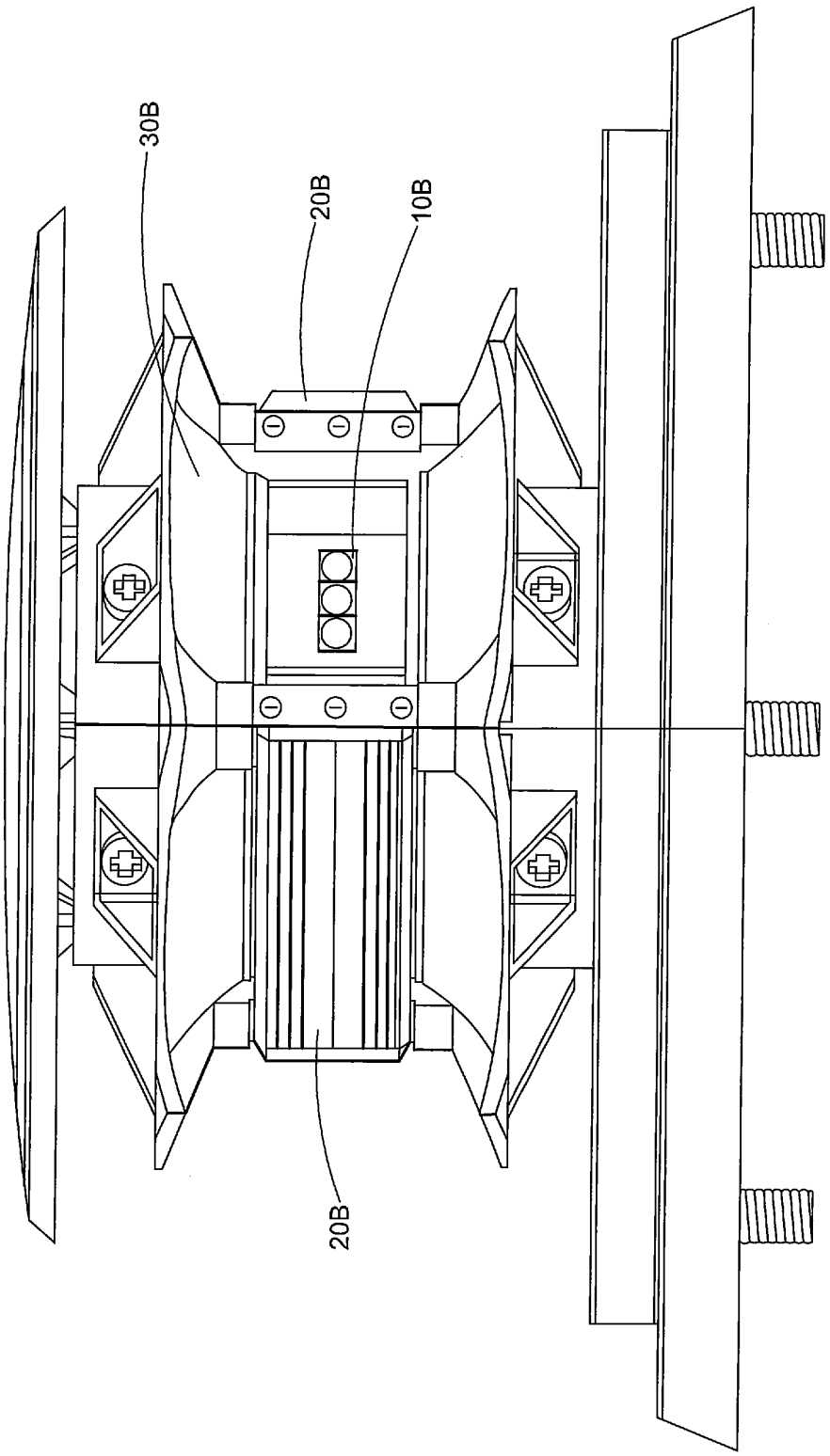

FIG. 10

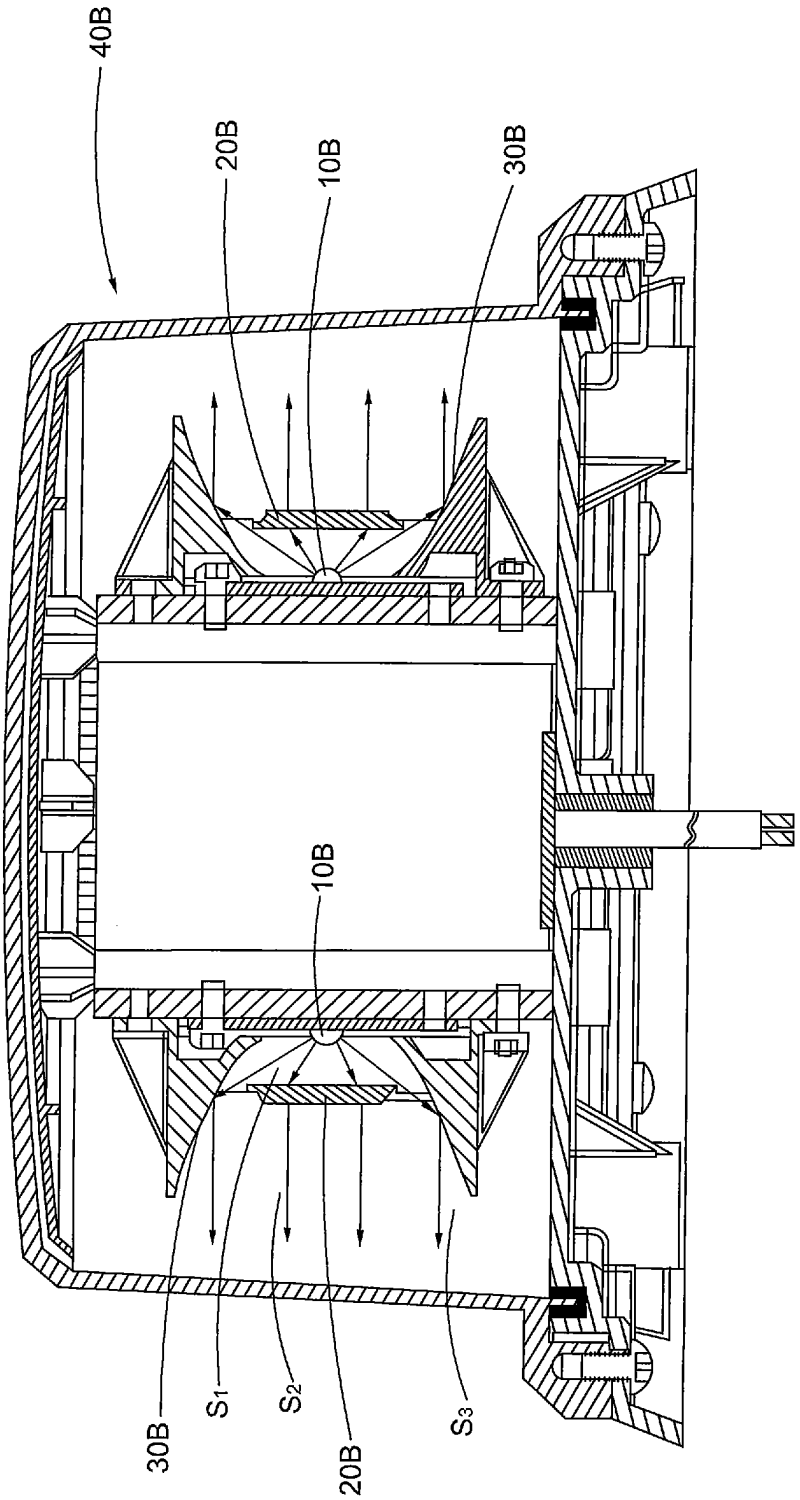

FIG. 11

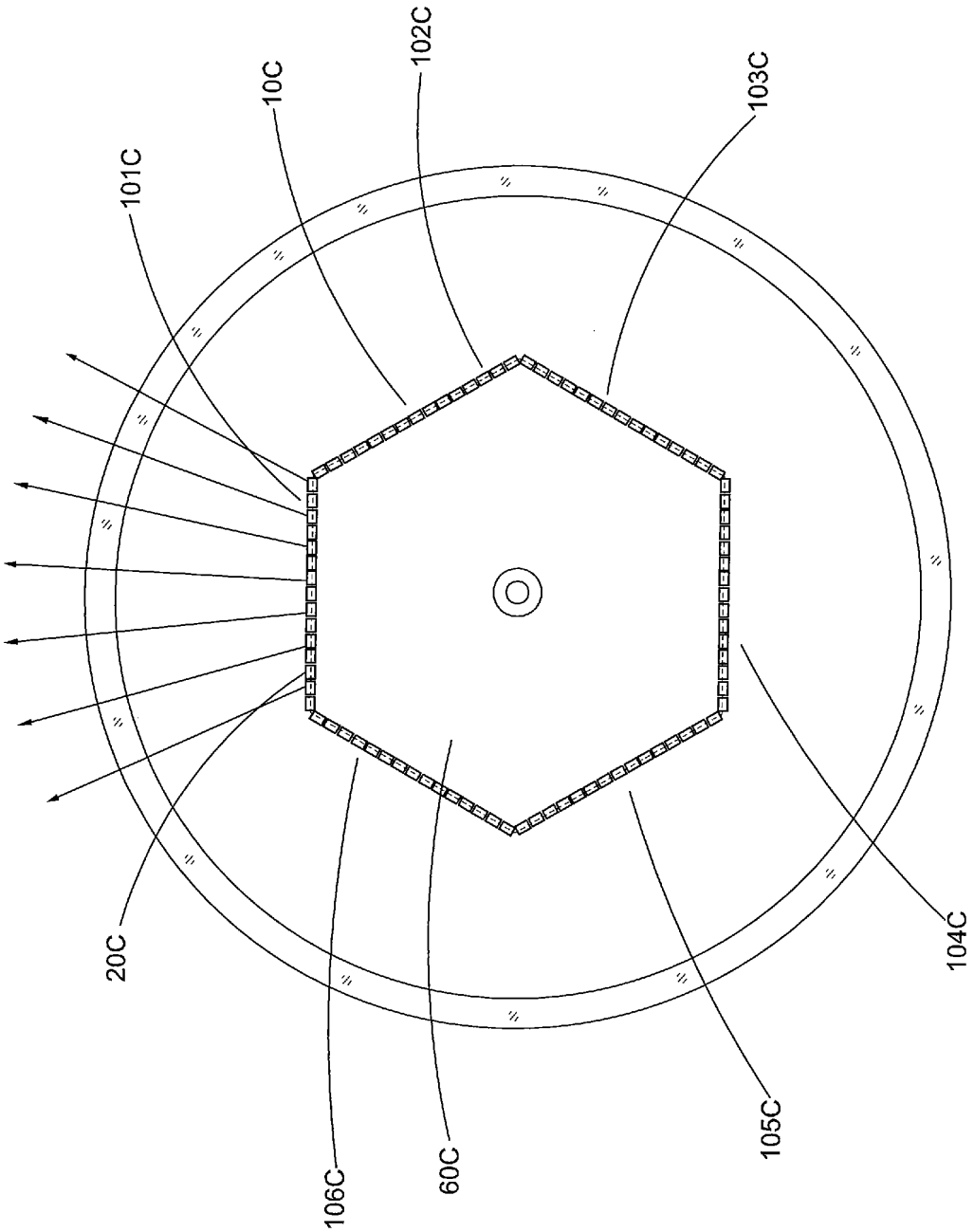

FIG. 12

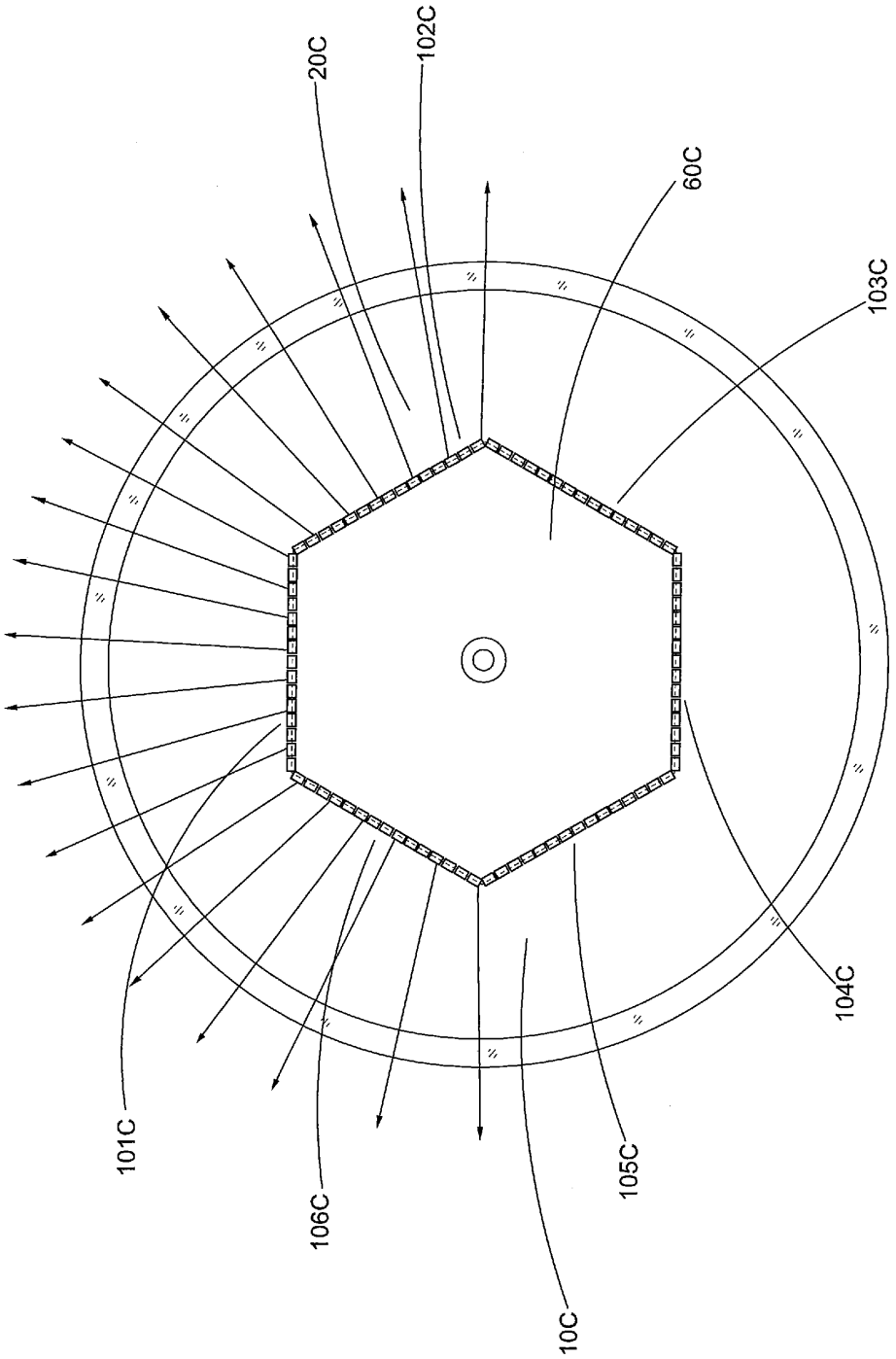

FIG. 13

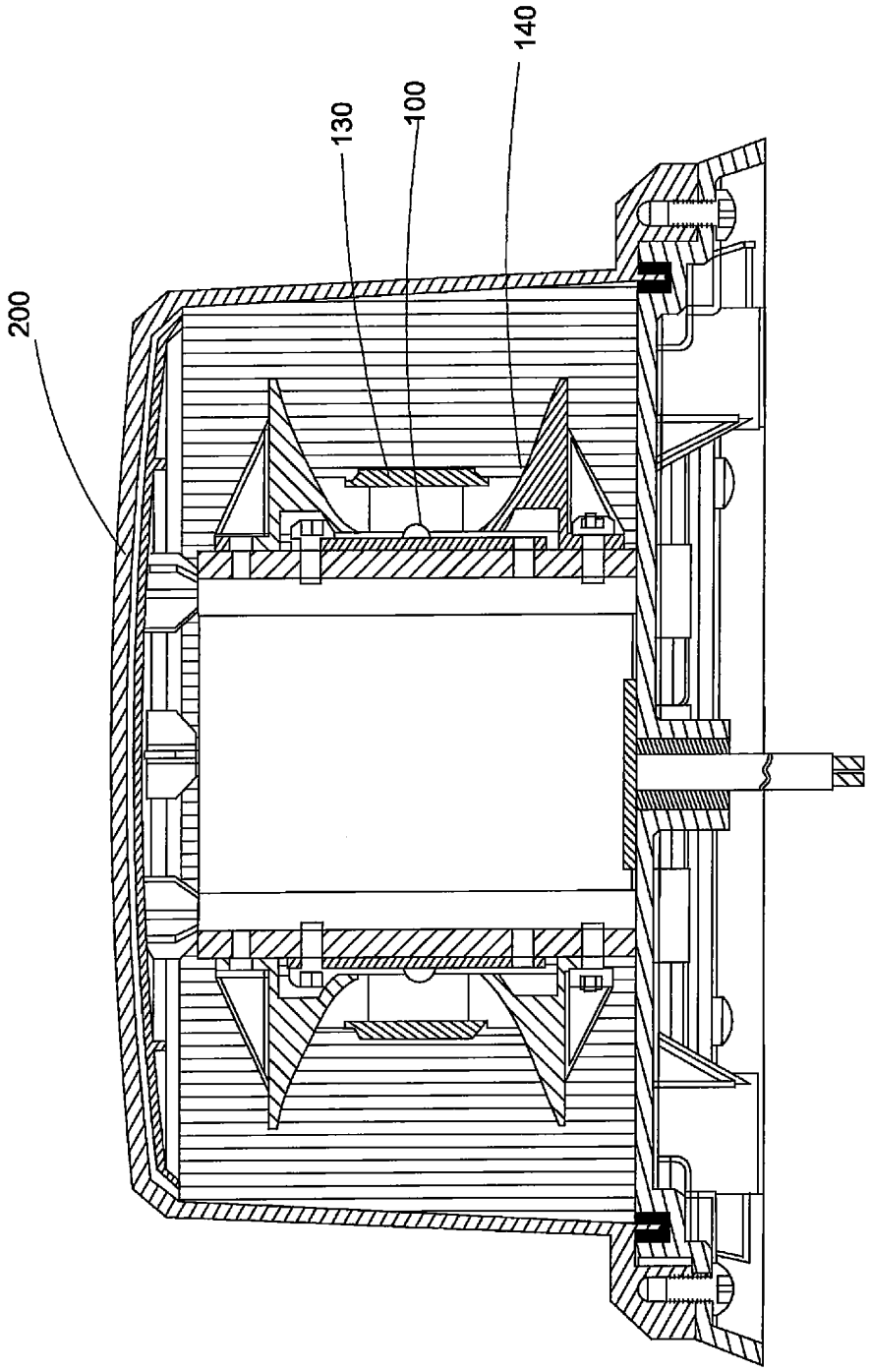

FIG. 14

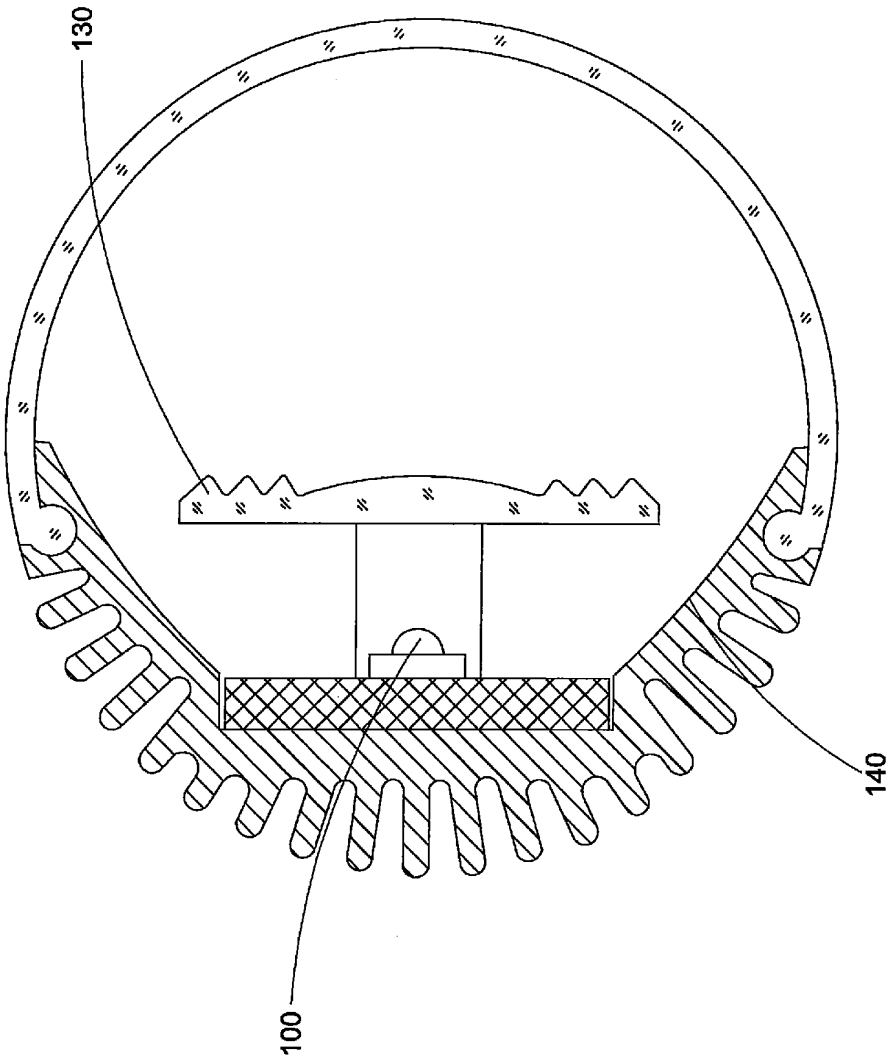

FIG. 15

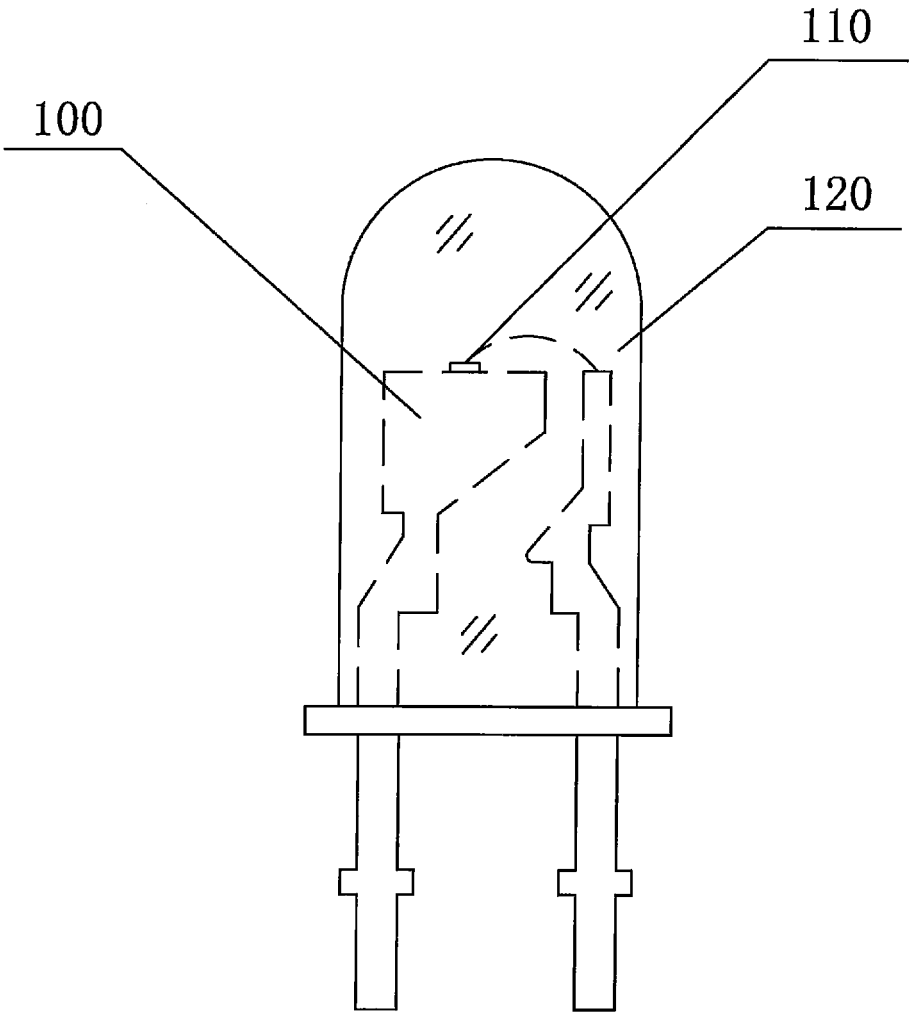

FIG. 16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/080162

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet

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)

IPC: F21, H01L 33

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

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

CNABS, CNTXT, VEN: signal light, traffic light, indicate, identification, airport, track, alarm, flight, light, illumination, colour filtering, light emitting diode, condensation, convergence, light harvesting, converge, reflection, light reflection, heat dissipation, multiple, array, multi-column, arrangement, white light, light source, shining, lamp bead, LED, white, filt+, color+, colour+, chromatic, red, yellow, blue, green

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 202972593 U (ZHANG, Wenhu), 05 June 2013 (05.06.2013), the whole document	1-25
PX	CN 102767726 A (ZHANG, Wenhu), 07 November 2012 (07.11.2012), the whole document	1-25
E	CN 103292238 A (ZHANG, Wenhu), 11 September 2013 (11.09.2013), description, paragraphs 45-84, and figures 1-7	1-11, 18-24
X	CN 101709838 A (OCEAN'S KING LIGHTING SCIENCE & TECHNOLOGY CO., LTD. et al.), 19 May 2010 (19.05.2010), description, paragraphs 2-4 and 29-44, and figures 1-6	1-25
X	CN 201606766 U (SHANGHAI SANSI TECHNOLOGY CO., LTD. et al.), 13 October 2010 (13.10.2010), description, paragraphs 14-20, and figures 1-4	1-12, 18-24
X	CN 102074623 A (LEDMAN OPTOELECTRONIC CO., LTD.), 25 May 2011 (25.05.2011), description, paragraphs 40-48, and figure 2	1, 4, 18, 19, 26-28

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"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	Date of mailing of the international search report
26 October 2013 (26.10.2013)	**07 November 2013 (07.11.2013)**
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer **GAO, Jie** Telephone No.: (86-10) **62085766**

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/080162

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 102042486 A (OCEAN'S KING LIGHTING SCIENCE & TECHNOLOGY CO., LTD. et al.), 04 May 2011 (04.05.2011), description, paragraphs 18-22, and figures 1-2	1-25
X	CN 1330243 A (TOSHIBA LIGHTING & TECHNOLOGY CORP.), 09 January 2002 (09.01.2002), description, page 3, line 14 to page 11, line 14, and figures 1-6	1-25
X	CN 102483212 A (SIEMENS AG), 30 May 2012 (30.05.2012), description, paragraphs 1 and 7-15, and figures 3-4	1-12, 18-24

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2013/080162

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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		EP 2473776 A	11.07.2012
		RU 2012112465 A	10.10.2013

Form PCT/ISA/210 (patent family annex) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2013/080162

A.CLASSIFICATION OF SUBJECT MATTER

F21S 2/00 (2006.01) i

F21V 9/08 (2006.01) i

F21W 111/00 (2006.01) n

F21Y 101/02 (2006.01) n

Form PCT/ISA/210 (extra sheet) (July 2009)