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(54) Improved LED arrangement and lamp assemblies

(57) LED arrangement for use in a lamp assembly comprising:
- a light emitting diode for emitting an amount of light;
- a metal guide structure arranged above the light emitting diode, the guide structure having an input section directed towards the light emitting diode and an output section, wherein the guide structure is designed for grouping substantially the complete amount of light within a certain radiation angle.

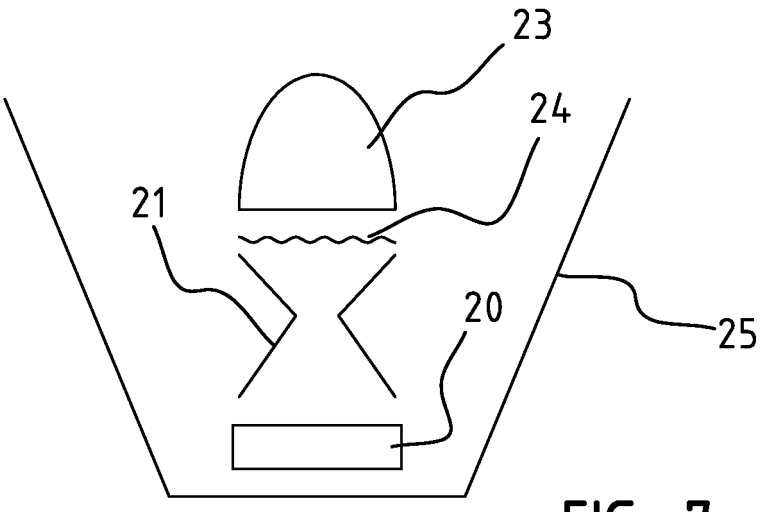

FIG. 7

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Description

[0001] The present invention relates to a LED arrangement for use in a lamp assembly, to the lamp assembly comprising a number of such LED arrangements and to further lamp assemblies.

[0002] The object of the invention is to provide a LED arrangement allowing to have a more efficient focused radiation pattern with a radiation angle which is adaptable.

[0003] To reach this object, the LED arrangement according to the invention is distinguished by comprising:

- a light emitting diode for emitting an amount of light;
- a guide structure arranged above the light emitting diode, the guide structure having an input section directed towards the light emitting diode and an output section, wherein the guide structure is designed for grouping substantially the complete amount of light within a certain radiation angle; and preferably
- a lens mounted at the output side of the guide structure, said lens being arranged for providing efficient focusing of the light entering the lens.

[0004] Advantageous embodiments of the invention are disclosed in claims 2-16.

[0005] According to a preferred embodiment the guide structure is a hollow metal tooling with an adapted shape, preferably made from copper. The guide structure has for example a conical input section narrowing in the direction away from the light emitting diode, and a conical output section narrowing in the direction away from the lens. In that way the light can leave the tooling according a specific radiation pattern with a wide or narrow angle depending on the location to be lit.

[0006] According to a further developed embodiment the conical output section has a center line, and an outer surface making an angle with the center line, wherein the angle lays between 2 degrees and 85 degrees depending on the required radiation pattern of the arrangement. For an angle of 2 degrees a narrow spot will be lit, while for an angle of 85 degrees a large area will be lit. According to an exemplary embodiment the conical output section can be asymmetric, wherein the angle varies so that an asymmetric radiation pattern is obtained.

[0007] Preferably the guide structure is substantially diabolic. This provides for a very efficient and compact guiding of the light

[0008] According to a further aspect of the invention the lens has a substantially flat base with dimensions which correspond substantially with the dimensions of the output section of the guide structure. The lens is preferably fixed on the guide structure using a glue, in particular an epoxy glue.

[0009] The invention further relates to a lamp assembly comprising a lamp body and a number of LED arrangements according to the invention, said number of LED arrangements being fixed in the lamp body for obtaining a certain total light pattern of the lamp assembly. According to a preferred embodiment the body is a tube-like body which is provided with lamp caps and electrode pins according to the same international standards as common lamp tubes.

[0010] According to a preferred feature there is provided a driver circuit for the plurality of LED arrangements in the body.

[0011] Conventional LED light is generally configured by directly mounting a control wiring board into a space formed by a circular tube made of plastic, or into a closed space formed by a base and a cover. The PCB is suspended or directly set within the base. Control elements of the LED light are provided in the lower portion of the PCB. Heat elimination from the PCB to the outside is by means of thermal conduction by air. The difficulty in heat elimination of the LEDs is a problem. Accordingly, the life of the LEDs is shortened due to the excessively high temperature of the LED.

[0012] Another purpose of the invention is to provide a lamp assembly with a good heat elimination performance, a simple configuration, a good illumination performance, a small size, a low cost and also a good appearance.

[0013] This is achieved by a lamp assembly comprising a tube shaped lamp body and a plurality of LEDs being fixed on a PCB in the lamp body, said lamp body comprising a metal lower part, and a transparent cover part, said metal lower part being arranged for transporting the heat of the plurality of LEDs to the outside.

[0014] According to a preferred embodiment the PCB is mounted on the metal lower part with insertion of a heat conducting, electrically insulating layer, for example a layer of the silicon type.

[0015] According to a preferred embodiment the lower part is made of aluminum or an aluminum alloy. Further, the cover part is preferably made from PC. The lower part and the cover part preferably extend over substantially the complete length of the tube like body and/or have substantially a semi-circular cross section. The cover part and the lower part can further be adapted so that the cover part can be snap-fitted on the lower part.

[0016] According to a further developed embodiment the lower part is provided with ribs to improve cooling thereof and at the same time strengthen the lower part.

[0017] According to another aspect of the invention the lamp assembly comprises a main body, said main body being constituted by a metal base, a transparent cover mounted on the metal base, a PCB provided within the metal base, and an LED light provided on the PCB, wherein a heat-conductive and electrical-insulated layer is attached in a heat-conductive way between the bottom surface of the PCB and the metal base.

In said lamp assembly, the overall profile of the main body may be a long tube shape.

[0018] In an embodiment of the lamp assembly, the cross section profile of the main body may be circular or rectangular.

[0019] In an embodiment of the lamp assembly, there may be lamp holders provided on the both ends of the main body.

[0020] In an embodiment of the lamp assembly, cross sections of the metal base and the transparent cover are half circles which buckle with each other in a symmetric way, and an integral fitting plate is provided in the metal base, the PCB and the heat-conductive and electrical-insulated layer which are attached with each other being fixed on the fitting plate.

[0021] In an embodiment of the lamp assembly, control elements of the LED lights are provided on both end portions of the PCB within the lamp holders.

[0022] With the above described configuration according to the invention, the heat-conductive and electrical-insulated layer made of silicon material provided between the PCB and the metal base enables the heat of the PCB to be directly conducted to the metal base using the fact that the metal base are able to rapidly conduct heat, and therefore the temperature inside the light body is significantly decreased. In addition, the metal base and the transparent cover constitute the main body in a long tubular shape, with the profile of the cross sections being in a circular shape, which enables the effective use of the spaces in the lamp holders on both ends for accommodating the control elements, and therefore the overall appearance is good and the configuration is compact. Furthermore, the corresponding transparent cover has a cross section in a half circle shape, which enhances the illuminating performance and focusing performance.

[0023] The accompanying drawings are used to illustrate presently preferred non-limiting exemplary embodiments of the present invention. The above and other advantages, features and objects of the invention will become more apparent and the invention will be better understood from the following detailed description when read in conjunction with accompanying drawings in which:

Figure 1 is a schematic longitudinal section of an embodiment of a lamp assembly according to the invention;

Figure 2 is a schematic perspective view of the first embodiment, partly exploded;

Figure 3 is a cross section along line A-A of figure 1;

Figure 4 is a cross section of a second embodiment of a lamp assembly of the invention;

Figure 5 is a perspective view of an end cap of the first embodiment;

Figure 6 is an example of the driver circuit for powering the LED components of a lamp assembly according to the invention;

Figure 7 is a detailed schematic drawing of an embodiment of a LED chip mounting according to the invention;

Figure 8(A)-(C) illustrate schematically how the radiation pattern of the emitted light of a LED can be changed with an embodiment of the invention;

Figures 9-11 illustrate a method for preparing a number of LED arrangements of the invention in a number of rows for mounting on a PCB.

[0024] Figures 1 to 3 illustrate an embodiment of a lamp assembly according to an embodiment of the invention. The embodiment of figure 1 comprises a cylindrical tube-like body 1 typically with the dimensions of a standard fluorescent tube (TL-D). The tube-like body consists of two parts: an aluminum-alloy lower part 11 and a cover part 12, typically fabricated from a PC (Polycarbonate) material. The aluminum-alloy lower part is provided with a support part 11a Cross sections of the metal base 11 and the transparent cover 12 are half circles which buckle with each other in a symmetric way, and the support part is here an integral fitting plate 11a provided in the metal base 11.

[0025] In the tube-like body 1 there are provided a number of LED components 14 which are here arranged in three rows. The skilled person will understand that this can be any number of rows depending of the dimensions of the lamp assembly, the required lighting, the dimensions of the LED components, etc.

[0026] The LED components are mounted on a printed circuit board (PCB) 13. The PCB 13 is supported on the lower part 11 with the intersection of a layer 15 for electric isolation on the one hand and heat transport on the other hand between the PCB 13 and the lower part 11. Layer 15 is for example fabricated in a silicon type of material.

[0027] The heat-conductive and electrical-insulated layer 15 is attached in a heat-conductive way between the bottom surface of the PCB 13 and the fitting plate 11a of the metal base 11. The PCB 13 and the heat-conductive and electrical-insulated layer 15 which are attached with each other are fixed on the fitting plate 11a.

[0028] The end parts of the body 1 are closed with end caps 16. The end caps 16 are for example adapted for lamp holders of the T8-type. A detailed perspective view of such an end cap 16 is shown in figure 5. The end cap basically consists of an end part 19 and two fixation sections 17, 18 extending inwardly in the body 1. A first fixation section 17 which can be fitted in the cover part 12 and a second fixation section 18 which can be fitted in the lower part 11.

[0029] Note that the lower part 11 is preferably fabricated in a material with good heat transport properties, but this material can be different from aluminum or an aluminum alloy. As shown in the figures the lower part can be provided on its outside surface with a corrugated profile in order to further improve cooling of the lamp as-

sembly.

[0030] The parts 15 schematically represent components of a driver circuit (i.e. a constant current power unit) for the LED components 14 on the PCB 13. An example of such a driver circuit is shown in figure 6. The control elements 15 can be provided on both end portions of the PCB 13 partly within the end caps 16.

[0031] Fig. 4 shows an LED fluorescent tube according to the second embodiment, which comprises a long tube shaped main body 1. The main body 1 is constituted by a long channel-shaped metal base 11, a transparent cover 12 mounted on the metal base 11, a PCB 13 provided within the metal base 11, and an LED light 14 provided on the PCB 13. A cross section of the metal base 11 is in a rectangular shape, and a cross section of the transparent cover 12 is in a half circular shape. A heat-conductive and electrical-insulated layer 15 is attached in a heat-conductive way between the bottom surface of the PCB 13 and an inner wall surface of a bottom plate of the metal base 11. The heat-conductive and electrical-insulated layer 15 is made of silicon. End caps 16 are provided on both ends of the main body 1. Control elements of the LED light 14 are provided on both end portions of the PCB 13. When the fluorescent tube is in use, the main body 1 is fitted in a lamp holder via connection pins on external end portions of the lamp holders.

[0032] Now the details of an embodiment of a LED arrangement will be set out in detail with reference to figure 7. A LED chip 20 is mounted on a base, typically inside a cup 25 of a stent as is known in the art. The light emitted by the LED chip is bundled via a hollow metal guide structure 21, preferably in the form of diabolic metal tooling, for example made in copper. A lens 23 is fixed on the guide structure 21 preferably using an epoxy glue 24. The form of the guide structure should be adapted to group substantially all the light emitted by the LED chip and to guide the light within a certain radiation angle before entering the lens 23.

[0033] As shown in figure 8 (A) the opening angle α of the output section of the guide structure 21 can be varied in function of the desired radiation pattern. Further the base dimensions of the lens 23 can be adapted accordingly. Figure 8(B) shows an embodiment with a small opening angle $\alpha 1$ for obtaining a narrow spot of light while figure 8(C) shows a wide opening angle $\alpha 2$ for obtaining a larger lit area.

[0034] Finally figures 9-11 illustrate how the LED arrangement shown in figure 7 is prepared for mounting in a number of rows on a PCB 13. Figure 9 is a top view of the stents and connection lines used for connecting the LED arrangements 20-24 on the PCB 13. The numbers 26 and 27 refer to the stents for connecting a LED placed in cup 25 with the positive and negative side of the power supply. Reference 29 refers to further connection lines for connecting the different LEDs. The metal is cut where necessary after packaging of the LEDs. The housing 30, 30' placed over the stents is shown in figures 10 and 11. The height of the cap-like housing 30, 30' is chosen in function of the radiation angle, and figure 10 shows a housing for a total radiation angle of 75/80 degrees while figure 11 shows a variant for a total radiation angle of 25/30 degrees with a higher housing 30'.

Figures 10 and 11 further show a stop element 32 for holding the stents 27, 28. Element 33, 33' is a module article with a first side on which the LEDs are mounted and a back side on which the stop elements 32 are mounted.

[0035] While the principles of the invention have been set out above in connection with specific embodiments, it is to be clearly understood that this description is merely made by way of example and not as a limitation of the scope of protection which is determined by the appended claims.

Claims

1. LED arrangement for use in a lamp assembly comprising:

   - a light emitting diode for emitting an amount of light;
   - a metal guide structure arranged above the light emitting diode, the guide structure having an input section directed towards the light emitting diode and an output section, wherein the guide structure is designed for grouping substantially the complete amount of light within a certain radiation angle.

2. Arrangement according to claim 1 further comprising:

   - a lens mounted at the output side of the guide structure, said lens being arranged for providing efficient focusing of the light entering the lens.

3. Arrangement according to any of the previous claims, **characterized in that** the guide structure is a hollow metal tooling with an adapted shape.

4. Arrangement according to claim 3, **characterized in that** the guide structure is a hollow tube-like section with a variable diameter, such that the input section is adapted to the dimensions of the light emitting diode and the output section is adapted to the required radiation angle.

5. Arrangement according to any of the previous claims, **characterized in that** the guide structure is made from copper.

6. Arrangement according to any of the previous claims, **characterized in that** the guide structure has a conical input section narrowing in the direction

away from the light emitting diode.

7. Arrangement according to any of the previous claims, **characterized in that** the guide structure has a conical output section narrowing in the direction away from the lens.

8. Arrangement according to claim 7, the conical output section having a center line, and an outer surface making an angle with the center line, **characterized in that** the angle lays between 2 degrees and 85 degrees depending on the required radiation pattern of the arrangement.

9. Arrangement according to claim 7 or 8, the conical output section having a center line, and an outer surface making an angle with the center line, **characterized in that** the conical output section is asymmetric, wherein the angle varies so that an asymmetric radiation pattern is obtained.

10. Arrangement according to any of the previous claims, **characterized in that** the guide structure is substantially diabolic.

11. Arrangement according to any of the previous claims, **characterized in that** the lens has a substantially flat base with dimensions which correspond substantially with the dimensions of the output section of the guide structure.

12. Arrangement according to any of the previous claims, **characterized in that** the lens is fixed on the guide structure using a glue, in particular an epoxy glue.

13. Lamp assembly comprising a lamp body and a plurality of LED arrangements according to any of the previous claims, said plurality of LED arrangements being fixed in the lamp body.

14. Lamp assembly according to claim 13, **characterised in that** the plurality of LED arrangements are arranged in a number of rows.

15. Lamp assembly according to claim 13 or 14, **characterised in that** the body is a tube-like body which is provided with lamp caps and electrode pins according to the same international standards as common lamp tubes.

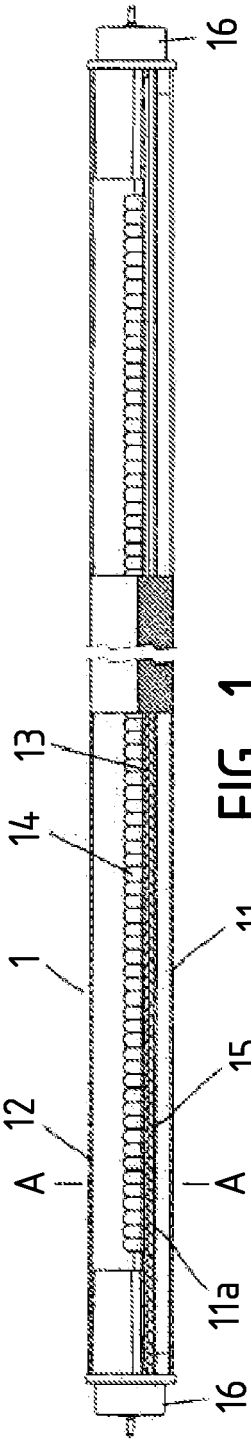

FIG. 1

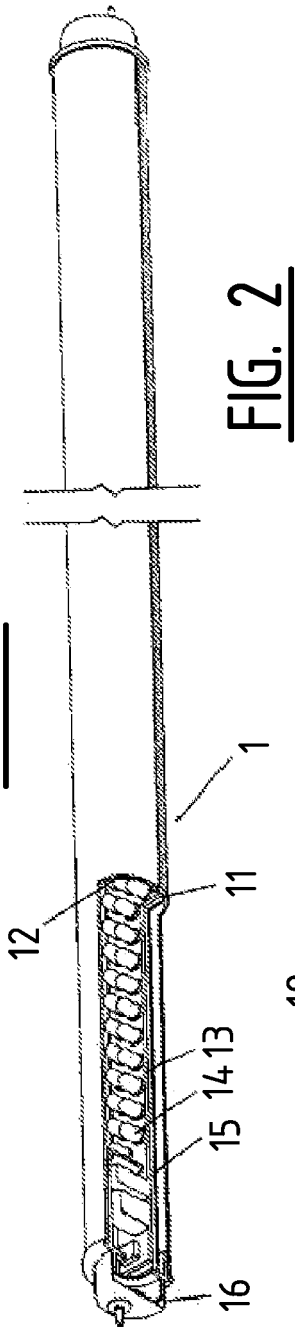

FIG. 2

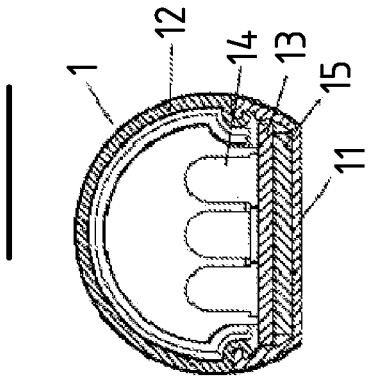

FIG. 4

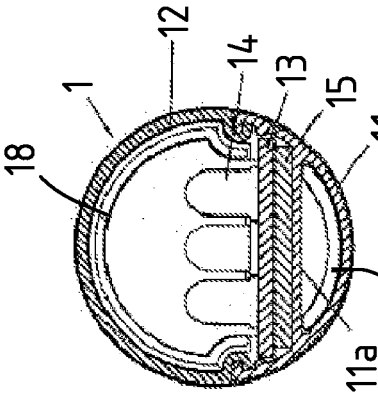

FIG. 3

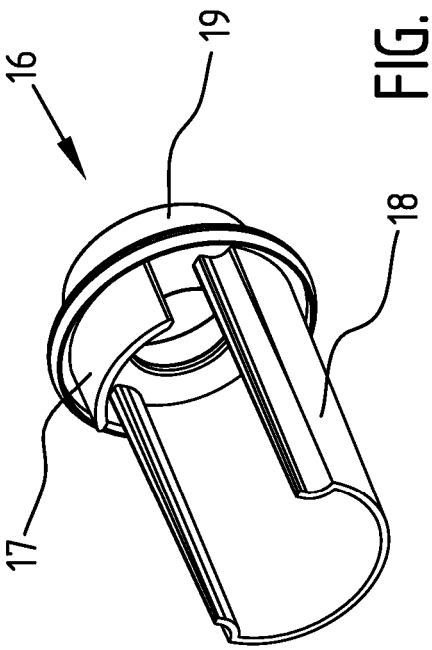
16
19
18
17

FIG. 5

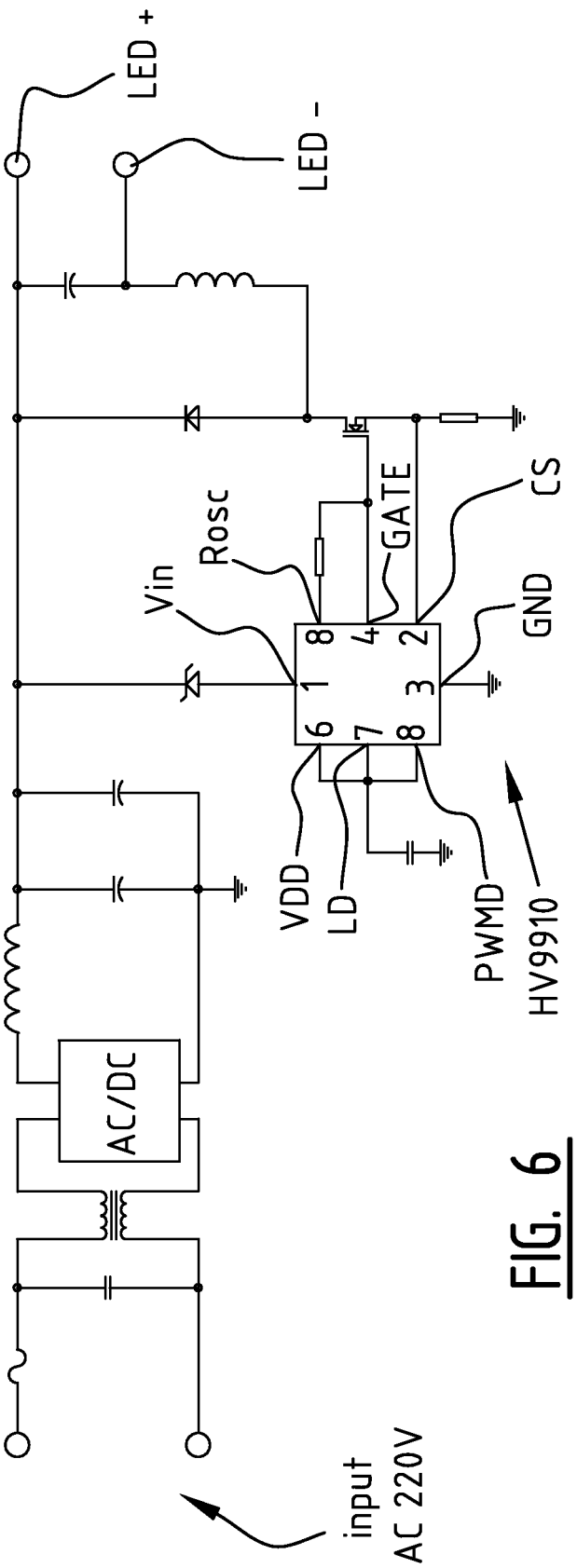
LED +
LED -
Vin
Rosc
GATE
CS
GND
8
4
2
1
3
6
7
8
VDD
LD
PWMD
HV9910
AC/DC
input
AC 220V

FIG. 6

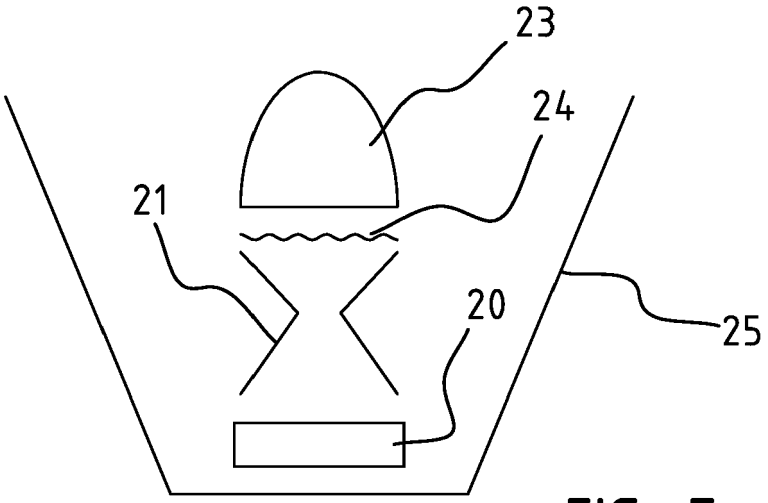

FIG. 7

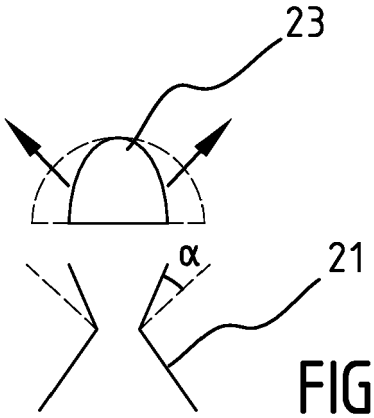

FIG. 8A

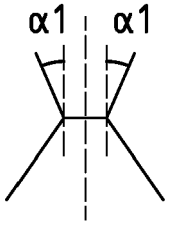

FIG. 8B

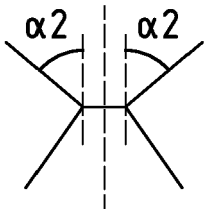

FIG. 8C

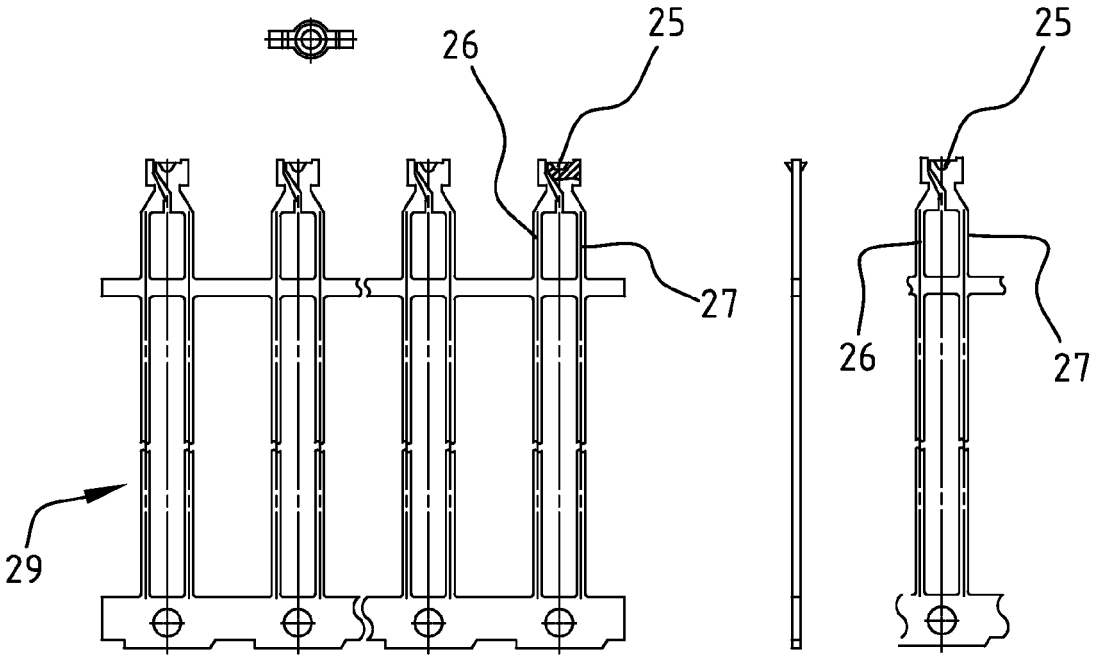

FIG. 9

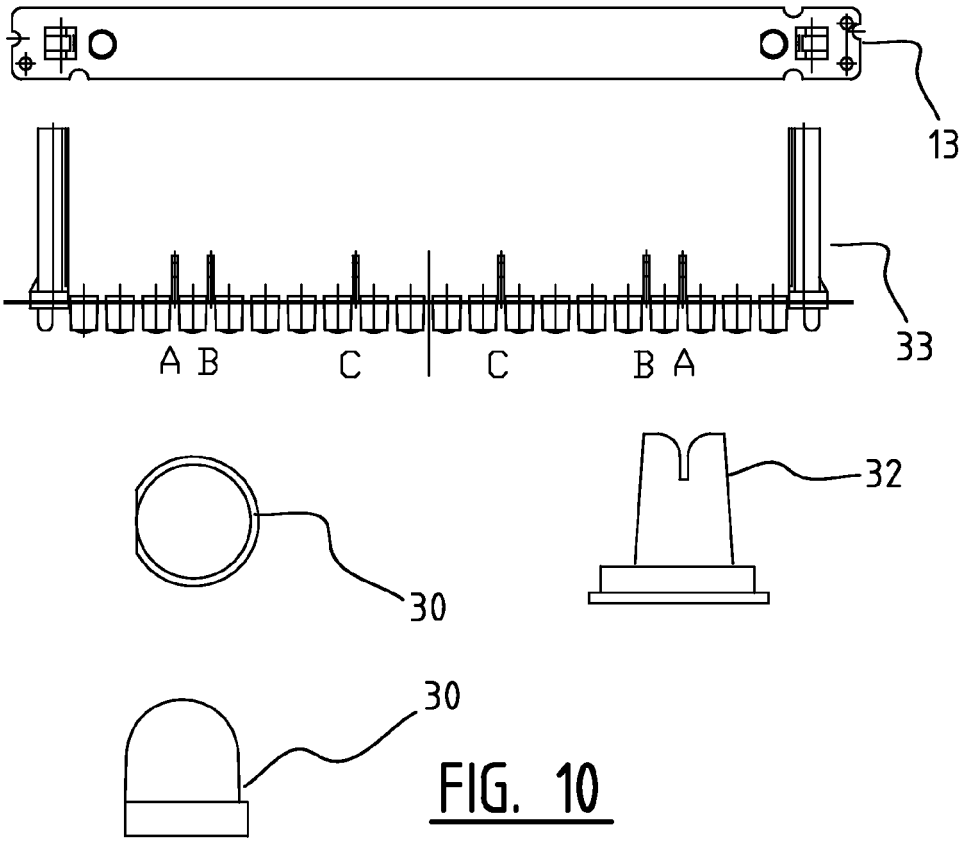

FIG. 10

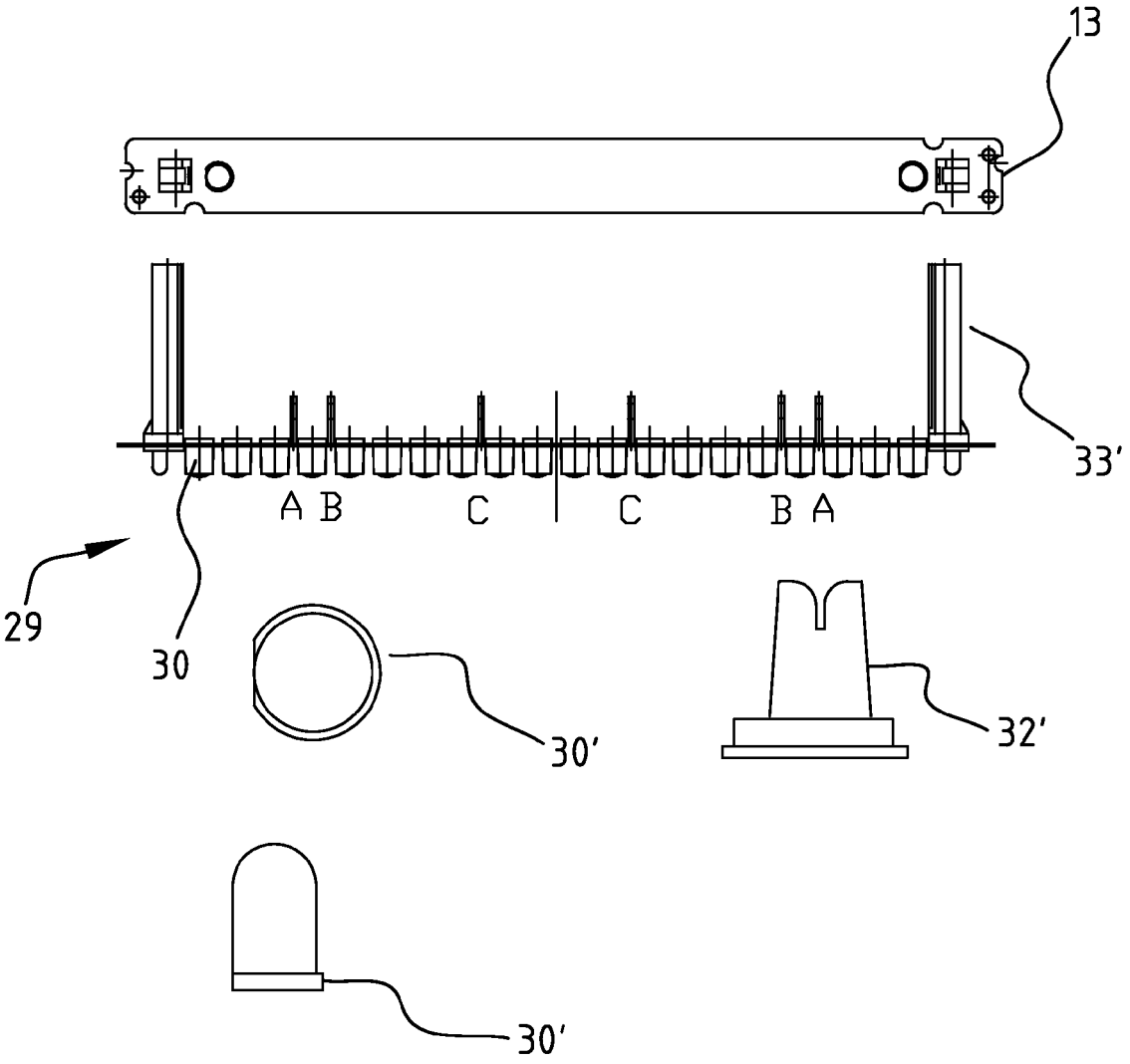

FIG. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 09 17 3914

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 357 335 A (NICHIA CORP [JP]) 29 October 2003 (2003-10-29) * abstract * * figures 1a,1b * -----	1-3, 11-15	INV. F21K99/00 F21S4/00
X	WO 2007/030542 A (LSI IND INC [US]; REED MARK C [US]; BOYER JOHN DELMORE [US]) 15 March 2007 (2007-03-15) * paragraph [0039] * * figure 4 * -----	1-3, 11-15	

TECHNICAL FIELDS SEARCHED (IPC)

F21S
F21K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 February 2010	Amerongen, Wim

CATEGORY OF CITED DOCUMENTS

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02-02-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1357335 A	29-10-2003	US 2006044804 A1	02-03-2006
		US 2003214803 A1	20-11-2003
WO 2007030542 A	15-03-2007	CA 2621160 A1	15-03-2007
		EP 1922227 A2	21-05-2008
		US 2009207602 A1	20-08-2009

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