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(71) Applicants:
- **OSRAM GmbH**
  80807 München (DE)
- **OSRAM S.P.A. - SOCIETA' RIUNITE OSRAM EDISON CLERICI**
  20126 Milano (IT)
  Designated Contracting States:
  IT

(72) Inventors:
- **BOBBO, Simon**
  I-35128 Padova (IT)
- **MICHIELAN, Valerio**
  I-30037 Gardigiano (Venezia) (IT)
- **ZANOTTO, Alberto**
  I-35127 Padova (IT)
- **REISS, Martin**
  D-93161 Sinzing (DE)
- **DIDONE', Roberto**
  I-36027 Rosà (Vicenza) (IT)
- **CALLEGARO, Antonio**
  I-31022 Preganziol (Treviso) (IT)

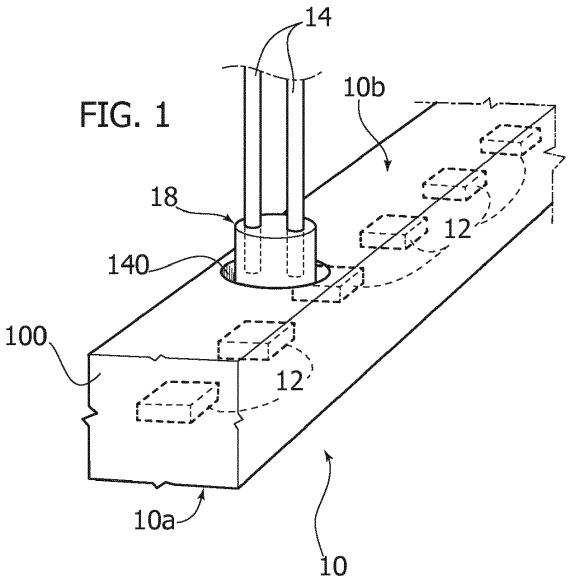
(74) Representative: **Bosotti, Luciano**
Buzzi, Notaro & Antonielli d'Oulx
Corso Vittorio Emanuele II, 6
10123 Torino (IT)

(54) A METHOD FOR INSTALLING LIGHTING DEVICES AND CORRESPONDING LIGHTING DEVICE

(57) A method for installing a lighting device (10), such as, for example, an LED module comprising an elongated body having a first, light-emitting surface (10a) and at least one second rear (10b) or side surface, with an encapsulation layer at the second surface (10b), and a distribution of electrically-powered light radiation sources (12) arranged in the elongated body along the length thereof to project light radiation towards the light-emitting surface (10a).

Electrically-conductive formations (14) are provided for transferring electrical signals with respect to the light radiation sources (12), which pass through one or more passageways (140) in the encapsulation layer (100) at the second surface (10b).

FIG. 1



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Description

Technical field

[0001] The description refers to lighting devices.

[0002] One or more embodiments may be applied to lighting devices using electrically-powered light radiation sources, for example, solid-state light radiation sources, such as LED sources.

Technological background

[0003] There is a growing diffusion in the lighting sector of linear LED lighting devices, for example, flexible.

[0004] As part of this trend, devices that can provide uniform and homogeneous illumination play a major role, without more pronounced lighting points or spots being detected at the LEDs.

[0005] Devices of this kind can be used both for decorative purposes and for general lighting functions, considering the possibility of providing a uniform and diffused light emission along the entire length of the device or module.

[0006] Devices of this nature, (also) indicated below as "modules", according to current use, are available in various configurations, for example, with white emissions for lighting purposes and with colored light emissions, which can be used for decorative purposes.

[0007] There are fundamentally two categories of products available on the market: top emitting modules and side emitting modules. These types of modules are characterized by the different direction of emission of the light radiation with respect to the folding direction of the module.

[0008] As mentioned, these modules can be used for decorative purposes (for example, with colored emissions, for example, RGB). In these applications, the light emission surface (for example, of a diffused type) can, for example, be directly visible.

[0009] This may, for example, also apply to general lighting applications, for example, for niche or cove-lighting or for functions of the type known as "wall-wash" lighting, with diffused lighting on a wall surface.

[0010] For these applications it is desirable to avoid (or at least reduce) the presence of dark areas, of lighting discontinuity (for example, light zones and dark zones), so as to achieve a diffused and homogeneous lighting effect.

[0011] In this context, problems can arise related to connecting the module with the drive unit.

[0012] For example, the presence of connectors intended to establish such a connection can, for example, give rise to inhomogeneity of light emission at the area of the module where the connection is made.

[0013] In addition, aspects related to the physical dimensions of the connector must be taken into account, for example, in consideration of the fact that - if the module and the connector are placed in a profiled bar, for example, of aluminum - some applications may involve specific forming or cutting of the connector.

[0014] Substantially analogous considerations can be applied in the case of installation in a groove provided in a wall, a furnishing element, a false ceiling, etc.

[0015] In this case, some installations may involve the production of a cavity of a larger size and/or of an appropriate shape at the position of the connector in order to allow its positioning. Regardless of any other consideration, this fact can result in additional costs and a greater time commitment at the installation level.

[0016] Similar overall aspects can emerge in the case in which installation of a module is required in close proximity (virtually "attached") to another module without the connection area being visible. If two modules are arranged next to each other, the presence, for example, of a dark area can be created, linked to the presence of the connector and/or the presence of welded wires for supplying power to the modules.

[0017] Problems of this nature have, however, already been confronted, by means of various solutions, which - in summary - can have one or more of the following drawbacks:

- the connector and wiring system have larger shapes and sizes than the module (for example LED module), so that they protrude with respect to the dimensions of the module;
- the connector and wiring system are located at one end of the module and, when two modules are arranged next to each other, the presence of a dark, non-lighted area is created between the two modules;
- if the module is intended to be placed in a recessed position with respect to a wall, in a metal profiled bar, etc., the installer must, for example, create a dedicated seat/groove at the connector/wiring system;
- even when the wiring system does not protrude beyond the external dimensions of the module, the cables themselves may end up creating a shaded area at the light-radiation emitting surface.

[0018] The aspects discussed above assume particular importance if the emission of colored radiation is provided, for example, according to RGB, RGBW schemes or in conditions where a correlated color temperature (CCT) regulation is provided for an overall white source.

[0019] Particularly when dealing with lighting devices of a certain length, the appearance of color uniformity may, for example, be critical when two or more modules placed next to each other are used. This, for example, considers the fact that, at the modules, there are cables for supplying the modules with power, which can either be connected by welding or, as already discussed above, by means of a connector.

[0020] For example, it may be difficult to maintain the same level of color uniformity at the ends of a module, particularly when two modules are arranged close to

each other. For example, it may also be difficult to maintain the same external dimensions of the module when a metal (profiled) rail is required, for example, of aluminum, for use as a mounting or installation structure

[0021] The above considerations apply in an almost identical manner independently of the solution adopted for welding the power supply cables at one end of the module: from the bottom, on the side, or at the top, for example, with a diffuser element.

[0022] In these cases, formation of a darker area (for example, at one end of the module) is expected to be almost unavoidable due to the need to protect the welding joint of the cables and ensure adequate protection (e.g. with an IPxx degree of protection) against the penetration of external agents. This may, for example, involve applying a cover on the cable sheath (which may correspond to a non-lighted area as no light radiation sources are present).

[0023] Similar overall considerations are valid, as has already been said, if a connector is used which could give rise to a darker area where the connector is applied, plus the possibility that the external dimensions of the module are increased due to the presence of the connector, even when connectors of a transparent type are used, which can reduce the effect of forming a darker area, without however solving the problem of the larger dimensions of the module at the application area of the connector.

Object and summary

[0024] One or more embodiments aim to overcome, at least partly, the drawbacks outlined above.

[0025] According to one or more embodiments, this object can be achieved, for example, thanks to a method having the characteristics referred to in the following claims.

[0026] One or more embodiments may concern a lighting device that can be used with this method.

[0027] The claims form an integral part of the technical disclosure provided here in relation to embodiments.

[0028] One or more embodiments may make it possible to achieve one or more of the following advantages:

- possibility of making an electrical connection (via cables/wires) without increasing the dimensions of the lighting device;
- minimizing the external dimensions of the device (also at the level of connection areas);
- possibility of installing more than one module without giving rise to dark areas due to the presence of connectors/cables;
- possibility of using supporting structures, for example, rails, without the need to make specific grooves/seats for cables/wires;
- possibility of welding the wires at a central area of the device, which can, for example, facilitate the production of longer modules/devices taking into consideration the lower ohmic drop along the aforesaid wires/cables.

Brief description of the figures

[0029] One or more embodiments will be now described, purely by way of non-limiting example, with reference to the attached figures, wherein:

- Figures 1 to 3 illustrate, respectively, a perspective view, a side view and a plan view of possible implementations of embodiments;
- Figures 4 to 7 illustrate possible embodiments and the advantages that can derive from them, respectively, according to a side observation point (Figures 4 and 6) and in plan view (Figures 5 and 7);
- Figures 8 to 11 illustrate possible criteria for applying embodiments to the installation of lighting devices in furnishing elements;
- Figures 12 and 13 illustrate possible application modes of embodiments in mounting structures, such as rails or metal profiled bars;
- Figures 14 to 16 show, respectively, in a cross-sectional view (Figures 14 and 15) and in a plan view (Figure 16), possible characteristics of embodiments;
- Figure 17 comprises three parts, indicated respectively by a), b), and c), which exemplify various possible details of embodiments,
- Figures 18 to 21 illustrate possible developments of embodiments, with Figures 18 to 20 corresponding to plan views, and Figure 21 constituting a cross-sectional view along the line XXI-XXI of Figure 20) ;
- Figure 22 is a cross-sectional view of a cover member which can be included in embodiments according to the modes exemplified in Figure 23;
- Figure 24 comprises three parts, indicated respectively by a), b) and c), exemplifying possible operations that can be implemented in the embodiments;
- Figure 25 illustrates, as for Figure 26 and Figure 27, possible developments of embodiments,
- Figure 28 comprises three parts, indicated respectively by a), b) and c), exemplifying possible steps that can be implemented in the embodiments;
- Figure 29 and Figure 30, each comprising two parts indicated respectively by a) and b), exemplify possible modes of implementing embodiments, and
- Figure 31, comprising two parts indicated respectively by a) and b), exemplifies possible ways of using embodiments according to (at least approximately) opposite points of view.

[0030] It will be appreciated that, for clarity and simplicity of representation, the various figures may not be reproduced on the same scale.

[0031] Furthermore, elements or characteristics described herein and/or illustrated, singly or in combination with each other, referring to embodiments exemplified in

any of the attached figures, can also be applied, singly or in combination, in embodiments exemplified in any other of the figures attached here. In other words, the fact that a given element or characteristic is presented here with reference to an embodiment exemplified in a certain figure is not intended, even in an indirect sense, as indicative of the fact that this element or characteristic is only intended to be used in this embodiment.

[0032] For immediate reference it can also be noticed that:

- Figures 1 to 13 illustrate - in general terms - an installation method according to one or more embodiments, and
- Figures 14 to 31 illustrate possible ways of implementing a device according to embodiments, which can be used in the context of such a method.

Detailed description of examples of embodiments

[0033] The following description illustrates one or more specific details in order to provide a thorough understanding of the examples of the embodiments of this description. The embodiments can be obtained without one or more of the specific details, or with other methods, components, materials, etc. In other cases, known structures materials or operations are not illustrated or described in detail so that certain aspects of the embodiments and not rendered unclear.

[0034] The reference to "an embodiment" in the context of the present description indicates that a particular configuration, structure or characteristic described with reference to the embodiment is included in at least one embodiment. Thus, phrases such as "in an embodiment", which may be present at one or more points in the present description do not necessarily refer to exactly the same embodiment. Moreover, particular configurations, structures or characteristics can be combined in any suitable way in one or more embodiments.

[0035] The references used here are provided simply for convenience and therefore do not define the field of protection or scope of the embodiments.

[0036] As exemplified in Figures 1 to 14, one or more embodiments may relate to a method for installing a lighting device ("module") indicated - in its entirety - by 10 (for example, with a quadrangular (e.g. rectangular) cross-section) of a generally elongated shape, for example, flexible, in which it is generally possible to distinguish:

- a front surface 10a, emitting light radiation,
- a rear surface 10b, opposite to the light-radiation emitting surface 10a, on which there is an encapsulation layer 100 (indicated as such in Figure 1 only),
- electrically-powered light radiation sources 12, such as, for example, solid-state light radiation sources, for example, LED sources, distributed along the length of the device 10 and capable of generating light radiation intended to be projected (e.g. diffused) starting from the light-radiation emitting surface 10a (downwards, according to the observation point of Figures 1 and 2).

[0037] Lighting devices/modules of the type discussed here (which, as far as we are concerned, can be seen as elements of indefinite length) are well known in the art, which makes it unnecessary to give a more detailed description here.

[0038] Furthermore, it will be appreciated that the connotation of the surfaces 10a and 10b, respectively, as "front" and "rear" refers primarily to the emission action of the light radiation, regardless of the possible spatial orientation of the module 10.

[0039] According to the methods of use and criteria known per se, the spatial orientation of the front surface 10a and of the rear surface 10b can be of any type. For example, in the case of a flexible module 10, the surface 10a and the surface 10b can be mutually opposite to each other, both in the direction of the plane in which the module is bent, and in a direction orthogonal to this plane, according to the module 10 with either "top emitting" or "side emitting" lighting.

[0040] One or more embodiments facilitate the production of an electrical connection toward the light radiation sources implemented by means of electrically-conductive formations, for example, cables or wires 14.

[0041] For the sake of simplicity, the attached figures refer to the presence of two wires 14, which can provide electrical power supply (for example, voltage +V and voltage -V or voltage +V and 0V) of the light radiation sources 12.

[0042] In one or more embodiments there may be additional electrically-conductive formations that can carry out the transfer of electrical signals with respect to the sources 12 (hence towards the sources 12 as well as coming from the sources 12 themselves), for example, in order to perform, according to criteria known per se, and possibly using electrical/electronic components/devices associated with the sources 12 - functions for controlling the operation of the sources 12 (for example, dimming functions, functions for varying the color point of the emitted total radiation, etc.).

[0043] One or more embodiments are aimed at producing this connection (including the relative wiring system) with reduced dimensions, without changing the appearance of the device 10 and, in particular, without giving rise to appreciable enlargements or protrusions with respect to the surface of the device 10, also facilitating installation operations.

[0044] In one or more embodiments, this result may, for example, be achieved by providing at least one passageway 140 for electrically-conductive formations (e.g., wires 14) to pass through the encapsulation layer 100 which - in the case exemplified in Figures 1 to 13 - is assumed to be located at the rear surface 10b.

[0045] As will emerge from the following description, this exemplification must not in any case be understood

in a limiting sense of the embodiments, since the solution described here with reference to the surface 10b (opposite to the front surface 10a) can be applied to the side surfaces (for example, the walls 102, which will be described below) of the module 10.

[0046] For example, in one or more embodiments as exemplified in Figures 1 to 3, this result may, for example, be achieved by piercing (e.g. by means of a milling or drilling operation - e.g. with a drill) the encapsulation layer 100 at the surface 10b, so as to form a hole 140 through which the electrically-conductive paths or tracks 16 (capable of being connected to the light radiation sources 12) become accessible, see for example, the plan view of Figure 3.

[0047] As possible alternatives to the perforation of the encapsulation layer (100 - or 102, with reference to Figure 14 and subsequent figures), it is possible to provide the passageway for the electrically-conductive formations (14) by punching the encapsulation layer or by means of removal (for example, with a cutter) of some of the material of said encapsulation layer.

[0048] In one or more embodiments it is possible to take into account the fact that these operations cause exposure of the surface of the support (for example, similar to a printed circuit board or PCB) on which the sources 12 facing the surface 10a are mounted, according to known criteria.

[0049] In particular, it is possible to take into account the fact that these operations can give rise to undesired residues (burrs) that could remain on the surface of the support: for example, it is possible to envisage removal of these residues with a cleaning operation by blowing air or suction.

[0050] In one or more embodiments, it is also possible to provide protective labels on the surface of the support or PCB intended to be exposed, applied before forming the encapsulation layer 100, and capable of being removed after the opening or passageway 140 has been formed.

[0051] As exemplified in Figure 3, in one or more embodiments it is possible to carry out the electrical (and mechanical) coupling - for example, by welding - of the wires 14 on the electrically-conductive formations 16.

[0052] Whatever the solution adopted in this regard, in one or more embodiments, it is possible to apply a sealing mass around the cables 14 (for example, a cylindrical mass of potting elastomeric material such as silicone or polyurethane) facilitating both the electrical insulation and insulation against penetration of external agents such as dust or water or moisture (for example, with an IPxx degree of protection).

[0053] For this purpose, it is possible to use a small hollow cylindrical mold, and dispensing the aforesaid potting material therein. In one or more embodiments, it is therefore possible to create the insulating body 18 in the form of an element that projects by a limited amount (for example, 2-3 mm) with respect to the surface 10b of the module 10.

[0054] As can be appreciated in the views of Figures 4 and 5 (which in the case - purely by way of example - of a module 10 of the "top-emitting" type may correspond to a side view and a plan view from below), the protrusion of the element 18 may, for example, be compatible with the possible presence of a strip-like element 20 (for example, a double-sided adhesive tape), which can be used for installing the device 10 on an installation surface.

[0055] Figures 6 and 7 show how two modules/devices 10 of the type exemplified in the preceding figures can be mounted side by side (juxtaposed) without giving rise to appreciable discontinuities at the light emission surface 10a. This is because the electrical coupling elements (cables 14 and insulating tips 18 possibly associated therewith) are located at the surface 10b, where it is possible, for example, to extend the fixing strip-like element 20 and which is opposite to the light-radiation emitting surface 10a.

[0056] Figures 8 to 11 illustrate possible methods of installing a device 10 as described above, for example, in a furnishing element (here exemplified for simplicity in the form of a ledge S, for example, of wood) in which a groove D is obtained (without particular shape characteristics), which is provided at its bottom wall with a hole H.

[0057] In one or more embodiments (see, for example, Figure 10), it is then possible to arrange the device 10 inside the groove D, aligning the passageway 140 for the cables 14 (with, possibly, the protective potting element 18) at the hole H, passing the cables 14 through the hole H itself while the device 10 can, for example, be fixed to the mounting member S, for example, by means of an adhesive tape such as the tape 20.

[0058] Figures 12 and 13 exemplify the fact that similar installation methods can be used in the case of a support S consisting of a rail such as a profiled bar of metal material (for example, aluminum), for example, of the type having a H-shaped or double T-shaped cross-section.

[0059] In this case, the hole H can, for example, be provided at the central section of the profiled bar, with a portion of the profiled bar constituting the recess or groove D in which the device 10 can, for example, be installed according to similar overall methods to those exemplified with reference to Figures 8 to 11 discussed above.

[0060] Figure 14 and subsequent figures exemplify possible embodiments of a lighting device 10 which can be used with the installation method exemplified in general terms above.

[0061] In one or more embodiments, as exemplified in Figure 14 and successive figures, the encapsulation layer can, for example, be formed by the central or bottom wall 100 and by the side walls 102 of a channel-shaped (or U-shaped) element.

[0062] This element can be made, for example, of a flexible material (for example, elastic material such as silicone, rubber, etc.) with the side walls 102 provided, for example, at their outer surface, with grooves 102a

extending in the lengthwise direction of the profiled element 100, 102.

[0063] As exemplified in Figure 15, for example, an assembly for generating light radiation can be placed inside this profiled element, comprising, according to criteria known per se, a substrate 12a (for example, substantially similar to a printed circuit board or PCB) on which the light radiation sources 12 are distributed.

[0064] Welding areas or pads 200 may be provided on the substrate 12a (as can be appreciated in the plan view of Figure 16), which may comprise electrically-conductive paths or tracks 16 (see also Figure 3) for transferring the electrical signal with respect to the sources 12 (for example, with a power supply function).

[0065] As exemplified in the sequence of parts a), b) and c) of Figure 17, in one or more embodiments, in the side walls 102 - for example, at the grooves 102a - it is possible to create (according to methods substantially similar to those described previously with reference to the opening 140) openings 140a located at some of the pads 200, for example, at pads 200 located in a central position of the assembly comprising the profiled bar 100, 102 which receives therein the light radiation sources 12 arranged on the substrate 12a.

[0066] It is possible to pass electrically-conductive formations 14 in the grooves 102a (for example, wires with a circular or flattened cross-section) extending towards the openings 140a along the side walls 102 starting from one end 100A of the profiled element 100, 102 with the light radiation sources 12 therein. All of this being able to provide proximal ends 14a of the wires 14 which are capable of passing through the openings 140a so as to be able to be welded (see for example, Figures 18 and 19) or in any case electrically connected, for example, at the pads 200, to the electrically-conductive formations 16 at the ends of the light radiation sources 12 (see also Figure 3).

[0067] All this with the possibility of envisaging that, in one or more embodiments as exemplified in Figure 20, the electrically-conductive formations 14 have distal ends 14b which protrude relative to the end 100A.

[0068] Of course, the terms "proximal" and "distal" generally refer to the longitudinal extension of the profiled element 100, 102 and of the assembly emitting light radiation 12, 12a arranged therein.

[0069] Figures 20 and 21 (with Figure 21 showing a cross-sectional view along the line XXI-XXI of Figure 20) exemplify the possibility of dispensing a mass of sealing material 22 within the channel-shaped profiled element 100, 102, for example, with light reflectivity/diffusivity characteristics (for example, a silicone material loaded with alumina particles or a light colored dye such as titanium dioxide - of a white color).

[0070] In one or more embodiments, the mass 22 can, for example, be delivered up to the "height" of the light radiation sources 12 so as not to cover the respective light-emitting surfaces (LES).

[0071] In one or more embodiments, an additional potting mass 24 of light-permeable material (e.g. transparent silicone material 24) can, for example, be dispensed so as to fill the channel profile of the profiled element 100, 102.

[0072] The sequence of Figures 22 and 23 exemplifies the possibility of completing the structure of the device 10 by applying a cover 26 on the structure, exemplified in Figure 21, comprising a layer 260 of light-permeable material, for example, with diffusivity characteristics (once again, it is possible, for example, to use a silicone material with dispersed alumina particles therein) capable of forming a diffusive/transparent/semi-transparent layer or combinations of these characteristics at the light radiation emitting surface 10a.

[0073] In one or more embodiments, the operation of forming the layer 260 can, for example, be facilitated by the presence of side walls 262 (possibly formed integrally - for example, by a co-extrusion method - with the layer 260) which can be provided with, e.g. on their inner faces, grooves 262a extending in a longitudinal direction with respect to the side walls 262 at the grooves 102a of the side walls 102, so as to give rise to "longitudinal" ducts within which the electrically-conductive formations (wires) can be extended 14.

[0074] In one or more embodiments it is possible to provide, within the aforesaid ducts, a material 1400 similar to glue points intended to hold the electrically-conductive formations 14 in an exact required position. A similar result can, for example, also be achieved by using retaining tools.

[0075] In one or more embodiments, the dimensions of the grooves 102a and 262a can be determined taking into account the fact that the electrically-conductive formations 14 extending therein can be designed to be bent, e.g. by 90°:

- towards the inside of the device 10, at the passageways 140a, and/or
- towards the (second) surface 10b, at the end 100A, according to the methods described below.

[0076] The sequence of parts a), b) and c) of Figure 24 exemplifies the fact that a result substantially similar to that exemplified in Figure 23 may, for example, be achieved by placing the set of parts exemplified in Figure 21 within a channel-shaped mold indicated with M, and dispensing sealing material (such as, for example, a silicone material) inside the mold M (for example, through a casting device P) which can give rise both to the side walls 262 and to the upper layer 260.

[0077] All this taking into account the fact that, either by operating as illustrated in Figures 22 and 23, or by operating as exemplified in Figure 24, the layer 260 and the side walls 262 may be made with different characteristics, for example, with the layer 260 being light-permeable - e.g. in a diffusive manner - and the side walls 262 being light-impermeable - e.g. light colored, so as to be reflective.

[0078] Figure 25 exemplifies the result that can be achieved with the sequence of operations exemplified in the various parts of Figure 24.

[0079] Comparing Figure 25 with Figure 23 (also being an ideal cross-section of a module 10 to be considered of indefinite length) exemplifies the substantial similarity of the results achievable with the different modalities of implementation.

[0080] The ideal plan view of Figure 26 exemplifies the fact that embodiment methods of the type discussed above allow the provision of the electrically-conductive formations 14 without resorting to dedicated connectors, even if their presence is foreseen, maintaining the dimensions of the module 10 constant, which can be appreciated in the plan view of Figure 26, in particular in relation to the layer 260, which actually corresponds to the surface 10a through which the emission of the light radiation from the device or module 10 is achieved.

[0081] Figure 27 exemplifies the possibility, in one or more embodiments, of locating the proximal ends 14a of the electrically conductive formations 14 at virtually any longitudinal position of the device 10, thus also near the end 100A avoiding the formation of dark areas and - at the same time -facilitating:

- the mechanical support of the proximal ends 14a and their electrical connection to the sources 12,
- the implementation of solutions in which the distal ends 14b protrude from the end 100A.

[0082] Figure 28 (where parts or elements similar or analogous to parts or elements already described in relation to previous figures are indicated with the same references, making it unnecessary to repeat here a description in greater detail) illustrates the possibility, in one or more embodiments, of limiting the presence of that which in the preceding figures is the cover 26 (layer 260 and side walls 262) to potting masses dispensed in the grooves 102a, so as to hold the electrically-conductive formations 14 in position.

[0083] In the embodiments exemplified in Figure 28 - as well as in the embodiments exemplified in the previous figures - there is the possibility of:

- passing the proximal ends 14a of the formations 14 through the openings 140a obtained in the encapsulation layer at the walls 102, bending them towards the inside of the device; and/or
- bending the distal ends 14b towards the surface 10b making them pass through corresponding passageways 140 provided in the encapsulation layer at the central wall 100.

[0084] These possibilities are illustrated in Figures 29 and 30 wherein:

- in both the figures, part a) is a side view of the end 100A, while part b) is an ideal "top" view of the same end (with the inner parts of the device 10 made ideally visible for clarity);
- Figure 29 illustrates the device 10 with the distal ends 14b of the formations 14 protruding from the body of the module 10, while Figure 30 illustrates the device 10 with the distal ends 14b of the formations 14 bent towards the surface 10b at passageways 140 in the layer 100, which may, for example, facilitate installation methods analogous to the installation methods discussed at the beginning of the present detailed description with reference to Figures 1 to 14.

[0085] Figures 29 and 30 exemplify these methods of installation with reference to embodiments of the device 10 as exemplified in Figure 28. As already mentioned, these installation methods can be implemented with reference to one or more embodiments of the device 10, as exemplified in the previous figures.

[0086] All with the possibility, exemplified in parts a) and b) of Figure 31, of juxtaposing two devices or modules 10 with mutually facing respective ends 100A, thus without the solution of continuity between two adjacent modules or devices 10, and in particular in continuity relation (without the formation of dark areas or shadows) between the respective light-radiation emitting surfaces 10a: see part a) of Figure 31.

[0087] In this regard, it is possible to exploit the fact that the cables or wires 14 at the ends of the light radiation sources 12 can extend through passageways 140 formed at the surface 10b of the device 10 opposite to the emission radiation light surface 10a, i.e. with the cables or wires 14 passing through the encapsulation layer 100: see the holes 140 visible in part b) of Figure 31.

[0088] One or more embodiments can, therefore, relate to a method for installing a lighting device (for example, 10) in which the device comprises an elongated body having a first, light-emitting surface (for example,10a) and at least one second surface (for example, rear 10b, 100, or side 102) with an encapsulation layer at the at least one second surface, and a distribution of electrically-powered light radiation sources (for example, 12) arranged in the elongated body along the length thereof to project light radiation towards the light-emitting surface, wherein the method comprises:

- providing electrically-conductive formations (for example, 14) configured (for example, 16) to convey electric signals with respect to the electrically-powered light radiation sources, and
- providing at least one passageway (for example, 140; 140a) for said electrically-conductive formations to pass through said encapsulation layer at the at least one second surface (for example, 10b, 100 and/or 102), wherein at least part of said electrically-conductive formations passes through said at least one passageway.

[0089] One or more embodiments may comprise the

provision of said at least one passageway for said electrically-conductive formations to pass through said encapsulation layer at at least one second surface of said elongated body selected out of:

- a rear surface (e.g. 10b or 100) opposite the light-emitting surface, and/or
- at least one side surface (e.g. 102) arranged at the side of the light-emitting surface.

[0090] One or more embodiments may comprise:

- providing said at least one passageway for said electrically-conductive formations by means of:
  - i) perforation of said encapsulation layer,
  - ii) punching of said encapsulation layer,
  - iii) removing material from said encapsulation layer,
- inserting said electrically-conductive formations into said at least one passageway,
- electrically coupling said electrically-conductive formations with the electrically-powered light radiation sources.

[0091] One or more embodiments may comprise providing electrically-conductive formations which extend along the length of the elongated body, the electrically-conductive formations having proximal ends (for example, 14a) and distal ends (for example, 14b), the proximal ends electrically coupled to the electrically-powered light radiation sources, wherein said proximal ends and/or said distal ends of the electrically-conductive formations pass through said at least one passageway.

[0092] One or more embodiments may comprise:

- providing a mounting member (for example, S) for said lighting device, the mounting member provided with an opening (for example, H) configured to be aligned with said at least one passageway for said electrically-conductive formations,
- mounting the lighting device on the mounting member and aligning said at least one passageway for said electrically-conductive formations with said opening in the mounting member, so that said electrically-conductive formations extend at least partly in said at least one passageway and in said opening aligned therewith.

[0093] One or more embodiments may comprise applying the method to a pair of lighting devices each comprising an elongated body having a first, light-emitting surface and at least one second surface with an encapsulation layer at the at least one second surface, and a distribution of electrically-powered light radiation sources arranged in the elongated body along the length thereof to project light radiation towards the light-emitting surface, the method comprising arranging the lighting devices in the pair of lighting devices with their light-emitting surfaces juxtaposed in the absence of separation gaps therebetween.

[0094] One or more embodiments may relate to a lighting device comprising an elongated body having a first, light-emitting surface and at least one second surface with an encapsulation layer at the at least one second surface, and a distribution of electrically-powered light radiation sources arranged in the elongated body along the length thereof to project light radiation towards the light-emitting surface, wherein the lighting device comprises:

- electrically-conductive formations configured to convey electric signals with respect to the electrically-powered light radiation sources, and
- at least one passageway for said electrically-conductive formations to pass through said encapsulation layer at the at least one second surface, wherein at least part of said electrically-conductive formations (for example, the proximal 14a and/or distal 14b ends) pass through said at least one passageway.

[0095] In one or more embodiments, said elongated body can, for example, have a front, light-emitting surface, a rear surface opposite the light-emitting surface, as well as two mutually opposite side surfaces (for example, the side walls 102) extending between the light-emitting surface and the rear surface, and an encapsulation layer at the side surfaces (as well as, possibly, as illustrated here, at the rear surface 10b or 100), said distribution of electrically-powered light radiation sources arranged in the elongated body along the length thereof starting from one end (for example, 100A) of the elongated body to project light radiation towards the light-emitting surface, said electrically-conductive formations extending along said two mutually opposite side surfaces (for example, 102), the electrically-conductive formations having proximal ends (for example, 14a) electrically coupled to the electrically-powered light radiation sources (12) said proximal ends (for example, 14a) passing through respective passageways (for example, 140a) in said side surfaces.

[0096] In one or more embodiments said electrically-conductive formations may have distal ends bent or bendable towards said rear surface at said end of the elongated body.

[0097] The fact of referring to "bent or bendable" distal ends (e.g., 14b) aims to take into account the fact that a device such as the one exemplified in Figures 14 to 30 may, for example, be made available:

- both in the conditions exemplified in Figure 30, i.e. with the distal ends 14b of the formations 14 bent and extending through the passageways 140 formed in the encapsulation layer 100,

- and in the conditions exemplified in Figures 27 and 29, i.e. with the distal ends 14b of the formations 14 protruding (so to speak "cantilevered") starting from the end 100A, with these distal ends possibly capable of being bent in the condition illustrated in Figure 30 (only) during the installation operations carried out in accordance with the procedure exemplified here.

[0098] One or more embodiments may, therefore, comprise the distal ends of the electrically-conductive formations bent towards the rear surface, which pass through respective passageways in the encapsulation layer at said rear surface.

[0099] One or more embodiments may comprise a channel-shaped support member (e.g., 100, 102, which may, for example, act overall as an encapsulation layer) with said distribution of electrically-powered light radiation sources arranged therein for projecting light radiation towards the mouth portion of the channel profile of the support member, the channel-like support member comprising a central wall (e.g., 100) as well as two side walls (e.g., 102) extending laterally with respect to said central wall, the side walls being provided with longitudinal grooves for the passage of the electrically-conductive formations along said grooves.

[0100] One or more embodiments may comprise a cover member (for example, 260, 262) having a light-permeable cover layer (for example, 260) extending across the mouth portion of the channel-shaped support member, as well as two side walls (for example, 262) of the cover member cooperating with the side walls of the channel-shaped support member, the side walls of the cover member provided with respective longitudinal grooves (for example, 262a) complementary with the longitudinal grooves of the side walls of the channel-shaped support member for the electrically-conductive formations to pass therealong.

[0101] One or more embodiments may comprise electrically-powered solid-state light radiation sources, optionally LED sources.

[0102] Without prejudice to the underlying principles of the invention, the details of construction and the embodiments may vary, even significantly, with respect to those illustrated here, purely by way of non-limiting example, without departing from the scope of the invention.

[0103] The extent of protection is determined by the attached claims.

LIST OF REFERENCE SIGNS

Lighting device	10
First surface	10a
Second surface	10b
Light radiation sources	12
Electrically-conductive formations	14
Proximal ends	14a
Distal ends	14b
Passageways	140,140a
Electrically-conductive tracks	16
Isolation body	18
Strip-like element	20
Mounting member	S
Opening	H
Encapsulation layer	100
End	100A
Opposite surfaces	102
Longitudinal grooves	102a
Cover layer	260
Side walls	262
Longitudinal grooves	262a

Claims

1. A method of installing a lighting device (10), wherein the device (10) comprises an elongate body having a first, light emitting surface (10a) and at least one second surface (10b; 100, 102) with an encapsulation layer at the at least one second surface (10b; 100, 102) and a distribution of electrically-powered light radiation sources (12) arranged in the elongated body along the length thereof to project light radiation towards the light emitting surface (10a), wherein the method comprises:

   - providing electrically-conductive formations (14) configured (16) to convey electric signals with respect to the electrically-powered light radiation sources (12), and
   - providing at least one passageway (140; 140a) for said electrically-conductive formations (14) through said encapsulation layer at the at least one second surface (10b; 100, 102), wherein at least part of said electrically-conductive formations (14) pass through said at least one passageway (140; 140a).

2. The method of claim 1, comprising providing said at least one passageway (140; 140a) for said electrically-conductive formations (14) through said encapsulation layer at at least one second surface (10b; 100, 102) of said elongate body selected out of:

   - a rear surface (10b; 100) opposite the light emitting surface (10a), and/or
   - at least one lateral surface (102) arranged sidewise of the light emitting surface (10a).

3. The method of claim 1 or claim 2, comprising:

   - providing said at least one passageway (140; 140a) for said electrically-conductive formations

(14) by:

- i) drilling through said encapsulation layer (10b; 100, 102), and/or
- ii) punching said encapsulation layer (10b; 100, 102), and/or
- iii) removing material from said encapsulation layer (10b; 100, 102),

- inserting said electrically-conductive formations (14) into said at least one passageway (140, 140a),
- electrically coupling (16) said electrically-conductive formations (14) with the electrically-powered light radiation sources (12).

4. The method of any of the previous claims, comprising providing electrically-conductive formations (14) extending along the length of the elongate body, the electrically-conductive formations (14) having proximal ends (14a) and distal ends (14b), the proximal ends (14a) electrically coupled to the electrically-powered light radiation sources (12), wherein said proximal ends (14a) and/or said distal ends (14b) of the electrically-conductive formations (14) pass through said at least one passageway (140; 140a).

5. The method of any of the previous claims, comprising:

- providing a mounting member (S) for said lighting device (10), the mounting member (S) provided with an aperture (H) configured to be aligned with said at least one passageway (140) for said electrically-conductive formations (14),
- mounting the lighting device (10) on the mounting member (S) aligning said at least one passageway (140) for said electrically-conductive formations (14) with said aperture (H) in said mounting member (S), wherein said electrically-conductive formations (14) pass at least partly in said at least one passageway (140) and said aperture (H) aligned therewith.

6. The method of any of the previous claims, comprising applying the method to a pair of lighting devices (10) each comprising an elongate body having a first, light emitting surface (10a) and at least one second surface (10b; 100) with an encapsulation layer at the at least one second surface (10b; 100) and a distribution of electrically-powered light radiation sources (12) arranged in the elongated body along the length thereof to project light radiation towards the light emitting surface (10a), the method comprising arranging the lighting devices (10) in the pair of lighting devices with their light emitting surfaces (10a) juxtaposed in the absence of gaps therebetween.

7. A lighting device (10) comprising an elongate body having a first, light emitting surface (10a) and at least one second surface (10b; 100, 102) with an encapsulation layer at the at least one second surface (10b; 100, 102) and a distribution of electrically-powered light radiation sources (12) arranged in the elongated body along the length thereof to project light radiation towards the light emitting surface (10a), wherein the lighting device (10) comprises:

- electrically-conductive formations (14) configured (16) to convey electric signals with respect to the electrically-powered light radiation sources (12), and
- at least one passageway (140; 140a) for said electrically-conductive formations (14) through said encapsulation layer at the at least one second surface (10b; 100, 102), wherein at least part (14a, 14b) of said electrically-conductive formations (14) pass through said at least one passageway (140; 140a).

8. The lighting device (10) of claim 7, wherein said elongate body has a front, light emitting surface (10a), a rear surface (10b; 100) opposite the light emitting surface (10a) as well as two mutually opposite, lateral surfaces (102) extending between the light emitting surface (10a) and the rear surface (10b; 100) and an encapsulation layer at the lateral surfaces (102), said distribution of electrically-powered light radiation sources (12) arranged in the elongated body along the length thereof starting from an end (100A) of the elongated body to project light radiation towards the light emitting surface (10a), said electrically-conductive formations (14) extending along said two mutually opposite, lateral surfaces (102), the electrically-conductive formations having proximal ends (14a) electrically coupled (16) to the electrically-powered light radiation sources (12) said proximal ends (14a) passing through respective passageways (140a) in said lateral surfaces (102).

9. The lighting device (10) of claim 8, wherein said electrically-conductive formations (14) comprise distal ends (14b) bent or bendable towards said rear surface (10b; 100) at said end (100A) of the elongated body.

10. The lighting device (10) of claim 9, comprising the distal ends (14b) of the electrically-conductive formations (14) bent towards the rear surface (10b; 100) passing through respective passageways (140) through the encapsulation layer (100) at said rear surface (10b).

11. The lighting device (10) of any of claims 7 to 10, comprising a channel-shaped support member (100, 102) having said distribution of electrically-powered

light radiation sources (12) arranged therein to project light radiation towards the mouth portion of the channel-shaped support member (100, 102), the channel-shaped support member having a central wall (100) as well as two lateral walls (102) extending sidewise of said central wall (100) the lateral walls (102) provided with longitudinal sculpturing (102a) for the electrically-conductive formations (14) to pass therealong.

12. The lighting device (10) of claim 11, comprising a cover member (260, 262) having a light-permeable cover layer (260) extending across the mouth portion of the channel-shaped support member (100, 102) as well as two lateral walls (262) of the cover member cooperating with the lateral walls (102) of the channel-shaped support member, the lateral walls (262) of the cover member provided with respective longitudinal sculpturing (262a) complementary with the longitudinal sculpturing of the lateral walls (102) the channel-shaped support member (100, 102) for the electrically-conductive formations (14) to pass therealong.

13. The lighting device (10) of any of claims 6 to 12, comprising solid-state electrically-powered light radiation sources (12), preferably LED light radiation sources.

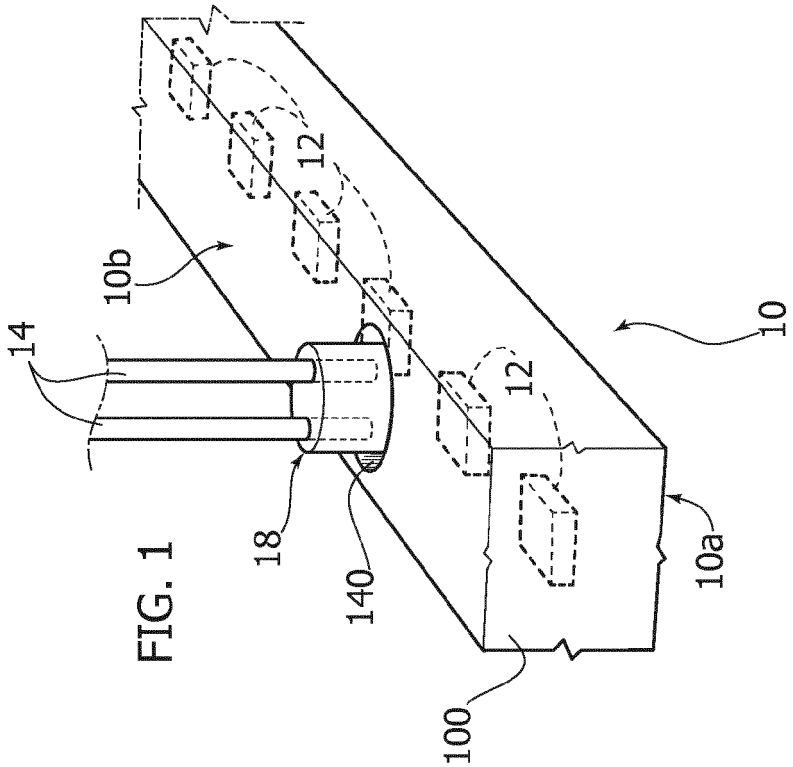


FIG. 1

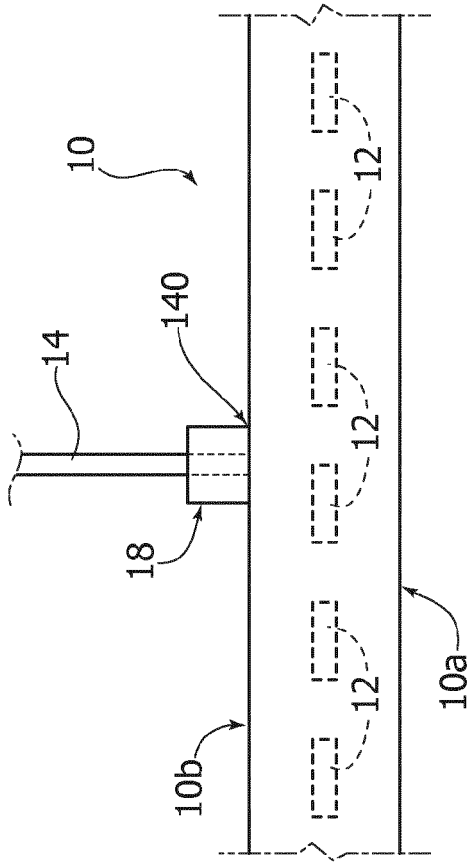


FIG. 2

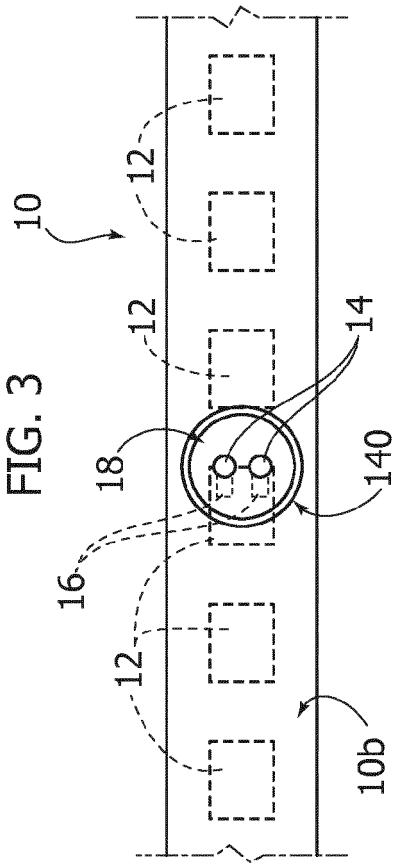


FIG. 3

FIG. 4

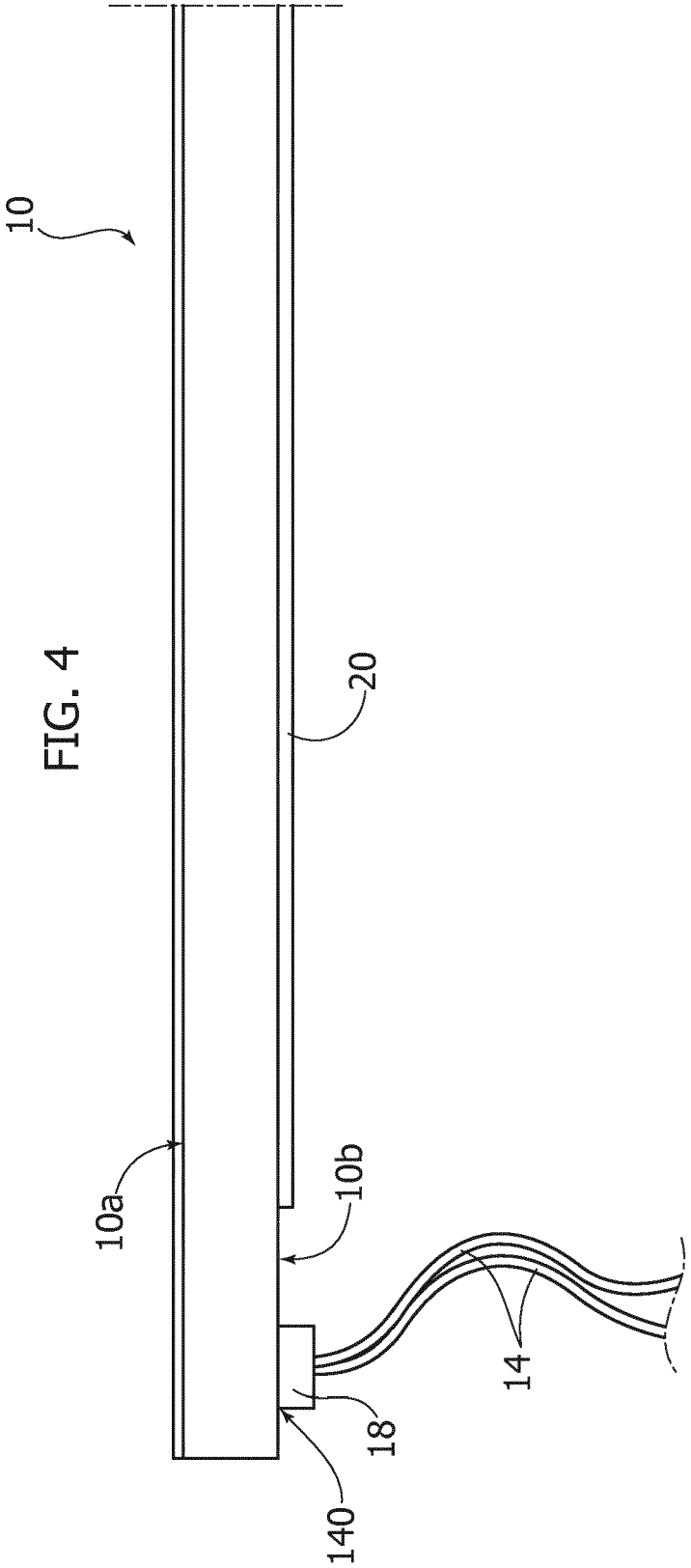
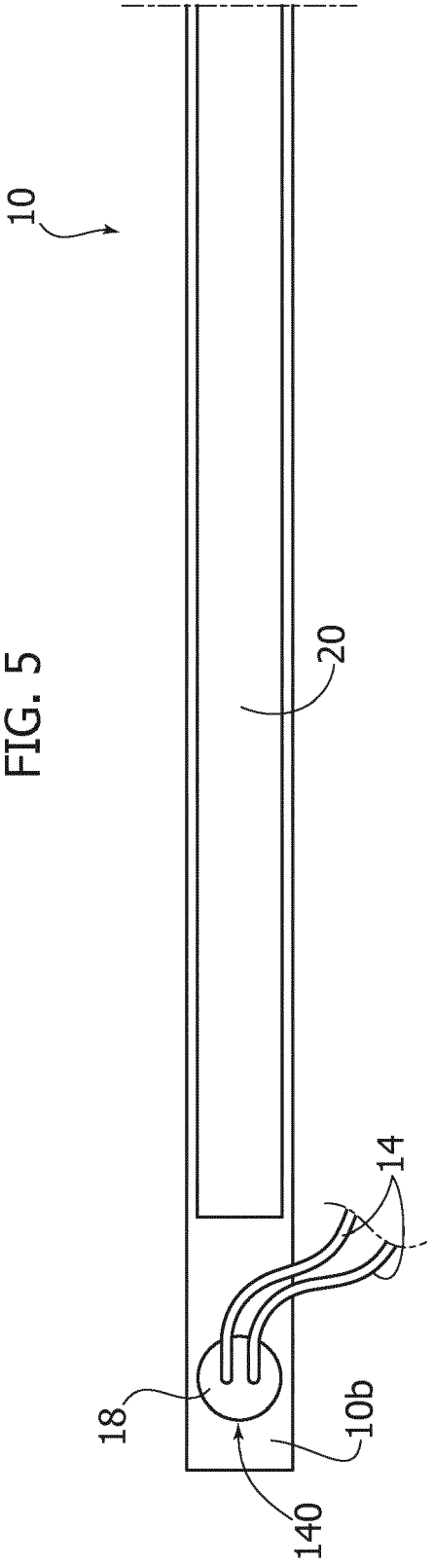


FIG. 5



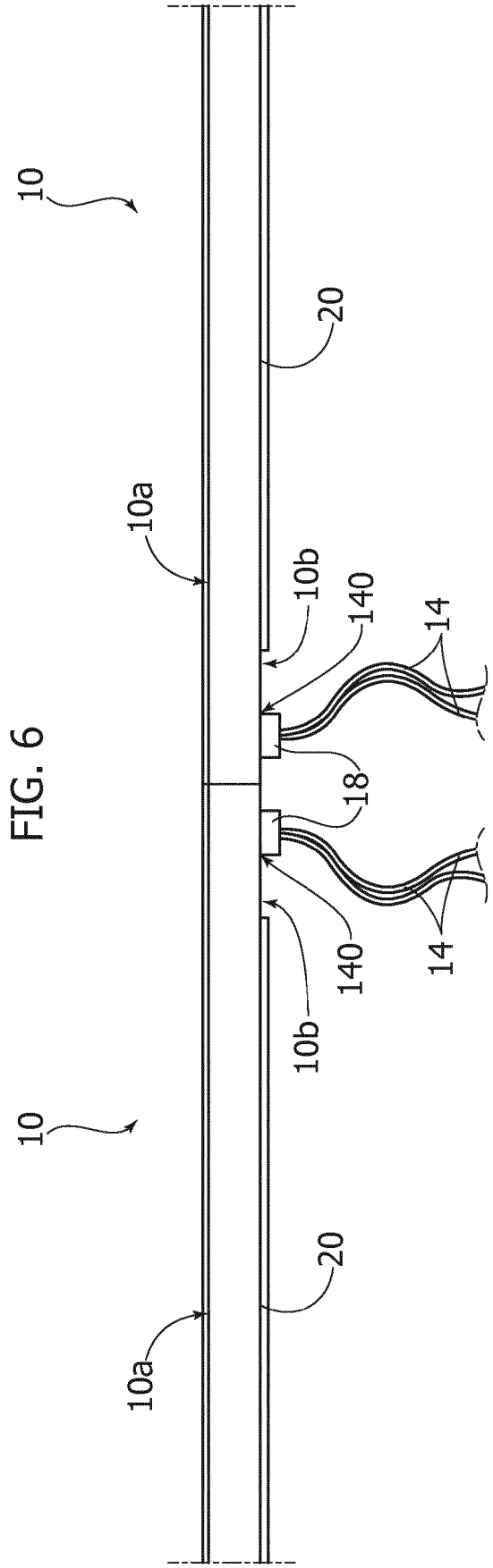


FIG. 6

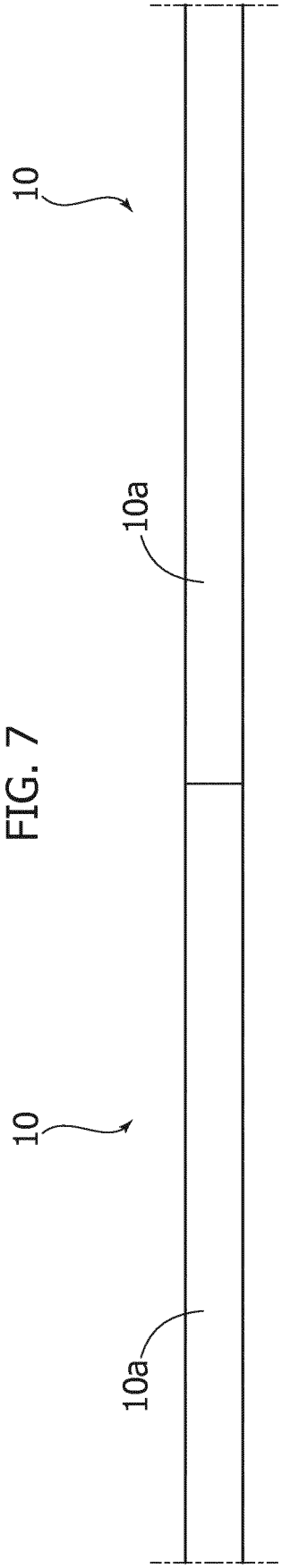


FIG. 7

FIG. 9

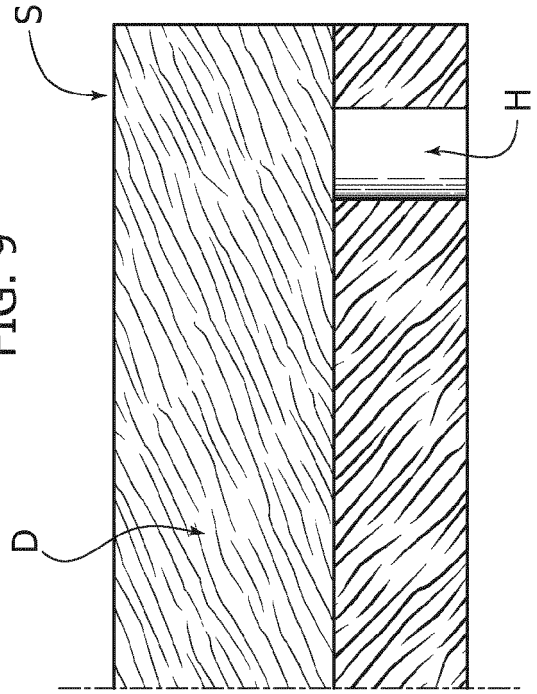


FIG. 11

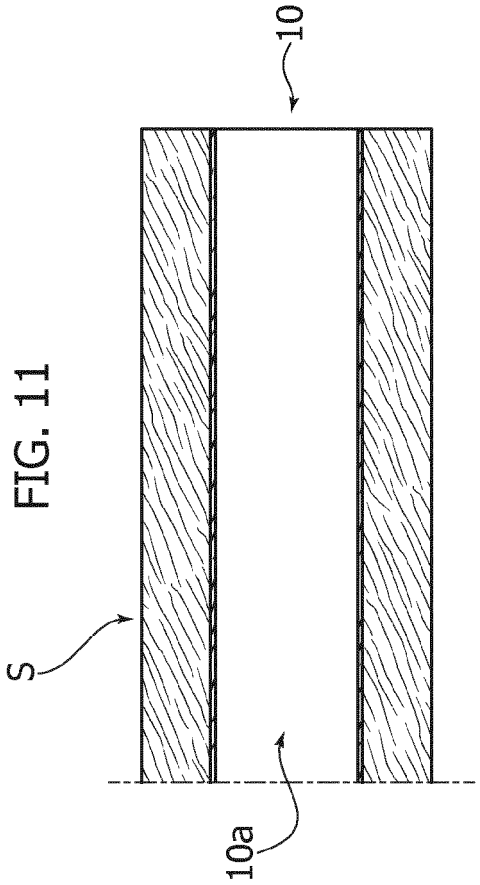


FIG. 8

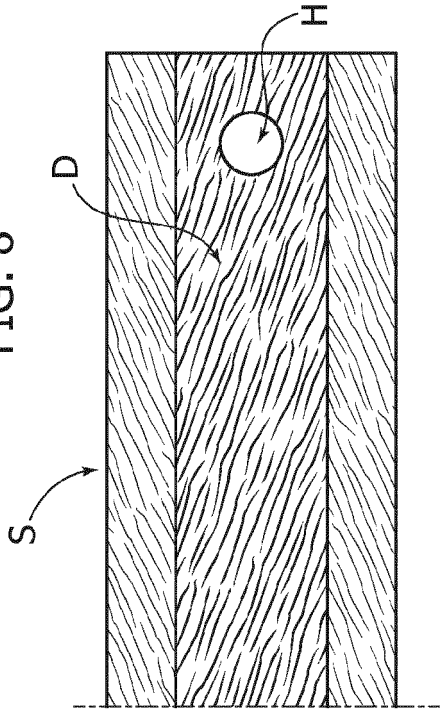
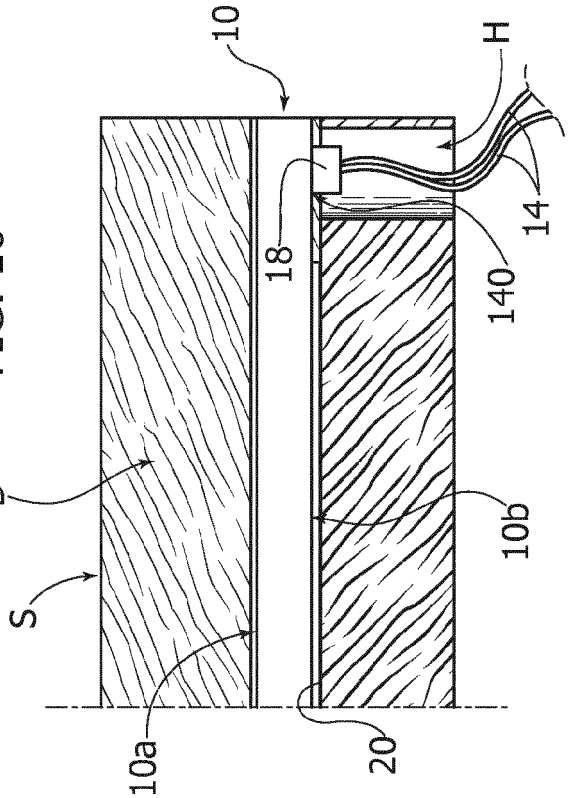


FIG. 10



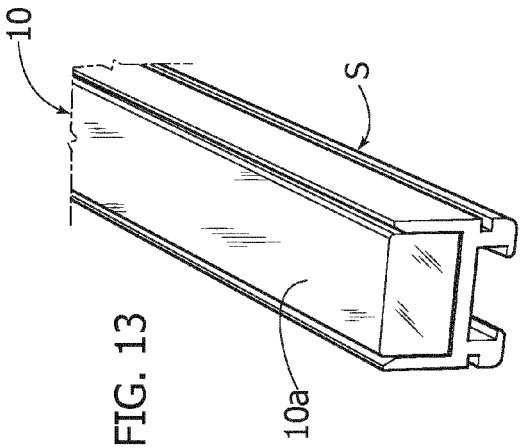


FIG. 13

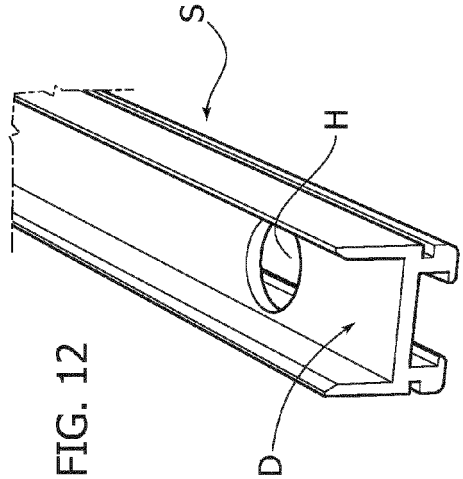


FIG. 12

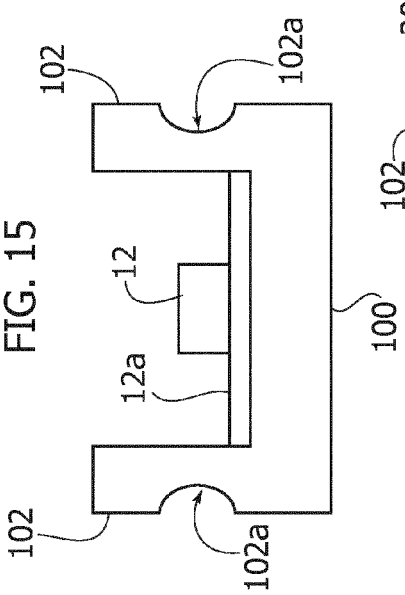


FIG. 15

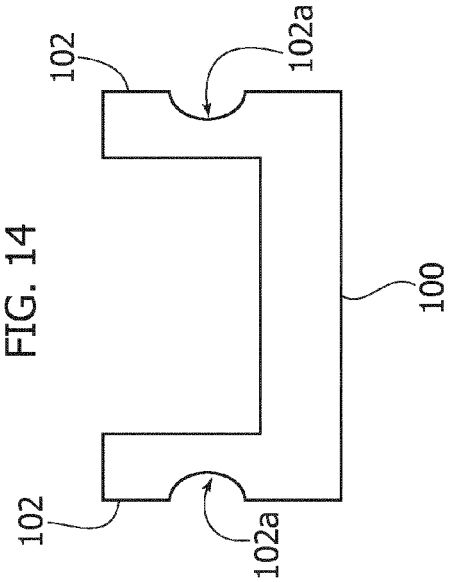


FIG. 14

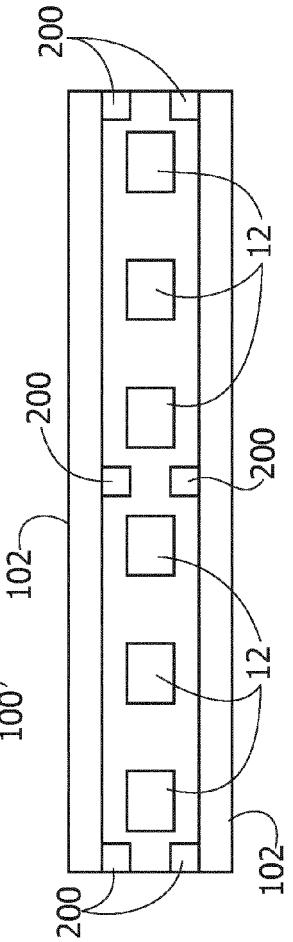


FIG. 16

FIG. 17

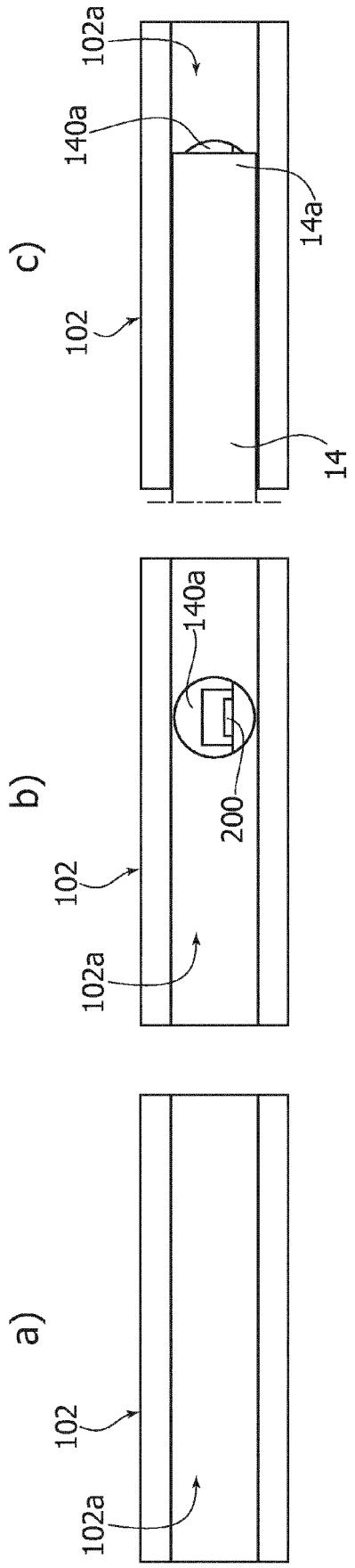

a)
102
102a
b)
140a
200
102
102a
c)
102a
140a
14a
102
14

FIG. 18

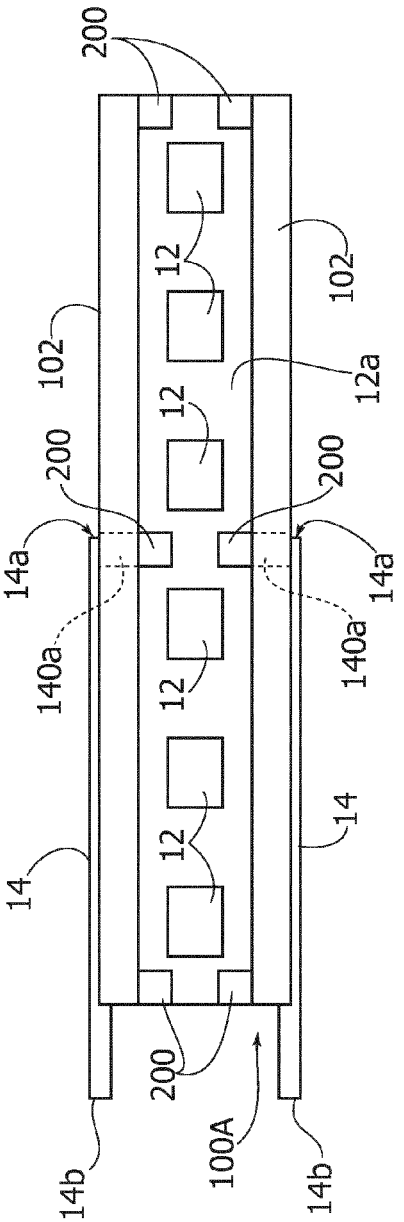

200
102
12
102
12a
12
200
200
14a
14a
140a
140a
12
12
14
14
200
100A
14b
14b

FIG. 19

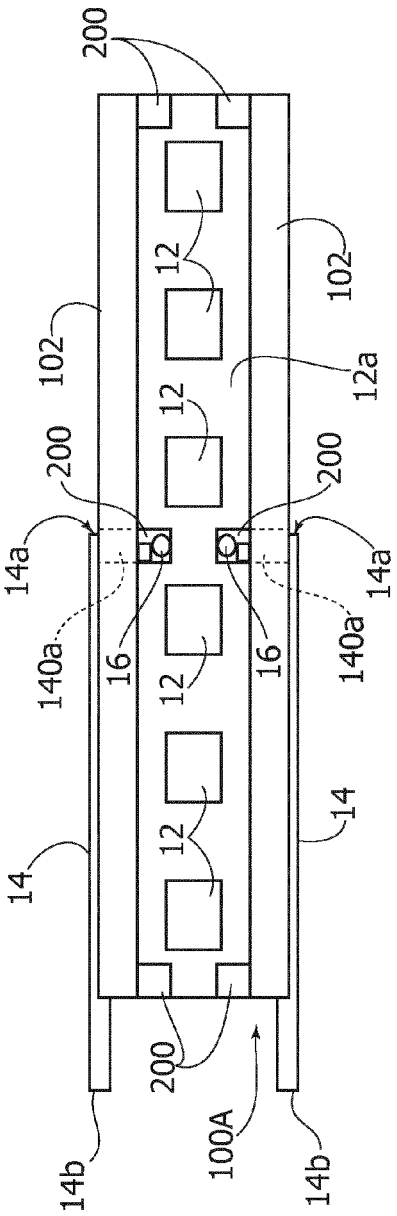


FIG. 21

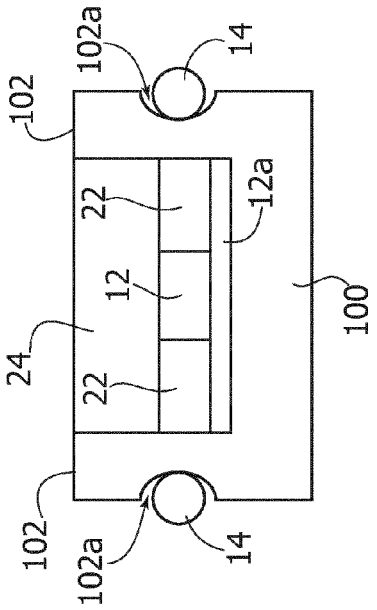


FIG. 20

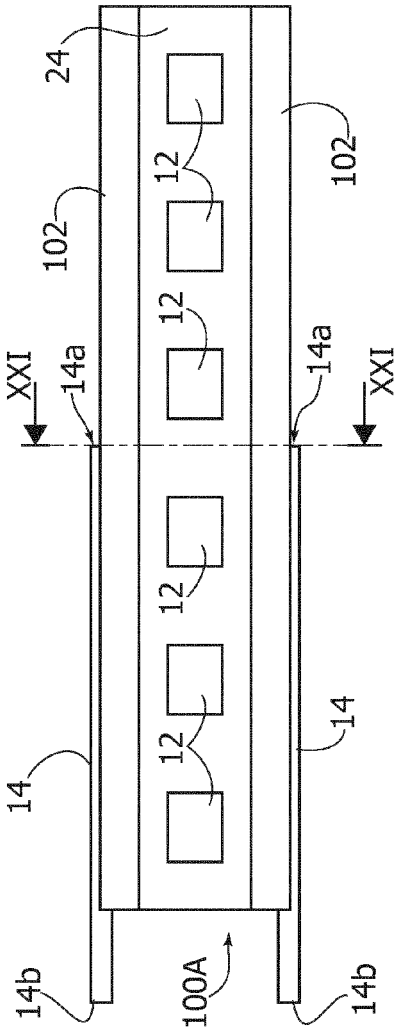


FIG. 22

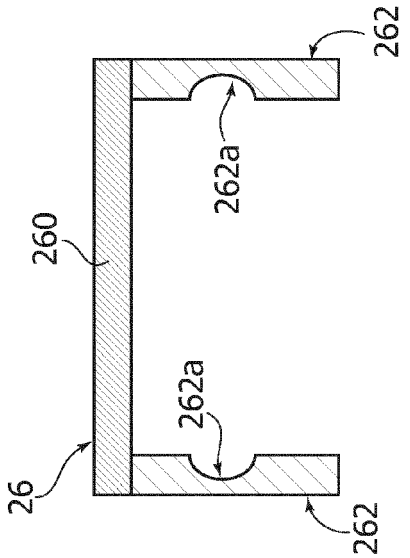


FIG. 23

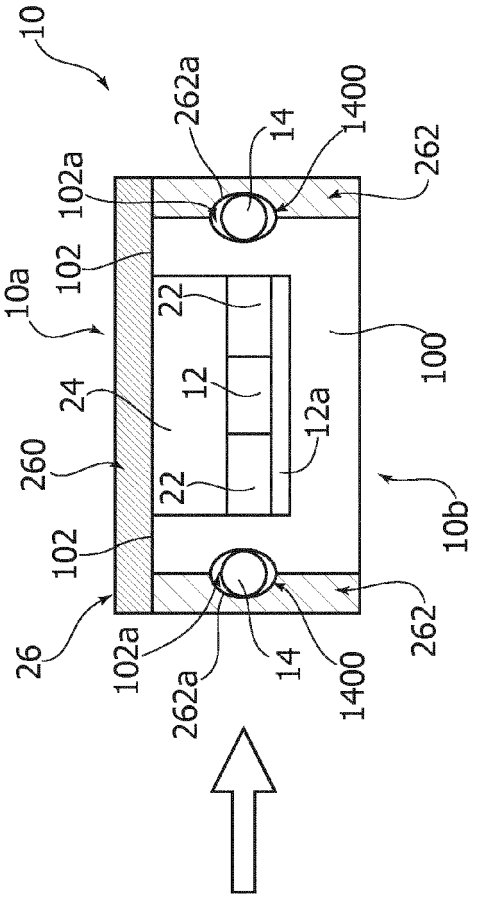


FIG. 24

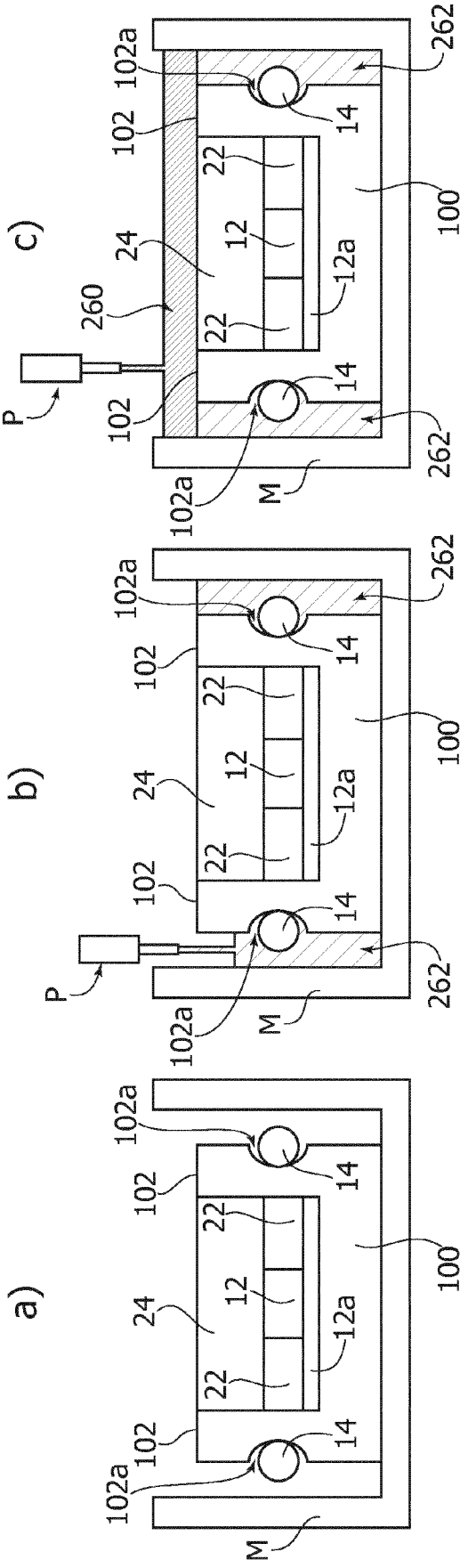


FIG. 25

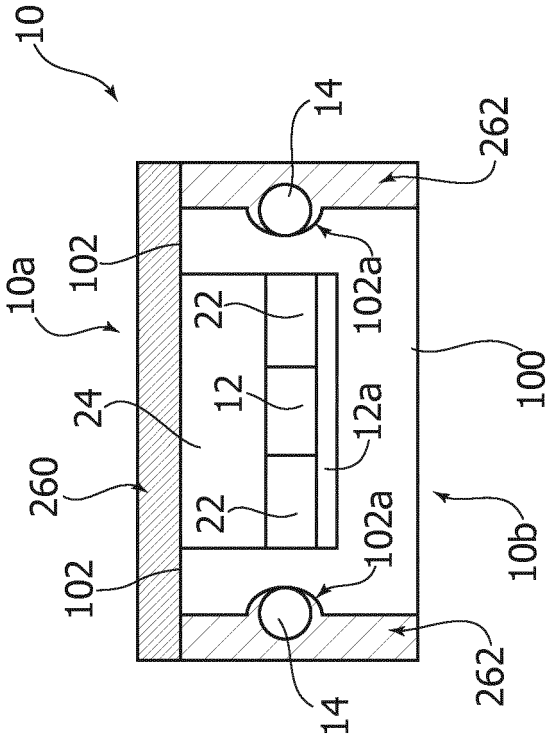


FIG. 26

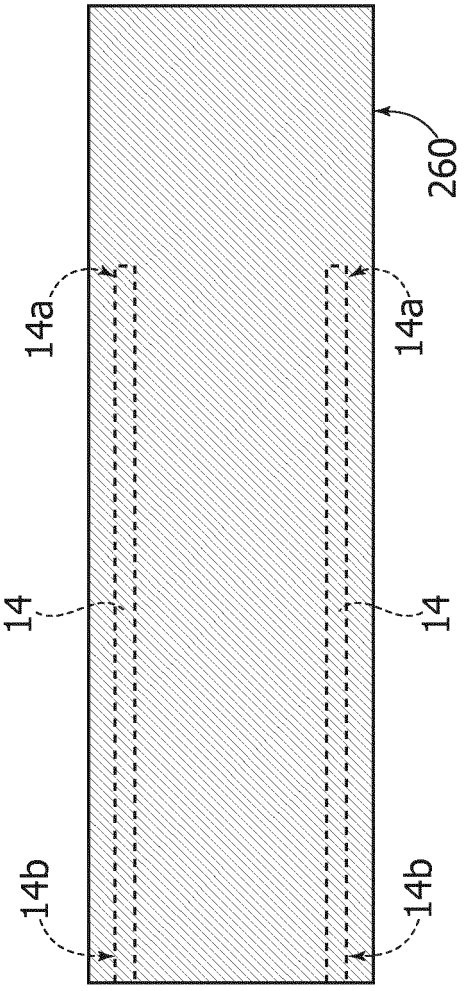


FIG. 27

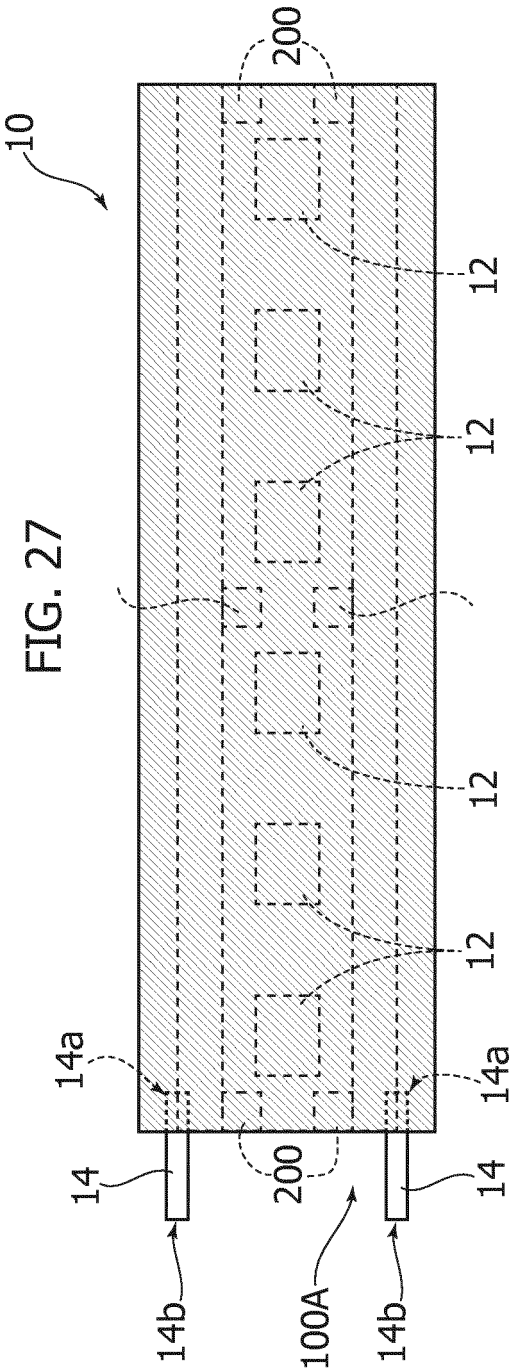
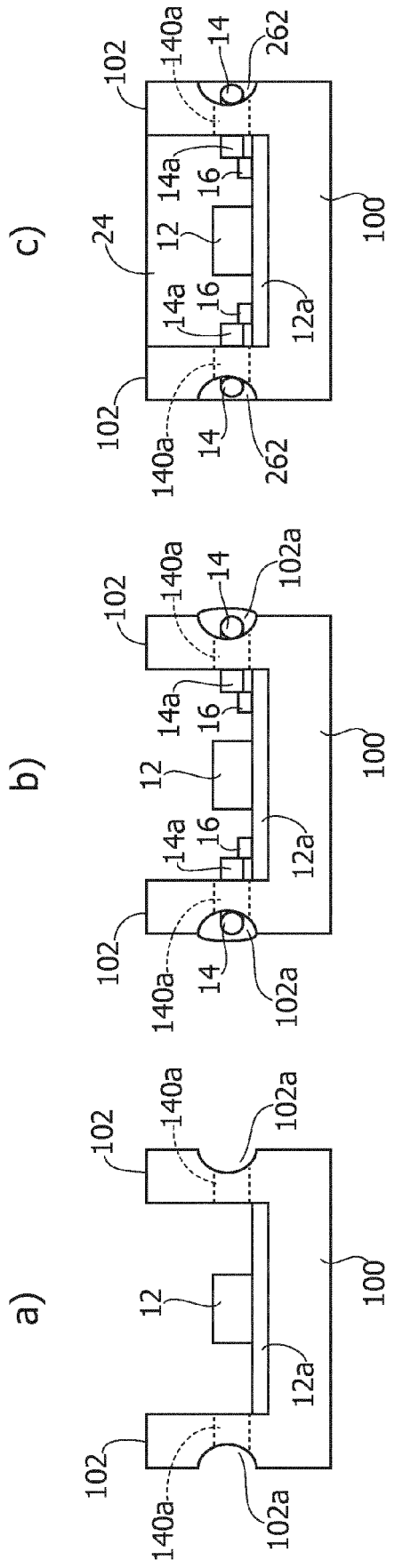


FIG. 28



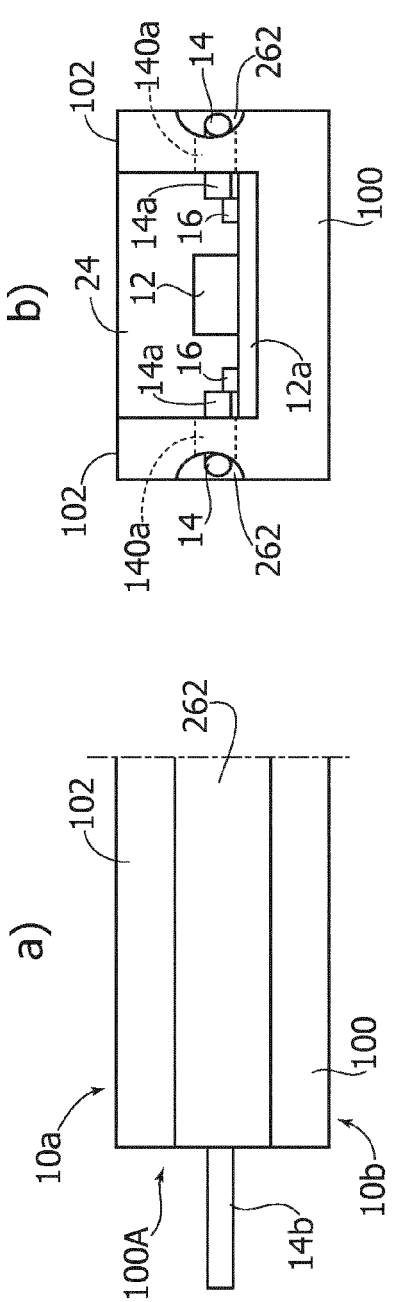


FIG. 29

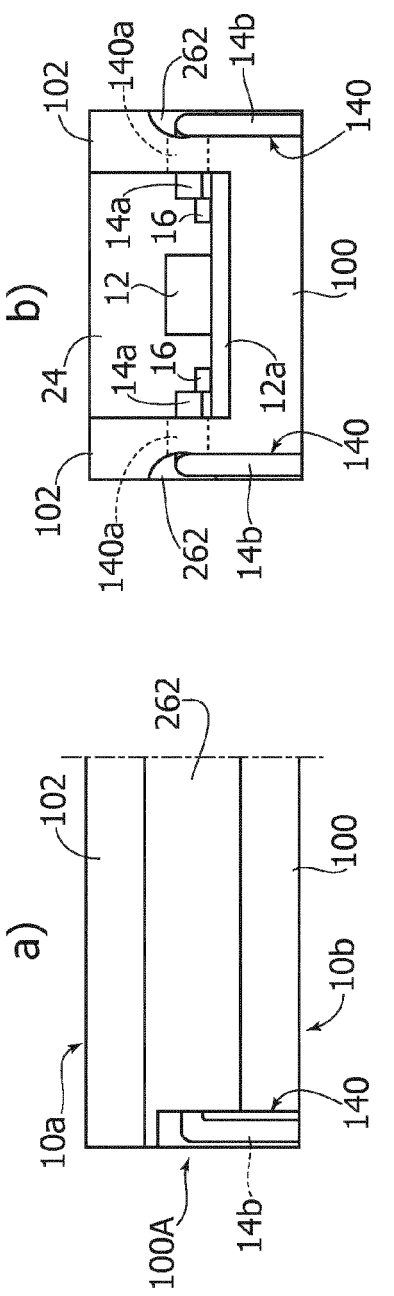


FIG. 30

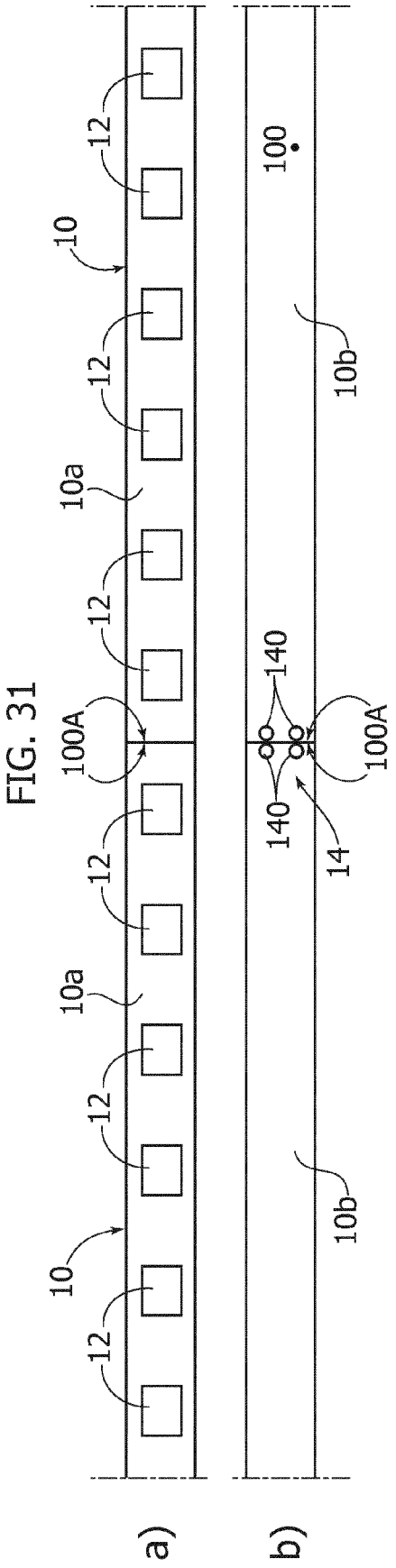


FIG. 31

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 19 17 5754

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	US 2014/043818 A1 (REISS MARTIN [DE] ET AL) 13 February 2014 (2014-02-13) * paragraphs [0012], [0023], [0024], [0057], [0074], [0075], [0076] * * figures 10,11 *	1-7, 11-13	INV. F21S4/22 F21V21/005 F21V23/00 F21V31/00
X	CN 201 126 117 Y (SHENZHEN CE LIGHTING CO LTD [CN]) 1 October 2008 (2008-10-01) * figures 1-3 *	1-7, 11-13	ADD. F21Y103/10 F21Y115/10
X	US 2012/120644 A1 (RIEGER THOMAS [DE]) 17 May 2012 (2012-05-17) * paragraph [0029] - paragraph [0031] * * figures 3,7 * * paragraph [0061] *	1-7, 11-13	
A	US 2014/334142 A1 (LEVANTE JAMES J [US] ET AL) 13 November 2014 (2014-11-13) * figure 8a *	1,7	
A	WO 2013/160834 A2 (SEVTSENKO JEVGENI [EE]) 31 October 2013 (2013-10-31) * page 5, line 7 - line 14; figure 4 *	1,7	TECHNICAL FIELDS SEARCHED (IPC) F21V F21S F21Y
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