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(54) **A METHOD OF PROVIDING AN ELECTRICAL CONNECTION, CORRESPONDING COMPONENT AND LIGHTING DEVICE**

(57) A laminar support member (10) for electrical user elements (e.g. electrically-powered light radiation sources L), having opposed first and second surfaces and at least one opening (10A) therethrough with an electrically-conductive formation (10B) at the periphery of said opening (10A) at the first surface of the laminar support member (10). An electric wire (C, C1) advanced into the opening (10A) starting from the second surface towards the first surface has a distal portion protruding with respect to the laminar support member (10) at the first surface. An electrically-conductive retaining member (12) is coupled with the distal portion of the electrical wire (C, C1), the retaining member is dimensioned to counteract extraction of the electrical wire (C, C1) from the opening (10A); the retaining member (12) being in electrical contact (14) with the electrically-conductive formation (10B).

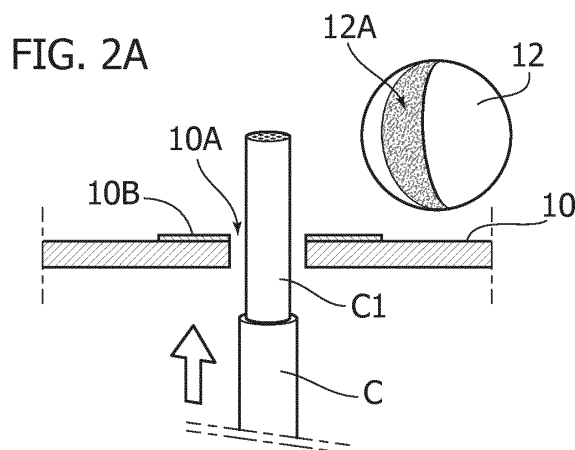


FIG. 2B

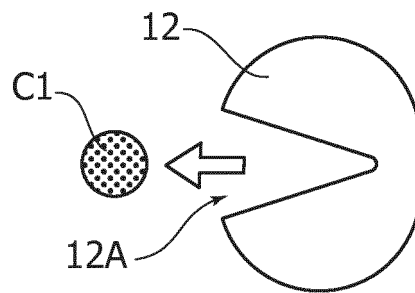


FIG. 2C

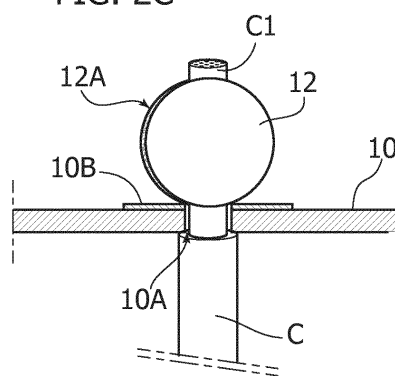


FIG. 2D

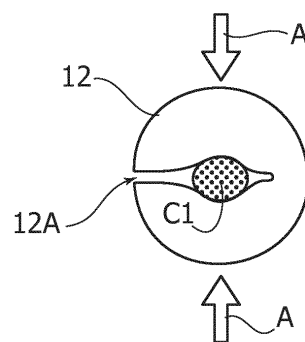
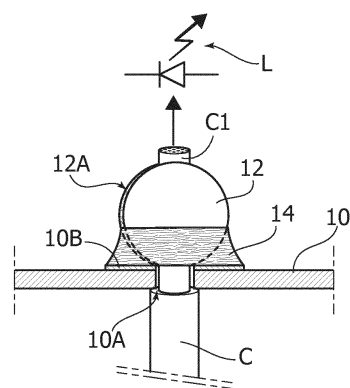


FIG. 2E



**Description**Technical field

5 **[0001]** The description refers to the production of electrical connections.

**[0002]** One or more embodiments can be applied to the production of components for lighting devices and corresponding devices.

**[0003]** One or more embodiments can be applied in the lighting sector, for example, in electrically-powered lighting devices using solid-state light radiation sources, for example, LED sources.

Technological background

**[0004]** Various lighting devices, for example, LED modules, may include multiple point sources, even in large numbers.

15 **[0005]** For various possible uses it is desirable that these sources can be homogeneously distributed on a laminar support, such as a printed circuit board (PCB), so as to obtain, for example, an overall homogeneous light emission surface.

**[0006]** In solutions of this type, the residual space available to place other elements, such as electrical connectors or terminal blocks, ends up being rather small.

20 **[0007]** In application sectors such as lighting, it is also desirable that the electrical connections present a certain degree of resistance or strength against mechanical stresses, such as, for example, the stresses deriving from tensile forces applied on electric cables.

**[0008]** In solutions in which electrical connectors are arranged on the same support (for example, a card) on which the light radiation sources are arranged, the fact that the connectors have contained dimensions allows avoiding an undesirable shadowing effect with respect to the light radiation sources located near the connectors.

25 **[0009]** The complex of problems outlined above has already been addressed in various ways, for example, using connectors of the type known as Insulation Displacement Connectors (IDC). These connectors do not require prior stripping of the electrical cables intended to be connected to the connectors themselves thanks to the presence of a channel-shaped groove able to cut the insulating material of the cable during insertion of the cable, thus being able to create the electrical contact with the electrically-conductive core (for example, copper) of the cable.

30 **[0010]** It is possible to provide caps of plastic material applicable on the body (typically metal) of the connector so as to achieve a certain retaining action, which, however, may not be sufficient to withstand quite high tensile forces.

**[0011]** Another solution is to use terminal blocks to which the cable is coupled after stripping. Although structurally different, this solution has the same critical aspects discussed above with regard to Insulation Displacement Connectors, plus the fact that the terminal blocks can be larger (and more cumbersome) than IDCs.

35 **[0012]** It is also common to use (even multiple) connectors that allow coupling to a board such as a PCB using a male/female configuration. For example, it is possible to provide a receptacle on the board (for example, by using a Surface Mount Soldering (SMD) technique), constituting a sort of plug/socket, which can be coupled with a complementary component crimped onto the cable or cables. In this case, the retaining force may depend on the design characteristics of the connector. In addition, preparation of the cables (for example, when dealing with multiple ribbon-like cables) can be quite complex. Furthermore, there may be quite a significant space occupied on the board (for example, PCB) by such a connection system, comparable with that required in the case where terminal blocks are used.

40 **[0013]** A simple way to achieve an electrical connection and, at the same time, a sufficiently strong retaining force, is to pass an electric cable through a hole in the board, and then weld the electrically-conductive terminal end onto a pad of electrically-conductive material, as in the case of the pin-through-hole connection of electronic components such as, for example, integrated circuits.

45 **[0014]** The retaining effect can be achieved simply by forming a knot in the cable at the end that has been passed through the hole in the board: the knot forms an enlarged part of the cable which counteracts the tensile forces exerted in the direction of extracting the cable with respect to the hole.

50 **[0015]** This solution presents some critical aspects related, for example, to the operations (typically manual) related to forming the knot, and to the fact that the connection is not exactly repeatable with the high degree of uniformity required for industrial processing. In addition, the cable portion included between the knot and the welding point may exert a shadowing effect (that could be significant) with respect to light radiation sources located at the passage point of the cable through the board, at the place where the knot is formed.

55 **[0016]** Still another possibility is that of producing a structure roughly similar to a metal bridge which can be applied (for example, with an SMD technique) at a hole in the board and - in turn - provided with a hole. The cable can be made to pass through the hole in the board and through the hole in the bridge, thus being secured against the tensile forces, even with a certain intensity, due to cooperation (roughly similar to a harpoon effect) with springing formations that protrude towards the inside of the hole in the bridge.

**[0017]** This solution has the drawback of the size of the bridge, which can also have a negative effect related to possible shadowing effects of the light radiation sources placed near the connector.

#### Object and summary

**[0018]** One or more embodiments aim to overcome the drawbacks outlined above.

**[0019]** According to one or more embodiments, this object can be achieved thanks to a method having the characteristics referred to in the following claims.

**[0020]** One or more embodiments may concern a corresponding component (connector).

**[0021]** One or more embodiments may refer to a corresponding device, for example, a lighting device.

**[0022]** The claims form an integral part of the technical disclosure provided here in relation to the embodiments.

**[0023]** One or more embodiments may make it possible to achieve one or more of the following advantages:

- ease in producing a reliable electrical connection, both for the continuity of the electrical connection and for the retaining force;
- reduction of the space occupied on the support (for example, PCB) thanks to the fact that the electrical connection can be achieved, for example, by using a single electrically-conductive pad (for example, of copper) for each cable;
- reduced physical dimensions of the blocking elements, with consequent reduction of the possible shadowing effect of the light radiation sources;
- possibility of not requiring additional holes through the support or board, at least in the cases in which the cables come from one side of the support board opposite to that in which the electrical contact is made;
- possibility of also using the solution for metal core supports (for example, metal core PCBs) thanks to electrically-insulating elements (washers);
- reduced cost compared to IDCs, terminal blocks or male/female couplings used in conventional connectors.

#### Brief description of the attached figures

**[0024]** One or more embodiments will be now described, purely by way of non-limiting example, with reference to the attached figures, wherein:

- Figure 1 illustrates a component that can be used in embodiments,
- Figures 2A-2E illustrate possible ways of using the component according to Figure 1 in the possible implementation of embodiments,
- Figures 3A-3D illustrate the possible implementation of embodiments,
- Figures 4A-4D illustrate the possible implementation of embodiments, and
- Figures 5A-5B, 6 and 7A-7B exemplify additional possibilities for implementing embodiments.

**[0025]** It will be appreciated that, for clarity and simplicity of illustration, the various figures may not be reproduced on the same scale.

**[0026]** Furthermore, it will be appreciated that parts or elements presented herein with reference to embodiments exemplified in a certain figure among the attached figures can be applied to embodiments exemplified in any other figure of the attached figures. Accordingly, these parts or elements should not be considered to be strictly bound to the use in the embodiment(s) in relation to which they are presented here.

#### **[0027]** Detailed description of examples of embodiments

**[0028]** The following description illustrates various specific details in order to provide a thorough understanding of various examples of embodiments according to the 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 the various aspects of the embodiments are not rendered unclear.

**[0029]** The reference to "an embodiment" in the context of the present description indicates that a particular configuration, structure or characteristic described in relation to the embodiment is included in at least one embodiment. Thus, sentences such as "in an embodiment", which may be present at various 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.

**[0030]** The references used herein are provided simply for convenience and therefore do not define the field of protection or scope of the embodiments.

**[0031]** One or more embodiments, as exemplified herein, are aimed at facilitating the electrical connection of (at least)

one electrical conductor, such as a cable C with an "electrical user" L, for example, an electrically-powered light radiation source. This can be, for example, a solid-state light radiation source, for example, an LED source (exemplified and indicated by L in figures such as Figures 2E, 3D, 4D, 5B, 6 and 7B) .

**[0032]** In one or more embodiments, as exemplified herein, the connection can be achieved by connecting the electrically-conductive core C1 (for example, of metal material such as copper) of the cable C itself with an electrically-conductive formation (e.g. a pad 10B, discussed below) which, in turn, is intended to be electrically connected (in a known manner) with the electrical user L.

**[0033]** In one or more embodiments, it is required that the connection between the cable C and the aforesaid formation can be either an electrical connection, in order to allow the transfer of electrical signals between the cable C and the electrical user L (e.g. LED source(s)), or a mechanical connection.

**[0034]** Regarding this last aspect, it is desirable that the cable C is able to withstand the tensile forces exerted (even in an accidental manner) in the direction that can cause possible detachment of the cable C with respect to a support 10 on which the user component L is mounted.

**[0035]** In the embodiments exemplified herein, the support 10 can be in the form of a laminar body substantially similar to a printed circuit board (PCB) able to support the user component L (directly or indirectly, according to known principles).

**[0036]** One or more embodiments envisage - for this purpose - that a hole 10A is provided in the laminar support 10 (hereinafter, for the sake of brevity, "board") through which the cable C can be passed, or at least the electrically-conductive core C1 of the cable.

**[0037]** In one or more embodiments, as exemplified herein, it is assumed that the cable C is passed through the hole 10A in the board 10, starting from one side or face thereof (below in the figures), and then making an electrical connection towards the user element L on the opposite side of the board 10 (at the top in the figures).

**[0038]** The accompanying figures refer, by way of example, to coated-type cables, i.e. cables C in which the electrically-conductive core C1 is wrapped by an electrically-insulating sheath or tunic. One or more embodiments, as exemplified herein, may also be used in connection with "bare" cables, i.e. cables in which only an electrically-conductive core (such as the core C1 in the figures) is present, without the provision of an electrically-insulating sheath or tunic.

**[0039]** Furthermore, the figures of the attached drawings refer to single cables, for simplicity and clarity of illustration. One or more embodiments may also be used in conjunction with multiple cables, for example, of the ribbon type comprising several electrically-conductive cores extending parallel to one another.

**[0040]** One or more embodiments (for example, those exemplified in Figures 4A-4D) may envisage that the passage of the cable through the opening 10A in the board 10 is implemented by providing the cable C with an extension or prolongation (for example, a threaded tip) that can be passed through the opening 10A: as far as it is concerned here, this extension or tip may - in all respects - be considered as a component part of the cable C.

**[0041]** Regarding the methods for implementing the electrical connection, it is possible to provide both a connection provided with material (for example, carried out by welding, brazing or gluing with electrically-conductive adhesives), as well as a purely mechanical contact connection (for example, implemented through pressing or crimping).

**[0042]** Figures 2A-2E exemplify the possible use of a blocking body 12 of the type illustrated on a magnified scale in Figure 1. In one or more embodiments, there may be a body 12, approximately spherical, of electrically-conductive and plastically-deformable material (for example, copper or brass, optionally tin-coated) that may have weldability characteristics.

**[0043]** To fix the ideas (of course, without limiting intentions of the embodiments), the body 12 can be roughly assimilated to a plumb bob (for example, of the type used for fishing and hunting) in which there is a notch 12A (substantially V-shaped). In other words, the body 12 can be seen as a spherical body from which a segment has been removed.

**[0044]** The presence of the notch 12A makes it possible to fit the body 12 onto the cable (for example, onto the core C1), which protrudes with respect to the board 10 on the opposite side with respect to the origin of the cable C, with a sequence exemplified in Figures 2A-2C.

**[0045]** In other words, the body (or "ball") 12 can be fitted onto the core C1 of the cable causing the sides of the notch 12A to enclose the core of the cable C1. There is also the possibility, exemplified in Figure 2D, of pressing (squeezing) the body 12 around the core C1 of the cable C so as to anchor the body 12 deformed as such onto the core C1 of the cable.

**[0046]** The coupling condition thus created proves to be rather solid, and created in such a way as to ensure a firm retaining action of the cable C against the extraction forces with respect to the support 10.

**[0047]** As exemplified in Figure 2C, in one or more embodiments, the position in which the body 12 is fitted onto the core C1 of the cable can be selected causing the body 12 to be in (close) proximity of the support surface 10 with the electrically-insulating sheath of the cable - if present - which, in turn, is placed in (close) proximity of the opposite face of the board 10, for example, by bringing itself against the contour of the opening 10A.

**[0048]** On the contour of the opening 10A (on the side of the board 10 at which the ball 12 is pressed onto the core C1 of the cable C), it is possible to provide - according to criteria of the prior art for producing printed circuits - an electrically-conductive ringshaped pad 10B that can produce (still according to widely known criteria) the electrical connection towards the user element L.

**[0049]** In one or more embodiments, using current application techniques such as welding/brazing or by applying electrically-conductive adhesives, it is possible to apply an electrically-conductive mass 14 between the body 12 (of electrically-conductive material, which receives the core C1 therewithin - also electrically-conductive - of the cable C) and the pad 10B.

**[0050]** In this way, it is possible to produce the electrical connection between the cable C and the user element L in such a configuration as to favor a solid mechanical connection of the cable C to the board 10, in order to withstand tensile forces (also quite significant) in the extraction direction of the cable C with respect to the board 10.

**[0051]** Figures 3A-3D (where parts or elements analogous or similar to parts or elements already discussed in relation to Figures 2A-2E are indicated with the same references, which makes it unnecessary to repeat a detailed description) exemplify embodiments in which the connection element - instead of the ball 12 of Figures 1 and 2A-2E - is a ring 120 (i.e. a closed or open tubular member) of electrically-conductive and plastically-deformable material (for example, copper or brass, optionally tin-coated), which can be first fitted around the core C1 of the cable passed through the opening 10A (Figure 3A) and then being pressed (or "caulked") on the cable as exemplified in Figures 3B and 3C.

**[0052]** In this way, in one or more embodiments, it is possible to make a connection, either electrical or mechanical, between the fastening element (ring 120) and the cable C (core C1).

**[0053]** As can be appreciated in Figure 3C, as a result of the pressing operation, the element 120 can assume a shape that can be defined as a slot-like shape.

**[0054]** This shape can, optionally, be combined with an elongated (rectangular or oval) configuration, rather than round, of the pad 10B.

**[0055]** In this case as well, the locking element 120 can be mounted on the core C1 of the cable C in order to be in close proximity to the opening 10A and to facilitate, according to the methods illustrated in Figure 3D, the application of a mass of electrically-conductive welding/brazing/adhesive 14 that can produce the electrical connection of the cable C (core C1) with the formation 10B and, therefore, with the user L.

**[0056]** The same considerations made with respect to the embodiments exemplified in Figures 2A-2E also apply - substantially - to the embodiments exemplified in Figures 3A-3D, with the additional fact that solutions (as exemplified in Figures 3A-3D) may allow implementation of locking elements 120 with significant retaining characteristics.

**[0057]** Embodiments, as exemplified in Figures 4A-4D, envisage using a nut 1200 (once again of an electrically-conductive material, such as copper or brass) as a locking element (designed to perform a function similar to that of the ball 12 or of the ring 120), which can be screwed onto a threaded tip C2 of electrically-conductive material coupled (e.g. by crimping an annular base portion C20) to the distal end of the core C1 of the cable C.

**[0058]** This can all be implemented with the possible provision of an annular flange C22 in a position interposed between the threaded tip C2 and the ring formation C20 for coupling to the cable C1.

**[0059]** As exemplified in the sequence of Figures 4A-4D, the cable C (provided at its distal end with the threaded tip C2) can be passed through the opening 10A under conditions in which it is possible to screw the nut 1200 onto the portion of the tip C2 protruding from the face of the board 10 opposite the face at which the cable C has been introduced into the opening 10A of the board 10.

**[0060]** This with the possibility of ensuring that, once the nut 1200 has been completely screwed onto the tip C2 (see Figure 4D) is completed, the nut 1200 is in electrical contact with the cable C as well as with the pad 10B.

**[0061]** In one or more embodiments, an electrical connection of this nature can be implemented, even without making use of an electrically-conductive mass, such as that indicated by 14 in Figures 2E and 3D. The electrically-conductive nut 1200 can, in fact, come into contact (mechanically or electrically) with the pad 10B simply by being screwed onto the tip C2, since it can also exploit the reaction force exerted on the opposite side of the opening 10A by the C22 flange possibly provided on the tip C2.

**[0062]** Figure 4B exemplifies the possibility of fitting an electrically-insulating sleeve C24 (for example a heat-shrinkable sleeve) on the connecting region between the tip C2 and the core C1 (for example, at the annular crimping structure C20) aimed at avoiding the risk of unwanted electrical contacts with metal parts located nearby.

**[0063]** The figures discussed above refer to embodiments applicable to boards 10 of electrically-insulating material (for example, a material of the type known as CEM or FR).

**[0064]** Figures such as Figures 5A-5B and 6 exemplify embodiments in which the board 10 that is provided with the hole or opening 10A for passing the cable C, is of the type known as "metal-core". In this case, the board 10 may comprise a base layer 101 of metal material (therefore electrically-conductive) coated with a layer of electrically-insulating dielectric material 102 on the side where the electrical connection is made with the pad 10B.

**[0065]** In solutions of this nature, the risk of an unwanted electrical contact between the electrically-conductive core C1 of the cable and the layer 101 - equally electrically conductive - of the board 10 could arise.

**[0066]** Figures 5A-5B and 6 exemplify possible solutions to overcome this risk, with reference to the use of the locking ring 120 or the locking nut 1200 discussed above.

**[0067]** Embodiments, as exemplified in Figures 5A-5B and 6, may envisage (by means of possible production of the hole 10A with slightly larger dimensions than the holes or openings of Figures 2, 3 and 4 - this of course is a possibility,

not an imperative data) inserting an electrically-insulating sleeve 100A (practically a sort of washer, for example, of plastic material) into the hole 10A, which can extend into the space (or gap) between the core C1 and the inner part of the opening 10A (and, in particular, the portion of said contour corresponding to the electrically-conductive layer 101, so as to avoid (see - in this regard - Figure 5B or Figure 6) any unwanted contact between the core C1 and the electrically-conductive layer 101 of the board 10.

**[0068]** Figure 6 exemplifies the possibility of interposing a ring (washer) 1200A of electrically-conductive material between the nut 1200 and the areola or pad 10B, able to facilitate an even better electrical contact between the nut 1200 and the pad 10B.

**[0069]** It will be appreciated, however, that these solutions (insulating sleeve 100A and/or conductive ring 1200A, as exemplified with reference to Figures 5A-5B and 6) are also applicable to embodiments as exemplified in the previous figures, e.g. to solutions in which the locking member comprises a ball 12, as exemplified in Figures 1 and 2A-2E.

**[0070]** Furthermore, it will be appreciated that parts or elements presented herein with reference to embodiments exemplified in a certain figure among the attached figures can be applied to embodiments exemplified in any other figure of the attached figures. Accordingly, these parts or elements should not be considered to be strictly bound to the use in the embodiment (s) in relation to which they are presented here.

**[0071]** Precisely for this reason, parts or elements that are the same or similar, which appear in the various figures, are indicated in the various figures with the same references, without having to repeat a corresponding detailed description each time.

**[0072]** The above considerations also apply to Figures 7A and 7B.

**[0073]** These figures illustrate the possibility, in one or more embodiments, of using (even independently of the fact that the board 10 is of the electrically-conductive core type) a sleeve 100A of electrically-insulating material (for example, a plastic material) which, in addition to performing the function of being an insulating seal of the opening 10A, can extend for a certain length around the distal portion of the cable C (for example, with a peripheral wall having a tubular shape, indicated by 1000A in Figures 7A and 7B). In this way, it is possible to further facilitate the electrical insulation action of the distal portion of the cable C (core C1), which could accidentally be exposed due to a tensile force exerted on cable C, for example, during installation.

**[0074]** One or more embodiments may, therefore, envisage that the sleeve 100A is designed to be inserted into the opening 10A starting from the face of the board 10 opposite to that in which the locking element is present (for example, the "caulked" ring 120 exemplified in Figure 7B).

**[0075]** This insertion method is also exemplified in Figures 5A to 5B and 6: it should also be noted that - in solutions as exemplified in these figures - the insertion method of the insulating sleeve 100A could be opposite and envisage insertion of the sleeve 100A into the opening 10A starting from the side on which the locking element is located (for example, the ring 120 or nut 1200), with the electrical contact with the pad 10B - in any case - favored by the presence of the ring/washer 1200A.

**[0076]** A method according to one or more embodiments may comprise.

- providing a laminar support member (e.g. 10) for electrical user elements (e.g. electrically-powered light radiation sources L), the laminar support member having opposed first and second surfaces and at least one opening (e.g. 10A) therethrough, with an electrically-conductive formation (e.g. 10B) at the periphery of said opening at the first surface of the laminar support member,
- advancing an electrical wire (e.g. C, C1, C2) through said opening from the second surface to the first surface of the laminar support member (10), the electrical wire advanced into said opening having a distal portion protruding from the laminar support member at the first surface,
- coupling an electrically-conductive retaining member (e.g. 12, 120, 1200) with said distal portion of the electric wire, the retaining member sized (for example, with the retaining member "larger" than the opening and/or of a different shape with respect to the opening, even if not larger than the opening itself) in such a way to counteract extraction of the electric wire from the opening, and
- establishing electrical contact (e.g. 14, 1200A) between the retaining member and the electrically-conductive formation.

**[0077]** In one or more embodiments, coupling the electrically-conductive retaining member with the distal portion of the electric wire may comprise one of:

- fitting a plastically-deformable electrically-conductive body onto the distal portion of the electrical wire and plastically deforming the deformable body fitted onto the distal portion of the electrical wire or
- screwing an electrically-conductive nut screw (e.g. the nut 1200) onto a threaded distal portion (e.g. C2) of the electric wire.

**[0078]** In one or more embodiments, said plastically-deformable body may comprise one of:

- a sphere (e.g. 12) with an inserting slot (e.g. 12A) for the electrical wire, or
- a ring-like body (e.g. 120, 1200) that can be fitted onto the electrical wire.

**[0079]** One or more embodiments may comprise providing the distal threaded portion (e.g. the tip C2) of the electrical wire with an annular flange (e.g. C22) and bringing said annular flange into abutment against the periphery of said opening at the second surface of the laminar support member.

**[0080]** One or more embodiments may comprise arranging an electrically-insulating tubular member (e.g., C24 in Figure 4B or 100A in Figures 5A-5B, 6, 7A-7B) around the electrical wire in at least one position that can be:

- the second surface of the laminar support member, and/or
- the inner surface of said opening.

**[0081]** In one or more embodiments the laminar support member may comprise at least one electrically-conductive layer (e.g. 101), and the electrically-insulating tubular member - at the inner surface of said opening - may facilitate electrical insulation of said electrically-conductive layer with respect to the electrical wire.

**[0082]** One or more embodiments providing the electrical contact of the retaining member with said electrically-conductive formation may comprise one of:

- applying electrically-conductive material (e.g. 14) onto the retaining member facing the electrically-conductive formation, or
- arranging an electrically-conductive body (e.g. 1200A) surrounding the electrical wire between the retaining member and said electrically-conductive formation.

**[0083]** An electrical component according to one or more embodiments may comprise:

- a laminar support member for electrical user elements, the laminar support member having opposed first and second surfaces and at least one opening therethrough, with an electrically-conductive formation at the periphery of said opening at the first surface of the laminar support member,
- an electrical wire inserted through said opening from the second surface to the first surface of the laminar support member (10), the electrical wire inserted into said opening having a distal portion protruding from the laminar support member at the first surface,
- an electrically-conductive retaining member coupled with said distal portion of the electric wire, the retaining member sized in such a way to counteract extraction of the electric wire from the opening (for example, with the retaining member "larger" than the opening and/or of a shape different from the opening, even if not larger than the opening itself), the retaining member being in electrical contact with said electrically-conductive formation.

**[0084]** A device according to one or more embodiments may comprise:

- an electrical component according to one or more embodiments, and
- at least one electrical user element (e.g. L) in electrical contact with said electrically-conductive formation in said electrical component.

**[0085]** In one or more embodiments, the at least one electrical user element may comprise an electrically-powered light radiation source, optionally an LED light radiation source.

**[0086]** 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.

**[0087]** This extent of protection is determined by the attached claims.

#### LIST OF REFERENCE SIGNS

|                                   |           |
|-----------------------------------|-----------|
| Electrical user element           | L         |
| Laminar support member            | 10        |
| Opening                           | 10A       |
| Electrically-conductive formation | 10B       |
| Electrical wire                   | C, C1, C2 |

(continued)

|    |                                         |           |
|----|-----------------------------------------|-----------|
|    | Retaining member/deformable body/sphere | 12, 120   |
|    | Slit                                    | 12A       |
| 5  | Retaining member/annular ring/nut screw | 1200      |
|    | Electrical contact                      | 14, 1200A |
|    | Distal threaded portion                 | C2        |
|    | Annular flange                          | C22       |
| 10 | Electrically-insulating member          | C24;100A  |
|    | Electrically-conductive layer           | 101       |

## Claims

- 15 1. A method, comprising:
- 20 - providing a laminar support member (10) for electrical user elements (L), the laminar support member (10) having opposed first and second surfaces and at least one opening (10A) therethrough with an electrically-conductive formation (10B) at the periphery of said opening (10A) at the first surface of the laminar support member (10),
- 25 - advancing an electrical wire (C, C1, C2) through said opening (10A) from the second surface to the first surface of the laminar support member (10), the electrical wire (C, C1, C2) advanced into said opening (10A) having a distal portion protruding from the laminar support member (10) at the first surface thereof,
- coupling with said distal portion of the electrical wire (C, C1, C2) an electrically-conductive retain member (12, 120, 1200), the retain member dimensioned to counter extraction of the electrical wire (C, C1, C2) from the opening (10A), and
- establishing electrical contact (14, 1200A) of the coupling member (12, 120, 1200) and the electrically-conductive formation (10B).
- 30 2. The method of claim 1, wherein coupling the electrically-conductive retain member with the distal portion of the electrical wire (C, C1, C2) comprises one of:
- 35 - fitting onto the distal portion of the electrical wire (C, C1, C2) a plastically-deformable electrically-conductive body (12, 120) and plastically deforming the deformable body (12, 120) fitted onto the distal portion of the electrical cable (C, C1), or
- threading an electrically-conductive female screw (1200) onto a distal threaded portion (C2) of the electrical wire.
3. The method of claim 2, wherein the plastically-deformable body comprises one of:
- 40 - a sphere (12) with a receiving slot (12A) for the electrical wire (C, C1), or
- a ring-like body (120, 1200) fittable onto the electrical wire (C1, C2).
4. The method of claim 2, comprising providing the distal threaded portion (C2) of the electrical wire with an annular flange (C22) and bringing said annular flange (C22) in abutment against the periphery of said opening (10A) at the second surface of the laminar support member (10).
- 45 5. The method of any of the previous claims comprising arranging an electrically-insulating tubular member (C24; 100A) around the electrical wire (C, C1, C2) at at least one location out of:
- 50 - the second surface of the laminar support member (10), and/or
- the inner surface of said opening (10A).
- 55 6. The method of claim 5, wherein the laminar support member (10) comprises at least one electrically-conductive layer (101), wherein the electrically-insulating tubular member (100A) at the inner surface of said opening (10A) facilitates electrical insulation of said electrically-conductive layer (101) with respect to the electrical wire (C, C1, C2) .
7. The method of any of the previous claims, wherein providing electrical contact of the retain member (12, 120, 1200)

with said electrically-conductive formation (10B) comprises one of:

- applying electrically-conductive material (14) on the retain member (12, 120, 1200) facing the electrically-conductive formation (10B), or
- arranging an electrically-conductive body (1200A) surrounding the electrical wire (C1) between the retain member (12, 120, 1200) and said electrically-conductive formation (10B).

**8.** An electrical component, comprising:

- a laminar support member (10) for electrical user elements (L), the laminar support member (10) having opposed first and second surfaces and at least one opening (10A) therethrough with an electrically-conductive formation (10B) at the periphery of said opening at the first surface of the laminar support member (10),
- an electrical wire (C, C1, C2) advanced through said opening (10A) from the second surface to the first surface of the laminar support member (10), the electrical wire (C, C1, C2) advanced into said opening (10A) having a distal portion protruding from the laminar support member (10) at the first surface thereof,
- an electrically-conductive retain member (12, 120, 1200) coupled with said distal portion of the electrical wire (C, C1, C2), the retain member dimensioned to counter extraction of the electrical wire (C, C1, C2) from the opening (10A), the retain member (12, 120, 1200) in electrical contact (14, 1200A) with the electrically-conductive formation (10B).

**9.** A device, comprising:

- an electrical component according to claim 8, and
- at least one electrical user element (L) in electrical contact with said electrically-conductive formation (10B) in said electrical component.

**10.** The device of claim 9, wherein the at least one electrical user element (L) comprises an electrically-powered light radiation source, preferably of the LED type.

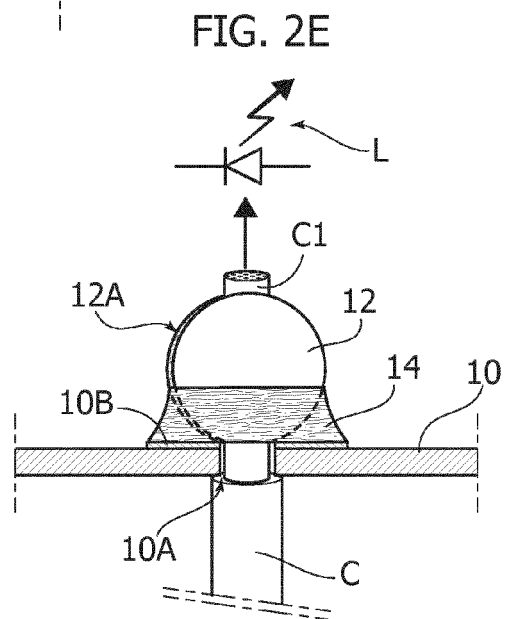
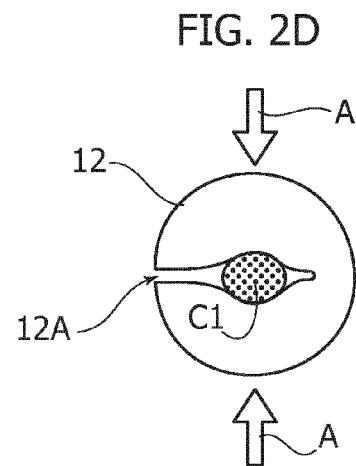
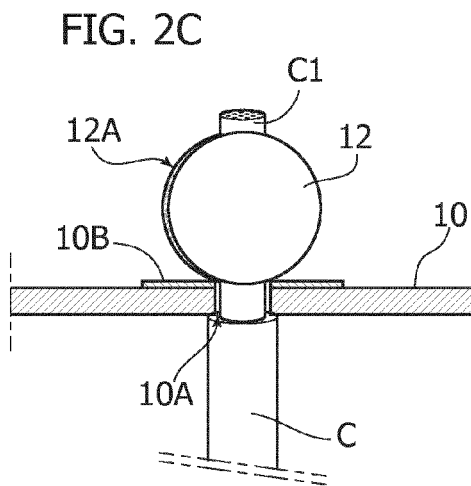
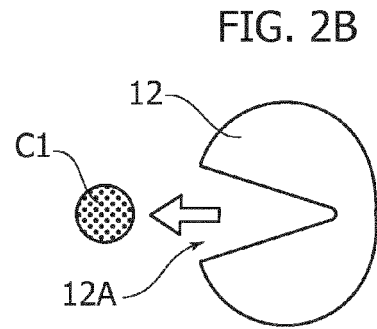
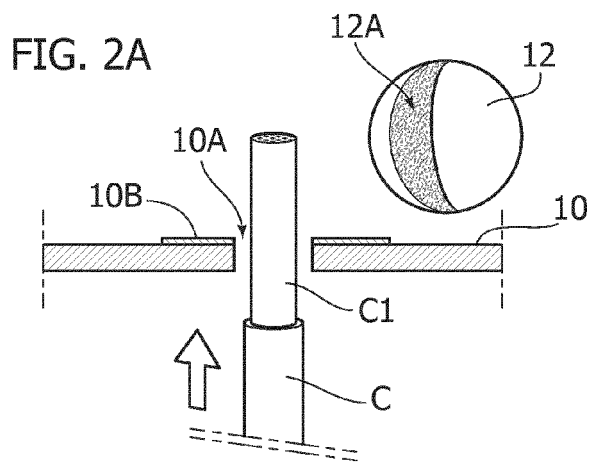
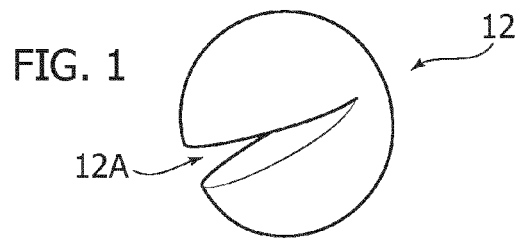


FIG. 3A

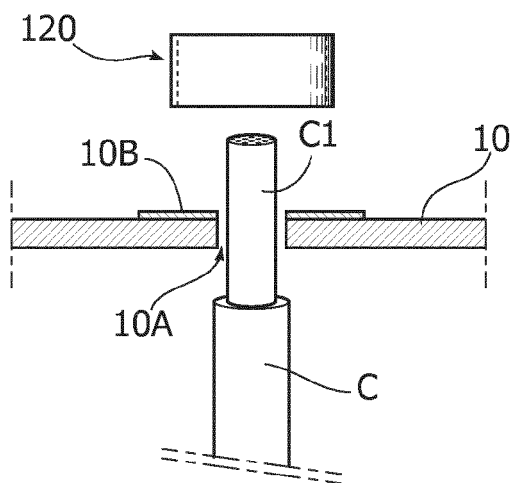


FIG. 3B

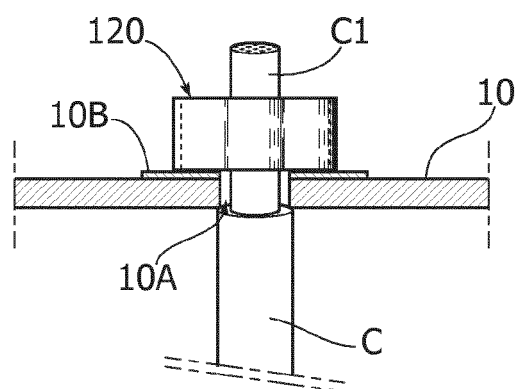


FIG. 3C

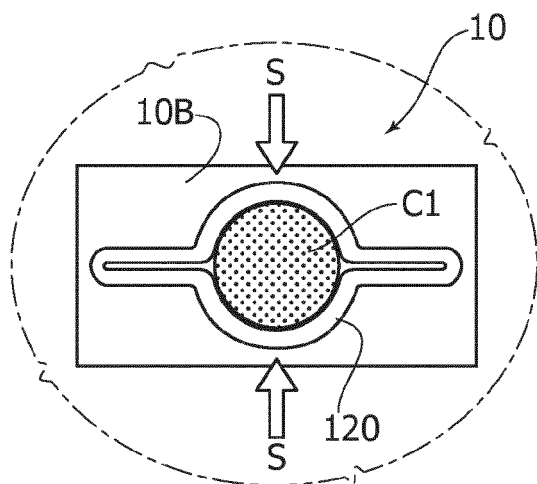


FIG. 3D

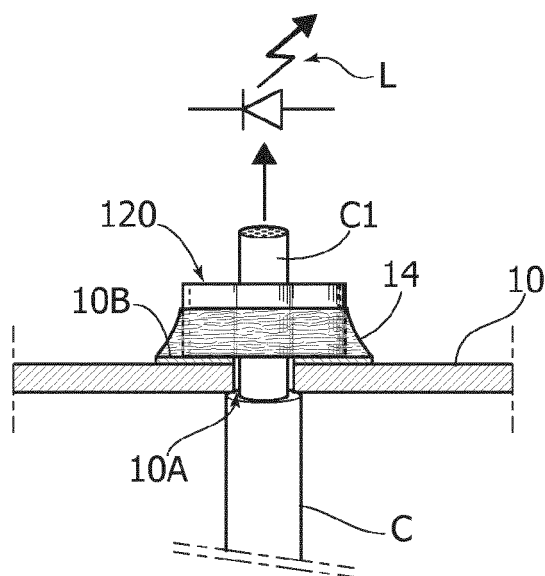


FIG. 4A

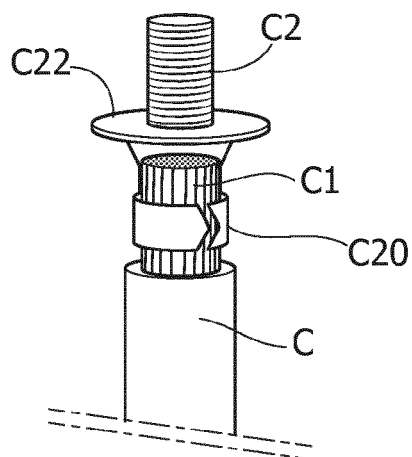


FIG. 4B

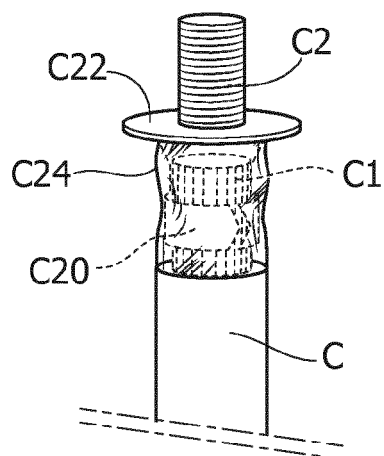


FIG. 4C

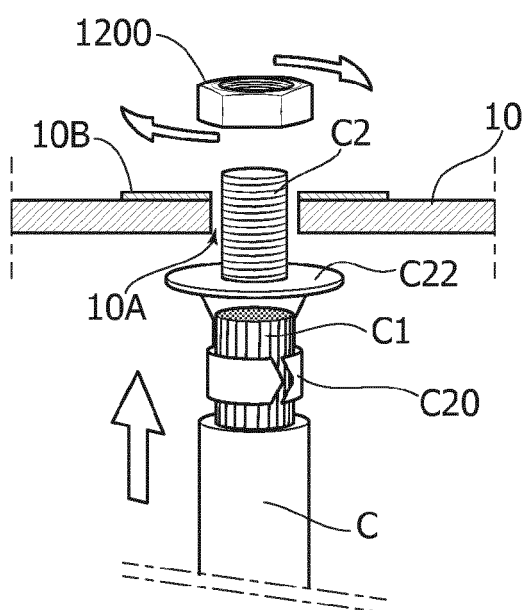


FIG. 4D

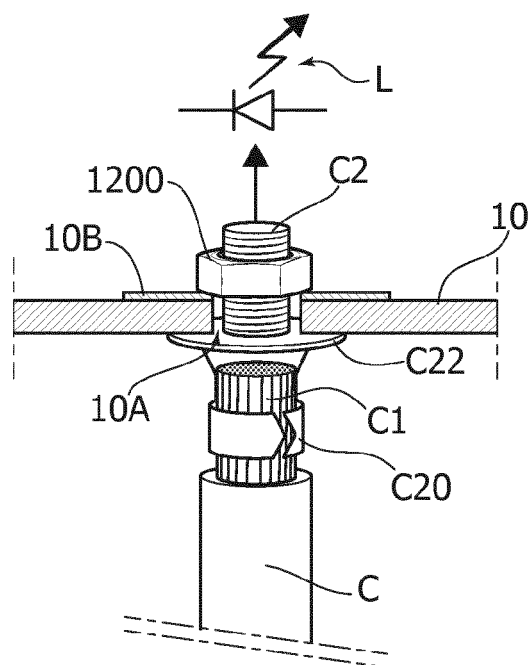


FIG. 5A

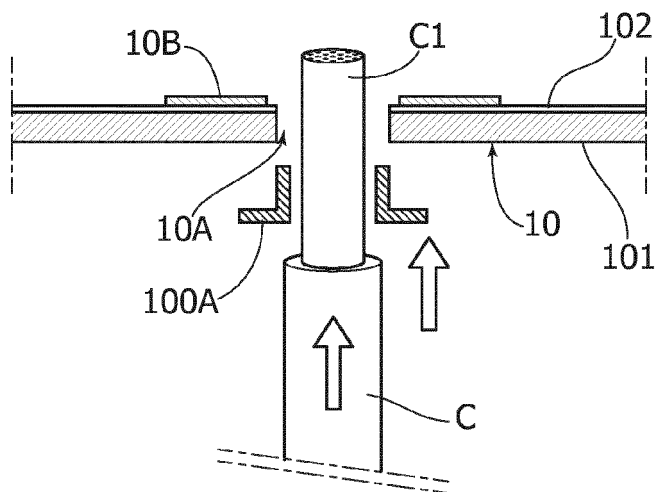


FIG. 5B

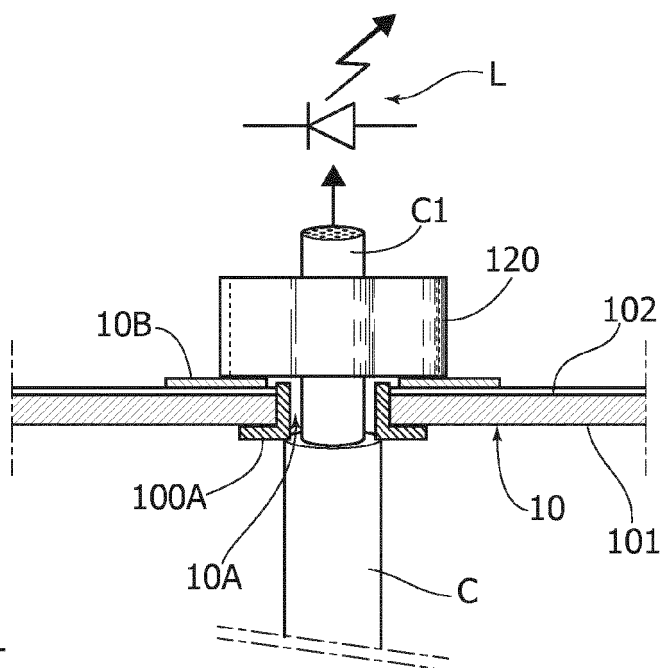


FIG. 6

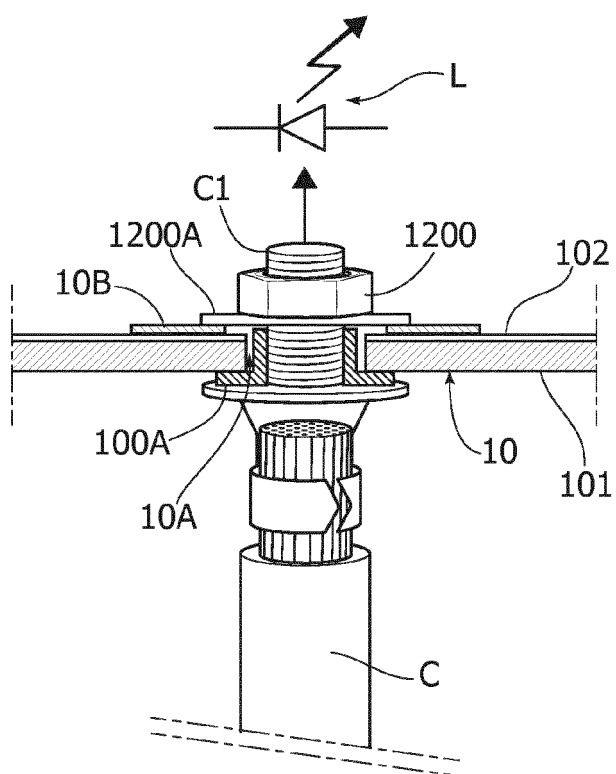


FIG. 7A

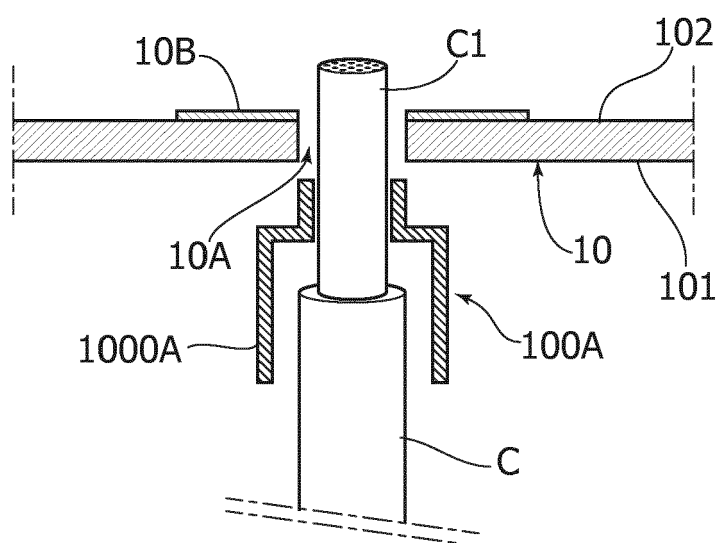
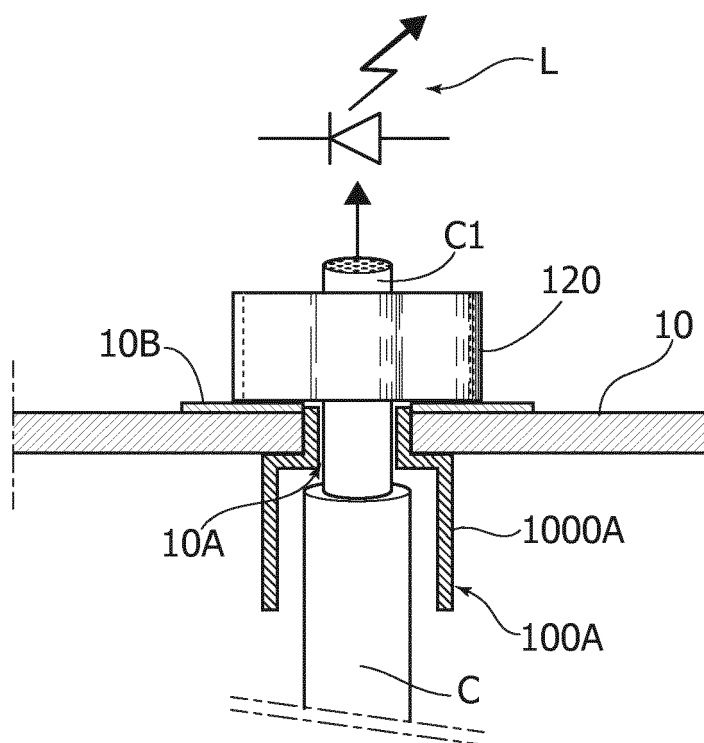


FIG. 7B





## EUROPEAN SEARCH REPORT

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                    |                                                          |                                                 |
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| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                    |                                                          |                                                 |
| Place of search<br><b>The Hague</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                    | Date of completion of the search<br><b>10 April 2019</b> | Examiner<br><b>Pugliese, Sandro</b>             |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                    |                                                          |                                                 |

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