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(54) LED LIGHTING DEVICE

(57) There is described an LED lighting device (1; 100; 110; 120) comprising a member (2; 102) for fixing an LED element (3) which has a receiving cavity (11; 103) for the LED element which is provided with an opening (12; 104), through which the light produced by the LED element (3) is emitted outwardly, a plate (7) which carries a printed circuit board for connection to the LED element (3), the plate (7) being received in the cavity (11; 103) and being configured to be fixed to the fixing member (2; 102), a lens (13) which is configured to concentrate the light beam which is emitted by the LED element (3) through the opening (12; 104), a support (14) for supporting the lens (13) with a predefined spacing from the LED element (3), wherein the support (14) is configured to be received in the cavity (11; 103) with relative freedom to slide away from and towards the opening (12; 104) and to be retained in the cavity (11; 103) by means of a locking element (15) which defines an abutment surface (15a) for the support (14), and wherein the locking element (15) is secured in a removable manner to the member (2; 102) inside the cavity (11; 103).

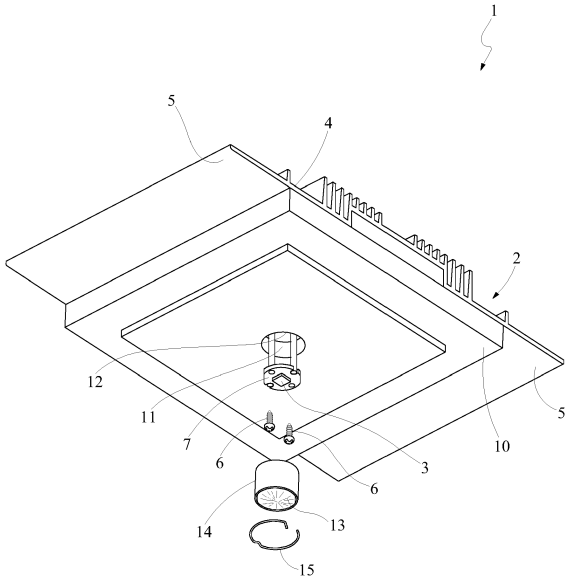

Fig. 1

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Description

[0001] The present invention relates to an LED lighting device having the features set out in the preamble of main claim 1.

[0002] In the specific technical field to which the invention relates, there are known lighting devices or groups which are configured to produce light points, the light beam of which is generated by an LED.

[0003] One known type relates to the so-called "recessed spotlight" which is defined in this manner because it is provided to be inserted, at least partially or completely, in a support structure, which is generally constituted by plasterboard panels which act as a covering, such as false walls and/or false ceilings, or which is configured for installation in the wall with formwork. Another known type comprises spotlights which are mounted in an articulated or hinged manner on support members and which are capable of producing orientable light beams or spotlights which are vertically suspended in a flush state from ceiling or false ceiling structures.

[0004] In both such types, the LED element is typically received in the cavity which is formed internally with respect to a fixing member and which opens outwardly by means of an opening, through which the light beam produced by the LED element is directed. The LED is fixed to a plate which carries the printed circuit board for connection which is secured, for example, by way of screw type fixing means, to the fixing member of the lighting device.

[0005] In order to concentrate the light beam which is emitted by the LED, there is further normally provided a lens which is mounted on a support which is suitable for maintaining the lens at a predetermined distance from the LED and in a centred position with respect thereto so as to obtain an effective concentration of the light beam through the lens.

[0006] Typically, the support which carries the lens is fixedly joined to the plate of the printed circuit board, for example, by means of adhesive bonding. This system, on the one hand, allows the lens to be retained in a stable manner in a centred position and at a predetermined distance from the LED but, on the other hand, it has a number of limitations.

[0007] Particularly in the case of an intervention for maintenance, for example, in order to change the LED as a result of it burning out, the lens-carrying support may also be lost, the parts being mutually bonded together. Alternatively, in order to re-use the lens-carrying support, it would be necessary to remove the adhesive beforehand in order then to re-clean the fixing zone between the printed circuit board and the support and to carry out the new bonding of the lens-carrying support to the printed circuit board of the new LED. These operations are quite complicated both as a result of the difficult access to the LED and as a result of the small dimensions of the components involved, and normally they do not appear to be justified for the time and costs which they involve. There are the same limitations if it were to be desirable to replace the lens or to replace it with a lens with a different optical unit.

[0008] These operations, particularly for replacing the LED, although they are not required often because of the long service-life of the LED elements, are therefore found to be quite complex and arduous where necessary. Therefore, there are found limitations in the solutions proposed from the prior art which are both linked to the fixing system of the lens-carrying support with respect to the body of the lighting device and linked to the centring system of the lens with respect to the LED element, which aspects make the interventions, even only for simple maintenance, in the body of the LED lighting device inconvenient and complicated.

[0009] The main objective of the invention is to provide an LED lighting device which is structurally and functionally configured to overcome the limitations set out above with reference to the solutions currently available.

[0010] This objective and other objectives which will be set out more clearly below are achieved by the invention by means of an LED lighting device constructed according to the features of claim 1.

[0011] Preferred embodiments of the invention are constructed according to the features of the dependent claims.

[0012] According to one aspect of the invention, a lighting device comprises a member for fixing an LED element which has a receiving cavity for the LED element which is provided with an opening, through which the light produced by the LED element is emitted outwardly, a plate which carries a printed circuit board for connection to the LED element, the plate being received in the cavity and being configured to be fixed to the member, a lens which is configured to concentrate the light beam which is emitted by the LED element through the opening, a support for supporting the lens with a predefined spacing from the LED element, wherein the support is configured to be received in the cavity with relative freedom to slide away from and towards the opening and to be retained in the cavity by means of a locking element which defines an abutment surface for the support, and wherein the locking element is secured in a removable manner to the member inside the cavity. In a preferred embodiment, the support has a cylindrical tubular formation which extends axially along a main axis and the cavity has an internal cylindrical formation which is coaxial with the main axis of the support. Preferably, the sliding of the support in the cavity is brought about along the axis with a limited relative radial play.

[0013] Preferably, the lens is connected to the support in an interlocking manner. In a preferred embodiment, the locking element is secured to the member by friction as a result of the pressure applied by the locking element against an internal surface of the member which defines the cavity.

[0014] Preferably, the locking element is configured as a locking ring with an open or closed profile.

[0015] In a preferred embodiment, the LED lighting device is configured in such a manner that the support can be removed by gravitational force from the cavity of the member after the locking element is disengaged from the cavity of the member.

[0016] According to another aspect of the invention, the LED element is positioned on one of the opposing faces of the plate, the faces being delimited by an edge of the plate which defines a first peripheral profile, and the support extends between a first end, in the region of which it is connected to the lens, and a second opposite end, in which the support is open towards the exterior through an opening which is delimited by a second peripheral profile of the support, the second peripheral profile of the support being configured to surround the first peripheral profile of the plate, with mainly positive-locking connection with a limited connection play, the LED element and the lens being provided on the plate and on the support, respectively, in such positions that, by means of the positive-locking connection between the first and second peripheral profiles, the centring of the lens with respect to the LED element is obtained in order to ensure a centred concentration of the light beam emitted by the LED element through the lens.

[0017] Preferably, the support has an axially symmetrical formation and the centring between the LED element and the lens is carried out along the axis of axial symmetry.

[0018] Preferably, the first and second peripheral profiles have a circular formation. Preferably, the plate has a cylindrical formation which has a reduced thickness and which is defined between the opposite faces and the LED element is provided on the corresponding face in a centred position with respect to the circular peripheral profile of the face.

[0019] Additional features and advantages of the invention will be better appreciated from the following detailed description of a number of preferred embodiments thereof which are illustrated by way of non-limiting example with reference to the appended drawings, in which:

- Figure 1 is a perspective view of an LED lighting device in a first exemplary embodiment,
- Figure 2 is a longitudinally sectioned view of the device of Figure 1,
- Figure 3 is a sectioned view, drawn to an enlarged scale, of a detail of the device of the preceding Figures,
- Figure 4 is an exploded perspective view, drawn to an enlarged scale, of the detail of Figure 3,
- Figure 5 is an exploded perspective view corresponding to Figure 4 in a construction variant of a component of the detail depicted,
- Figure 6 is an exploded perspective view of a second exemplary embodiment of the LED lighting device according to the invention,
- Figure 7 is a perspective view of the device of Figure 6 in an assembled condition,
- Figure 8 is a perspective view of the device of Figure 1 in an assembled condition,
- Figures 9 and 10 are perspective views of two respective additional exemplary embodiments of the lighting device according to the invention. Initially with reference to Figures 1 to 4, there is generally designated 1 a first embodiment of an LED lighting device which is constructed according to the present invention.

[0020] The LED lighting device 1 is mainly configured for applications on panels L, which are only schematically depicted in Figure 2, for example, made from plasterboard, and which constitute false walls and/or false ceilings. Typically, the wall constructed with plasterboard panels is positioned with spacing from the wall/ceiling which is behind and in the gap which is generated the rear portion of the LED lighting device is received.

[0021] The LED lighting device 1 comprises a member 2 for fixing an LED element 3, the member 2 comprising two main portions which are different from each other and which are intended to be assembled together, as will become evident in greater detail below. A first portion comprises a plate-like base 4 on which the LED element 3 is fixed (as a light source of the LED lighting device). The base is provided with a pair of opposite lateral wings 5 for coupling to the internal portion of the plasterboard panel L to which the LED lighting device is intended to be applied. The base 4 is preferably made from a material with a high level of thermal conductivity (for example, from aluminium or another similar material or metal alloy which are suitable for the purpose) in order to rapidly dissipate the heat which is produced by the LED element 3. This element 3 is applied to the base 4 of the fixing member 2 by way of screw type fixing means 6.

[0022] In a preferred embodiment, there is provision for a plate 7 which has a printed circuit board (PCB) for connection to the LED to be provided with eyelets or notches 8 for engaging with one or more clamping screws 6 (in the example of Figure 1, there are provided two clamping screws 6).

[0023] There are designated 9 the electrical wires for connecting the printed circuit board and therefore the LED to the electrical network or another electrical power supply source. The second portion of the fixing member 2 comprises a plate-like element 10 which is capable of being fixed to the base 4 and which has a through-cavity 11, which is preferably in the form of a cylindrical through-hole and which is provided with an outwardly directed opening 12 through which the light which is generated by the LED element 3 is emitted. The LED element is therefore at least partially received inside the cavity 11, through which the LED element 3 and therewith the plate 7 of the printed circuit board are inserted in order to reach the mounting position or are removed in the disassembly step.

[0024] The LED element 3 is mounted in a position interposed between the base 4 and the plate-like element

10 so as to be substantially in axial alignment with the opening 12 (that is to say, the light source of the LED element is arranged in the direction of the main axis of the cylindrical hole which defines the cavity 11). It will be understood that it is possible, as an alternative, to provide through-cavities having a different formation from the cylindrical formation described above.

[0025] The plate-like element 10 serves to protect the LED element so as to close the seat which is formed in the plasterboard panel L but remains in view once the application is completed. It is further conveniently made from a material which facilitates the external shaving operation with the plasterboard panel. The LED lighting device 1 further comprises a lens which is designated 13 and which is configured to concentrate the light beam which is emitted by the LED element 3 through the opening 12. As a result of the structure of the lens, the light beam can be guided with a preselected angulation and different angulations of the light beam can be obtained on the basis of the preselected lens structure.

[0026] There is designated 14 a support which is configured to support the lens 13 in the lighting device so that the lens is maintained in a state positioned at a predetermined and appropriate distance from the LED element 3. The lens 13 is connected to the support 14, preferably with an interlocking connection. The support 14 is further configured to be received in the cavity 11 with relative freedom to slide towards and away from the opening 12 and to be retained in the cavity 11 by means of a locking element 15.

[0027] The locking element 15 is configured to define an abutment surface 15a for the support 14 inside the cavity and is further configured to be secured in a removable manner to the fixing member 2 inside the cavity itself.

[0028] In a preferred embodiment, the locking element 15 has a ring-like formation with an open profile and can be advantageously made from metal material, for example, from steel or another alloy, which is suitable for conferring thereon a capacity for resilient deformation. The locking ring is preferably made from metal wire with suitable resilience for generating the blocking pressure in the cavity as a result of a resilient deformation thereof so as to generate a resilient return force towards the non-deformed configuration. There is designated 15b an end portion of the locking element which extends in the region of the interruption of the profile and which serves to facilitate the grip of the locking element in the positioning operations inside the cavity and particularly during the removal thereof from the cavity.

[0029] In an alternative embodiment, the locking element 15 may have a ring-like formation with a closed profile and may be made from a plastics material, for example, from rubber, with a suitable degree of resilient deformability.

[0030] The locking element 15, in the embodiments thereof, is therefore configured to be secured to the fixing member 2 by friction as a result of the pressure applied thereby against the internal surface of the cavity 11 with mutual relative contact.

[0031] In greater detail, the support 14 has a tubular cylindrical formation which extends axially along a main axis which is designated X and the cavity 11 has a corresponding cylindrical internal surface formation which is coaxial with the support 14 when it is slidingly received in the cavity. The sliding of the support 14 inside the cylindrical cavity is carried out in the direction of the axis X with limited radial play of the relative connection.

[0032] As a result of the relative sliding freedom, in the assembly step of the lighting device the support 14 for carrying the lens 13 can be inserted in the cavity 11 through the opening 12 until it moves into abutment with an axial end 14a thereof against the base 4 of the fixing member. The support can be retained in this position which has been reached inside the cavity by means of insertion of the locking element which is moved into abutment against a second opposite axial end 14b of the support. In this position, the end 14b of the support is maintained in abutment against the abutment surface 15a of the locking element.

[0033] The removal of the locking element (extracted outside through the opening 12) from the retention condition of the support inside the cavity allows the sliding of the support to be released in the direction of the opening 12, the support therefore being able to be removed from the cavity.

[0034] In a vertical assembly configuration, in which the axis X is substantially directed parallel with the direction of gravitational force, the support 14, once the locking element has been disengaged from the cavity, is autonomously removed from the cavity as a result of the action of gravitational force and the relative freedom of the support to slide in the cavity.

[0035] The LED element 3 is positioned on a face 16a of the plate 7 of the printed circuit board opposite the other face 16b, the faces 16a, 16b being delimited by an edge of the plate which defines a peripheral profile 17.

[0036] The support 14 extends between the end 14a thereof in the region of which it is connected to the lens 13 and the second opposite end 14b, at which the support 14 is open outwardly through an opening 18 which is delimited by a peripheral profile 19 of the support itself.

[0037] The peripheral profile 19 is configured to surround, in the condition assembled on the device (Figure 2), the peripheral profile 17 of the plate with mainly positive-locking connection with a limited radial connection play. The LED element and the lens are provided on the plate 7 and on the support 14, respectively, in such positions that, by means of the positive-locking connection between the peripheral profiles 17 and 19, the centring of the lens 13 with respect to the LED element is obtained so as to ensure a centred concentration of the light beam emitted by the LED element through the lens. Preferably, there may be provision for the LED element to be secured to the face 16a in a position centred on the plate and the lens 13 to be mounted on the support in a centred position with respect to the peripheral profile 19 of the support.

As a result of this configuration, the connection of the support to the plate, in the assembled condition of the device, consequently ensures the centring of the lens with respect to the LED element, independently of the relative angular orientation between the support and the plate of the printed circuit board which it has in the assembly step of the lens-carrying support on the device.

[0038] In a preferred embodiment, the support 14 is constructed with an axially symmetrical formation about the axis X and the centring between the LED element 3 and the lens 13 is brought about along the axis X of axial symmetry. In this embodiment, the peripheral profiles 17 and 19 have a formation with a mainly circular extent.

[0039] In one embodiment, the plate 7 of the printed circuit board has a cylindrical formation with a reduced thickness which is defined between the opposite faces 16a, 16b and the LED element 3 is provided on the face 16a in a centred position with respect to the circular peripheral profile of the face.

[0040] With reference to Figures 6 and 7, a second example of the LED lighting device according to the invention is designated 100 and similar details to those of the example described above are denoted with the same reference numerals.

[0041] The LED lighting device 100 is configured as a spotlight which can be orientated and comprises a first attachment portion 101 (for fixing to a wall surface, ceiling surface or other similar structure) on which a fixing member 102 is mounted in an articulated manner, for example, by means of a hinged joint.

[0042] The fixing member 102 has a hollow tubular configuration, in particular of cylindrical form, defining a cavity 103 for receiving the LED element 3.

[0043] The plate 7 which has the printed circuit board of the LED element is configured to be fixed to an end 102a of the fixing member 102 (the end arranged near the attachment portion), there being provided at the opposite axial end 102b an opening 104, through which the light produced by the LED element is emitted outwards.

[0044] The fixing member 102 together with the attachment portion 101 is preferably made from metal material.

[0045] In a generally similar manner to the example described above, the support 14 which carries the lens 13 with a tubular, cylindrical formation is configured to be received in the cavity 103 with relative freedom to slide and with limited radial connection play towards and away from the opening 104 and to be retained in the cavity by means of the locking element 15.

[0046] The locking element 15 which is secured by pressure friction against the internal cylindrical wall of the cavity 103 forms with the surface 15a an abutment surface against which the support 14 remains in abutment.

[0047] In this example, the locking element 15 is configured as a ring with an open profile, which is preferably made from metal wire with suitable resilience in order to generate the blocking pressure in the cavity, as a result of a resilient deformation thereof so as to generate a resilient return force towards the non-deformed configuration.

[0048] As in the preceding example, the support 14 is configured to surround, with the peripheral profile 19 thereof, the peripheral profile 17 of the plate 7, with a limited connection play between the respective connected surfaces in order to ensure the centring of the lens with respect to the LED element and to consequently ensure the centred concentration of the light beam emitted by the LED element through the lens.

[0049] Figures 9 and 10 depict additional possible embodiments of the LED lighting device according to the invention in which the characteristics described in the preceding examples can be carried out.

[0050] Figure 9 illustrates particularly an LED lighting device which is generally designated 110 and in which a fixing member which is generally similar to the fixing member 102 and which is directed towards a spotlight with orientable light is mounted in a fixing structure of the type of the one described for the LED lighting device 1.

[0051] Figure 10 illustrates an LED lighting device which is designated 120 and which has a fixing member which is similar to the one of the LED lighting device 100 although it is constructed without any capacity for angular orientation. Such an LED lighting device is particularly suitable for constructing suspension type spotlights, in particular spotlights which are suspended from the ceiling, for example, which are suspended by means of locking wires or cables.

[0052] The invention thereby achieves the objects proposed while affording a number of advantages with respect to the known solutions.

[0053] A first advantage is that, as a result of the mounting system of the lens-carrying support, which is of the removable type and independent of the LED element and the printed circuit board to which the LED element is connected, the maintenance operations for replacing the LED element and/or the lens are convenient, easy and rapid for the operator, allowing easy accessibility to the components indicated. Furthermore, the lens and the LED element being structurally independent of each other, the mounting and dismounting of one and/or the other of these components is simple and practical and further allows the re-use of the lens in the case of replacement of the LED element or allows the lens to be replaced with other lenses with different optical properties, keeping the LED element mounted on the device.

[0054] Another advantage is linked with the fact that, as a result of the provision of the centring system between the lens and the LED element according to the invention, the assembly operations are easier and simplified for the operator, an aspect which is particularly appreciable in the case of dimensions and spatial requirements which are reduced for the components of the device and in the presence of limited accessibility for the installer.

[0055] Furthermore, as a result of the centring system of the invention, wherein the lens-carrying support is configured to externally surround the profile of the printed

circuit board which carries the LED element, in a position moved apart from the LED element, the dissipation of the heat is improved, substantially reducing the heat generated by the LED element and transmitted to the lens-carrying support.

Claims

1. An LED lighting device (1; 100; 110; 120) comprising:

   - a member (2; 102) for fixing an LED element (3) which has a receiving cavity (11; 103) for the LED element which is provided with an opening (12; 104), through which the light produced by the LED element (3) is emitted outwardly,
   - a plate (7) which carries a printed circuit board for connection to the LED element (3), the plate (7) being received in the cavity (11; 103) and being configured to be fixed to the member (2; 102),
   - a lens (13) which is configured to concentrate the light beam which is emitted by the LED element (3) through the opening (12; 104),
   - a support (14) for supporting the lens (13) with a predefined spacing from the LED element (3),

   characterized in that the support (14) is configured to be received in the cavity (11; 103) with relative freedom to slide away from and towards the opening (12; 104) and to be retained in the cavity (11; 103) by means of a locking element (15) which defines an abutment surface (15a) for the support (14), and **in that** the locking element (15) is secured in a removable manner to the member (2; 102) inside the cavity (11; 103).

2. An LED lighting device according to claim 1, wherein the support (14) has a cylindrical tubular formation which extends axially along a main axis (X) and the cavity (11; 103) has an internal cylindrical formation which is coaxial with the main axis (X) of the support (14).

3. An LED lighting device according to claim 2, wherein the sliding of the support (14) in the cavity (11; 103) is brought about along the axis (X) with a limited relative radial play.

4. An LED lighting device according to any one of the preceding claims, wherein the lens (13) is connected to the support (14) in an interlocking manner.

5. An LED lighting device according to any one of the preceding claims, wherein the locking element (15) is secured to the member (2; 102) by friction as a result of the pressure applied by the locking element (15) against an internal surface of the member which defines the cavity (11; 103).

6. An LED lighting device according to any one of the preceding claims, wherein the locking element (15) is configured as a locking ring with an open or closed profile.

7. An LED lighting device according to any one of the preceding claims, which is configured in such a manner that the support (14) can be removed by gravitational force from the cavity (11; 103) of the member (2; 102) after the locking element (15) is disengaged from the cavity (11; 103) of the member.

8. An LED lighting device according to any one of the preceding claims, wherein the LED element (3) is positioned on one (16a) of the opposing faces (16a, 16b) of the plate (7), the faces (16a, 16b) being delimited by an edge of the plate which defines a first peripheral profile (17), and the support (14) extends between a first end (14a), in the region of which it is connected to the lens (13), and a second opposite end (14b), in which the support (14) is open towards the exterior through an opening (18) which is delimited by a second peripheral profile (19) of the support, the second peripheral profile (19) of the support (14) being configured to surround the first peripheral profile (17) of the plate, with mainly positive-locking connection with a limited connection play, the LED element (3) and the lens (13) being provided on the plate (7) and on the support (14), respectively, in such positions that, by means of the positive-locking connection between the first and second peripheral profiles (17, 19), the centring of the lens (13) with respect to the LED element (3) is obtained in order to ensure a centred concentration of the light beam emitted by the LED element (3) through the lens (13).

9. An LED lighting device according to claim 8, wherein the support (14) has an axially symmetrical formation and the centring between the LED element (3) and the lens (13) is carried out along the axis (X) of axial symmetry.

10. An LED lighting device according to claim 8 or 9, wherein the first and second peripheral profiles (17, 19) have a circular formation.

11. An LED lighting device according to any one of claims 8 to 10, wherein the plate (7) has a cylindrical formation which has a reduced thickness and which is defined between the opposite faces (16a, 16b) and the LED element (3) is provided on the corresponding face (16a) in a centred position with respect to the circular peripheral profile of the face.

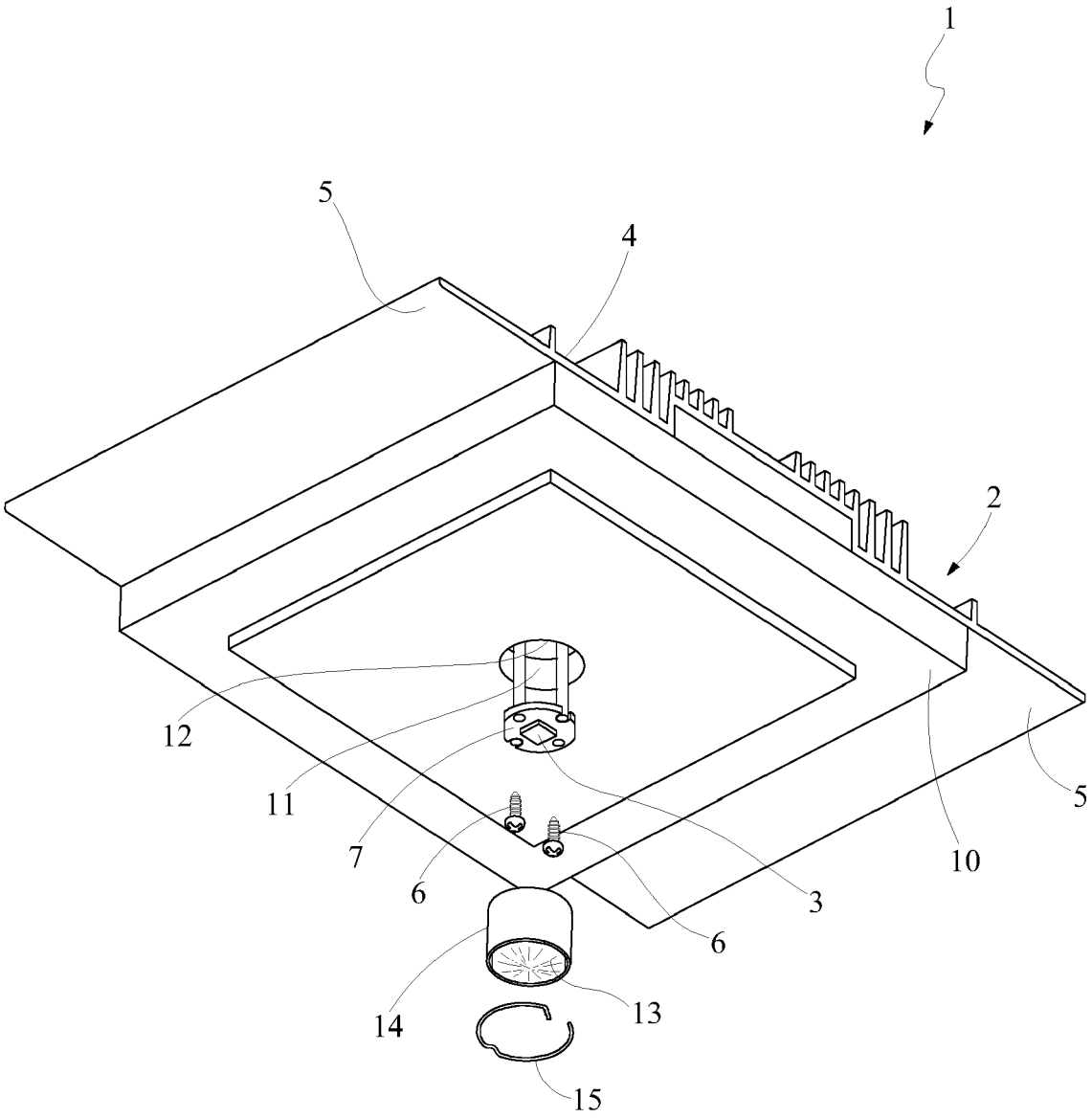

Fig. 1

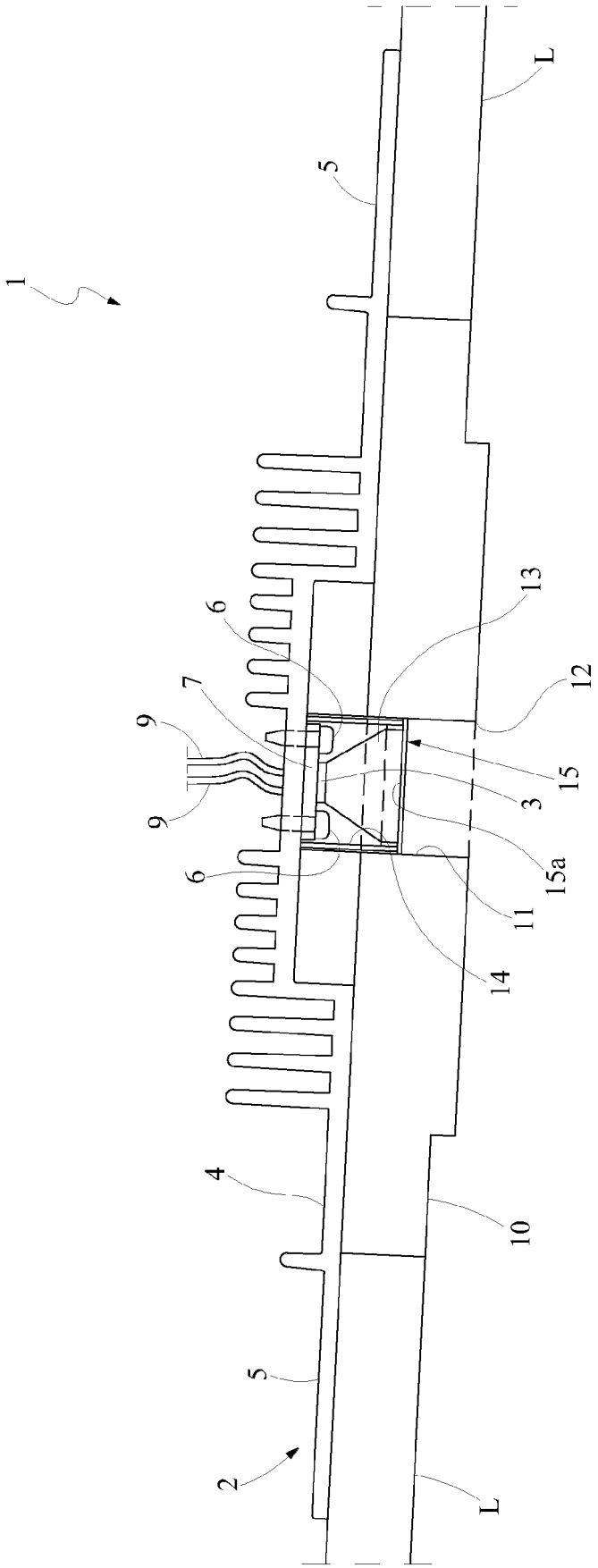

Fig. 2

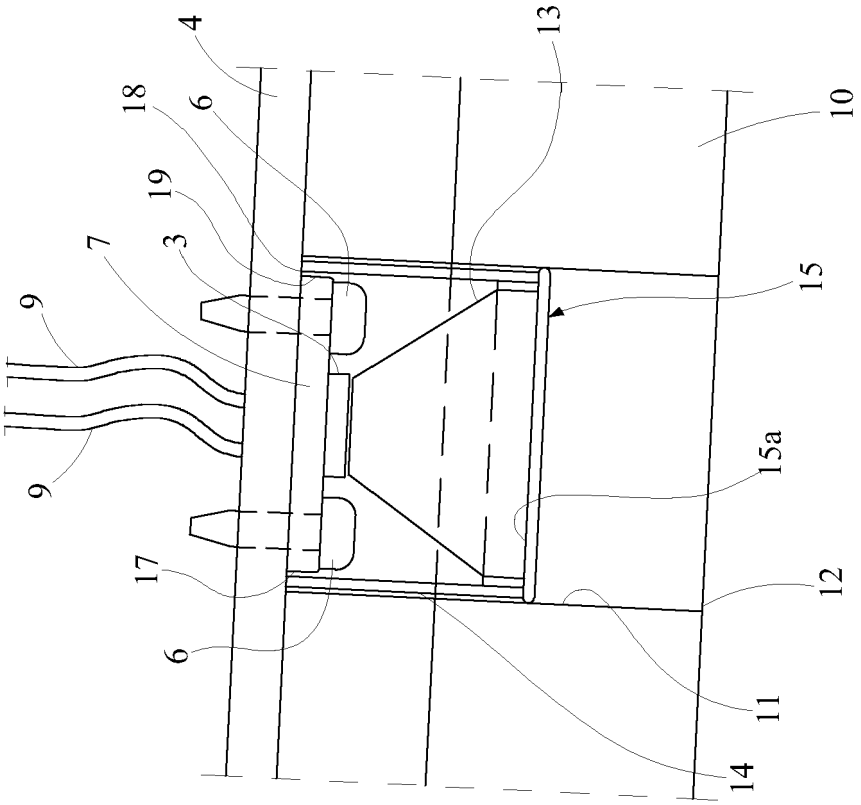

Fig. 3

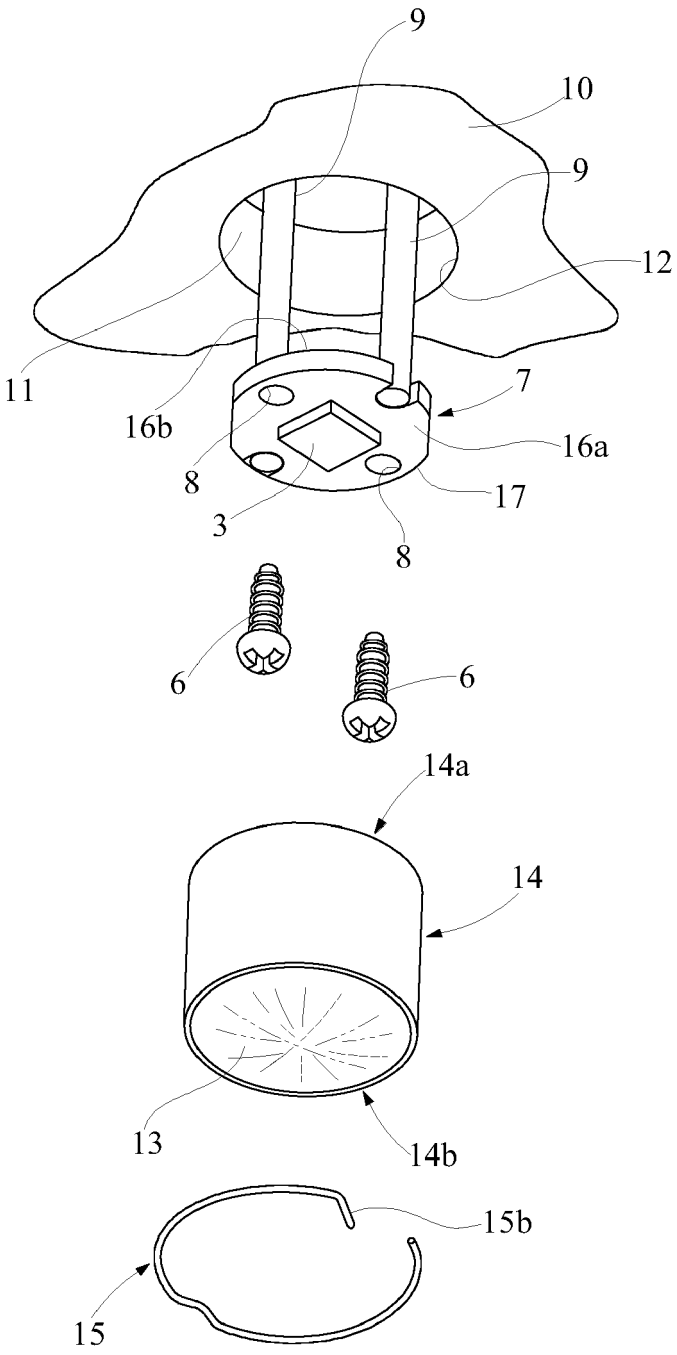

Fig. 4

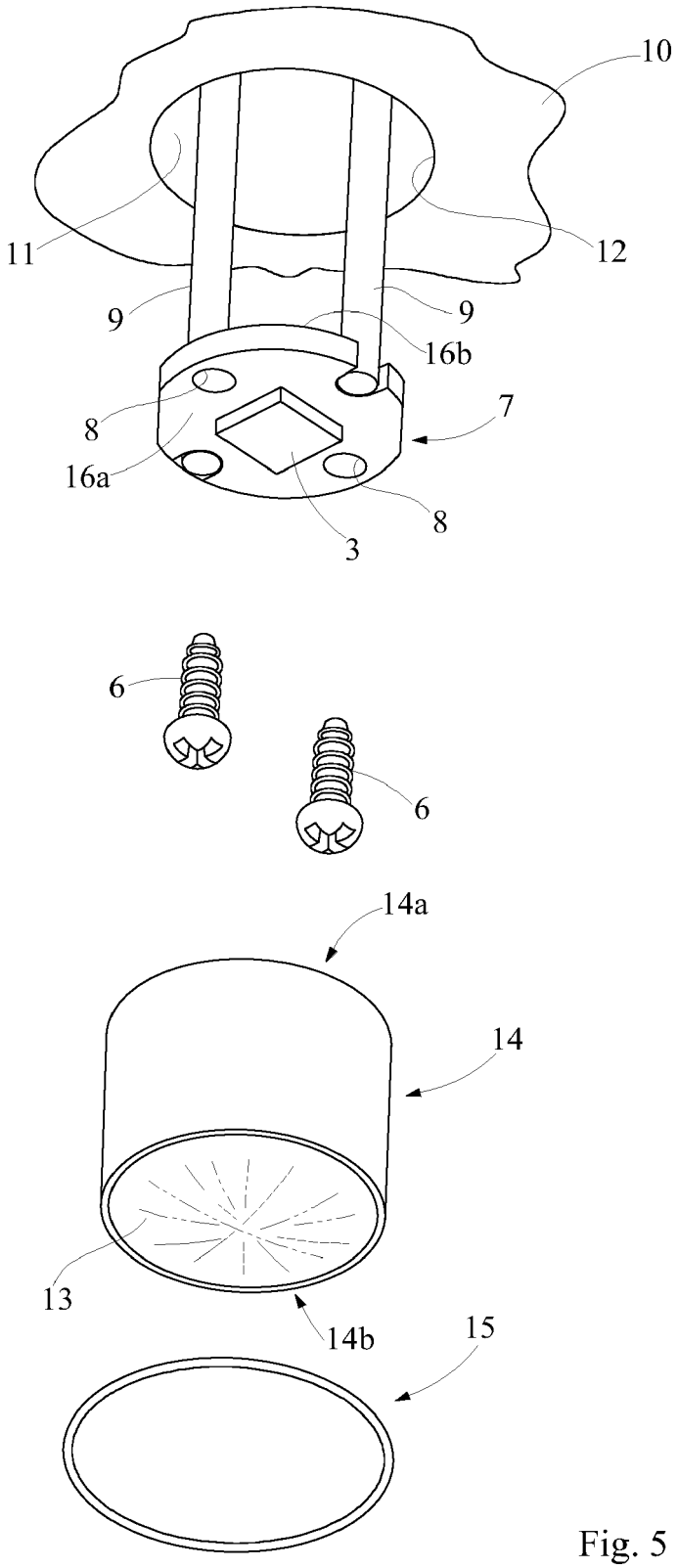

Fig. 5

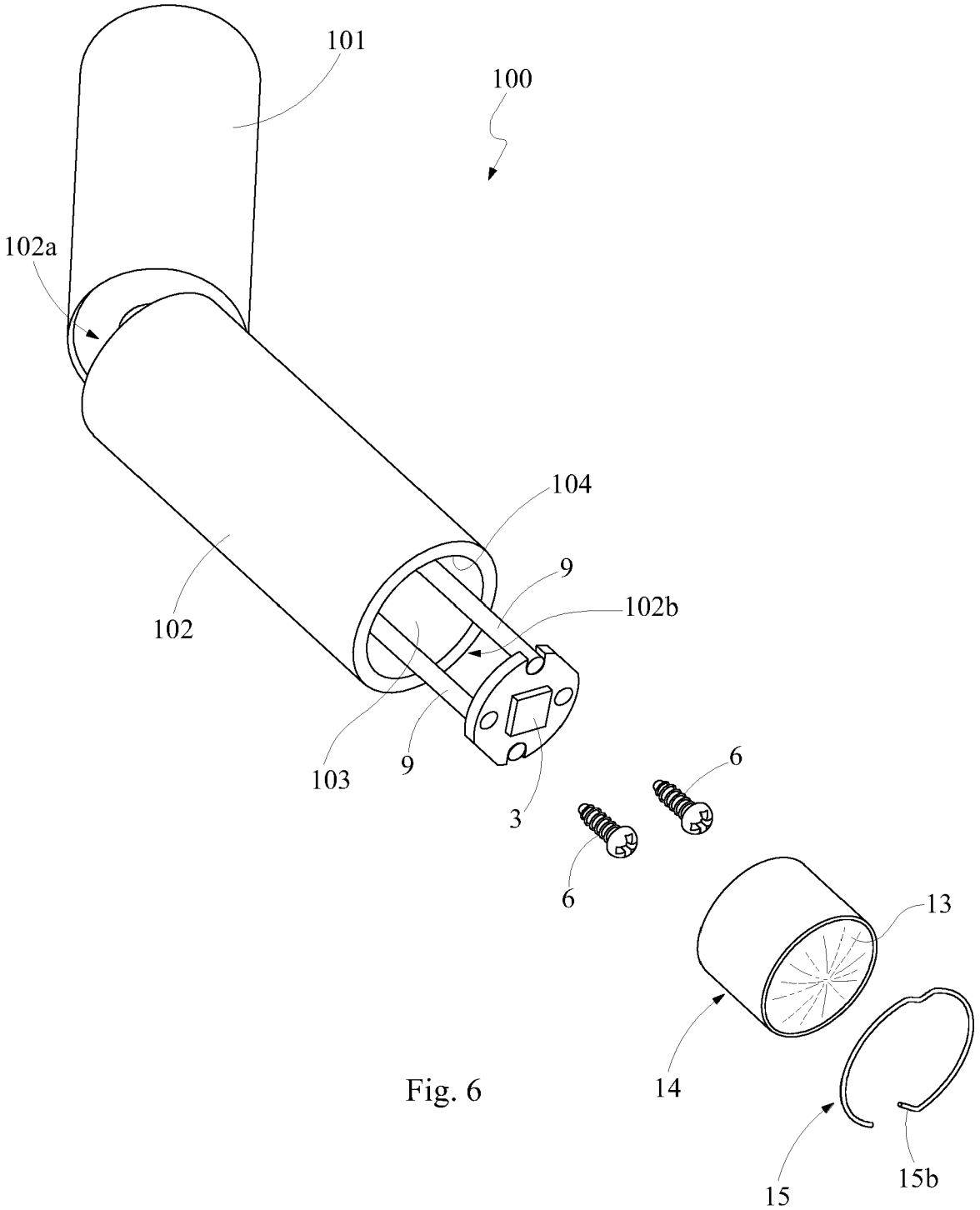

Fig. 6

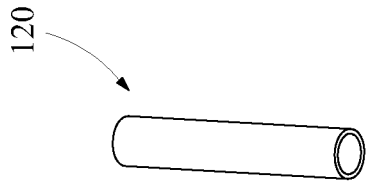

Fig. 10

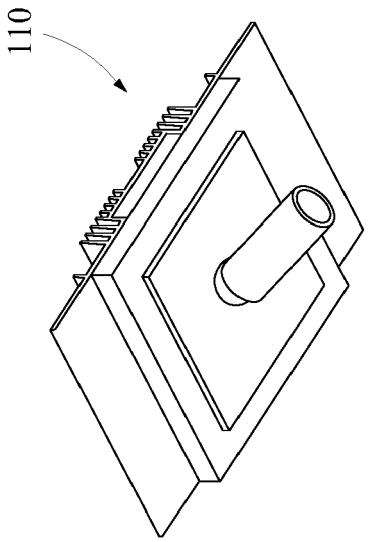

Fig. 9

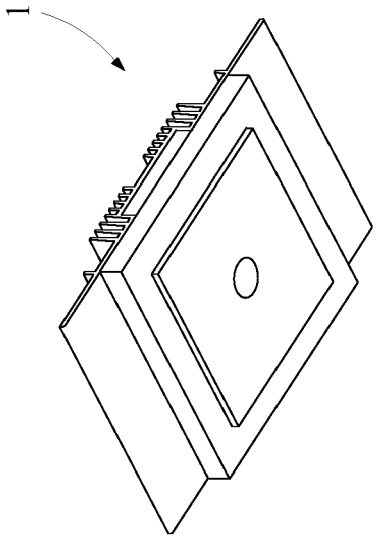

Fig. 8

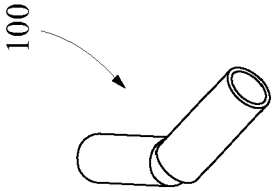

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
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F21V
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 September 2024	Menn, Patrick

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