(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 604 898 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
07.04.2021 Bulletin 2021/14

(21) Application number: **19188739.7**

(22) Date of filing: **29.07.2019**

(51) Int Cl.:
F21S 8/04 *(2006.01)* ***F21V 19/00*** *(2006.01)*
F21V 21/03 *(2006.01)* *F21Y 115/10* *(2016.01)*
F21Y 105/18 *(2016.01)*

(54) **LIGHTING DEVICE**

BELEUCHTUNGSVORRICHTUNG

DISPOSITIF D'ÉCLAIRAGE

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **30.07.2018 GB 201812460**

(43) Date of publication of application:
05.02.2020 Bulletin 2020/06

(73) Proprietor: **Thorn Lighting Limited**
Spennymoor, Durham DL16 6HL (GB)

(72) Inventors:
- **Round, David**
  Durham, DL17 9AF (GB)
- **Hodgson, Robert**
  Spennymoor, DL16 6SG (GB)
- **Bowness, Anton**
  Newcastle Upon Tyne (GB)

(74) Representative: **Kiwit, Benedikt**
Mitscherlich PartmbB
Patent- und Rechtsanwälte
Sonnenstraße 33
80331 München (DE)

(56) References cited:
CN-A- 103 836 469 **KR-U- 20110 000 262**

EP 3 604 898 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The invention is in the field of luminaires and in particular in the field of LED lighting devices. A lighting device housing arrangement, in particular for a lighting device comprising a first housing and a printed circuit board is proposed.

[0002] Lighting devices in the form of LED luminaires are widely used. During installation and maintenance of the luminaires the printed circuit board needs to be removed to allow access to mounting fixings and to connect the luminaire to the electricity supply. When the printed circuit board is detached it is either disconnected from the luminaire by means of a plug and socket connector and set aside when the luminaire is secured to the mounting surface or it stays connected and is retained by a support cord during the installation process, or it is set aside when the luminaire is attached to the mounting surface and then connected directly to the incoming electrical supply.

[0003] As printed circuit boards are fragile and susceptible to mechanical and electrostatic damage. Each of the methods above require considerable handling by the installer increasing the risk of this damage. There is also a risk of strain being applied to the connecting cables.

[0004] KR 2011 0000262 U shows a wall-mounted luminaire with an LED substrate that rotates left and right or up and down about an eccentric pivot point to expose a mounting surface of the wall-mounted luminaire.

[0005] CN 103 836 469 A shows an LED ceiling lamp with supporting pieces between the outer shell and the LED light source plate, so that a distance is formed between the LED light source plate and the outer shell. The invention addresses the technical problem of improving the known lighting devices for use in a mounted state while reducing handling and mounting complexity so that overload installation is easily possible.

[0006] The technical problem is solved by a lighting device according to claim 1. The dependent claims define further advantageous aspects of the inventive lighting device.

[0007] The problem is solved by a lighting device comprising a first housing and a lighting means arranged on a printed circuit board. An electronic circuitry is accommodated in the first housing for operating the lighting means and electrically connected to the lighting means by means of wires. The printed circuit board being mounted to an off-centre pivot point by holding means to the first housing, whereby the printed circuit board is designed to be rotated in a plane parallel to the a first housing whereby the holding means keeps the printed circuit board being mechanically connected to the first housing. The holding means may formed by a screw.

[0008] The first housing further comprises a first fixing element and second fixing element whereby the both fixing elements are designed to hold the printed circuit board in a fixed and secure position mounted to the first housing allowing operation of the lighting means.

[0009] The first housing further comprises a stopping element designed to retain the printed circuit board when the printed circuit board is released from the first housing by unlocking the printed circuit board from the first fixing element and the second fixing element, whereby the printed circuit board is designed to rotate around the off-centre pivot point formed by the holding means and to retain in a defined position when the stopping element stops the rotation of the printed circuit board. The printed circuit board may comprise a handling element, preferably a tab, designed to be used by an installer to hold the printed circuit board without touching the lighting means. The first fixing element may be formed by a screw and the second fixing element may be formed by a clip. A visible marking, preferably an arrow, may be placed on top of the printed circuit board to indicate the rotation direction of the printed circuit board.

[0010] The printed circuit board comprises at least one opening in close position to the holding means designed to feed through the wires for connecting the lighting means to the electronic circuitry.

[0011] The lighting means may be is formed by at least one light emitting diode or a plurality of light emitting diodes.

[0012] The first housing may comprise a terminal block whereby the terminal block can be accessed by an installer when the printed circuit board is unlocked from the first fixing element and the second fixing element and rotated to the stopping element.

[0013] The first housing may be designed to hold a diffuser cover, whereby preferably the printed circuit board is protected against mechanical impacts when the diffuser cover is mounted to the first housing. The first fixing element and the second fixing element are preferably covered by the diffuser cover then the diffuser cover is mounted to the first housing.

[0014] The lighting device according to the invention may be mounted on a wall or ceiling.

[0015] The pivotal (rotatable) mechanical connection between the first housing and the printed circuit board enables access to the interior of the inventive lighting device whereby the printed circuit board will stay in defined position towards the first housing.

[0016] In the lighting device according to an advantageous embodiment, the printed circuit board is rotatably connect the first housing. The rotatable mechanical connection by the holding means enables easy access for the installer in case that the installer needs to get access to the terminal block or electronic circuitry whereby the printed circuit board remains in a defined position and keeps connected to the first housing.

[0017] In a preferred embodiment the rotational mechanical connection keeps the wires in a position where a damaging of those wires can be prevented.

[0018] Preferably the lighting device arranges the electronic circuitry on the first housing and optionally on at least one further electric circuit board or control circuit e. g. for wired or wireless communication, and the printed

circuit board, the electronic circuitry and the at least one further electric circuit board are connected by wires e.g. flexible cables.

[0019] The first housing comprises the electronic circuitry for interfacing the mains supply, optionally a circuitry for a charging means for charging an energy storage means and circuitry for a driving means driving the lighting means, for example one or more light emitting diodes (LED's).

[0020] Multiple circuit parts or modules in the first housing enable a best possible use of the limited available space in the first housing and offer flexible combination of different functions.

[0021] The lighting means may by an emergency lighting means.

[0022] The energy storage means can therefore be replaced easily by the rotating connection mechanism of the printed circuit board when reaching an end of its life expectation or when the energy storage capacity needs to be adapted to changing requirements for the emergency lighting device.

[0023] The invention will be described in more detail in preferred embodiments with reference to the attached figures, in which

Figure 1 shows a perspective view of an assembled lighting device of a preferred embodiment,

Figure 2 shows another perspective view of an assembled lighting device of a preferred embodiment,

Figure 3 provides a view of a lighting device of a preferred embodiment showing the rotated printed circuit board, and

Figure 4 provides a perspective view of a partial sectional view of a preferred embodiment.

[0024] Throughout the attached figures, same reference numerals denote the same elements. In the description of different figures, the description of elements denoted by the same reference signs is not necessarily repeated for sake of conciseness.

[0025] In the following description of embodiments a lighting device as an example is discussed. The invention is, nevertheless not restricted to a lighting device, but may be applied to any lighting device including an energy storage means.

[0026] Figure 1 shows a perspective view of an assembled lighting device of a preferred embodiment.

[0027] The lighting device comprises a first housing 7 and a lighting means 12 arranged on a printed circuit board 8. The lighting means 12 is preferably formed by at least one light emitting diode or a plurality of light emitting diodes.

[0028] The printed circuit board 8 is being mounted to an off-centre pivot point by holding means 1 to the first housing 7, whereby the printed circuit board 8 is designed to be rotated in a plane parallel to the a first housing 7 whereby the holding means 1 keeps the printed circuit board 8 being mechanically connected to the first housing 7. The example of figure 1 shows the printed circuit board 8 in a fix mounted position to the first housing 7. The holding means 1 is preferably formed by a screw but may be also formed by another type of mechanical connector e.g. a rivet.

[0029] The first housing 7 further comprises a first fixing element 4 and second fixing element 5 whereby the both fixing elements 4, 5 are designed to hold the printed circuit board 8 in a fixed and secure position mounted to the first housing 7 allowing operation of the lighting means 12. The first fixing element 4 may be formed by a screw or another releasable fixing element. The second fixing element may be formed by a clip and is preferably mounted fix to the first housing 7.

[0030] The first housing 7 further comprises a stopping element 6 described herein later with figure 3.

[0031] The printed circuit board 8 further comprises a handling element 2, preferably a tab, described herein later with figure 2.

[0032] A visible marking 11, preferably an arrow, may be placed on top of the printed circuit board 8 to indicate the rotation direction of the printed circuit board 8 as described later herein.

[0033] The printed circuit board 8 comprises at least one opening 16, 17 in close position to the holding means 1 designed to feed through the wires for connecting the lighting means 12 to the electronic circuitry 13 (covered by the printed circuit board 8 in this view). The printed circuit board 8 further comprises at least one connector block 9, 10 in close position to the at least one opening 16, 17 to connect the wires fed through the least one opening 16, 17 for connecting the lighting means 12.

[0034] The first housing 7 is designed to hold a diffuser cover (not shown here), whereby preferably the printed circuit board 8 is protected against mechanical impacts when the diffuser cover is mounted to the first housing 7.

[0035] The first fixing element 4 and the second fixing element 5 are covered by the diffuser cover then the diffuser cover is mounted to the first housing 7.

[0036] A handling element 2, preferably a tab, is folded downwards to allow fitment of the diffuser cover.

[0037] Figure 2 shows a perspective view of an assembled lighting device 1 where the first fixing element 4 has been released.

[0038] As the printed circuit board 8 comprises a handling element 2, preferably a tab, the installer may touch and hold the printed circuit board 8 without touching the lighting means 12. The handling element 2 is pulled out in order to enable handling by the installer.

[0039] When the first fixing element 4 has been released and the second fixing element 5 is brought into a release position not fixing the printed circuit board 8 anymore the printed circuit board 8 may be rotated as described now by the example of figure 3.

[0040] The second fixing element 5 may be formed as a clip holding the printed circuit board 8. The second fixing element 5 can be bend away from printed circuit board 8 and thus the printed circuit board 8 will be released from the second fixing element 5.

[0041] Figure 3 provides a perspective view of the printed circuit board 8 where it has been rotated around the off-centre pivot point by holding means 1.

[0042] As visible in figure 3 an electronic circuitry 13 is accommodated in the first housing 7 for operating the lighting means 12 and electrically connected to the lighting means 12 by wires (not shown in this example).

[0043] The first housing 7 further comprises a stopping element 6 designed to retain the printed circuit board 8 when the printed circuit board 8 is released from the first housing 7. As soon as the printed circuit board 8 is unlocked and released from the first fixing element 4 and the second fixing element 5 the printed circuit board 8 can be to rotated around the off-centre pivot point formed by the holding means 1 and to retain in a defined position when the stopping element 6 stops the rotation of the printed circuit board 8.

[0044] The first housing 7 comprises a terminal block 14 whereby the terminal block 14 can be accessed when the printed circuit board 8 is unlocked from the first fixing element 4 and the second fixing element 5 and rotated to the stopping element 6.

[0045] As it can be seen the mounting holes 15a and 15b can be also accessed as the printed circuit board 8 is in the rotated position as shown in figure 3.

[0046] The printed circuit board 8 comprises at least one opening 16, 17 in close position to the holding means 1 designed to feed through the wires for connecting the lighting means 12 to the electronic circuitry 13 (covered by the printed circuit board 8 in this view). The openings 16, 17 provide a kind of strain relief for the wires fed through. As the openings 16, 17 are in close position to the holding means 1 the wiring will be protected from damaging as the movement ways and area is kept limited.

[0047] Figure 4 presents a partial sectional view of a preferred embodiment showing attachment details of the holding means 1 connected to the first housing 7 and holding printed circuit board 8.

[0048] The lighting device according to the invention can be mounted on a wall or ceiling.

Preferably the lighting device arranges the electronic circuitry 13 on the first housing and optionally on at least one further electric circuit board or control circuit e.g. for wired or wireless communication, and the printed circuit board 8, the electronic circuitry 13 and the at least one further electric circuit board are connected by wires e.g. flexible cables.

[0049] The first housing comprises 7 the electronic circuitry 13 for interfacing the mains supply, circuitry for a driving means driving the lighting means, for example one or more light emitting diodes (LED's) and optionally a circuitry for a charging means for charging an energy storage means.

[0050] Multiple circuit parts or modules in the first housing enable a best possible use of the limited available space in the first housing and offer flexible combination of different functions.

Claims

1. Lighting device, comprising

   a first housing (7),
   a lighting means (12) arranged on a printed circuit board (8),
   an electronic circuitry (13) accommodated in the first housing (7) for operating the lighting means (12) and electrically connected to the lighting means (12) by wires,
   the printed circuit board (8) being mounted to an off-centre pivot point by holding means (1) to the first housing (7), whereby
   the printed circuit board (8) is designed to be rotated in a plane parallel to the a first housing (7) whereby the holding means (1) keeps the printed circuit board (8) being mechanically connected to the first housing (7),
   the first housing (7) further comprises a first fixing element (4) and a second fixing element (5), whereby the both fixing elements (4, 5) are designed to hold the printed circuit board (8) in a fixed and secure position mounted to the first housing (7) allowing operation of the lighting means (12), and
   the first housing (7) further comprises a stopping element (6) designed to retain the printed circuit board (8) when the printed circuit board (8) is released from the first housing (7) by unlocking the printed circuit board (8) from the first fixing element (4) and the second fixing element (5), whereby the printed circuit board (8) is designed to rotate around the off-centre pivot point formed by the holding means (1) and to retain in a defined position when the stopping element (6) stops the rotation of the printed circuit board (8).

2. The lighting device according to claim 1, **characterized in**
   that the holding means (1) is formed by a screw.

3. The lighting device according to claim 1 or 2, **characterized in**
   that the first fixing element (4) is formed by a screw and the second fixing element (5) is formed by a clip.

4. The lighting device according to any one of claims 1 to 3, **characterized in**
   that the first housing (7) comprises a terminal block (14) whereby the terminal block (14) can be ac-

cessed when the printed circuit board (8) is unlocked from the first fixing element (4) and the second fixing element (5) and rotated to the stopping element (6).

5. The lighting device according to any of claims 1 to 4, **characterized in**
that the first housing (7) is designed to hold a diffuser cover, whereby preferably the printed circuit board (8) is protected against mechanical impacts when the diffuser cover is mounted to the first housing (7).

6. The lighting device according to claim 5, **characterized in**
that the first fixing element (4) and the second fixing element (5) are covered by the diffuser cover when the diffuser cover is mounted to the first housing (7).

7. The lighting device according to any one of claims 1 to 6, **characterized in**
that the printed circuit board (8) comprises a handling element (2), preferably a tab, designed to be used by an installer to hold the printed circuit board (8) without touching the lighting means (12).

8. The lighting device according to any one of claims 1 to 7, **characterized in**
that there is a visible marking (11), preferably an arrow, placed on top of the printed circuit board (8) to indicate the rotation direction of the printed circuit board (8).

9. The lighting device according to any one of claims 1 to 8, **characterized in**
that the printed circuit board (8) comprises at least one opening (16, 17) in close position to the holding means (1) designed to feed through the wires for connecting the lighting means (12) to the electronic circuitry (13).

10. The lighting device according to any one of claims 1 to 9, **characterized in**
that the lighting means (12) is formed by at least one light emitting diode or a plurality of light emitting diodes.

Patentansprüche

1. Beleuchtungsvorrichtung, umfassend
ein erstes Gehäuse (7),
ein auf einer Leiterplatte (8) angeordnetes Leuchtmittel (12),
eine elektronische Schaltungsanordnung (13), die in dem ersten Gehäuse (7) zum Betreiben des Leuchtmittels (12) untergebracht und durch Drähte mit dem Leuchtmittel (12) elektrisch verbunden ist,
wobei die Leiterplatte (8) an dem ersten Gehäuse (7) durch ein Haltemittel (1) an einem außermittigen Drehpunkt angebracht ist, wobei
die Leiterplatte (8) ausgelegt ist, in einer Ebene parallel zu dem einem ersten Gehäuse (7) gedreht zu werden, wobei das Haltemittel (1) die Leiterplatte (8) mechanisch mit dem ersten Gehäuse (7) verbunden hält,
das erste Gehäuse (7) ferner ein erstes Befestigungselement (4) und ein zweites Befestigungselement (5) umfasst, wobei die beiden Befestigungselemente (4, 5) ausgelegt sind, die Leiterplatte (8) in einer fixierten und gesicherten Position an dem ersten Gehäuse (7) montiert zu halten, was den Betrieb des Leuchtmittels (12) ermöglicht, und
das erste Gehäuse (7) ferner ein Anschlagelement (6) umfasst, das ausgelegt ist, die Leiterplatte (8) zurückhalten, wenn die Leiterplatte (8) durch Entriegeln der Leiterplatte (8) von dem ersten Befestigungselement (4) und von dem zweiten Befestigungselement (5) von dem ersten Gehäuse (7) gelöst wird, wobei die Leiterplatte (8) ausgebildet ist, sich um den durch das Haltemittel (1) gebildeten außermittigen Drehpunkt zu drehen und in einer definierten Position zurückzuhalten, wenn das Anschlagelement (6) die Drehung der Leiterplatte (8) stoppt.

2. Beleuchtungsvorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** das Haltemittel (1) durch eine Schraube gebildet ist.

3. Beleuchtungsvorrichtung nach Anspruch 1 oder 2, **dadurch gekennzeichnet,**
dass das erste Befestigungselement (4) durch eine Schraube gebildet ist und das zweite Befestigungselement (5) durch eine Klammer gebildet ist.

4. Beleuchtungsvorrichtung nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet,**
dass das erste Gehäuse (7) einen Anschlussklemmenblock (14) aufweist, wobei auf den Anschlussklemmenblock (14) zugegriffen werden kann, wenn die Leiterplatte (8) von dem ersten Befestigungselement (4) und von dem zweiten Befestigungselement (5) entriegelt und zu dem Anschlagelement (6) gedreht ist.

5. Beleuchtungsvorrichtung nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet,**
dass das erste Gehäuse (7) ausgelegt ist, eine Diffusorabdeckung zu halten, wobei vorzugsweise die Leiterplatte (8) vor mechanischen Stößen geschützt ist, wenn die Diffusorabdeckung an dem ersten Gehäuse (7) montiert ist.

6. Beleuchtungsvorrichtung nach Anspruch 5, **dadurch gekennzeichnet,**
dass das erste Befestigungselement (4) und das zweite Befestigungselement (5) durch die Diffusorabdeckung abgedeckt sind, wenn die Diffusorab-

deckung an dem ersten Gehäuse (7) montiert ist.

7. Beleuchtungsvorrichtung nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet,**
dass die Leiterplatte (8) ein Handhabungselement (2) umfasst, vorzugsweise eine Lasche, die ausgelegt ist, durch einen Monteur verwendet zu werden, um die Leiterplatte (8) zu halten, ohne das Leuchtmittel (12) zu berühren.

8. Beleuchtungsvorrichtung nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet,**
dass auf der Leiterplatte (8) eine sichtbare Markierung (11) angeordnet ist, vorzugsweise ein Pfeil, um die Drehrichtung der Leiterplatte (8) anzuzeigen.

9. Beleuchtungsvorrichtung nach einem der Ansprüche 1 bis 8, **dadurch gekennzeichnet,**
dass die Leiterplatte (8) mindestens eine Öffnung (16, 17) in naher Position zu dem Haltemittel (1) umfasst, die zum Durchführen der Drähte ausgelegt ist, um das Leuchtmittel (12) mit der elektronischen Schaltungsanordnung (13) zu verbinden.

10. Beleuchtungsvorrichtung nach einem der Ansprüche 1 bis 9, **dadurch gekennzeichnet,**
dass das Leuchtmittel (12) durch mindestens eine Leuchtdiode oder eine Vielzahl von Leuchtdioden gebildet ist.

Revendications

1. Dispositif d'éclairage, comprenant
un premier logement (7),
un moyen d'éclairage (12) agencé sur une carte à circuit imprimé (8),
un circuit électronique (13) reçu dans le premier logement (7) pour faire fonctionner le moyen d'éclairage (12) et connecté électriquement au moyen d'éclairage (12) par des fils,
la carte à circuit imprimé (8) étant montée sur un point de pivot décentré par un moyen de maintien (1) au premier logement (7), moyennant quoi
la carte à circuit imprimé (8) est conçue pour être mise en rotation dans un plan parallèle au un premier logement (7) moyennant quoi le moyen de maintien (1) garde la carte à circuit imprimé (8) connectée mécaniquement au premier logement (7),
le premier logement (7) comprend en outre un premier élément de fixation (4) et un deuxième élément de fixation (5), moyennant quoi l'un et l'autre des éléments de fixation (4, 5) sont conçus pour maintenir la carte à circuit imprimé (8) dans une position fixée et sûre montée au premier logement (7) permettant un fonctionnement du moyen d'éclairage (12), et
le premier logement (7) comprend en outre un élément d'arrêt (6) conçu pour retenir la carte à circuit imprimé (8) lorsque la carte à circuit imprimé (8) est libérée du premier logement (7) en déverrouillant la carte à circuit imprimé (8) du premier élément de fixation (4) et du deuxième élément de fixation (5), moyennant quoi la carte à circuit imprimé (8) est conçue pour tourner autour du point de pivot décentré formé par le moyen de maintien (1) et pour rester dans une position définie lorsque l'élément d'arrêt (6) arrête la rotation de la carte à circuit imprimé (8).

2. Dispositif d'éclairage selon la revendication 1, **caractérisé en**
ce que le moyen de maintien (1) est formé par une vis.

3. Dispositif d'éclairage selon la revendication 1 ou 2, **caractérisé en**
ce que le premier élément de fixation (4) est formé par une vis et le deuxième élément de fixation (5) est formé par une attache.

4. Dispositif d'éclairage selon l'une quelconque des revendications 1 à 3, **caractérisé en**
ce que le premier logement (7) comprend un bornier (14) moyennant quoi le bornier (14) est accessible lorsque la carte à circuit imprimé (8) est déverrouillée du premier élément de fixation (4) et du deuxième élément de fixation (5) et mise en rotation vers l'élément d'arrêt (6).

5. Dispositif d'éclairage selon l'une quelconque des revendications 1 à 4, **caractérisé en**
ce que le premier logement (7) est conçu pour maintenir un couvercle de diffuseur, moyennant quoi de préférence la carte à circuit imprimé (8) est protégée contre des impacts mécaniques lorsque le couvercle de diffuseur est monté au premier logement (7).

6. Dispositif d'éclairage selon la revendication 5, **caractérisé en**
ce que le premier élément de fixation (4) et le deuxième élément de fixation (5) sont couverts par le couvercle de diffuseur lorsque le couvercle de diffuseur est monté au premier logement (7).

7. Dispositif d'éclairage selon l'une quelconque des revendications 1 à 6, **caractérisé en**
ce que la carte à circuit imprimé (8) comprend un élément de manipulation (2), de préférence une languette, conçu pour être utilisé par un installateur pour maintenir la carte à circuit imprimé (8) sans toucher le moyen d'éclairage (12).

8. Dispositif d'éclairage selon l'une quelconque des revendications 1 à 7, **caractérisé en**
ce qu'il y a un marquage visible (11), de préférence une flèche, placé au-dessus de la carte à circuit im-

primé (8) pour indiquer le sens de rotation de la carte à circuit imprimé (8).

9. Dispositif d'éclairage selon l'une quelconque des revendications 1 à 8, **caractérisé en ce que** la carte à circuit imprimé (8) comprend au moins une ouverture (16, 17) en position proche par rapport au moyen de maintien (1) conçue pour faire passer les fils pour connecter le moyen d'éclairage (12) au circuit électronique (13).

10. Dispositif d'éclairage selon l'une quelconque des revendications 1 à 9, **caractérisé en ce que** le moyen d'éclairage (12) est formé par au moins une diode électroluminescente ou une pluralité de diodes électroluminescentes.

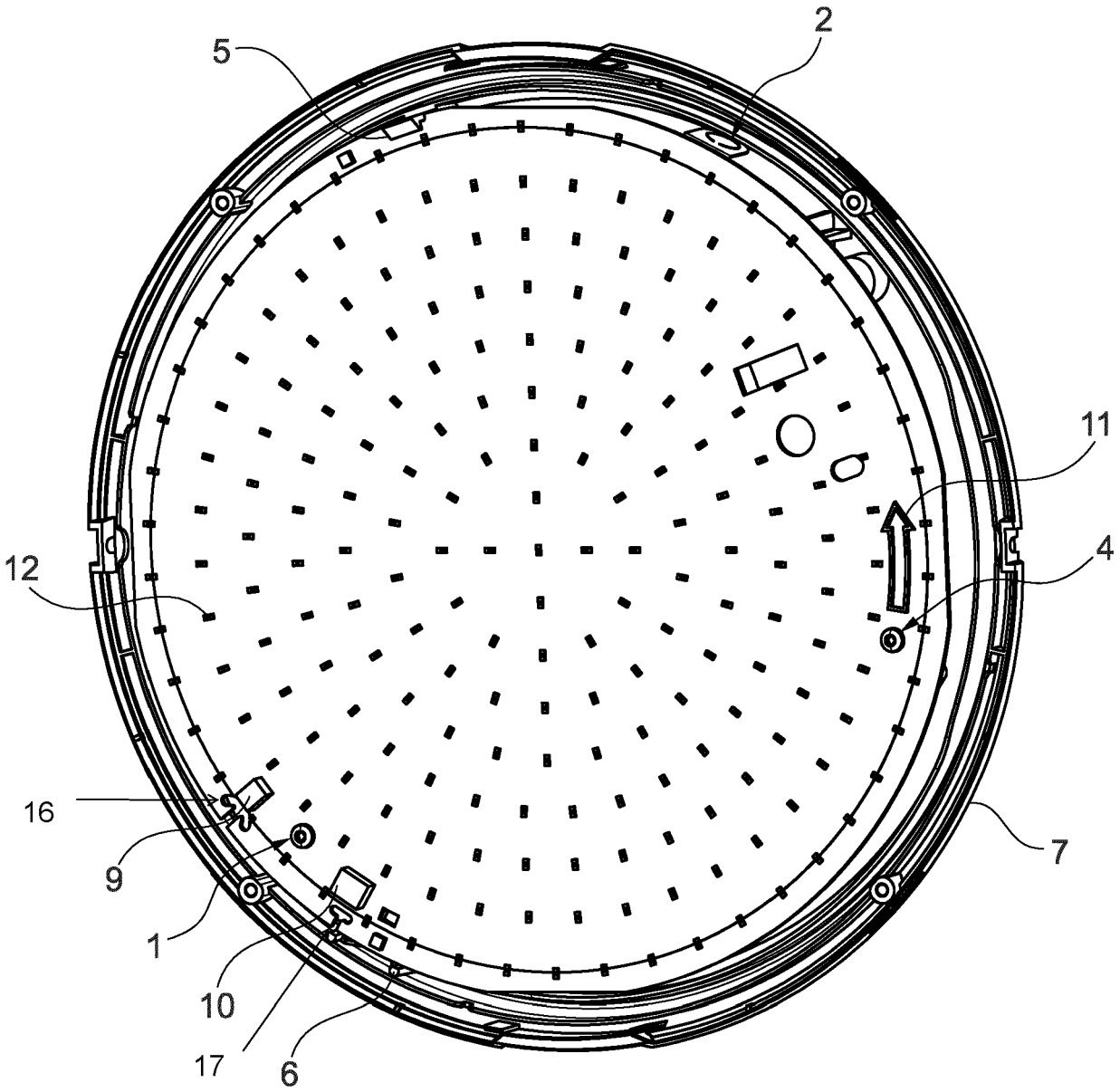

Fig. 1

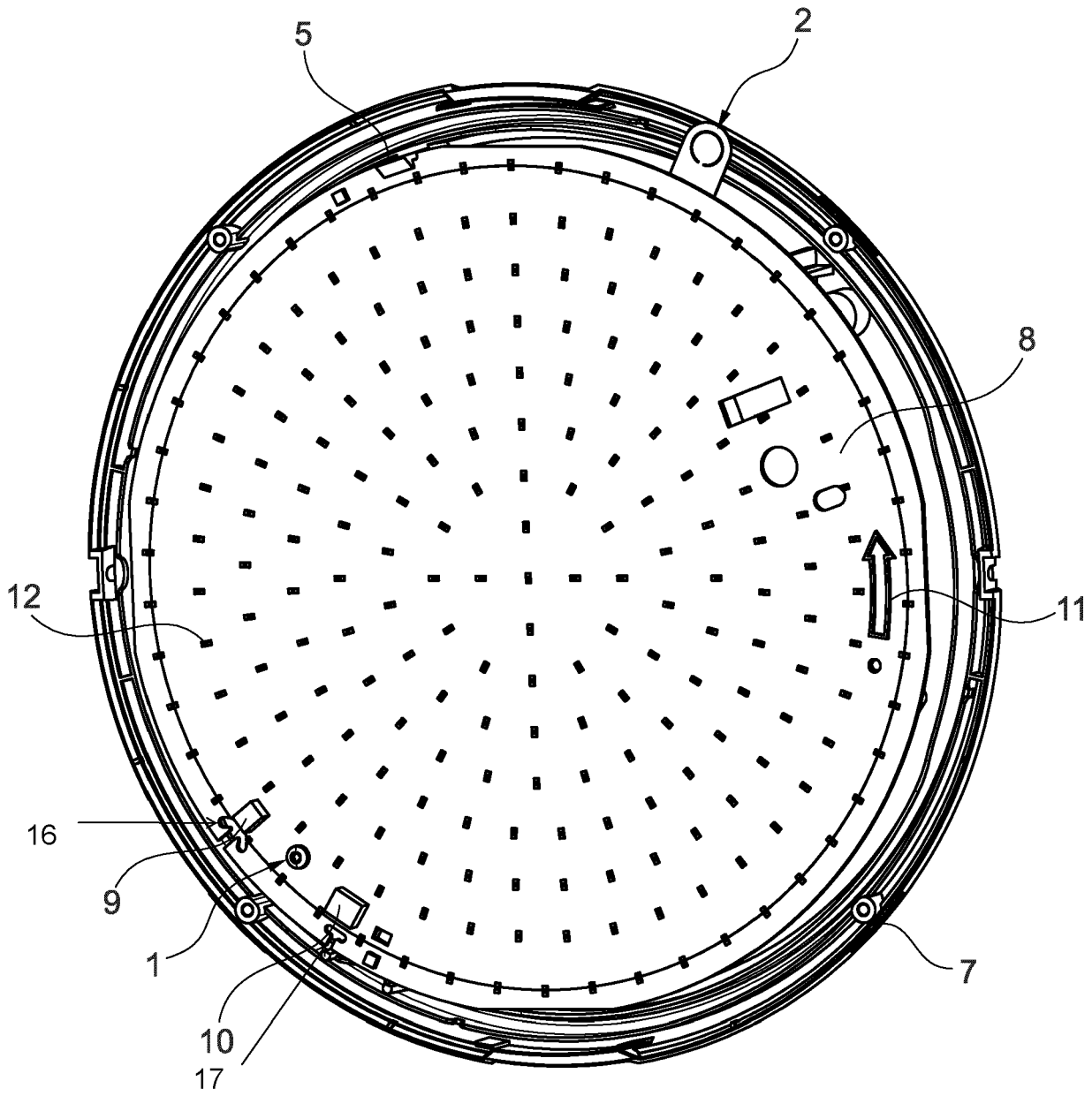

Fig. 2

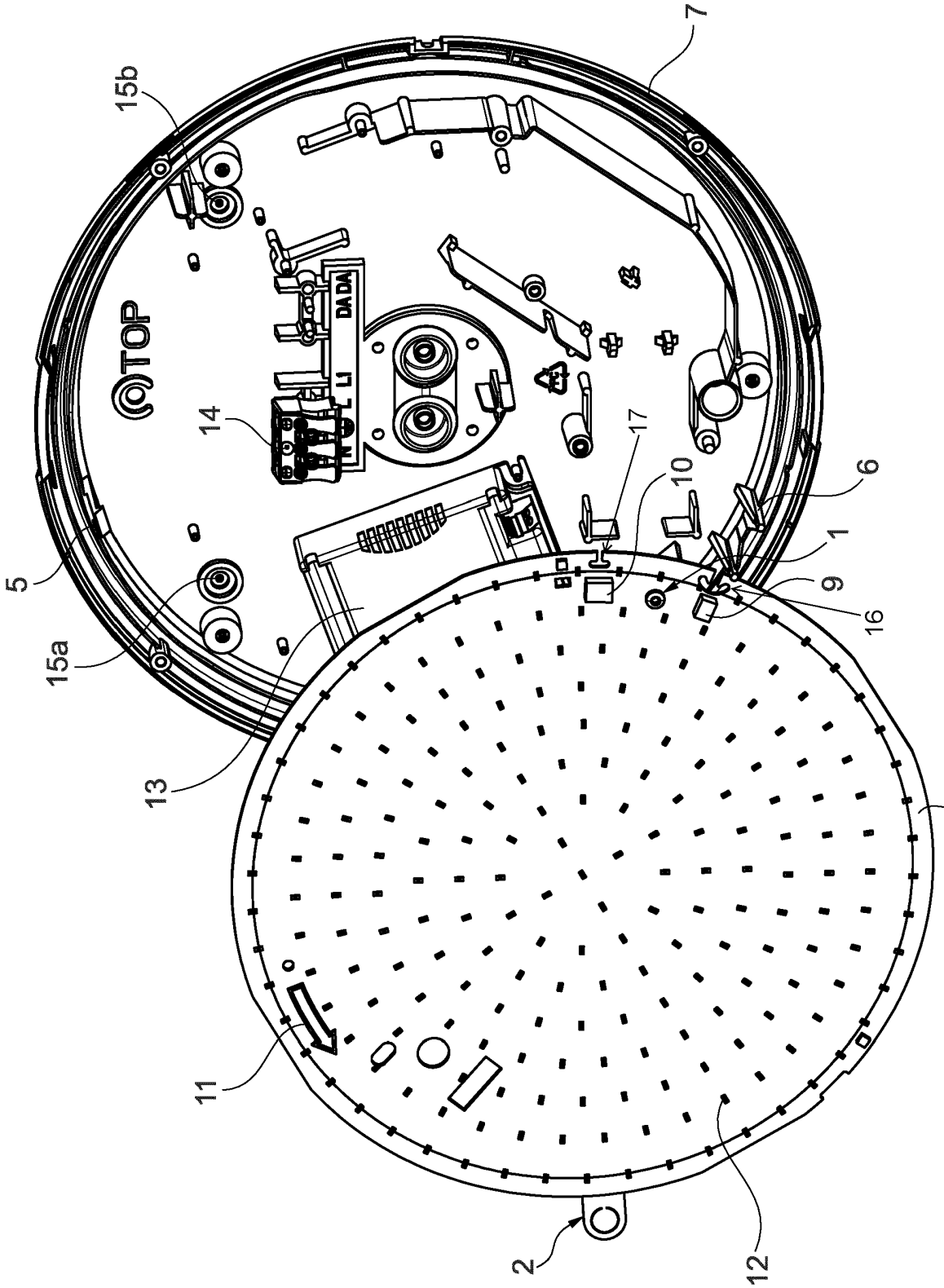

Fig. 3

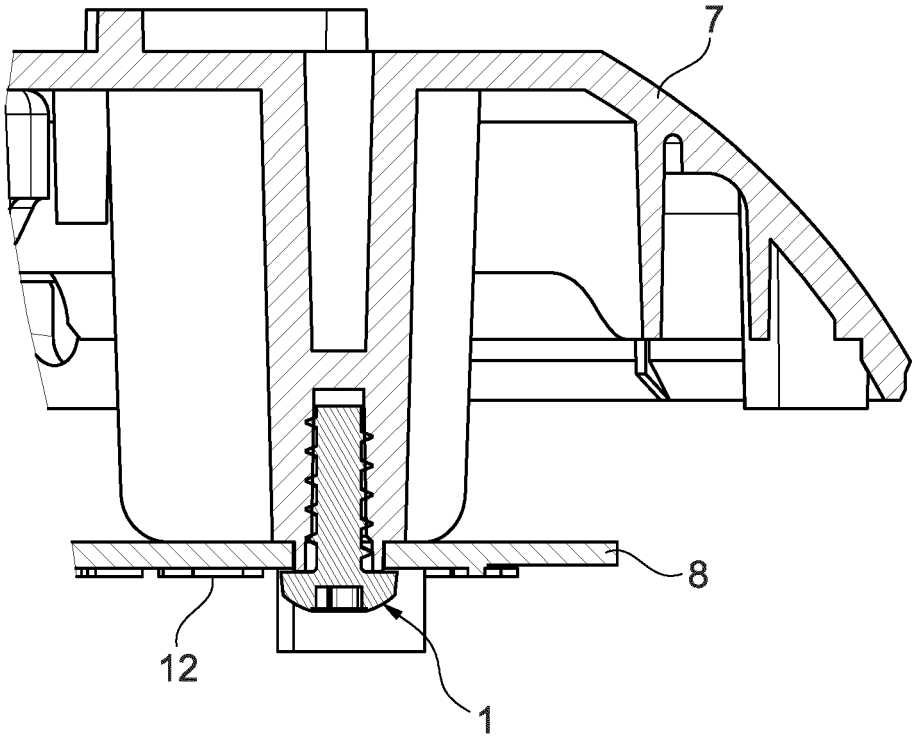

Fig. 4

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- KR 20110000262 U **[0004]**
- CN 103836469 A **[0005]**