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

(11) **EP 4 497 992 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
29.01.2025 Bulletin 2025/05

(21) Application number: **24190688.2**

(22) Date of filing: **24.07.2024**

(51) International Patent Classification (IPC):
F21S 8/02 *(2006.01)* ***F21V 23/00*** *(2015.01)*
F21V 23/06 *(2006.01)* ***F21V 5/00*** *(2018.01)*
F21V 17/16 *(2006.01)* *F21Y 115/10* *(2016.01)*
F21V 13/04 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
G06V 20/41; F21S 8/026; F21V 5/00; F21V 17/002; F21V 17/164; F21V 23/008; F21V 23/06; G06V 10/764; G06V 20/46; G06V 20/49;
F21V 13/04; F21Y 2115/10; G06V 2201/03

(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 ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

(30) Priority: **27.07.2023 GB 202311543**

(71) Applicant: **Collingwood Lighting Limited**
Northampton, Northamptonshire NN6 0BT (GB)

(72) Inventor: **JOHNSON, Mark**
Northampton, NN2 8ES (GB)

(74) Representative: **Murgitroyd & Company**
Murgitroyd House
165-169 Scotland Street
Glasgow G5 8PL (GB)

(54) **DOWNLIGHT WITH REPLACABLE PARTS**

(57) A lighting unit (1), such as a downlight, at least part of which is arranged to be mounted in an aperture in a partition, such as a ceiling, the lighting unit (1) comprising: a first housing (3), said first housing (3) having a front side (A) and a rear side (B); a solid-state lighting device (5) mounted within the first housing (3) on the front side (A) thereof; a second housing (7) mounted to the rear side (B) of the first housing (3); a driver (9) arranged to convert a mains electrical signal to an electrical signal suitable for driving the solid-state lighting device (5), wherein the driver (9) is located in the second housing (7); and an electrical connection assembly (11) that is arranged to electrically connect the driver (9) to the solid-state lighting device (5), the electrical connection assembly (11) including first and second electrical connectors (13,15) that are releasably attachable to one another to form an electrical connection and are separable from one another to break the electrical connection; wherein the driver (9) is removably mounted in the second housing (7); the solid-state lighting device (5) is removably mounted in the first housing (3).

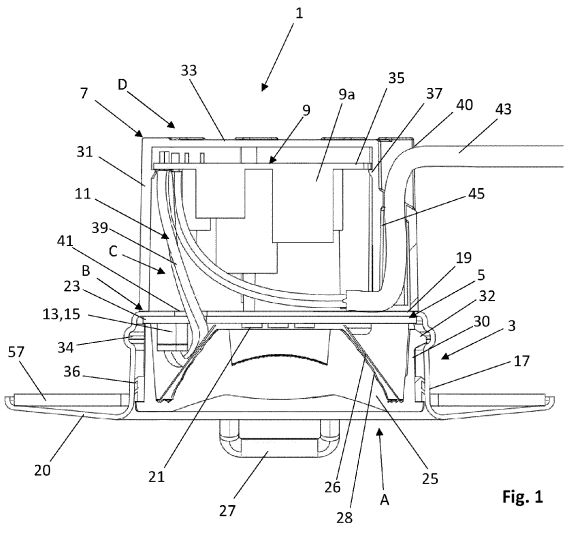

Fig. 1

EP 4 497 992 A2

Description

[0001] The invention relates to a downlight, and a method for removing a lens module from the downlight.

[0002] Downlights are a well-established technology which are used in many residential and commercial properties. Traditionally, LED downlights are a single use technology. That is, when any part of the downlight fails the entire LED downlight is removed and replaced, including the entire casing. This leads to a significant amount of waste and/or recycling of parts that are not themselves damaged.

[0003] Some attempts have been made to modularize downlights however the issue with these is that if the driver electronics fail, which is by far the most common failure mode currently, it is necessary to replace the entire module, leading to unnecessary waste of perfectly good optics, casings and LEDs.

[0004] Replaceable drivers are known, but these typically tend to be external to the luminaire on a flying lead, or contained within large luminaires other than downlights that allow easy access (anti-corrosives for example). Downlights are typically small, going into ceiling hole cut-outs from 40mm-120mm with ceiling void heights of 100mm or less, so there are space limitations that require bespoke drivers and limited space to incorporate replaceability.

[0005] Another issue with known downlights is that as developments are made, for example improvements to LED efficiency and their drives, many existing downlights are not able to benefit from such developments because they are designed to be single use. In order to benefit from the improvements to the LED technology and/or the driver technology it is often necessary to replace the entire downlight since the downlight is typically designed in a manner that does not allow parts to be replaced. This again leads to significant waste and/or recycling of parts that are not themselves damaged.

[0006] With environmental concerns and climate change, it is desirable to minimise waste, minimize the amount of raw materials used when producing products, and to continue to use parts that are operational, where possible.

[0007] It is therefore desirable to be able to disassemble a downlight in a quick and easy manner.

[0008] Accordingly, the invention seeks to mitigate at least one of the aforementioned problems or to at least provide an alternative downlight, to known downlights, and a method for removing a lens assembly from a downlight.

[0009] According to one aspect, there is provided a downlight according to claim 1. Optional features of the invention are recited in the dependent claims.

[0010] The invention enables the driver to be electrically disconnected from the solid-state lighting device manually, that is, in a manner that requires no tools. This enables the driver to be replaced in the event that the driver fails without having to dispose of the entire downlight. The invention enables the solid-state lighting device to be replaced in the event that the solid-state lighting device fails without having to dispose of the entire downlight. In this manner, it is only necessary to replace the operating part that fails rather than having to replace the entire downlight. This provides a significant saving it terms of the amount of material that is recycled or that is sent to landfill, and ensures that components that still function adequately continue to be used. The invention also enables the downlight to be upgraded by replacing the driver with a new driver that is dissimilar from the one being replaced and/or replacing the solid-state lighting device with a new solid-state lighting device that is dissimilar from the one being replaced, for example to provide new functionality and/or to make the downlight more efficient.

[0011] According to another aspect of the invention there is provided a lighting unit, such as a downlight.

[0012] At least part of the lighting unit can be arranged to be mounted in an aperture in a partition, such as a ceiling.

[0013] The lighting unit can include a first housing. The first housing can have a front side and a rear side.

[0014] The lighting unit can include a solid-state lighting device. The solid-state lighting device can be mounted within the first housing on the front side thereof.

[0015] The lighting unit can include a second housing. The second housing can be mounted to the rear side of the first housing.

[0016] The lighting unit can include a driver arranged to convert a mains electrical signal to an electrical signal suitable for driving the solid-state lighting unit. The driver can be located in the second housing.

[0017] The lighting unit can include an electrical connection assembly. The electrical connection assembly can be arranged to electrically connect the driver to the solid-state lighting device. The electrical connection assembly can include first and second electrical connectors that can be releasably attachable to one another to form an electrical connection and can be separable from one another to break the electrical connection. Having the ability to uncouple the first and second electrical connectors helps to facilitate removal of the driver and/or solid-state lighting device from the lighting unit.

[0018] The downlight according to the invention is typically used for use in residential units, such as houses and apartments. The aperture formed through the partition into which the downlight is mounted is typically circular and has a diameter that is less than or equal to around 100mm. The first and second housings are sized accordingly to fit into the aperture. For example, the first and second housings can have an outer diameter that is less than or equal to 100mm.

[0019] The driver can be removably mounted in the second housing. This enables the driver to be removed from the second housing, for example to replace it with a similar driver (repair) or a dissimilar driver (upgrade) without can have to dispose of the second housing. This

significantly reduces the amount of material that can be wasted.

[0020] The driver can be mounted on a lip located within the second housing.

[0021] The solid-state lighting device can be removably mounted in the first housing. This enables the solid-state lighting device to be removed from the first housing, for example to replace it with a similar solid-state lighting device (repair) or a dissimilar solid-state lighting device (upgrade) without can have to dispose of the first housing. This significantly reduces the amount of material that can be wasted. The solid-state downlight can be releasably attached to the first housing, for example by at least one fixing element, such as at least one screw element.

[0022] The second housing can be releasably attached to the first housing. This helps to disassemble the lighting unit. It enables the second housing to be separated from the first housing thereby providing ease of access to the interior of the second housing. Having the second housing separable from the first housing provides an opportunity for the second housing and driver to be replaced or changed as a unit. Having the second housing separable from the first housing provides an opportunity for the first housing and solid-state lighting unit to be replaced or changed as a unit.

[0023] The lighting unit can include means for releasably attaching the second housing to the first housing.

[0024] The first housing can include a first engagement formation. The second housing can include a second engagement formation. The second engagement formation can be arranged to releasably engage the first engagement formation.

[0025] In some embodiments the second engagement formation can be arranged to protrude into the first housing, for example in a condition wherein the second housing is seated on a wall of the first housing, such as an end wall of the first housing.

[0026] In some embodiments the first engagement formation can be arranged to protrude into the second housing, for example in a condition wherein the second housing is seated on the wall of the first housing, such as the end wall of the first housing.

[0027] One of the first housing and the second housing can be arranged to move laterally relative to the other one of the first housing and the second housing from a first position in which the second engagement formation does not engage the second engagement formation to a second position wherein the first formation engages the second engagement formation. This facilitates arrangements of the first and second housings that do not easily separate from one another in an axial direction, since the first and second engagement formations prevent such separation. By "move laterally" it is meant, move in a direction that is perpendicular to a central axis of the downlight, which is generally aligned with the direction in which light is emitted from the downlight. The central axis of the downlight is typically arranged perpendicularly to a printed circuit board of the solid-state lighting device. This facilitates arrangements of the first and second housings that do not easily separate from one another in an axial direction, since the first and second engagement formations prevent such separation.

[0028] In some embodiments the second housing can be arranged to slide across part of the first housing from the first position to the second position, for example second housing is arranged to slide across part of the end wall of the first housing when moving from the first position to the second position. This facilitates arrangements of the first and second housings that do not easily separate from one another in an axial direction, since the first and second engagement formations prevent such separation.

[0029] In some embodiments one of the first and second engagement formations comprises a hook formation. This provides an arrangement that is able to accommodate, that is partially wrap, around the first engagement formation, thereby providing a good connection between the first and second engagement formations.

[0030] In some embodiments the first housing includes an aperture formed through an end wall of the first housing, and the second engagement formation is arranged to protrude through the aperture in a condition wherein the second housing is seated on an end wall of the first housing. This provides an easy way for the second engagement formation to access the first engagement formation, for example in embodiments wherein the first engagement formation is located in the first housing.

[0031] In some embodiments the aperture and the second engagement formation are arranged such that it is necessary to incline the second housing away from a central longitudinal axis of the downlight in order to insert the second engagement formation into the aperture. For example, in an embodiment wherein the second engagement formation comprises a hook formation, inclining the second housing relative to the first housing can help to insert the hook formation into the aperture. The hooked formation can include a sloped surface, which helps to facilitate insertion of the second engagement formation into the aperture, and to facilitate engagement and disengagement with the first engagement formation.

[0032] The means for releasably attaching the second housing to the first housing can include a first screw element. This provides a quick and easy way to separate the first and second housings.

[0033] The means for releasably attaching the second housing to the first housing can include a second screw element. This provides a quick and easy way to separate the first and second housings.

[0034] In some embodiments, the second housing can be connected to the first housing by two screw elements only. This provides a good balance on the one hand between speed and ease of disassembly and on the other hand of providing a secure connection between the first and second housings without obscuring light emitted from the solid-state lighting device.

[0035] One of the first and second electrical connec-

tors comprises a plug and the other of the first and second electrical connectors comprise a socket. A plug and socket provides a convenient form of electrical connectors.

[0036] The solid-state lighting device can include a PCB. The solid-state lighting device can include at least one LED.

[0037] The driver can include a PCB. The driver can include driver electronics.

[0038] The electrical connection assembly can include at least one electrical wire which can be electrically connected to the driver. One of the first and second electrical connectors can be mounted on the solid-state lighting device PCB and can be electrically connected to the at least one LED. The other one of the first and second electrical connectors can be attached to the at least one electrical wire. This provides a convenient way of releasably electrically coupling the driver to the solid-state lighting device. A first end of the at least one electrical wire can be electrically connected to the driver. A second end of the at least one electrical wire can be electrically connected to the other one of the first and second electrical connectors. The at least one electrical wire can be electrically connected to the driver electronics via the driver PCB, for example by solder. A first end of the at least one electrical wire can be electrically connected to the driver electronics via the driver PCB.

[0039] The electrical connection assembly can include at least one electrical wire which can be electrically connected to the solid-state lighting device. One of the first and second electrical connectors can be mounted on the driver PCB and can be electrically connected to the driver electronics. The other one of the first and second electrical connectors can be attached to the at least one electrical wire. This provides a convenient way of releasably electrically coupling the driver to the solid-state lighting device. A first end of the at least one electrical wire can be electrically connected to the solid-state lighting device. A second end of the at least one electrical wire can be electrically connected to the other one of the first and second electrical connectors. The solid-state lighting device can include a PCB. The solid-state lighting device can include at least one LED. The at least one electrical wire can be electrically connected to the at least one LED via the solid-state lighting device PCB, for example by solder. A first end of the at least one electrical wire can be electrically connected to at least one LED via the solid-state lighting device PCB.

[0040] The electrical connection assembly can include at least a first electrical wire and a second electrical wire. A first end of the first electrical wire can be electrically connected to the driver electronics via the driver PCB, for example by solder. A first end of the second electrical wire can be electrically connected to the at least one LED via the solid-state lighting device PCB, for example by solder. One of the first and second electrical connectors can be electrically connected to a second end of the first electrical wire. The other of the first and second electrical connectors can be electrically connected to a second end of the second electrical wire. This arrangement provides greater flexibility for positioning the first and second electrical connectors within the first or second housings, for example to take account of packaging constraints.

[0041] At least one of the first and second electrical connectors can be located in the first housing. At least one of the first and second electrical connectors can be located in the second housing. In some embodiments, both the first and second electrical connectors are located in the first housing. In some embodiments, both the first and second electrical connectors are located in the second housing.

[0042] The second housing can include at least one side wall. The second housing can include an end wall. The second housing can include an open front. The open front can be located adjacent a rear side of the first housing. Having the second housing releasably attached to the first housing can be particularly useful for embodiments wherein the second housing has an open end adjacent the first housing.

[0043] The first housing can include at least one side wall. The first housing can include an end wall. The first housing can include an open front. The first housing can include a flange. The flange can extend radially outwards from the side wall. The flange can be located towards the open front.

[0044] The first housing can include a hole formed through the side wall or the end wall and the at least one wire protrudes through the hole. Thus the wires that electrically connect the driver to the solid-state lighting device can pass through the through hole.

[0045] The first housing can include a hole formed through the end wall. The second housing can include a first locating pin that can be arranged to protrude through the hole to engage the solid-state lighting device PCB. This helps to position the solid-state lighting device PCB with respect to the first housing.

[0046] The first housing can include a further hole formed through the end wall. The second housing can include a second locating pin that can be arranged to protrude through the further hole to engage the solid-state lighting device PCB. This helps to position the solid-state lighting device PCB with respect to the first housing.

[0047] The solid-state lighting device can be mounted in thermal contact with the first housing so that heat generated in use by the solid-state lighting device can be transferred by conduction into the first housing. The first housing can be arranged to dissipate heat to the surrounding environment. Thus the first housing can function as a heatsink.

[0048] The first housing can be fire resistant.

[0049] The first housing can include material that is arranged to melt at a temperature that can be greater than or equal to 900C. In some embodiments the housing can include material that can be arranged to melt at a temperature that can be greater than or equal to 1000C. In some embodiments the housing can include material

that can be arranged to melt at a temperature that can be greater than or equal to 1100C. For example, the first housing can include steel.

[0050] The first housing can be made from sheet material. The sheet material can have a thickness in the range 0.2mm to 3mm. The sheet material can be pressed to form the first housing. Thus the first housing can comprise pressed sheet material.

[0051] The lighting unit can include a first part comprising a collar. The first part can include a flange. The lighting unit can include a second part comprising the first housing and the second housing. The second part can be pivotable with respect to the first part. The lighting unit can include a seal arranged to seal the first part to the second part. The seal can be arranged to deform to accommodate pivoting movement of the second part with respect to the first part. The invention enables angularly adjustable downlights to be disassembled in a similar manner to regular downlights, in order to be able to replace damaged parts of the downlights.

[0052] The second part can include the solid-state lighting device. The second part can include the lens module. The second part can include the driver.

[0053] The seal can include a membrane. The membrane can have an outer peripheral portion that sealably engages to the first part. The membrane can include an inner part that sealably engages to the second part. A flexible connector portion can connect the outer peripheral portion to the inner part. The inner part can comprise an end wall, which is connected to the flexible connector portion.

[0054] The inner part can be clamped between the first housing and the second housing.

[0055] The seal can include a retaining member arranged to hold the outer peripheral portion in contact with the first part. The retaining member can be annular. The retaining member can be resiliently deformable.

[0056] The retaining member can be embedded in the seal.

[0057] The connector portion of the membrane can include a hollow substantially ∩-shaped, or U-shaped, cross-section. The connector portion of the membrane can have an annular inner side wall. The connector portion of the membrane can have an annular outer side wall.

[0058] The seal can have a central vertical axis when the lighting unit can be in its normal orientation. The inner part can be vertically offset from the lower end of the outer peripheral portion in the axial direction.

[0059] The lighting unit can include retaining means for engaging the partition and retaining the lighting unit therein.

[0060] The retaining means can include at least one clip, and preferably a plurality of clips.

[0061] The or each clip can be resilient and/or can include resilient means for biasing the or each clip against the partition.

[0062] The lighting unit can include a lens module. The lens module can be removably mounted in the first housing. The lens module can include a first flexible member. The first flexible member can include a first locating lug. The first housing can include a locating formation that is arranged to engage with the first locating lug. The locating formation can include a recess formed in the side wall of the first housing. The recess can comprise channel, for example a circumferential channel that extends around the side wall of the first housing. The lens module can include a second flexible member. The second flexible member can include a second locating lug. The first housing can include a locating formation that can be arranged to engage with the second locating lug. The locating formation can comprise the recess formed in the side wall of the first housing. The lens module can include a further flexible member. The further flexible member can include a further locating lug. The first housing can include a locating formation that can be arranged to engage with the further locating lug. The locating formation can comprise the recess formed in the side wall of the first housing. In some embodiments, the first locating lug, second locating lug and further locating lug can engage with respect formations, for example respective recesses, formed in the first housing.

[0063] The lens module can be arranged to be removed from the first housing by means of a sucker tool. The sucker tool can be arranged to engage with an outer surface of the lens module. Pulling on the sucker tool can provide sufficient force to the lens module to cause the first flexible member and/or second flexible member and/or further flexible member to flex sufficiently to cause the first locating lug and/or the second locating lug and/or further locating lug to disengage from the recess or respective recesses, thereby enabling the lens module to be removed from the first housing, for example via the open side.

[0064] The lens module can be arranged to be removed from the first housing manually by a user. The user pulling on lens module can provide sufficient force to the lens module to cause the first flexible member and/or second flexible member and/or further flexible member to flex sufficiently to cause the first locating lug and/or the second locating lug and/or further locating lug to disengage from the recess or respective recesses, thereby enabling the lens module to be removed from the first housing, for example via the open side.

[0065] An IP65 seal can be provided to seal the lens module to the first housing.

[0066] The second housing can include an aperture formed to receive a mains cable. The second housing can include an internal formation that is arranged to engage the mains cable and cause the mains cable to follow a tortuous path within the second housing. The internal formation acts as a stain reliever, such that an axial load applied to the mains cable does not load the electrical connection between the mains cable and the driver.

[0067] According to another aspect there is provided a downlight. At least part of the downlight can be arranged

to be mounted in an aperture in a partition, such as a ceiling.

[0068] The downlight can include a first housing. The first housing can have a front side and a rear side.

[0069] The downlight can include a solid-state lighting device. The solid-state lighting device can be mounted within the first housing on the front side thereof.

[0070] The downlight can include a second housing. The second housing can be mounted to the rear side of the first housing.

[0071] The downlight can include a driver arranged to convert a mains electrical signal to an electrical signal suitable for driving the solid-state downlight. The driver can be located in the second housing.

[0072] The downlight can include an electrical connection assembly that is arranged to electrically connect the driver to the solid-state lighting device. The electrical connection assembly can include a first electrical connector. The electrical connection assembly can include a second electrical connector. The first and second electrical connectors can be releasably attachable to one another to form an electrical connection and are separable from one another to break the electrical connection.

[0073] The downlight can include a lens module. The lens module can include a first flexible member. The first flexible member can have a first locating lug.

[0074] The first housing can include a locating formation that is arranged to engage with the first locating lug to retain the lens module within the first housing.

[0075] The lens module can be manually removable from the first housing, for example through the open side of the first housing, in response to a user manually applying a pulling force to the lens module, either directly or via a sucker tool. The first locating lug can be arranged to automatically disengage from the locating formation in response to the pulling force applied to the lens module.

[0076] The solid-state lighting device can be removably mounted in the first housing. The solid-state lighting device can be releasably attached to the first housing.

[0077] The driver can be removably mounted in the second housing. The driver can be releasably attached to the second housing.

[0078] According to another aspect there is provided a downlight, at least part of which is arranged to be mounted in an aperture in a partition, such as a ceiling, the downlight comprising: a first housing, said first housing having a front side and a rear side; a solid-state lighting device mounted within the first housing on the front side thereof; and a lens module including a first flexible member having a first locating lug, wherein the first housing includes a locating formation that is arranged to engage with the first locating lug to retain the lens module within the first housing, the lens module is manually removable from the first housing through the open side of the first housing in response to a user manually applying a pulling force to the lens module, either directly or via a sucker tool, and wherein the first locating lug is arranged to automatically disengage from the locating formation in response to the pulling force applied to the lens module.

[0079] According to another aspect there is provided a downlight according to any configuration described herein in combination with a sucker tool, which is arranged to remove a lens assembly from the downlight.

[0080] According to another aspect there is provided a method for removing a lens module from a downlight. The method can include providing a downlight having a first housing having an open side, and a lens module located within the first housing. The lens module can have a first flexible member having a first locating lug. The first housing can include a locating formation and the first locating lug can engage the first locating formation to retain the lens module within the first housing. The user can attach a sucker tool to an exposed surface of the lens module. The user can remove the lens module from the first housing through the open side of the first housing by applying a pulling force to the lens module via the sucker tool. The pulling force can cause the first locating lug to automatically disengage from the first locating formation to release the lens module from the first housing.

[0081] The method can include providing a lens module including a second flexible member. The second flexible member can include a second locating lug. The second locating lug can be arranged to engage with the first locating formation or a second locating formation formed in the first housing. The second locating formation can comprise a second recess formed in the side wall of the first housing. The user removing the lens module from the first housing through the open side of the first housing can include the pulling force applied to the lens module by the sucker tool causing the second locating lug to automatically disengage from the first locating formation, or the second locating formation, to release the lens module from the first housing. Having a second flexible member helps to ensure that the lens module is properly retained within the first housing while still enabling the force applied to the lens assembly by the sucker tool to withdraw the lens module from the first housing without the sucker tool disengaging from the first module.

[0082] The method can include providing a lens module including a further flexible member. The further flexible member can include a further locating lug. The further locating lug can be arranged to engage with the first locating formation or a further locating formation formed in the first housing. The further locating formation can comprise a further recess formed in the side wall of the first housing. The user removing the lens module from the first housing through the open side of the first housing can include the pulling force applied to the lens module by the sucker tool causing the further locating lug to automatically disengage from the first locating formation, or the further locating formation, to release the lens module from the first housing. Having a further flexible member helps to ensure that the lens module is properly retained within the first housing while still enabling the force applied to the lens assembly by the sucker tool to withdraw

the lens module from the first housing without the sucker tool disengaging from the first module.

[0083] According to another aspect there is provided a downlight, at least part of which is arranged to be mounted in an aperture in a partition, such as a ceiling, the downlight comprising: a first housing, said first housing having a front side and a rear side; a solid-state lighting device mounted within the first housing on the front side thereof; a second housing mounted to the rear side of the first housing; a driver arranged to convert a mains electrical signal to an electrical signal suitable for driving the solid-state lighting unit, wherein the driver is located in the second housing; an electrical connection assembly that is arranged to electrically connect the driver to the solid-state lighting device, the electrical connection assembly including first and second electrical connectors that are releasably attachable to one another to form an electrical connection and are separable from one another to break the electrical connection; and a lens module including a first flexible member having a first locating lug, wherein the first housing includes a locating formation that is arranged to engage with the first locating lug to retain the lens module within the first housing; manually removing the lens module from the first housing through the open side of the first housing in response to a user manually applying a pulling force to the lens module, either directly or via a sucker tool, and wherein the first locating lug is arranged to automatically disengage from the locating formation in response to the pulling force applied to the lens module. The method enables easy access to the solid state lighting device, for example so a damage solid-state lighting device can be replaced.

[0084] According to another aspect there is provided a method for removing a lens module from a downlight, the method including providing a downlight, at least part of which is arranged to be mounted in an aperture in a partition, such as a ceiling, the downlight comprising: a first housing, said first housing having a front side and a rear side; a solid-state lighting device mounted within the first housing on the front side thereof; a second housing mounted to the rear side of the first housing; a driver arranged to convert a mains electrical signal to an electrical signal suitable for driving the solid-state lighting unit, wherein the driver is located in the second housing; an electrical connection assembly that is arranged to electrically connect the driver to the solid-state lighting device, the electrical connection assembly including first and second electrical connectors that are releasably attachable to one another to form an electrical connection and are separable from one another to break the electrical connection; and a lens module including a first flexible member having a first locating lug, wherein the first housing includes a locating formation that is arranged to engage with the first locating lug to retain the lens module within the first housing; manually removing the lens module from the first housing through the open side of the first housing in response to a user manually applying a pulling force to the lens module, either directly or via a sucker tool, and the first locating lug automatically disengaging from the locating formation in response to the pulling force applied to the lens module.

[0085] Embodiments of the invention will now be described by way of example only with reference to the drawings, wherein:

Figure 1 is a vertical cross-sectional view of a first embodiment of the invention;

Figure 2 is the vertical cross-sectional view of the embodiment of Figure 1 with a lens removed for clarity;

Figure 3 is an exploded assembly view of the embodiment of Figure 1;

Figures 4 to 8 illustrate the steps undertaken to disassemble the embodiment of Figure 1, for example to remove a driver and/or an LED lighting device;

Figure 9 is a vertical cross-sectional view of a second embodiment of the invention;

Figure 10 is the vertical cross-sectional view of the embodiment of Figure 9 with a lens removed for clarity;

Figure 11 is an exploded assembly view of the embodiment of Figure 9;

Figure 12 is a vertical cross-sectional view of a third embodiment of the invention, having a first housing, which houses an LED lighting device, and a second housing, which houses an LED driver, wherein the second housing is mounted on the first housing;

Figure 13 is an enlarged view of part of Figure 12, and shows a hook formation engaging a tongue pressed out of an end wall of the first housing to help secure the second housing to the first housing;

Figure 14 is an enlarged view of part of Figure 12, and shows the second housing sliding relative to the first housing in order to disengage the hook formation from the tongue; and

Figure 15 is a vertical cross-sectional view of the embodiment of Figure 12 in a condition wherein the second housing is partially removed from the first housing.

[0086] Figure 1 shows a lighting unit 1 according to a first embodiment of the invention. The lighting unit 1 is in the form of a downlight, for example for use in a house or an apartment, which is typically mounted in an aperture in a partition, such as a ceiling, though of course the lighting unit 1 can be mounted in other partitions, such as a wall.

The aperture is typically circular and has a diameter that is less than or equal to around 100mm. The lighting unit is sized to fit into the aperture.

[0087] The lighting unit 1 includes a first housing 3 and a solid-state lighting device 5, which is located within the first housing 3. The lighting unit 1 includes a second housing 7 mounted to the rear side of the first housing 3, and a driver 9 arranged to drive the solid-state lighting device 5. The driver 9 is located in the second housing 7. The lighting unit 1 includes an electrical connection assembly 11 that is arranged to electrically connect the driver 9 to the solid-state lighting device 5, wherein the electrical connection assembly 11 includes first and second electrical connectors 13,15 that are releasably attachable to one another.

[0088] The first housing 3 resembles an open ended cylindrical box having a side wall 17 and an end wall 19. The first housing 3 may of course take any convenient shape, for example the housing may be generally cuboid. The first housing 3 has a front side 'A' that faces outwards towards the open end and a rear side 'B' that faces inwards into the recess behind the partition. The outer diameter of the first housing can be less than or equal to 100mm.

[0089] In some embodiments, the first housing 3 can be fire resistant. For example, the first housing 3 can be made from material having a melting point that is greater than or equal to 900°C, preferably greater than equal to 950°C, and more preferably greater than or equal to 1000°C. At least part of the first housing 3, and preferably the entire housing, can be made from metal, such as steel. The first housing 3 is preferably made from sheet material, such as sheet steel, and is formed by a pressing process. Typically the thickness of the sheet material, and hence the walls of the housing 17,19, is in the range 0.3 to 3mm, and preferably 0.3 to 2mm. Thus the first housing 3 can be arranged such that it does not melt at temperatures below 900°C. The first housing 3 preferably comprises a single pressed component. In other arrangements, the first housing 3 can comprise a plurality of parts connected together. Each component part can be made from a different material.

[0090] In the event of a fire, the fire barrier formed by the partition and the first housing 3 is not compromised for the period of its fire rating. For example, a ceiling may be rated in accordance with the test outlined in BS 476: Part 21: 1987, or BS EN 1363-1:2012. The material and the thickness of the material for the first housing 3 is selected according to the rating of the ceiling. Typically, the first housing 3 is designed to withstand temperatures of around 900°C and will not fail in fires having temperatures below its design threshold. For a lighting unit rated at 90 minutes, the fire resistant barrier must not melt in temperatures of around 1000°C. Thus the lighting unit according to the invention has the advantage that it meets current safety standards, while at the same time providing a simple structure that is relatively cheap to manufacture and relatively easy to install when compared with known fire resistant lighting units.

[0091] The first housing can include a flange 20 extends outwards from the open lower end of the first housing 3. The flange 20 is arranged to engage a lower face of the partition when the lighting unit 1 is located within the aperture formed in the partition. The flange 20 provides an effective barrier against fire leaking through the ceiling, for example in the situation where the installer has not cut a neat hole into the ceiling for the lighting unit 1.

[0092] For embodiments, where it is not necessary for the lighting unit 1 to be fire resistant, the first housing 3 can be made from other materials, such as plastics and/or metal having a lower melting point than required to provide fire resistance.

[0093] The solid-state lighting device 5 can comprise at least one LED 21, and typically a plurality of LEDs 21, and a printed circuit board (PCB) 23. Any suitable type of LED 21 can be used. For example, each LED 21 may comprise a COB (Chip On Board) type LED, a surface mounted LED or a packaged LED. The solid-state lighting device 5 can include any suitable number of LEDs 21 can be included. Typically, the solid-state lighting device 5 includes N LEDs, wherein N is in the range 1 to 10.

[0094] The solid-state lighting device 5 is located within the first housing 3 on the front side 'A' thereof. In some embodiments, the solid-state lighting device 5 is mounted on the front side 'A' of the end wall 9 of the first housing 3. The solid-state lighting device 5 can be mounted in good thermal contact with the first housing 3. For example, a thermal paste can be located between the PCB 23 and the end wall 19. In use, heat generated by the solid-state lighting device 5 is thermally conducted into the first housing 3. In the absence of a dedicated heatsink, the first housing 3 acts as a heatsink for the solid-state lighting device 5.

[0095] The lighting unit 1 can include a lens module 25. The lens module 25 can be mounted in the first housing 13 on the front side 'A'. The lens module 23 can comprise a single lens or can include a plurality of lenses. The lens module 25 preferably comprises a moulded component. Preferably the lens module 25 is made from a plastics material such as acrylic and is formed by injection moulding. The lens module 25 closes the open side of the first housing 3. The lens module 25 can be located within the front side A of the first housing by flexible side members 30, having locating lugs 32, which are arranged to engage with a circumferential channel 34 formed in the first housing side wall 17.

[0096] The lens module 25 can be sealed to the first housing 3 by a seal 36 to prevent moisture from entering the first housing 3.

[0097] The lighting unit can include a reflector 26, which is arranged to sit on a tapered face 28 of the lens module 25, and to help prevent light escaping through the tapered face 28.

[0098] The lighting unit 1 can include spring loaded clips 27. The spring loaded clips 27 can be pivotally

mounted to the first housing 3, or to support members 29 attached to the first housing 3. The spring loaded clips 27 are arranged to be manually pinched closed by the installer when inserting the lighting unit into the partition and to spring outwards when released to load the partition. The biasing force generated by the spring loaded clips 27 is typically sufficient to retain the lighting unit 1 within the partition. However, if additional support is required the lighting unit can additionally, or alternatively, be fixed within the partition using some other means, for example screws or bolts (not shown).

[0099] The second housing 7 resembles an open ended cylindrical box having a side wall 31 and an end wall 33. The second housing 7 may of course take any convenient shape, for example the housing may be generally cuboid. The second housing 7 has a front side 'C' that faces outwards towards the open end and a rear side 'D' that faces inwards into the recess behind the partition. The outer diameter of the second housing 7 can be less than or equal to 100mm.

[0100] The second housing 7 is typically made from a plastics material. Typically, the second housing 7 is moulded. For example, the second housing 7 can be made by injection moulding. Alternatively, the second housing can be made from metal. For example, the second housing can be made from aluminium.

[0101] The driver 9 is removably mounted within the second housing 7. The driver 9 includes a driver printed circuit board (PCB) 35. The driver PCB 35 sits on a lip 37 adjacent the end wall 33, on a front side C of the second housing 7. Typically, the driver PCB 35 is push fit on to the lip 37.

[0102] The second housing 7 includes a through hole 40. The through hole 40 is arranged to receive an electrical cable 43, which provides a mains electrical signal to the driver 9. In particular, the electrical cable 43 is electrically connected to the driver PCB 35, for example by soldering. The through hole 40 is located towards an upper part of the second housing 7 and is located in the side wall 31 or end wall 33. The second housing 7 includes a formation, such as an internal wall 45, which is arranged to engage and hold the electrical cable 43. Typically, the internal formation 45 causes the cable 45 to follow a tortuous path with the second housing 7, thereby providing strain relief on the cable 43 and preventing external axial loads applied to the electrical cable 43 from mechanically loading the electrical connection with the driver PCB 35.

[0103] The electrical connection assembly 11 electrically connects the driver PCB 35 to the solid-state lighting device PCB 23. The electrical connection assembly 11 includes electrical wiring 39. A first end of each wire 39 is soldered to the driver PCB 35 and is electrically connected to driver components mounted on the driver PCB 35. The second end of each wire 39 is electrically connected to the first electrical connector 13. The first electrical connector 13 can be in the form of a plug. The second electrical connector 15 is mounted on the solid-state lighting device PCB 23 and is electrically connected to the LEDs 21. The second electrical connector 15 can be in the form of a socket which is arranged to electrically connect with the plug attached to the wiring 39. The first and second electrical connectors 13,15 can be coupled together to form an electrical connection between the driver 9 and the solid-state lighting device 5. This can be achieved, for example by forming a through hole 41 through the first housing 3 to enable the wiring 39 to protrude into the front side A of the first housing. Typically, the through hole 41 is formed through the end wall 19 of the first housing.

[0104] It will be appreciated by the skilled person that the plug can be mounted on the solid-state lighting device PCB 23 and the socket can be attached to the wiring 39.

[0105] The second housing 7 includes a first protrusion 47. The first protrusion 47 comprises an elongate member, which protrudes downwards through a first aperture formed through the end wall 19 of the first housing, into the front side A of the first housing. The first protrusion 47 is arranged to engage with a first hole 51 formed through the solid-state lighting device PCB 23. The purpose of the first protrusion 47 and first through hole in the solid-state lighting device PCB is to aid assembly of the lighting unit 1, by properly positioning the solid-state lighting device PCB 23 with respect to the first housing 3.

[0106] In some embodiments, the second housing 7 includes a second protrusion 53. The second protrusion 53 comprises an elongate member, which protrudes downwards through a second aperture (not shown) formed through the end wall 19 of the first housing, into the front side A of the first housing. The second protrusion 53 is arranged to engage with a second hole 55 formed through the solid-state lighting device PCB 23. The purpose of the second protrusion 53 and the second through hole 55 in the solid-state lighting device PCB is to aid assembly of the lighting unit 1, by properly positioning the solid-state lighting device PCB 23 with respect to the first housing 3.

[0107] If the driver 9 were to fail, and it is necessary to replace the driver 9, the first and second electrical connectors 13,15 can be uncoupled from one another and the damaged driver 9 can be removed from the lighting unit 1. The damaged driver 9 can be replaced with a similar driver 9 to repair the lighting unit 1.

[0108] If the solid-state lighting device 5 were to fail, and it is necessary to replace the solid-state lighting device 5, the first and second electrical connectors 13,15 can be uncoupled from one another and the damaged solid-state lighting device 5 can be removed from the lighting unit 1. The damaged solid-state lighting device 5 can be replaced with a similar solid-state lighting device 5 to repair the lighting unit.

[0109] It may be desirable in some circumstances to upgrade the lighting unit 1 by replacing the driver 9 and/or solid-state lighting device 5 with a new, dissimilar, driver and/or solid-state lighting device, for example to improve the function and/or efficiency of the lighting unit 1. This

can be achieved by uncoupling the first and second electrical connectors 13,15, removing the solid-state lighting device 5 and/or driver 9 that is to be upgraded, inserting the new solid-state lighting device 5 and/or driver 9 respectively, and coupling the first and second electrical connectors 13,15 together.

[0110] Optionally, the lighting unit 1 can include an annular membrane 57, which is made from a resilient material such as rubber. The annular membrane 57 sits on an upper surface of the flange 20 and is arranged to engage a lower face of the partition to prevent the flange 20 from damaging the partition and to prevent moisture from passing through the aperture formed in the partition into the recess behind the partition.

[0111] The solid-state lighting device 5 is fixed to the first housing 3, and the first housing 3 is fixed to the second housing 3, by a first screw 59 and a second screw 61. The first screw 59 passes through a first aperture 63 formed through the solid-state lighting device 23, through an aperture 65 formed through the end wall 19 of the first housing, and into a threaded hole 67 formed in the second housing 7. The first screw 69 passes through a second aperture 71 formed through the solid-state lighting device 23, through an aperture 73 formed through the end wall 19 of the first housing, and into a threaded hole 75 formed in the second housing 7. Since the whole lighting unit 1 is held together by two screws, the lighting unit 1 is quick and easy to assemble and is quick and easy to disassemble, for example when it is necessary to replace a damaged part of the lighting unit 1, or to upgrade a part of the lighting unit 1.

[0112] Figures 4 to 8 illustrate how the lighting unit 1 can be disassembled and how the driver and/or solid-state lighting device 5 can be replaced or upgraded.

[0113] Figure 4 shows that the lighting unit 1 can be attached to a first mains electrical connector 77 via the electrical cable 43. The first mains electrical connector 77 is arranged to be coupled with a complementary second mains electrical connector (not shown), which is connected to a mains electrical cable. Thus by coupling the first 77 and second mains electrical connectors together, a mains electrical signal can be provided to the driver 9 via the electrical cable 43.

[0114] When removing a part of the lighting unit 1, it is first necessary to uncouple the lighting unit 1 from the mains by uncoupling the first 77 and second mains electrical connectors (see Figure 4). If desirable, the lighting unit 1 can be separated from the first mains electrical connector 77 by disconnecting the electrical cable 43 from the first electrical connector 77 (see Figure 5).

[0115] The lens module 25 can then be removed from the first housing 3. This can be achieved, for example by using a suction tool 79 to pull the lens module 25 out of the open end of the first housing 3 (see Figure 6). By attaching the suction tool 79 to the outer face of the lens module 25 and applying an axial load to the suction tool 79, the axial load can cause the flexible side members 30 to flex thereby enabling the locating lugs 32 to disengage from the circumferential channel 34. The suction tool 79 has the advantage that the lens module 25 and the seal 36 are not damaged when the lens module 25 is removed, whereas using a prising tool such as a screwdriver could successfully remove the lens module 25, however it may damage the lens module 25 and/or seal 36 and is therefore less desirable.

[0116] Having removed the lens module 25, the first and second electrical connectors 13,15 are manually accessible. The first electrical connector 13 can be manually uncoupled from the second electrical connector 15 (see Figure 7).

[0117] The first and second screws 59,61 can then be removed by a suitable tool, such as a screwdriver 81. This enables the second housing 7 to be manually separable from the first housing 3 (see Figure 8).

[0118] In the condition shown in Figure 8, it is possible to manually remove the driver 9 from the second housing 7. A replacement driver 9, or an upgraded driver, can be inserted into the second housing 7. Typically, the replacement driver 9, or an upgraded driver, will come together with a new electrical cable 43, which can be threaded through the aperture 40. With this arrangement, it is usually required to remove the first mains electrical connector 77 from the original electrical cable 43.

[0119] In some arrangements, it can be possible to replace the second housing 7, driver 9 and electrical cable 43 as a unit. While this leads to more waste, since the second housing 7 is also replaced, it makes it far easier and quicker to remove and replace the driver 9 and reassemble the lighting unit 1.

[0120] From the condition shown in Figure 8, it is also possible to manually remove the solid-state lighting device 5 from the first housing 3, for example to replace the solid-state lighting device 5 with a replacement solid-state lighting device 5, or an upgraded solid-state lighting device.

[0121] The lighting unit 1 can be reassembled after the replacement/new parts have been provided.

[0122] Figures 9 to 11 show a lighting unit 101 according to a second embodiment of the invention. The lighting unit 101 is similar to the first embodiment, except in the respects outlined below. The same reference numbers used in the first embodiment have been used in the drawings for the second embodiment in respect of similar components, where appropriate.

[0123] The first housing 3 does not include the flange 20 located at its open end. Instead, the flange 20 is provided by on a separate part. Thus the lighting unit 101 includes a first part 102 comprising a collar 104, annular membrane 57 and the flange 20; and a second part 106 comprising the first housing 3, solid-state lighting device 5, lens module 25, second housing 7 and driver 9.

[0124] The second part 106 is pivotally attached to the first part 102 in the manner described below. This enables the angular orientation of the solid-state lighting device 5

to be adjusted with respect to the first part 102, thereby adjusting the angle at which light is emitted from the lighting unit 101.

[0125] The lighting unit 101 also includes a seal 108 that seals the first part 102 to the second part 106. The seal 108 prevents moisture passing through the lighting unit via the gap between the first and second parts 102,106.

[0126] The collar 104 provides a mounting structure. The collar 104 comprises an annular wall 105 and a flange 20. The flange 20 protrudes radially outwards from the annular wall at first, lower, end 110 thereof. The collar 104 has a first opening 112 at a first end 110 and a second opening 114 at a second end 116.

[0127] The collar 104 is preferably made from steel. The flange 20 provides an initial barrier against fire leaking through the hole formed in the ceiling, for example in the situation where the installer has not cut a neat hole into the ceiling.

[0128] The collar 104 includes a circumferential groove 118 formed in its inner surface. The seal 108 engages with the seal 108 the groove 118. First and second holes 120, or recesses, are formed in the collar 104. The first and second holes 120, or recesses, are formed diametrically opposite to one another, and enable the second part 106 to be pivotally connected to the first part 102.

[0129] The second part 106 comprises an assembly that is pivotable with respect to the first part 102 as a unit. The arrangement of the assembly is described below.

[0130] The first housing 3 includes two pivot members 122 formed in the side wall 17. The pivot members 122 are arranged to engage with the holes 120, or recesses, formed in the collar 104. The pivot members 122 enable the second part 106 to pivot with respect to the first part 102. The pivot members 122 can be formed integrally with the first housing 3, for example can be pressed from the housing material. For a substantially cylindrical first housing 3 having one side wall 17, the pivot members 122 are arranged diametrically opposite to one another. Each pivot member 122 extends radially outwardly from the side wall 17.

[0131] The second housing 7 is mounted on the rear side 'B' of the end wall 19 of the first housing. The second housing 7 clamps the seal 108 to the second part 106 of the lighting unit, and preferably to the rear side 'B' of the first housing 3. The clamping member 17 can comprise a plastics member.

[0132] The seal 108 provides a moisture barrier between the first and second parts 102,106, of the lighting unit and therefore prevents moisture from entering the void above the ceiling via the gap between the first and second parts 102,106. The seal 108 is flexible. It is made from a resilient material such as silicone or natural rubber, and is able to deform elastically.

[0133] The seal 108 comprises a flexible membrane having the shape shown in Figures 9 -11, said shape being formed by a moulding process. The flexible membrane provides the seal 108 with a thin walled structure that enables the seal to deform, for example flex and/or stretch, when the second part 106 is pivoted with respect to the first part 102, without compromising the seal between the first and second parts 102,106.

[0134] The seal 108 is annular, and is substantially circular in plan view. The seal 108 includes a connector portion in the form of central portion 124. The central portion 124 has a hollow substantially ∩-shaped, or U-shaped, cross-section. The central portion 124 includes an annular inner side wall 126 and an annular outer side wall 128. Typically, at least a portion of the inner side wall 126 is substantially parallel with at least a portion of the outer side wall 128 in a non-deformed state. The ∩-shaped, or U-shaped, cross-section provides a flexible folded membrane structure, which reduces the load required in order to deform the membrane. The seal 108 is closed at a first side 130 and open at a second side 132. The closed side 130, inner side wall 126 and outer side wall 128 define an annular channel 132.

[0135] The seal 108 is located within the unit such that the closed side 130 is oriented upwards (∩-shaped), however it will be appreciated by the skilled person that the seal 108 can be inverted with respect to the first and second parts 102,106, thereby providing a substantially U-shaped arrangement.

[0136] The seal 108 includes an inner membrane part in the form of an inner end wall 134. The inner end wall 134 extends substantially radially inward from the end portion of the inner side wall 126. The inner end wall 134 is located between first housing 3 and second housing 7. The second housing 7 clamps the inner end wall 134 to the rear side B of the end wall 19. The inner end wall 134 includes through holes 140 to accommodate screws 59,61, through holes to accommodate the first and second protrusions, and a though hole to accommodate wiring 39.

[0137] The seal includes an outer peripheral portion in the form of an annular outer lip 136. The outer lip 136 extends substantially radially outwards from the outer side wall 128, towards the end thereof. The central portion 124 connects the inner end wall 134 to the outer lip 136.

[0138] The seal 108 includes a retaining member in the form of a retaining ring 138. The retaining ring 138 is moulded into the outer lip 136. The purpose of the retaining ring 138 is to hold the outer lip 136 in engagement with the first part 102 of the lighting unit, for example in engagement with groove 118. The retaining ring 138 also makes assembly of the lighting unit easier since it is not necessary to adhere the seal 108 in place, which is a messy process and leads to a significant number of rejections during the assembly process. The retaining ring 138 is preferably made from metal, such as steel. However, other materials such as plastics can be used, for example the retaining ring 138 can be made from nylon or similar materials. The retaining ring 138 is resilient, so that it can bias the outer lip 136 into engagement with the first part of the lighting unit 102, such as

groove 118. For example, the retaining ring 138 can be made from spring steel. Typically, the retaining ring 138 comprises a loop of wire, for example a circular loop. The retaining ring typically has a circular transverse cross-section, however the transverse cross-section can have other shapes, such as rectangular.

[0139] The seal 108 has a central axis 140, and the inner end wall 134 can be offset from the outer lip 136 in the axial direction. Typically inner end wall 134 is offset OS from the outer lip 136 in the axial direction by around 5mm to 30mm, depending on the arrangement of the lighting unit 101.

[0140] The outer lip 136 is seated in the annular groove 118 formed in the collar 104. The outer lip 136 is sized and shaped to form a seal with the groove 118 and hence the first part 102. The outer lip 136 is firmly attached to the groove 118 by the retaining ring 138. The function of the groove 118, and retaining ring 138, is to ensure that the seal 108 does not disassociate from the collar 104 when the second part 106 is tilted with respect to the first part 102. The inner end wall 134 is sized and shaped to be clamped between the second housing 7 and the rear side 'B' of the end wall 19 of the first housing 3.

[0141] The clamping load on the seal 108 by the first housing 3 and the second housing is provided by first and second screws 59,61.

[0142] In use, the lighting unit is arranged such that a user is able to adjust the angle of the second part 106 of the lighting unit by a limited amount, typically ± 20 degrees, without breaking the seal between the first and second parts 102,106. The seal 108 deforms, for example by stretching and/or flexing in the fully tilted positive orientation and fully tilted negative orientation respectively. Thus the seal 108 provides an effective moisture barrier regardless of the operational orientation of the second part 106 with the respect to the first part 102. Since the seal 108 is resilient it returns to its original shape when the lighting unit is adjusted so that the central axis of the second part 106 is substantially co-axial (or at least substantially parallel) with the central axis of the first part 102.

[0143] Since the lighting unit 101 is held together by the screws 59,61 it can be disassembled in a similar manner to the first embodiment as described above to separate the second housing 7 from the first housing 3. It will be appreciated, that when the second housing 7 is separated from the first housing 3, it will be possible to remove and replace the seal 108, if necessary or desirable.

[0144] Figures 12 and 13 show a third embodiment of the invention. The third embodiment is similar to the first embodiment except in the respects mentioned below. The same reference numbers used in the first embodiment have been used in the drawings for the third embodiment in respect of similar components, where appropriate.

[0145] A pair of wires, not shown, are soldered at their first ends to the solid-state lighting device PCB 23. The wires protrude through a hole formed in the end wall 9 of the first housing 3 into the second housing 7. The first electrical connector 13 is connected to the second ends of the wires. Thus the first electrical connector 13 is located inside the second housing 7. The second electrical connector 15 is electrically connected to the driver PCB 35. The second electrical connector 15 can be directly mounted on to the driver PCB 35, or can be electrically connected to the driver PCB 35 by a pair of wires. The first electrical connector 13 can be one of a plug and a socket and the second electrical connector 15 can be the other one of a plug and a socket. The first and second electrical connectors 13,15 enable the driver 9 to be electrically connected to the solid-state lighting device 5, in a releasable manner.

[0146] The second housing 7 includes an engagement formation 250, which is arranged to help secure the second housing 7 to the rear side B of the first housing 3. The engagement formation 250 can comprise a hook formation 250. The hook formation 250 can depend downwards from a lower part of the side wall 31. The hook formation can have a first part 250a that extends radially inwardly from the side wall 31, a second part 250b that extends downwards from the first part 250a, and a third part 250c that extends radially outwards from the second part 250b. The first and third parts 250a,250b are arranged parallel to one another. The second part 250b is arranged perpendicular to the first and third parts 250a,250c. The third part 250c includes a chamfered face 250d (see Figure 13).

[0147] The first part 250a, second part 250b and third part 250c of the hook formation 250 define a recess 252, which is arranged to accommodate an engagement formation, such as a tongue 254. The tongue 254 can be pressed out of the end wall 19 of the first housing 3. The tongue 254 depends downwards into the first housing 3. At least part of the hook formation 250 is arranged to be inserted into an aperture 256 formed through the end wall 19, adjacent the tongue 254, in a manner such that the hook formation is arranged to engage and accommodate the tongue 254 in the recess 252 (see Figure 13). This helps to secure the second housing 7 to the first housing 3.

[0148] When the second housing 7 is mounted on to the end wall 19 of the first housing, a screw element 258 secures the second housing 7 to the first housing 3. The screw element 258 screws into a threaded hole 260 formed in the end wall 19 of the first housing. Optionally, the screw element 258 can be located in a cavity 262 formed in the second housing. Optionally, a plug (not shown) can be inserted into the cavity 262 to hide the screw element 258.

[0149] In order to remove the second housing 7 from the first housing 3, for example to gain access to the driver 9 located within the second housing 7, the plug and screw element 258 are removed from the cavity 262. Disengaging the screw element 258 from the threaded hole 260 releases the mechanical lock between the second housing 7 and the first housing 3. The operator then slides the

second housing 7 relative to the first housing 3 in the direction X in Figure 14 to disengage the hook formation 252 from the tongue 254. The operator then pivots the second housing 7 relative to the first housing 3 in order to remove the hook formation 254 from the aperture 256. At this stage, the second housing 7 is fully separated from the first housing 3. The operator is able to access the driver 9, for example to repair the driver or to replace the driver with a new driver 9.

[0150] In order to mount the second housing 7 on to the end wall 19 of the first housing, the aforementioned steps are reversed. That is, the second housing 7 is inclined relative to the first housing 7. The hook formation 250 is inserted into the aperture 256, and the orientation of the second housing 7 is adjusted so that an end face of the side wall 31 of the second housing 7 is seated on the end wall 19 of the first housing. The operator then slides the second housing 7 relative to the first housing 3, in a direction that is opposite to the direction X shown in Figure 14, thereby moving the hook formation 250 into engagement with the tongue 254, in a manner such that the tongue 254 is located in the recess 252. The operator inserts the screw element 258 into the cavity 262 and screws the screw element into the threaded hole 260, thereby fully securing the second housing 7 to the first housing 3.

[0151] It is to be noted that the PCB 23 of the solid state lighting unit 5 is fixed to the end wall 19 of the first housing 3 by screws 262. If the operator wants to gain access to the solid state lighting unit 5, for example to replace the solid state lighting unit 5, it is necessary to remove the lens module 25 from the first housing 3, for example in a manner similar to that described with reference to the first embodiment.

[0152] It will be appreciated by the skilled person that modifications can be made to the above embodiments that fall within the scope of the invention, for example the solid-state lighting device does not strictly require a printed circuit board. The or each LED 21 can be mounted directly onto the fire resistant housing. The solid-state lighting device 5 can include any practicable number of LEDs 21.

[0153] Materials other than steel can be used in the construction of the first housing 3 that have a high melting point, for example brass, ceramic and/or copper.

[0154] Instead of having wiring 39 soldered to the driver PCB 35 and the first electrical connector 13 mounted on the solid-state lighting device PCB 23, the wiring 39 can be soldered to the solid-state lighting device PCB 23 and the first electrical connector 13 can be mounted on the driver PCB 35. Alternatively, each first end of a first set of wires can be soldered to the driver PCB 35, each first end of a second set of wires can be soldered to the solid-state lighting device PCB 23, the first electrical connector 13 can be electrically connected to each second end of the first set of wires and the second electrical connector 15 can be electrically connected to each second end of the second set of wires.

[0155] While the embodiments use two screws to hold the second housing 7 to the first housing 3, it is possible to use a single screw. Alternatively three or more screws could be used to hold the second housing 7 to the first housing. It is preferable to use fewer screws to make it easier for a user to disassemble the lighting unit. Having two screws provides a good compromise on the one hand between speed and ease of disassembly of the lighting unit and on the other hand providing a secure connection between first and second housings 3,7 which does not obscure the LEDs. The first and second housings 3,7 can be releasably attached to one another using some other mechanical fixing.

[0156] It is apparent from the description above that the hook formation is located on the second housing and the aperture and tongue are formed in the first housing. In some embodiments, the hook formation can be located on the first housing and the aperture and tongue can be formed in the second housing.

[0157] The description presents exemplary embodiments and, together with the drawings, serves to explain principles of the invention. However, the scope of the invention is not intended to be limited to the precise details of the embodiments or exact adherence with all method installation steps, since variations will be apparent to a skilled person and are deemed also to be covered by the claims. Terms for components used herein should be given a broad interpretation that also encompasses equivalent functions and features. In some cases, several alternative terms (synonyms) for structural features have been provided but such terms are not intended to be exhaustive.

[0158] Descriptive terms should also be given the broadest possible interpretation; e.g. the term "comprising" as used in this specification means "including" such that interpreting each statement in this specification that includes the term "comprising", features other than that or those prefaced by the term may also be present. Related terms such as "comprise" and "comprises" are to be interpreted in the same manner. Directional terms such as "vertical", "horizontal", "up", "down", "upper" and "lower" may be used for convenience of explanation usually with reference to the illustrations and are not intended to be ultimately limiting if an equivalent function can be achieved with an alternative dimension and/or direction.

[0159] The description herein refers to embodiments with particular combinations of configuration steps or features, however, it is envisaged that further combinations and cross-combinations of compatible steps or features between embodiments will be possible. Indeed, isolated features may function independently as an invention from other features and not necessarily require implementation as a complete combination. Any feature from an embodiment can be isolated from that embodiment and included in any other embodiment.

[0160] The term "at least one of' is to be interpreted in the sense of "and/or". For example, the term "at least one of X and Y" is to be interpreted as meaning any one of the

following: X alone; Y alone; or the combination of X and Y. As another example, the term "at least one of X, Y and Z" is to be interpreted as meaning any one of the following: X alone; Y alone; Z alone; the combination of X and Y; the combination of transmission X and Z; the combination of Y and Z; or the combination of X, Y, Z.

Claims

1. A downlight, at least part of which is arranged to be mounted in an aperture in a partition, such as a ceiling, the lighting unit comprising: a first housing, said first housing having a front side and a rear side; a solid-state lighting device mounted within the first housing on the front side thereof; a second housing releasably mounted to the rear side of the first housing; a driver arranged to convert a mains electrical signal to an electrical signal suitable for driving the solid-state lighting device, wherein the driver is located in the second housing; and an electrical connection assembly that is arranged to electrically connect the driver to the solid-state lighting device, the electrical connection assembly including first and second electrical connectors that are releasably attachable to one another to form an electrical connection and are separable from one another to break the electrical connection; wherein the driver is removably mounted in the second housing; the solid-state lighting device is removably mounted in the first housing.

2. The downlight of claim 1, wherein the first housing includes a first engagement formation and the second housing includes a second engagement formation, wherein the second engagement formation is arranged to releasably engage the first engagement formation.

3. The down light of claim 2, wherein the second engagement formation is arranged to protrude into the first housing, in a condition wherein the second housing is seated on a wall of the first housing, such as an end wall of the first housing.

4. The down light of claim 2 or 3, wherein the first engagement formation is arranged to protrude into the second housing, in a condition wherein the second housing is seated on the wall of the first housing, such as the end wall of the first housing.

5. The downlight of any one of claims 2 to 4, wherein one of the first housing and the second housing is arranged to move laterally relative to the other one of the first housing and the second housing from a first position in which the second engagement formation does not engage the second engagement formation to a second position wherein the first formation engages the second engagement formation.

6. The downlight of any one of claims 2 to 5, wherein the second housing is arranged to slide across part of the first housing from the first position to the second position, for example second housing is arranged to slide across part of the end wall of the first housing when moving from the first position to the second position.

7. The downlight of any one of claims 2 to 6, wherein one of the first and second engagement formations comprises a hook formation.

8. The downlight of any one of claims 2 to 7, wherein the first housing includes an aperture formed through an end wall of the first housing, and the second engagement formation is arranged to protrude through the aperture in a condition wherein the second housing is seated on an end wall of the first housing.

9. The downlight of claim 8, wherein the aperture and the second engagement formation are arranged such that it is necessary to incline the second housing away from a central longitudinal axis of the downlight in order to insert the second engagement formation into the aperture.

10. The downlight of any one of the preceding claims, including a first screw element arranged to releasably secure the second housing to the first housing.

11. The downlight of claim 10, including a second screw element arranged to releasably secure the second housing to the first housing.

12. The downlight of any one of the preceding claims, wherein the first housing includes a hole formed through the end wall, and the second housing includes a first locating pin that is arranged to protrude through the hole to engage the solid-state lighting device PCB; optionally the first housing includes a further hole formed through the end wall, and the second housing includes a second locating pin that is arranged to protrude through the further hole to engage the solid-state lighting device PCB.

13. The downlight of any one of the preceding claims, wherein the solid-state lighting device is mounted in thermal contact with the first housing so that heat generated in use by the solid-state lighting device is transferred by conduction into the first housing, and the first housing is arranged to dissipate heat to the surrounding environment.

14. The downlight of any one of the preceding claims, wherein the first housing is fire resistant; and/or the first housing includes material that is arranged to

melt at a temperature that is greater than or equal to 900C; and/or the first housing is made from sheet material, the sheet material has a thickness in the range 0.2mm to 3mm, and the sheet material is pressed to form the housing.

15. The downlight of any one of the preceding claims, including a first part comprising a collar and a flange; and a second part comprising the first housing and the second housing, wherein the second part is pivotable with respect to the first part; and a seal arranged to seal the first part to the second part, said seal being arranged to deform to accommodate pivoting movement of the second part with respect to the first part; wherein the seal includes a membrane having an outer peripheral portion that sealably engages to the first part, an inner part that sealably engages to the second part, a flexible connector portion connecting the outer peripheral portion to the inner part; preferably the inner part is clamped between the first housing and the second housing.

16. The downlight of claim 15, including a retaining member arranged to hold the outer peripheral portion in contact with the first part, wherein the retaining member is annular and is resiliently deformable; preferably the retaining member is embedded in the seal.

17. The downlight according to any one of the preceding claims, including a lens module, wherein the lens module is removably mounted in the first housing, the lens module including a first flexible member having a first locating lug, the first housing includes a locating formation that is arranged to engage with the first locating lug; optionally the lens module is arranged to be removed from the first housing by means of a sucker tool.

18. A method for removing a lens module from a downlight, the method including providing a downlight having a first housing having an open side, a lens module located within the first housing, the lens module including a first flexible member having a first locating lug, wherein the first housing includes a locating formation and the first locating lug engages the first locating formation to retain the lens module within the first housing; the user attaching a sucker tool to an exposed surface of the lens module; and a user removing the lens module from the first housing through the open side of the first housing by applying a pulling force to the lens module via the sucker tool, the pulling force causing the first locating lug to automatically disengage from the first locating formation to release the lens module from the first housing.

19. A downlight, at least part of which is arranged to be mounted in an aperture in a partition, such as a ceiling, the downlight comprising: a first housing, said first housing having a front side and a rear side; a solid-state lighting device mounted within the first housing on the front side thereof; a second housing mounted to the rear side of the first housing; a driver arranged to convert a mains electrical signal to an electrical signal suitable for driving the solid-state lighting unit, wherein the driver is located in the second housing; an electrical connection assembly that is arranged to electrically connect the driver to the solid-state lighting device, the electrical connection assembly including first and second electrical connectors that are releasably attachable to one another to form an electrical connection and are separable from one another to break the electrical connection; and a lens module including a first flexible member having a first locating lug, wherein the first housing includes a locating formation that is arranged to engage with the first locating lug to retain the lens module within the first housing, the lens module is manually removable from the first housing through the open side of the first housing in response to a user manually applying a pulling force to the lens module, either directly or via a sucker tool, and wherein the first locating lug is arranged to automatically disengage from the locating formation in response to the pulling force applied to the lens module.

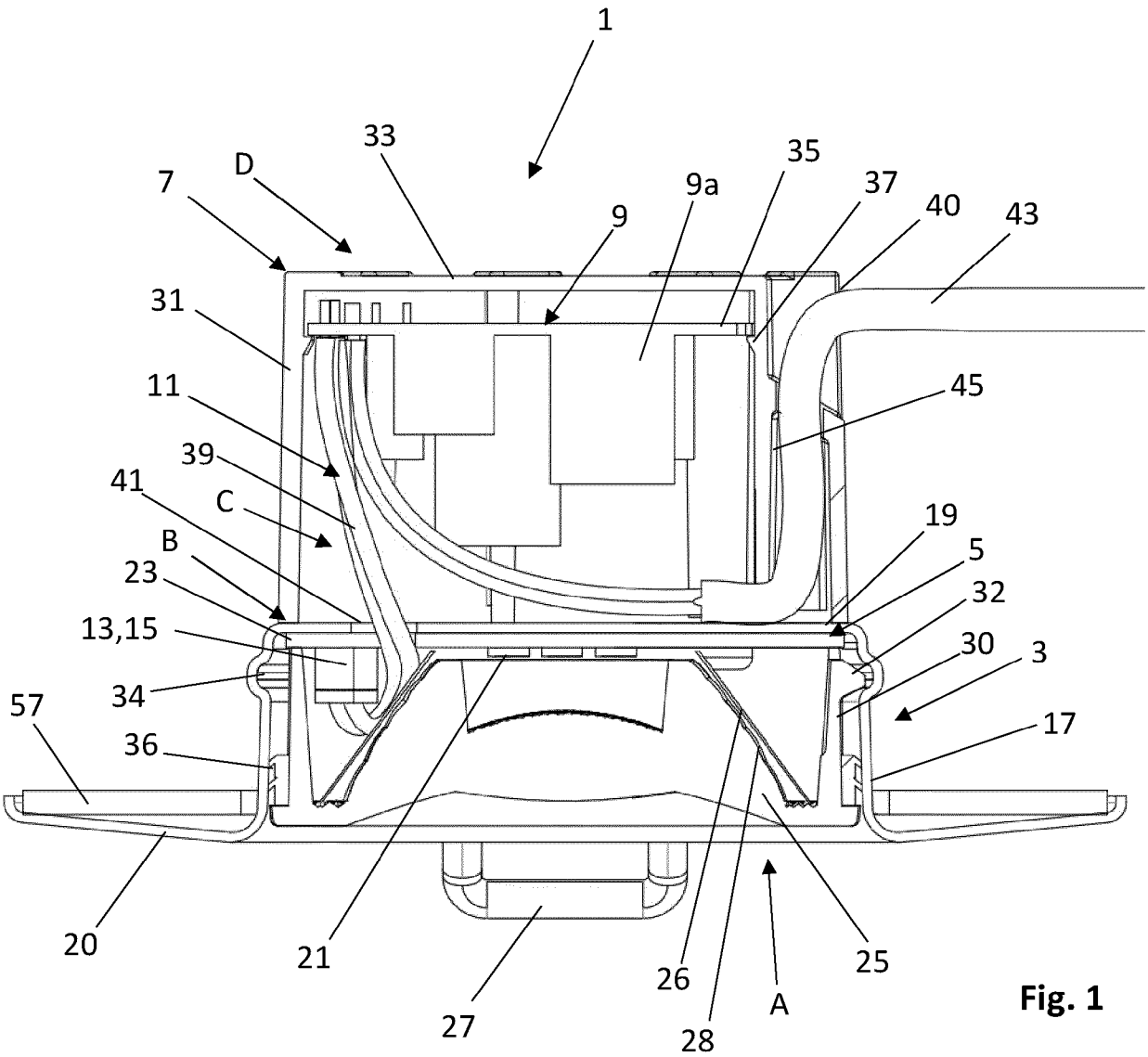
1
33
D
7
9
9a
35
37
40
43
31
45
11
39
41
C
B
23
13,15
34
57
36
19
5
32
30
3
17
20
21
27
26
28
A
25

Fig. 1

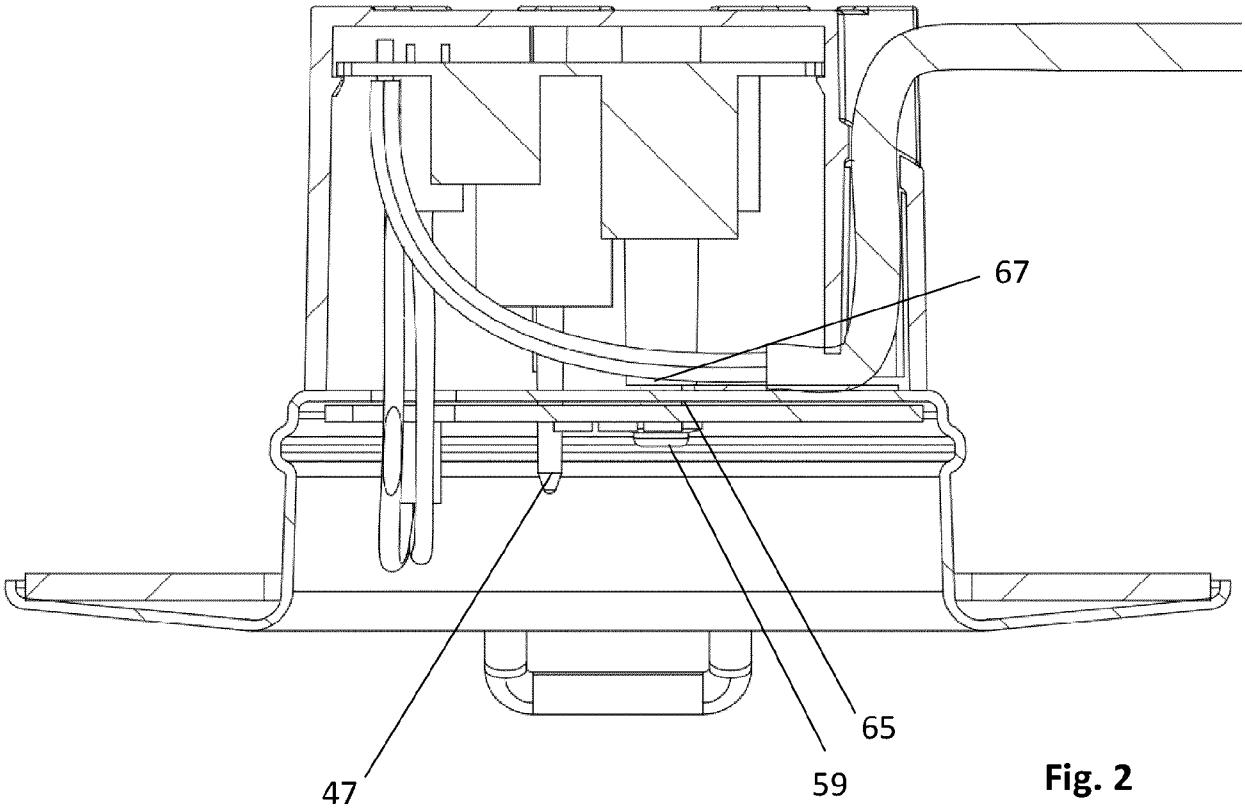

Fig. 2

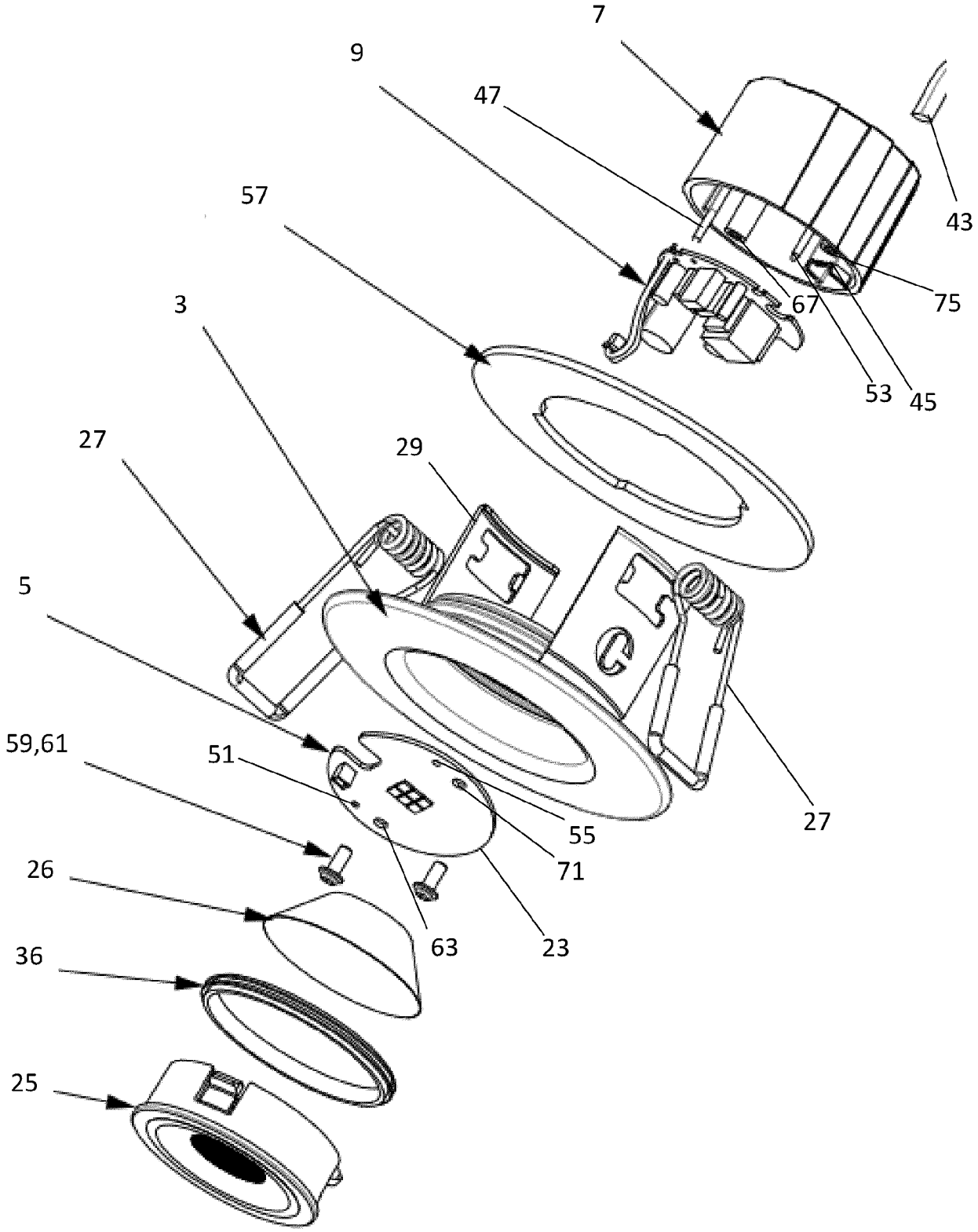

Fig. 3

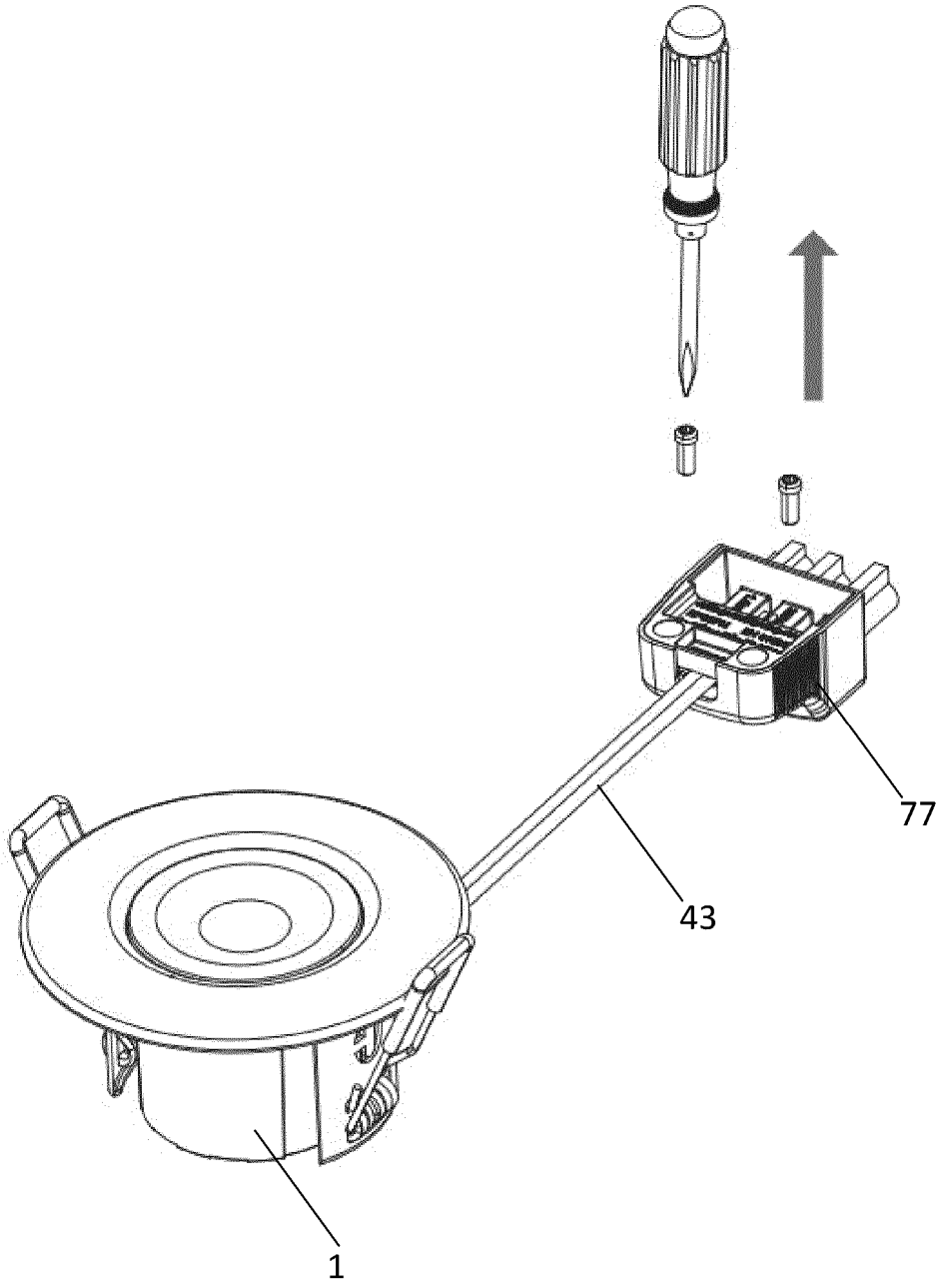

Fig. 4

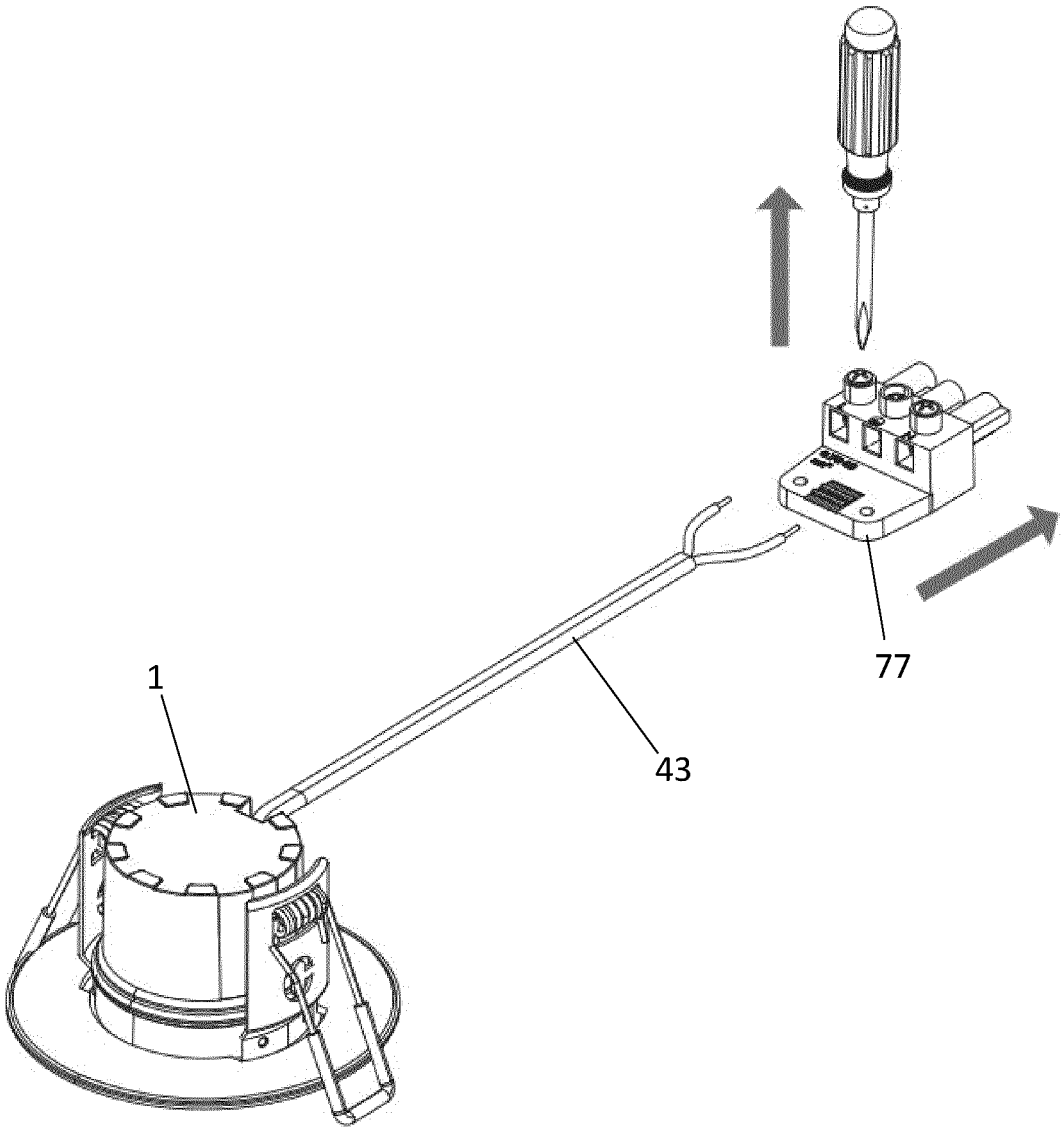

Fig. 5

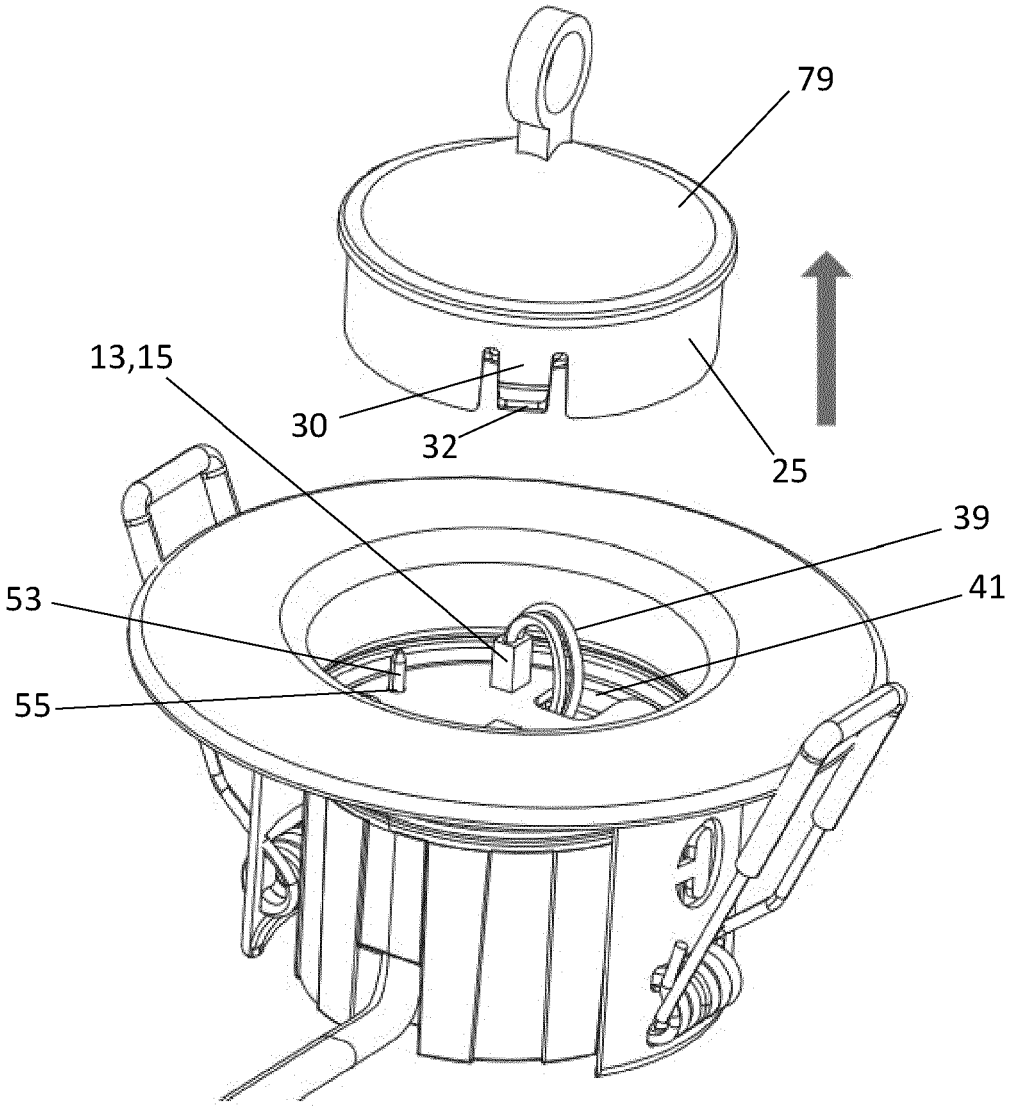

Fig. 6

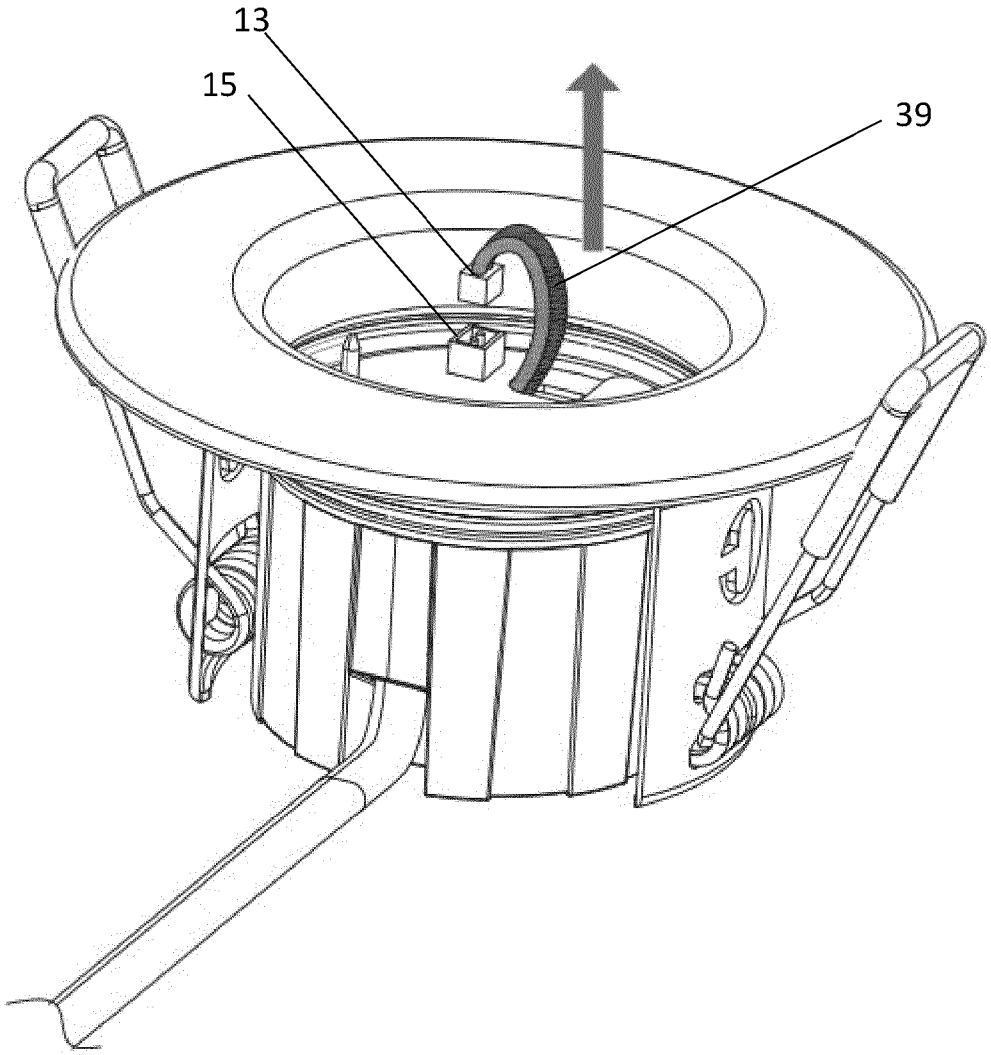

Fig. 7

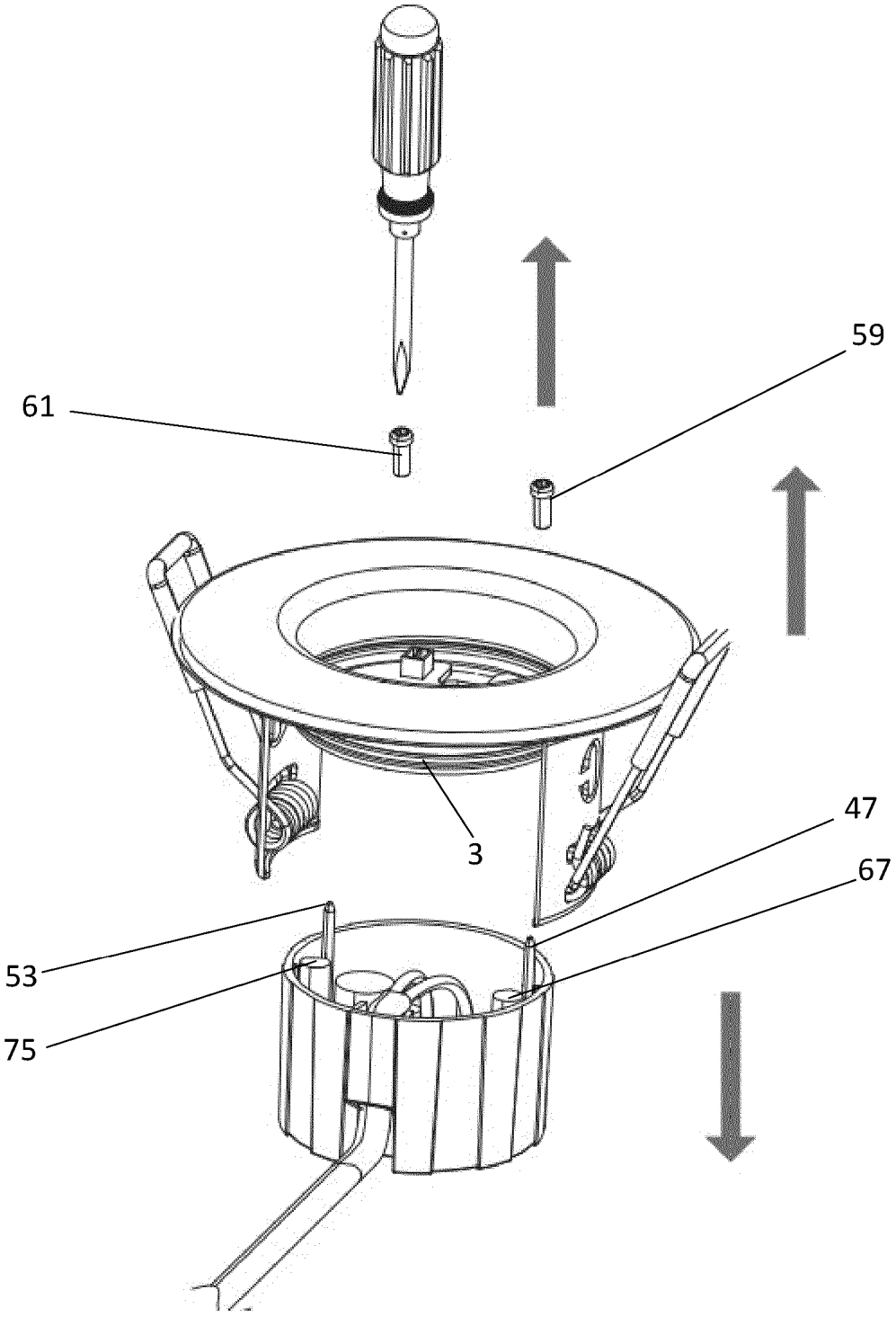

Fig. 8

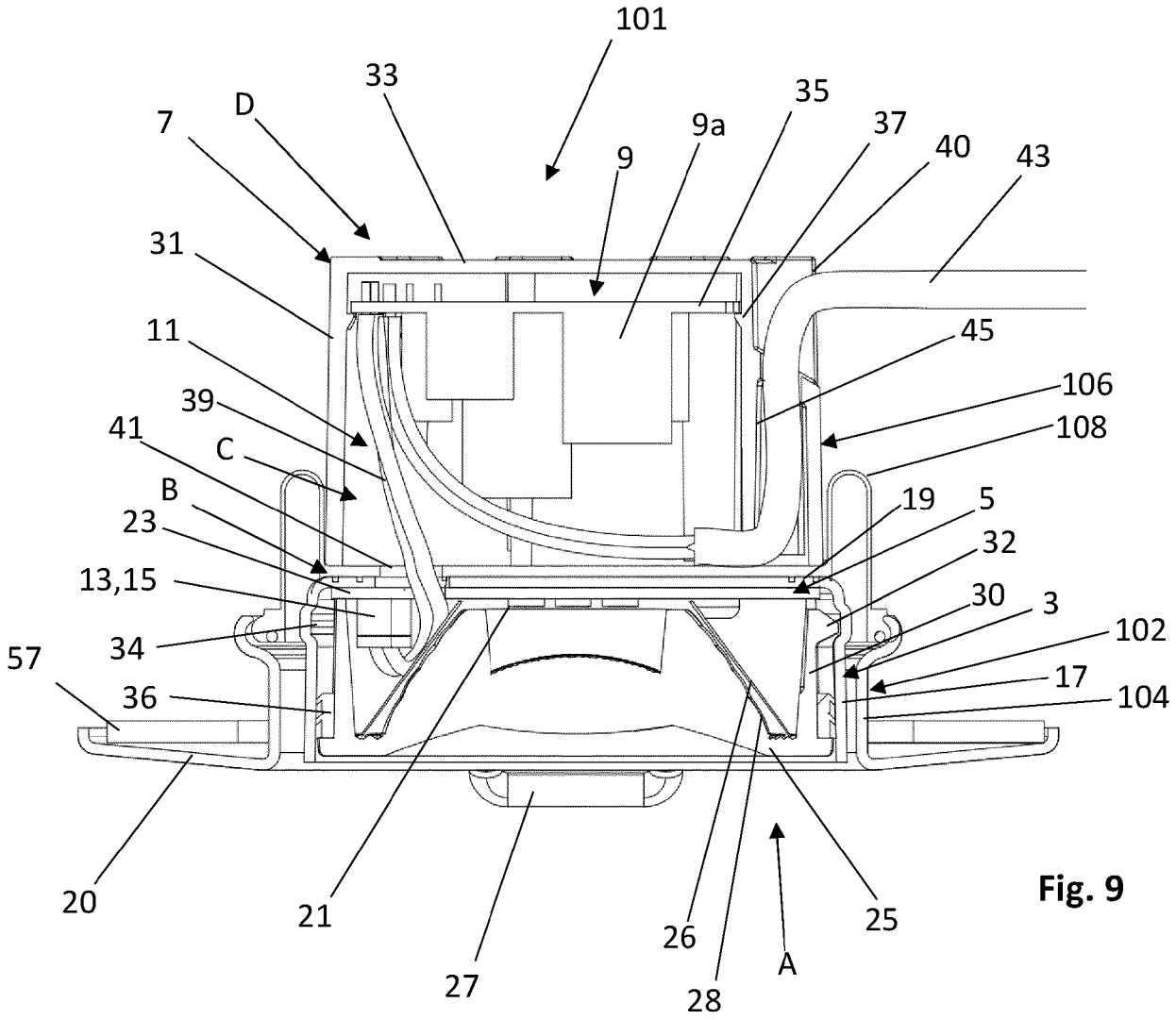
101
33
D
7
9
9a
35
37
40
43
31
11
45
106
39
108
41
C
B
19
5
23
32
13,15
30
3
34
102
57
17
36
104
20
21
27
26
28
A
25

Fig. 9

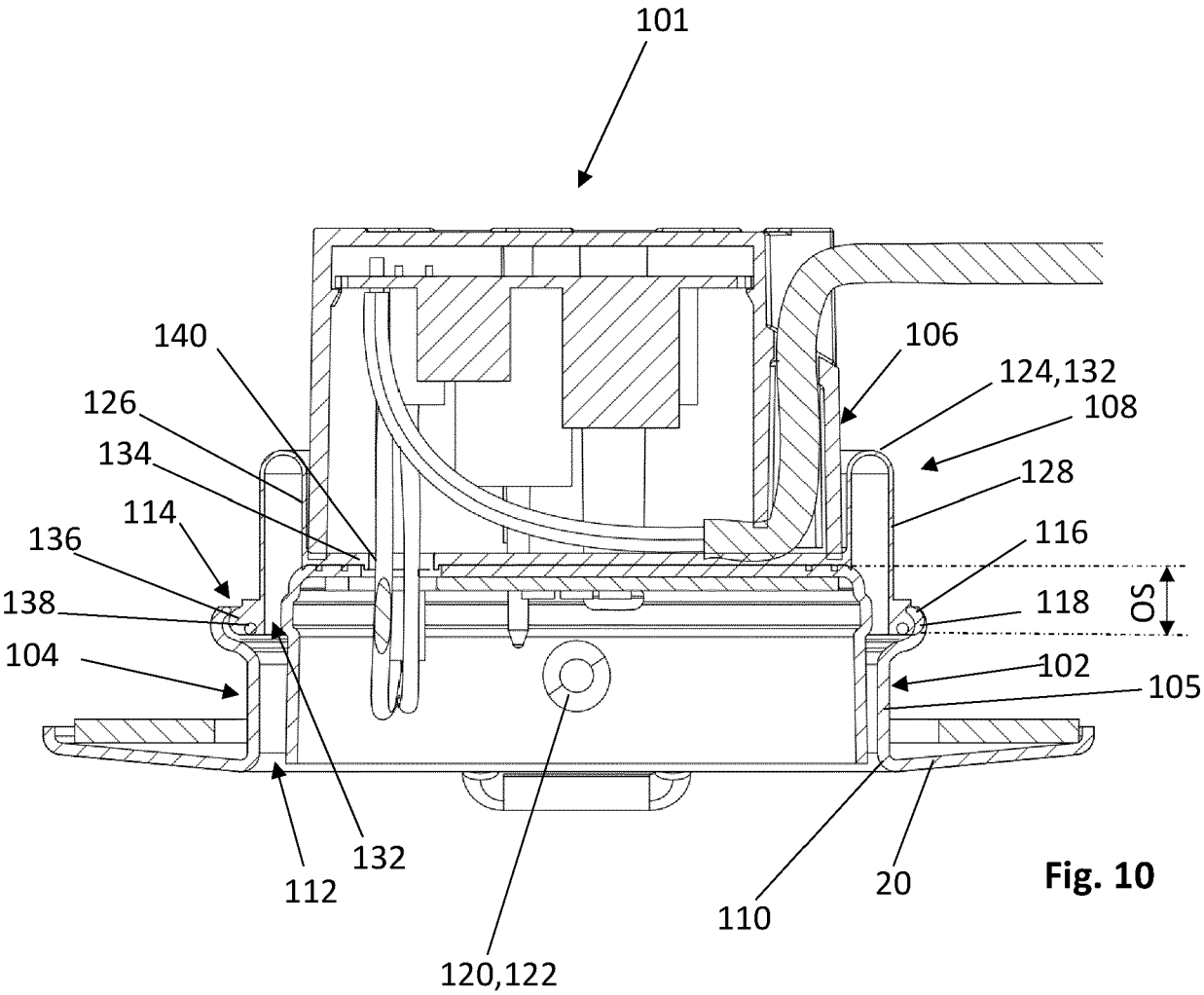
101
140
126
134
114
136
138
104
106
124,132
108
128
116
118
OS
102
105
132
112
120,122
110
20

Fig. 10

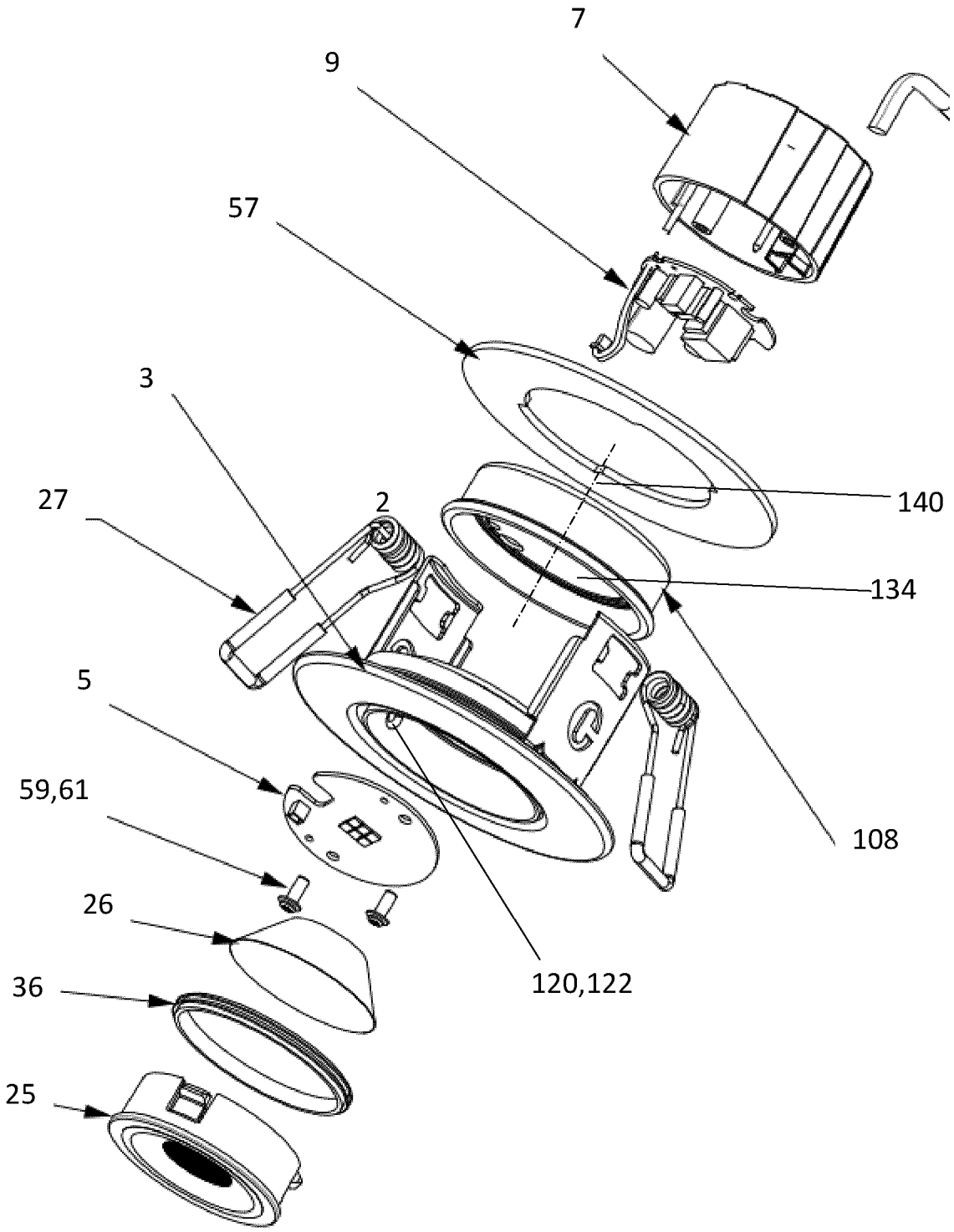

Fig. 11

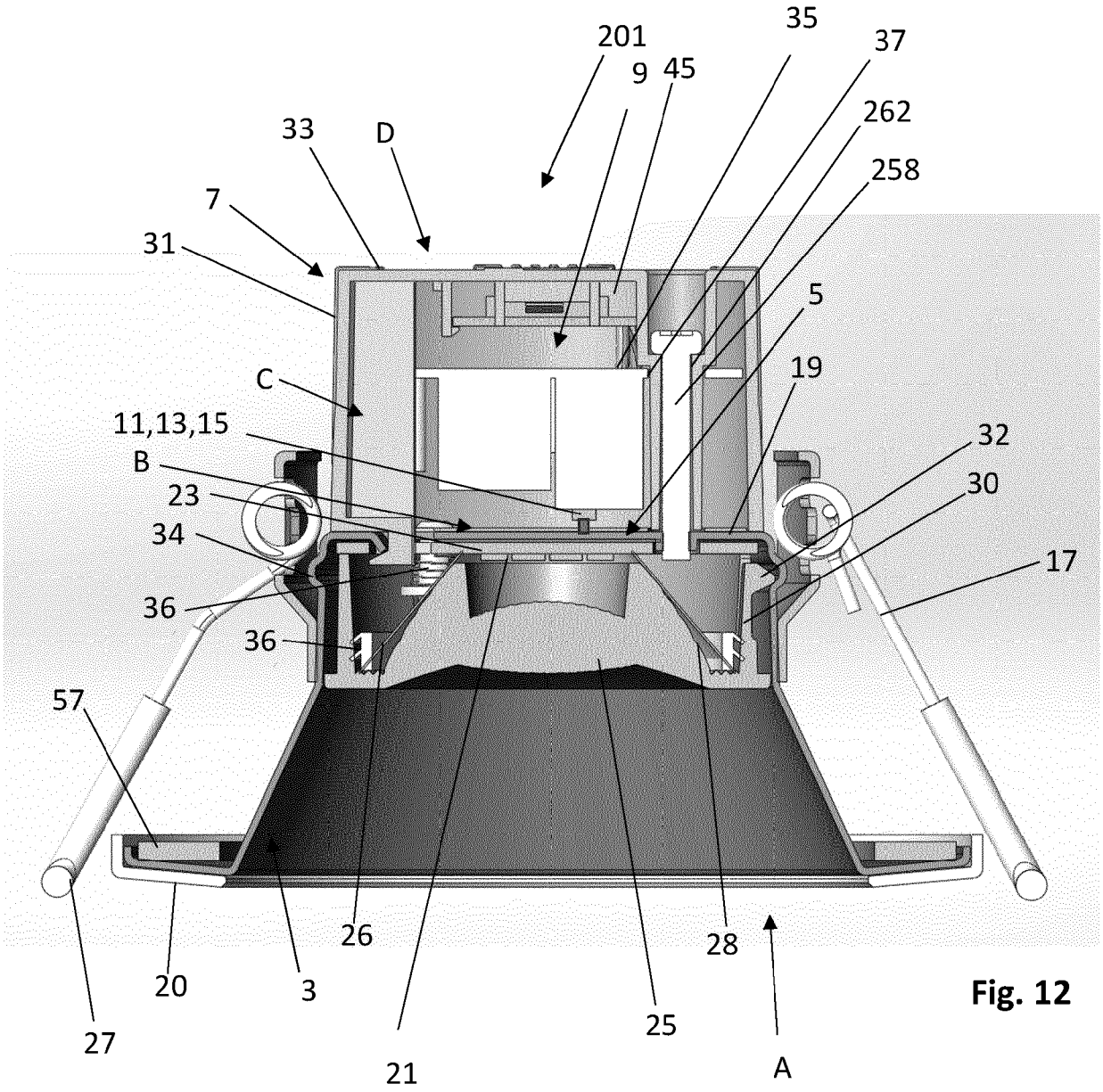
201
35
37
9
45
262
33
D
258
7
31
5
C
19
11,13,15
32
B
30
23
34
17
36
36
57
26
28
20
3
25
27
21
A

Fig. 12

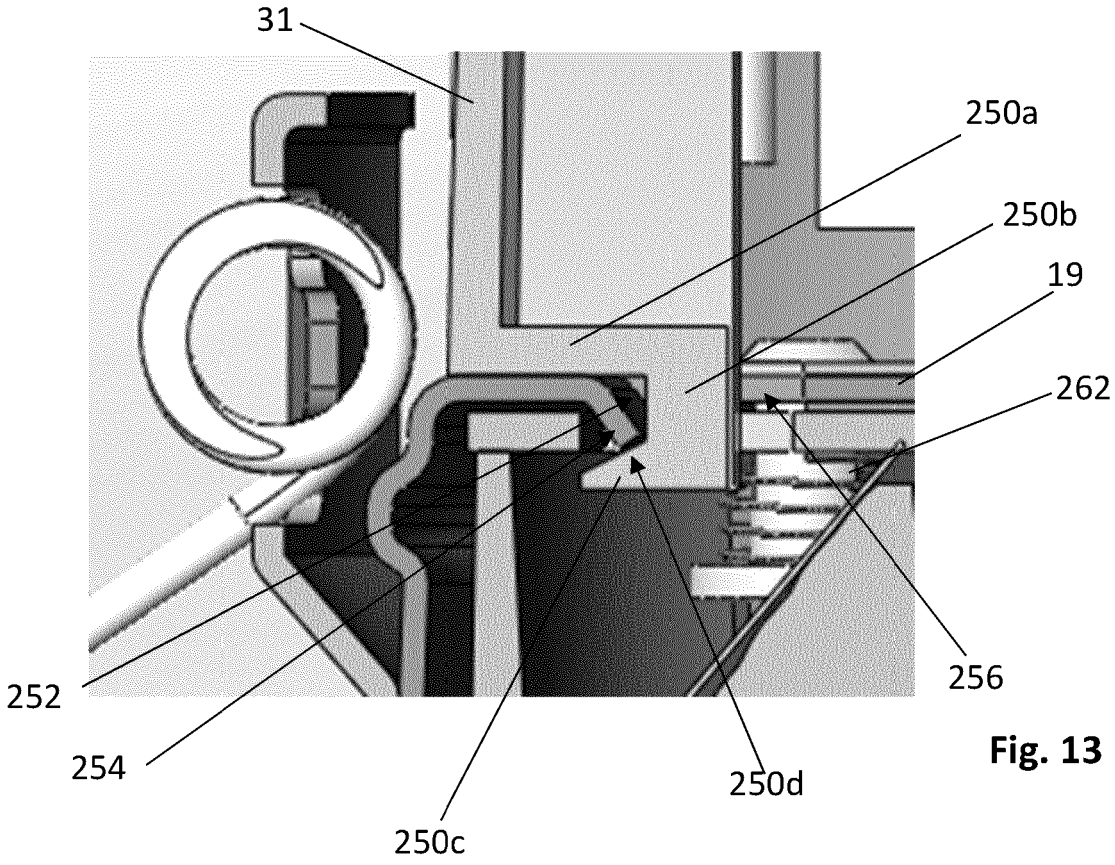

Fig. 13

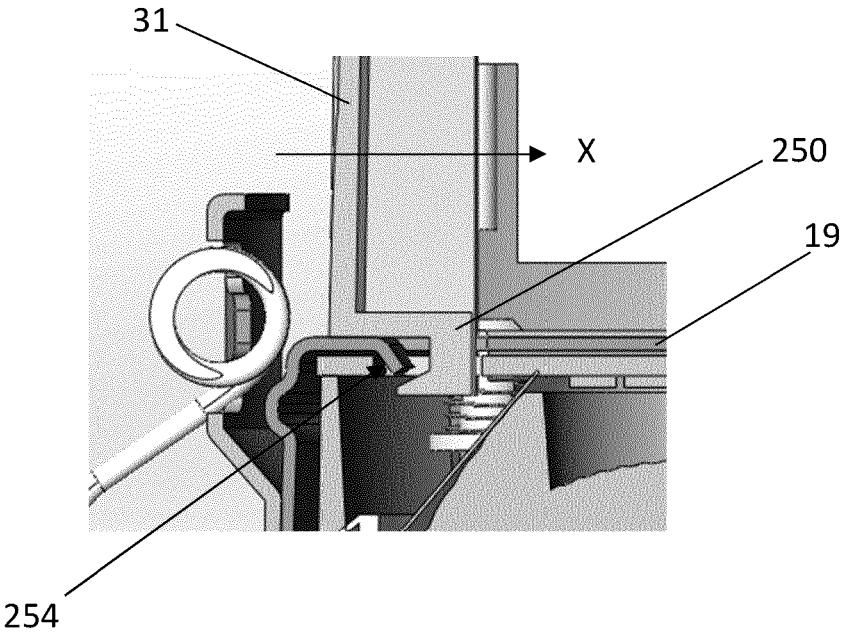

Fig. 14

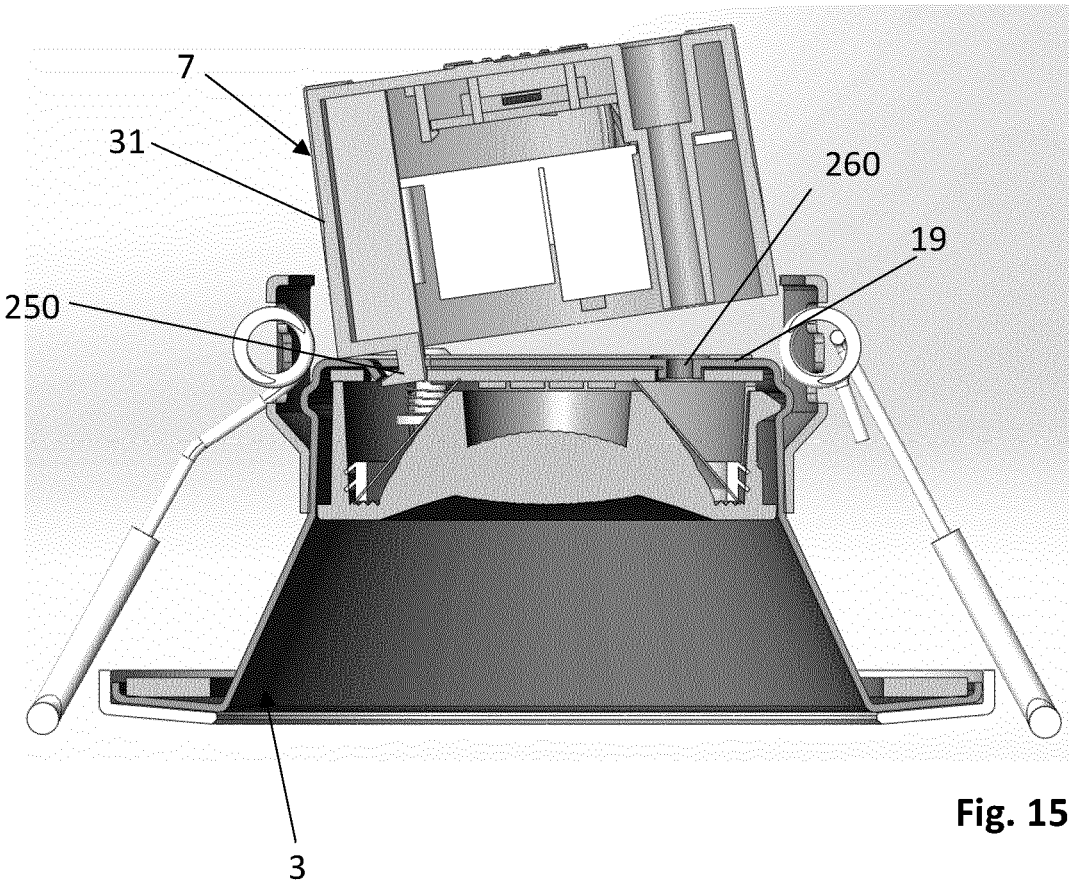

Fig. 15