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(54) LED lighting device and LED lighting arrangement

(57) A lighting device (100), comprising a track connector (102) comprising a first electrical contact (101) for electrically contacting a corresponding electrical conductor of a track and comprising mechanical fixation means for mechanically fixating the track connector (102) to the track, and a LED module comprising at least one LED (107) provided on a substrate (106), the LED module being mounted on the track connector (102) and electrically contacting the track connector (102). A lighting arrangement (200), comprises the lighting device (200) and

a track comprising a housing (110) of thermally conductive material with at least one open side for mechanically and electrically receiving the track connector (102), and comprising an electrical conductor (103) on an inside of the housing (110), wherein the electrical conductor (103) is electrically isolated from the housing (110), the first electrical contact (101) of the track connector (102) being aligned with and electrically contacting the corresponding electrical conductor (103) of the track, and wherein a part of a surface of the substrate (106) of the LED module thermally contacts a surface (114) of the track.

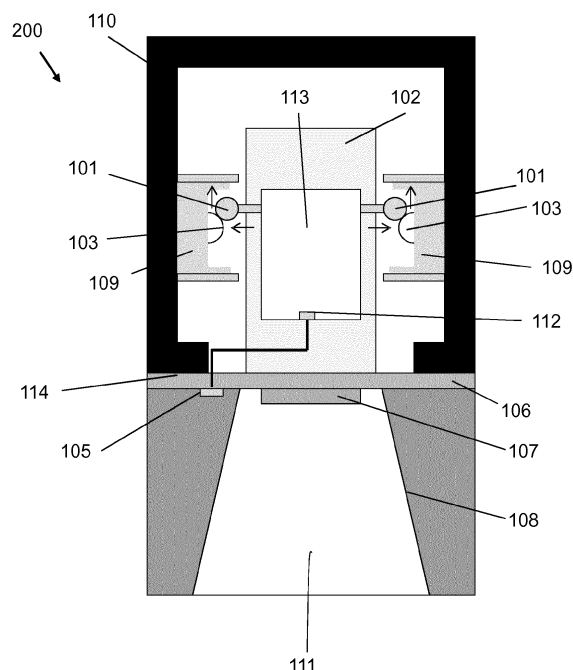


Fig. 3

EP 2 672 177 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to the field of lighting systems, and more specifically to a rail or track system for lighting devices.

BACKGROUND OF THE INVENTION

[0002] In a lighting system lighting devices are mechanically attached via a track connector anywhere on a continuous track or rail which comprises electrical conductors for electrically contacting the lighting device to, for example, a power supply. The track comprises a housing with one open side for mechanically and electrically receiving the track connector. The track may have more than one conductor electrically isolated from the housing, so that multiple switched circuits can be used to control different lighting devices on the same track. The electrical conductors for powering the devices and for (digital) communication are located at the inside of the housing of the track. These lighting systems with tracks can be mounted to ceilings or walls, lengthwise down beams or crosswise across rafters or joists. The systems can also be mounted on relatively high locations, like ceilings, using rods. Typical systems are supplied with a line voltage (100V in Japan, 120V in North America, 240V elsewhere) via a recessed track.

[0003] Lighting systems with tracks on which the lighting devices are mounted are also available with a low voltage applied to the track, for example 12V or 24V supplied by a transformer. Also electrical conductors for digital control interfaces such as DALI may be incorporated in the track to independently control the lighting devices. The lighting devices are attached in different ways to the track through track connectors suitable for a specific track design.

[0004] Nowadays more lighting devices comprise Light Emitting Diodes (LEDs). Also track lighting systems are available for LED lamps. Furthermore, the LED lamps comprise heat sinks to transport the heat generated by the LEDs away in order to prevent overheating of the LEDs.

SUMMARY OF THE INVENTION

[0005] It is an object of the present invention to provide an improved lighting device comprising a LED module for use with a track and a lighting arrangement comprising track and a LED module.

[0006] According to an aspect of the present invention a lighting device is provided which comprises a track connector comprising a first electrical contact for electrically contacting a corresponding electrical conductor of a track and comprising mechanical fixation means for mechanically fixating the track connector to the track, and a LED module comprising at least one LED provided on a sub-

strate, the LED module being mounted on the track connector and electrically contacting the track connector.

[0007] The present invention provides for a smaller and flatter design of a lighting device suitable for a track lighting system by providing the possibility to mount a LED module which is provided on a substrate directly onto the track connector. Optionally the substrate of the LED module has a width that is larger than a width of the track connector such that the substrate abuts the track when it is mounted to the track.

[0008] Optionally the electrical contacts are comprised in the mechanical fixation means thereby combining two functions in the mechanical fixation means: mechanical fixation of the track connector to the track and electrically contacting the track connector to the track.

[0009] In an embodiment the LED module further comprises an optical element. The optical element may be a reflector or a collimator. Obviously the optical element is mounted on the light emitting surface of the LED module.

[0010] In an embodiment the LED module electrically connects to the first electrical contact or a second electrical contact of the track connector via a bottom surface of the substrate. The bottom surface of the substrate is in this case the surface opposite to a surface on which the LED is provided. Advantageously electrical connection means between the LED module and the track connector are provided at a mechanical contact surface between the LED module and the track connector.

[0011] In an alternative embodiment the LED module electrically connects to the first electrical contact or a second electrical contact of the track connector via electrical connection means provided on a top surface of the LED module. The top surface of the substrate is in this case the surface on which the LED is provided. For example, an electrical wire provides for the electrical connection between the LED module and the track connector.

[0012] In an embodiment the substrate of LED module is a metal core PCB.

[0013] In an embodiment the LED module further thermally contacts the track connector and the track connector comprises a heat conducting material. Advantageously the track connector functions as a heat sink and a separate heat sink for the LED module is not required.

[0014] In an embodiment the track connector further comprises an electronic circuit for supplying power to the LED module. In this way less space is required for electronic circuits because the electronic circuit is integrated in the track connector. Preferably, the electronic circuit is adapted to convert a voltage to a current which is supplied to the LED module.

[0015] In an embodiment the LED module is mounted on the track connector via screwing or gluing.

[0016] According to another aspect of the present invention a lighting arrangement is provided comprising a lighting device as described above, the lighting arrangement further comprising a track comprising a housing of thermally conductive material with at least one open

side for mechanically and electrically receiving the track connector, and comprising an electrical conductor on an inside of the housing, wherein the electrical conductor is electrically isolated from the housing, the first electrical contact of the track connector being aligned with and electrically contacting the corresponding electrical conductor of the track, and wherein a part of a surface of the substrate of the LED module thermally contacts a surface of the housing of the track.

[0017] The track connector provides for a thermal connection between the LED, which is attached to the track connector, and the track, which, for example, comprises aluminum material. The present invention provides for a smaller and flatter design, because the LED does not need to be equipped separately with a heat sink because the heat conducting material of the track functions as the heat sink. Furthermore, the track has a larger surface and volume than the standard heat sinks of the LEDs, thus leading to a lower temperature and improved heat sinking properties of the lighting arrangement, which improves the lifetime and efficiency of the LED and the lighting arrangement. Alternatively, less LED light sources may be used wherein each LED is driven with a higher power to produce the same total light output.

[0018] In an embodiment a bottom surface of the track connector is flush with the surface of the housing of the track which thermally contacts the part of the substrate of the LED module. In this way, the bottom surface of the track connector is in-line with the bottom surface of the track and an improved thermal contact between the LED module and the track is ensured.

[0019] In an embodiment the mechanical fixation means of the track connector provides for a force which presses the substrate of the LED module against the surface of the housing of the track. A sufficient thermal contact is achieved by an appropriate mechanical fixation of the track connector to the track, which provides for a force which presses a bottom surface the substrate of the LED module against a surface of the housing of the track. A sufficient thermal interface means in this context that the heat that is generated by the LED module can be transported via the thermal interface to the housing of the track such that the performance of the LED module is not affected in a negative way by a temperature rise.

[0020] In an embodiment the thermally conductive material of the housing of the track comprises aluminum. Aluminum is a material which is a good thermal conductor and thus provides for a heat sink with a relatively good thermal performance.

[0021] In an embodiment a thermal paste is provided between the surface of the substrate of the LED module and the surface of the housing of the track which thermally contacts the surface of the substrate of the LED module. In this way a further improvement of the thermal interface between the LED module and the track is achieved.

[0022] In an embodiment the lighting arrangement further comprises a track connection means for mechani-

cally and electrically connecting the track to another track, wherein the track connection means comprises an electronic circuit. For example, the electronic circuit may be a sensor, a communication module, a LED driver module and/or any other electronic circuit required for the lighting arrangement. In this way, the track will not be cluttered with electronic circuits due to the fact that the electronic circuit is integrated in the track connection means which is used to mechanically interconnect different tracks or to connect the track to a separate device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] These and other aspects of the present invention will now be described in more detail, with reference to the appended drawings showing example embodiments of the invention, wherein:

Fig. 1a illustrates a prior art cross-section of a track;

Fig. 1b shows a known track connector;

Fig. 2 shows a schematic cross-section of an embodiment of a lighting device according to an aspect of the invention; and

Fig. 3 shows a schematic cross-section of an embodiment of a lighting arrangement according to another aspect of the invention.

DETAILED DESCRIPTION

[0024] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which currently preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided for thoroughness and completeness, and fully convey the scope of the invention to the skilled addressee. Like reference characters refer to like elements throughout.

[0025] Referring now to the drawings and to Fig. 1a in particular, there is depicted a cross-section of a track 10 known in the art, comprising a housing 11 with an open side 13 and electrical conductors 12. Fig. 1b shows an embodiment of a known track connector 20 which is suitable to be mechanically mounted inside track 10 via the opening or open side 13 of the track 10. Protrusions 22 provide for an electrical connection to the conductors 12 of the track 10 and furthermore provide for a mechanical fixation of the track connector 20 to the track 10 together with mechanical fixation means 25. The protrusions 22 are activated via a mechanical switch 23 after insertion of the track connector 20 into the track 10 via the open side or opening 13. To be sure that the track connector 20 is inserted at the right location before activating the switch, track connector 20 comprises surfaces 24 that abut a bottom surface 14 of the track 10 when inserted at the appropriate location such that after activation of the mechanical switch 23 the protrusions 22 extend out-

wardly and contact the corresponding electrical conductors 12 of the track 10.

[0026] Fig.2 shows a schematic cross-section of an embodiment of a lighting device 100 according to the invention. The lighting device 100 comprises a LED 107 mounted on a substrate 106, which is for example a metal core PCB. Alternatively more than one LED is mounted on the substrate 106. The light is emitted in a direction of a light output window 111. In this embodiment an optional reflector 108 is shown, which may also be another optical element, such as a collimator. Alternatively, the lighting device 100 does not comprise an optical element, or the optical element is integrated with the LED 107, for example a dome over the LED 107. The substrate 106 is mounted on a track connector 102 via a bottom surface of the substrate 106, which is the surface opposite to a surface on which the LED 107 is provided. The track connector 102 comprises a first electrical contact 101 suitable for contacting to corresponding electrical contacts of a track (not shown) and which ultimately provides for transport of the power required, for example, to power the LED. The first electrical contact 101 in this example may also provide for a mechanical fixation of the track connector to the track, which is explained in more detailed in the text corresponding to Fig.3.

[0027] Optionally, the track connector 102 further comprises a second electrical contact 112 which is in this case electrically connected to a substrate electrical contact 105 on a top surface of the substrate 106 and which provides for an electrical connection between the LED 107 and the first electrical contact 101 of the track connector 102 via internal wiring for example. Alternatively, there is a direct electrical connection, e.g. via a wire, between the substrate electrical contact 105 and the first electrical contact 101 of the track connector 102. In this embodiment the electrical connection is on the side opposite to the bottom surface of the substrate, however it is also possible to provide for an electrical connection between the LED 107 and the track connector 102 through the substrate 106 via so-called through vias. Furthermore, in this embodiment the track connector comprises an electronic circuit 113 which, for example, comprises driver electronics that provides a supply current to the LED 107. Alternatively the driver electronics is provided on the substrate 106, and no electronic circuit 113 is comprised in the track connector 102. A combination of the electronics circuit 113 integrated in the track connector 102 and another electronic circuit, such as for example a microcontroller, on the substrate 106 and connecting to the LED 107 is another embodiment. The track connector 102 may comprise a thermally conducting material such that it functions as the heat sink of the LED module 107 via thermal conduction of heat from the LED 107 through the substrate 106 to the track connector 102.

[0028] Fig. 3 shows a lighting arrangement 200 according to the invention in which the lighting device 100 is mechanically fixed. The lighting arrangement 200 comprises a track housing 110, which comprises a heat con-

ducting material, for example aluminum. In this example the track housing 110 comprises at least one open side, which is used to insert the track connector 102 into the track housing 110. The track housing 110 extends in a linear direction and Fig. 3 shows a cross-section in a plane perpendicular to this linear direction. A part of the bottom surface of the substrate 106 abuts and thermally contacts a surface 114 of the track housing 110. Optionally a thermally conducting paste is provided on the surface 114 to further improve the thermal properties of the thermal contact. The first electrical contact 101 of the track connector 102 electrically contacts a track electrical conductor 103. In this embodiment two first electrical contacts 101 electrically contact two corresponding track electrical conductors 103. A power source unit (not shown) provides for the supply of power, e.g. voltage, to the track electrical conductor 103. Furthermore, the first electrical contact 101 of the track connector 102 and the track electrical conductor 103 provide in this case for a mechanical fixation of the track connector 102 to the track housing 110 as is indicated with the horizontal arrows. The first electrical contact 101 is movable in a linear direction (see arrows), inwardly and outwardly of the track connector 102, e.g. via a spring arrangement, and the first electrical contact 101 including the track connector 102 are forced to abut the track electrical conductor 103 by an outwardly oriented force of the first electrical contact 101. Additionally, this mechanical fixation provides for a force in a vertical direction that provides for a firm abutment of the substrate 106 against the surface 114 of the track housing 110, as is indicated with the vertical arrows. For example, ball joints may be used as the mechanical fixation means. In this way the shape of the track electrical conductor 103, for example a ball, in combination with the shape of the first electrical contact 101, for example also ball shaped, and the outwardly pressing force of the first electrical contact 101 forces the track connector 102 to be mechanically fixed to the track housing 110 while at the same time providing an electrical connection between the track connector 102 and the track housing 110. Alternatively, a mechanical fixation means separate from the first electrical contact may be provided. In this way a part of the substrate 106 functions as the abutment surface of the track connector 102 when inserting and aligning the track connector 102 at the right position in the track housing 110. In between the track housing 110 and track electrical conductor 103 an electrical insulator 109 is provided to ensure that the track housing 110 is electrically isolated.

[0029] In an embodiment the lighting arrangement 200 further comprises a track connection means (not shown) for mechanically and electrically connecting the track to another track. For example track housing with different lengths or for connecting track housings in different directions. Hence, the track connection means may be straight or bended. Optionally, the track connection means comprises an electronic circuit. For example, the electronic may be a sensor, a communication module, a

LED driver module and/or any other electronic circuits required for the lighting arrangement. In this way, the track housing 110 will not be cluttered with electronic circuits due to the fact that the electronic circuits are integrated in the track connection means that are used to connect different tracks or to connect the track to a separate device.

[0030] Even though the invention has been described with reference to specific exemplifying embodiments thereof, many different alterations, modifications and the like will become apparent for those skilled in the art. Variations to the disclosed embodiments can be understood and effected by the skilled addressee in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. For example, the light converting device may be connected to even further group of light sources, i.e. the above described example embodiment having a first, a second and a fourth group of light sources connected to the light converting device should not be construed as limiting the scope of the present invention. Furthermore, in the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality.

Claims

1. A lighting device (100), comprising:

- a track connector (102) comprising a first electrical contact (101) for electrically contacting a corresponding electrical conductor of a track and comprising mechanical fixation means for mechanically fixating the track connector (102) to the track, and
- a LED module comprising at least one LED (107) provided on a substrate (106), the LED module being mounted on the track connector (102) and electrically contacting the track connector (102).

2. The lighting device (100) according to claim 1, wherein the LED module further comprises an optical element (108).

3. The lighting device (100) according to claim 1 or 2, wherein the LED module electrically connects to the first electrical contact (101) or a second electrical contact (112) of the track connector (102) via a bottom surface of the substrate.

4. The lighting device (100) according to claim 1 or 2, wherein the LED module electrically connects to the first electrical contact (101) or a second electrical contact (112) of the track connector (102) via electrical connection means provided on a top surface of the LED module.

5. The lighting device (100) according to any of the previous claims, wherein the substrate (106) of the LED module is a metal core PCB.

6. The lighting device (100) according to any of the previous claims, wherein the LED module further thermally contacts the track connector (102) and wherein the track connector (102) comprises a heat conducting material.

7. The lighting device (100) according to any of the previous claims, wherein the track connector (102) further comprises an electronic circuit for supplying power to the LED module.

8. The lighting device (100) according to claim 7, wherein the electronic circuit is adapted to convert a voltage to a current which is supplied to the LED module.

9. The lighting device (100) according to any of the previous claims, wherein the LED module is mounted on the track connector (102) via screwing or gluing.

10. A lighting arrangement (200), comprising:

- a lighting device (100) according to any of the previous claims,
- a track comprising a housing (110) of thermally conductive material with at least one open side for mechanically and electrically receiving the track connector (102), and comprising an electrical conductor (103) on an inside of the housing (110), wherein the electrical conductor (103) is electrically isolated from the housing (110), the first electrical contact (101) of the track connector (102) being aligned with and electrically contacting the corresponding electrical conductor (103) of the track, and wherein a part of a surface of the substrate (106) of the LED module thermally contacts a surface (114) of the housing (110) of the track.

11. The lighting arrangement (200) according to claim 10, wherein a bottom surface of the track connector (102) is flush with the surface (114) of the housing of the track which thermally contacts the part of the substrate of the LED module.

12. The lighting arrangement (200) according to claim 10 or 11, wherein the mechanical fixation means of the track connector (102) provides for a force which presses the substrate (106) of the LED module against the surface (114) of the housing (110) of the track.

13. The lighting arrangement (200) according to any of claims 10 to 12, wherein the thermally conductive

material of the housing (110) of the track comprises aluminum.

14. The lighting arrangement (200) according to any of claims 10 to 13, wherein a thermal paste is provided between the surface of the substrate (106) of the LED module and the surface (114) of the housing (110) of the track which thermally contacts the surface of the substrate (106) of the LED module.
15. The lighting arrangement (200) according to any of claims 10 to 14, further comprising a track connection means for mechanically and electrically connecting the track to another track, wherein the track connection means comprises an electronic circuit.

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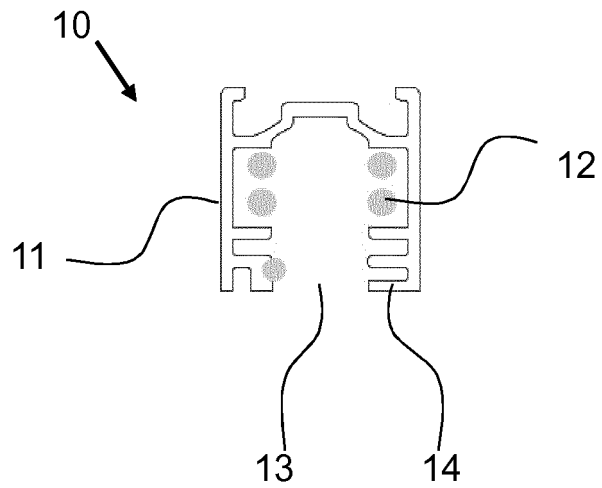


Fig. 1a (PRIOR ART)

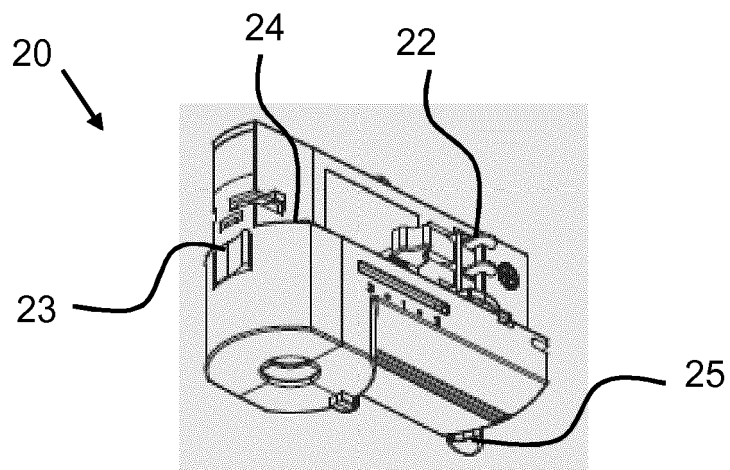


Fig. 1b (PRIOR ART)

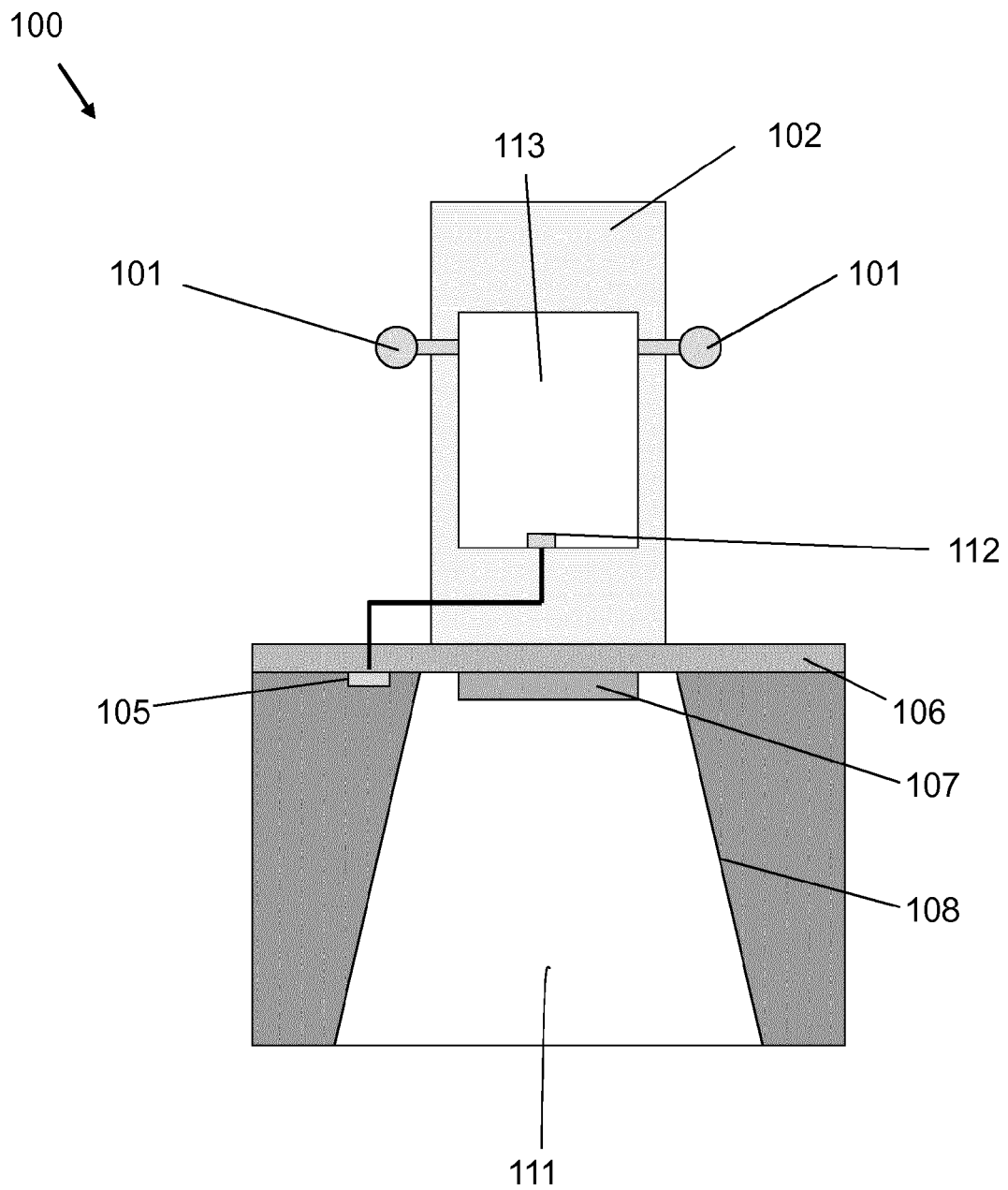


Fig. 2

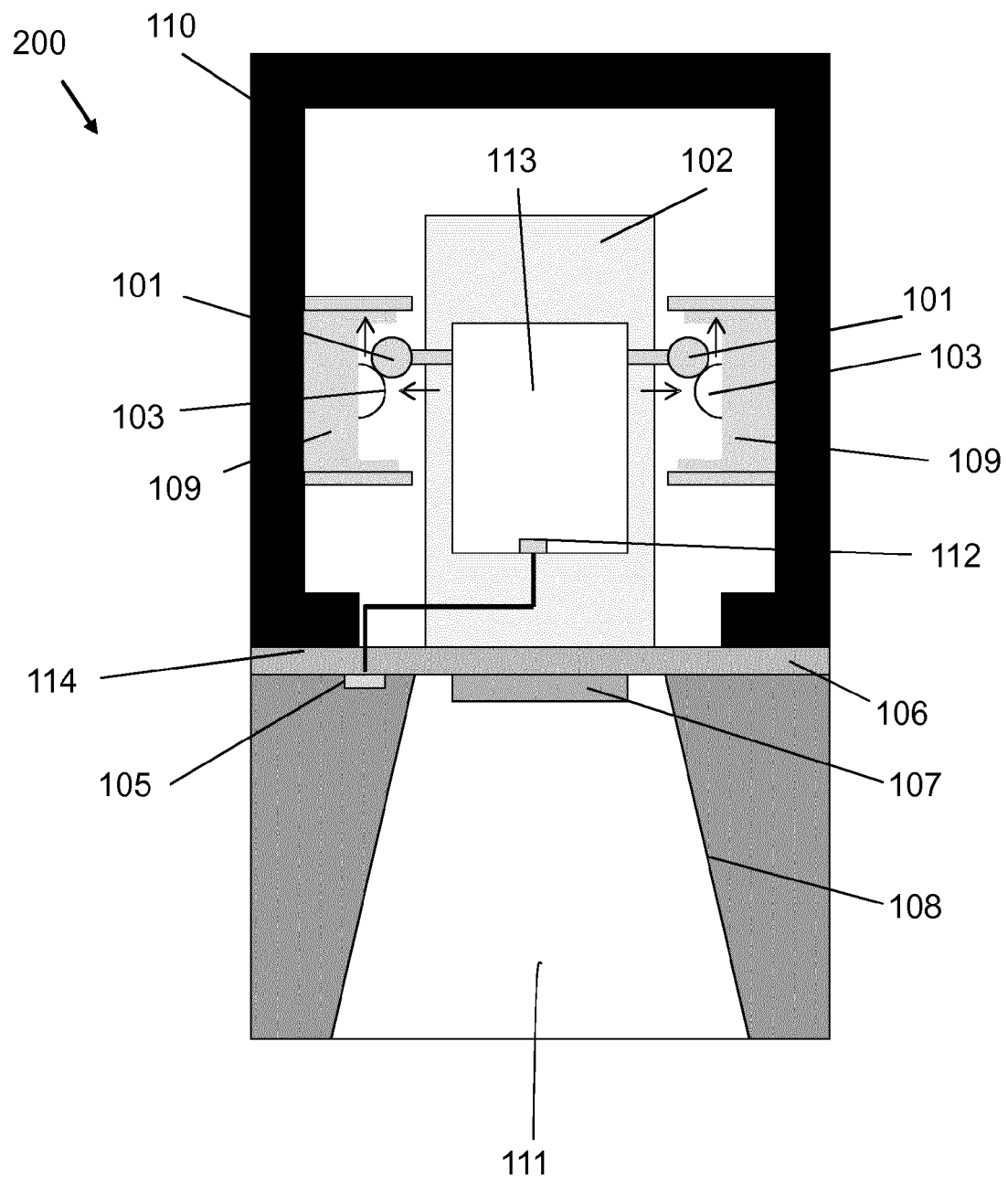


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 12 17 1169

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 1 November 2012	Examiner Amerongen, Wim
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 12 17 1169

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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