



(51) International Patent Classification:

F21V 14/06 (2006.01) *F21V 21/30* (2006.01)
F21V 21/15 (2006.01) *F21V 14/02* (2006.01)

(21) International Application Number:

PCT/EP2020/081569

(22) International Filing Date:

10 November 2020 (10.11.2020)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

PCT/CN2019/117827

20157586.7 13 November 2019 (13.11.2019) CN
17 February 2020 (17.02.2020) EP

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(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD,

(54) Title: LIGHTING DEVICE

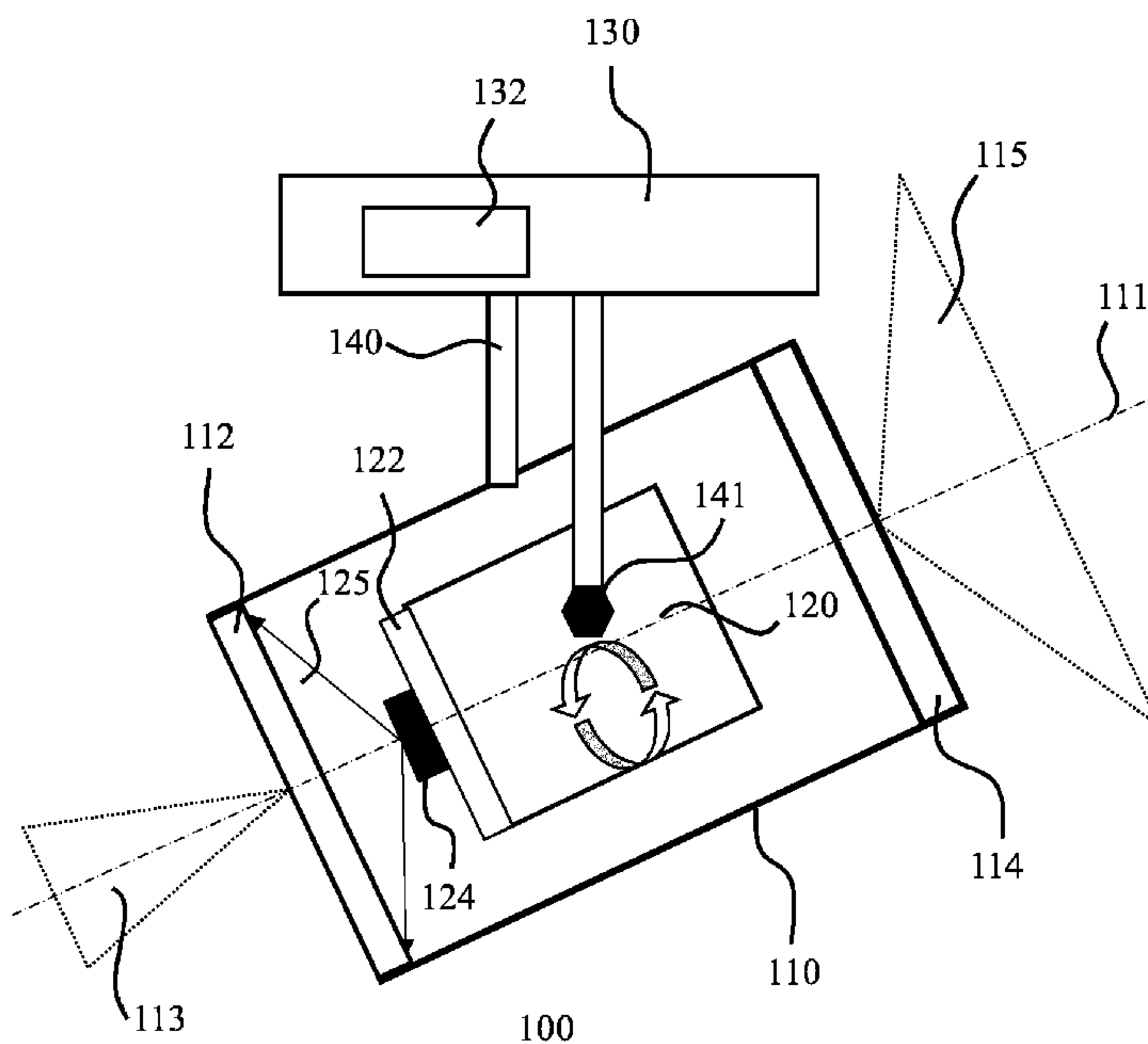


FIG. 1

(57) Abstract: A lighting device (100) is disclosed comprising a tubular housing (110) having a first beam shaping element (112) at a first end and a second beam shaping element (114) at a second end opposing said first end, the first beam shaping element being different to the second beam shaping element, a holder (130, 140) of said tubular housing, the tubular housing being rotatably mounted on said holder such that the first beam shaping element and the second beam shaping element are interchangeable in space through rotation of said tubular housing relative to said holder; and a light engine arrangement (124, 128) within said tubular housing arranged to generate a first beam (113) having a beam angle in a first range of beam angles with the first beam shaping element and generate a second beam (115) having a beam angle in a second range of beam angles different to the first range of beam angles with the second beam shaping element; wherein the lighting device is operable in a first configuration in which the light engine arrangement generates

ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available):* ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

— *with international search report (Art. 21(3))*

LIGHTING DEVICE

5 FIELD OF THE INVENTION

The present invention relates to a lighting device comprising a housing having a first beam shaping element at a first end and a light engine arrangement within said housing arranged to generate a first beam with the first beam shaping element.

10 BACKGROUND OF THE INVENTION

In accent lighting, a lighting device is used to project a light beam onto an object or area of interest in order to highlight or otherwise draw attention to this object or area. This for example may require illuminating the object or area with a light beam having a certain beam angle, e.g. a narrow beam angle in a range of 6-18°, or a wide
15 beam angle in a range of 18-36° for example. In application domains where such accent lighting is applied, such as retail lighting for example, a space to be illuminated may require a mixture of accent lighting, e.g. a mixture of narrow and wide beams to create the desired lighting atmosphere across the space with lighting devices such as spot lights. For example, particular objects may be highlighted with light beams having narrow beam
20 angles whereas other areas may be illuminated using wider angle light beams.

This therefore requires the provision of lighting devices that can produce light beams having narrow beam angles as well as lighting devices that can produce light beams having wide beam angles. For this purpose, lighting devices dedicated to providing light beams having narrow beam angles and lighting devices dedicated to
25 providing light beams having wide beam angles may be provided. However, this is cumbersome where the area to be illuminated is reconfigured, e.g. because a shop display is redesigned, as this may require the physical interchanging of such dedicated lighting devices in order to achieve the desired lighting effect in the reconfigured area, which is time-consuming.

30 It is known to implement zoom functionality in a lighting device, which may be used to alter the beam angle of the light beam produced with such a lighting device.

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However, such optics can be costly, and may not be sufficient to cover the full range of beam angles to be produced by the lighting device. Alternatively, US 2015/0009677 A1 discloses a light source with arrangements of multiple LEDs disposed at or near the focus of a reflecting optic having multiple segments to facilitate a variation in the angular distribution of the light beam (the beam divergence) via the drive currents supplied to the LEDs. However, such a device requires a complex reflecting optic to achieve multiple beam angles, and may not be capable of generating the full range of beam angles required in certain application domains such as retail lighting.

WO2010027160A2 discloses a digital spotlight including a light body provided with a lamp, a yoke for supporting the light body such that the light body moves in the forward and backward directions and in the lateral direction.

WO2019201634A1 discloses a lighting device comprising a plurality of solid state lighting elements arranged in a ring-shaped geometry; an optical element comprising a ring-shaped collimating structure configured to collimate light emitted by the plurality of solid state lighting elements; and light-mixing optics configured to mix light emitted by the plurality of solid state lighting elements.

WO2011127481A2 discloses a lighting apparatus which includes a Fresnel lens fixed in a housing which contains a tight array of high power LEDs. The LED panel or board is mated to a heat dissipating apparatus to provide active cooling and together forming an LED engine.

US20140085886A1 discloses a spotlight, with at least one closed housing, in which there are at least one light emitting diode arranged on a circuit board, a converging lens assigned to one of each aforesaid light emitting diodes and at least one dispersing lens that can be assigned to one of each aforementioned light emitting diodes.

SUMMARY OF THE INVENTION

The present invention seeks to provide a lighting device that can produce light beams with different beam angles that can be aimed at the same target location in a space to be illuminated in a relatively straightforward manner.

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According to an aspect, there is provided a lighting device comprising a tubular housing having a first beam shaping element at a first end and a second beam shaping element at a second end opposing said first end, the first beam shaping element being different to the second beam shaping element, a holder of said tubular housing, the tubular housing being rotatably mounted on said holder such that the first beam shaping element and the second beam shaping element are interchangeable in space through rotation of said tubular housing relative to said holder, and a light engine arrangement within said tubular housing arranged to generate a first beam having a beam angle in a first range of beam angles with the first beam shaping element and to generate a second beam having a beam angle in a second range of beam angles different to the first range of beam angles with the second beam shaping element, wherein the lighting device is operable in a first configuration in which the light engine arrangement generates the first beam only and a second configuration in which the light engine arrangement generates the second beam only; wherein the light engine arrangement comprises a body carrying one or more light sources within said tubular housing, and wherein said body is rotatable within the tubular housing.

The present invention is based on the insight that the provision of a lighting devices having beam shaping elements on opposite sides of its housing, e.g. a pair of different lenses such as Fresnel lenses and/or total internal reflection (TIR) lenses or a pair of differently shaped reflectors, for generating different beam angles in combination with the housing being rotatably mounted on (or in) a holder, both beam shaping elements can be aimed at the same target by rotation, e.g. swivelling, of the housing of the lighting device relative to its holder, such that beams with different beam angles may be aimed at a target location by simply rotating the lighting device such that the appropriate beam shaping element of the first and second beam shaping elements is aimed at the target location. The rotatable body within the tubular housing has the advantage that the light source arrangement requires a set of light sources on one side of the body only, e.g. on one side of a heat sink or the like, because the body may be rotated within the tubular housing such that the aim of the set of light sources can be redirected from the first beam shaping element to the second beam shaping element or vice versa.

The tubular housing may have a circular or rectangular cross-section, i.e. may be a round or square tube shape.

The first beam shaping element and the second beam shaping element may be individually selected from a group of non-imaging optical elements including a Fresnel
5 lens, a total internal reflection (TIR) lens and a reflector.

The holder may comprise a surface mount and a bracket extending from said surface mount, wherein said bracket is rotatably mounted on said surface mount. The rotation of the bracket relative to the surface mount allows for the swivelling of the tubular housing such that the location in space of the first beam shaping element and the
10 second beam shaping element in space may be interchanged. To this end, the tubular housing may be rotatably mounted in said bracket, e.g. to allow a particular end of the tubular housing to be aimed at a target location.

In an embodiment, the bracket further comprises an axle extending normally from a surface of said surface mount and through said tubular housing, and wherein said body
15 is mounted on said axle and is rotatable through said axle within the tubular housing.

The tubular housing may be secured on the axle or body through a spacer comprising a protruding pin mating with an arcuate channel in said tubular housing to define a range of rotation of the body around said axle. This for instance facilitates correct alignment of the set of light sources with one of the first and second beam shaping
20 elements, as the end points of the arcuate channel may define such a correct alignment.

The lighting device may further comprise a motor for rotating the tubular housing relative to said holder and a communication module, wherein said motor is responsive to said communication module. This for instance allows the remote readjustment of the aim of the lighting device, e.g. using a remote controller communicatively coupled to the
25 communication module, which may be advantageous in environments in which physical access to the lighting device is cumbersome.

In an embodiment, the light engine arrangement comprises a first arrangement of solid state lighting (SSL) elements as such SSL elements have benefits such as long lifetime, low energy consumption and robustness against physical shocks or the like.

30 Preferably, the first arrangement of solid state lighting elements comprises a plurality of individually addressable spatial arrangements of solid state lighting elements

for generating light beams having different beam angles with the first lens or the second lens. This further increases the functionality of the lighting device, as a range of different beam angles may be produced with each of the first beam shaping element and the second beam shaping element by engaging different spatial arrangements of the SSL elements.

5 The light engine arrangement may further comprise a second arrangement of solid state lighting elements arranged on the body opposing the first arrangement of solid state lighting elements. In this embodiment, the body carrying the light engine arrangement does not need to be rotatably mounted in the housing, as the light beams produced through the first beam shaping element and second beam shaping element respectively
10 may be generated using the first arrangement of SSL elements and the second arrangement of SSL elements respectively, thereby simplifying the mechanical design of the lighting device. However, where the first arrangement of SSL elements is different to the second arrangement of SSL elements, a rotatable body may still be advantageous because a different range of beam angles may be formed by the cooperation of the first
15 arrangement of SSL elements with one of the first and second beam shaping elements compared to with the cooperation of the second arrangement of SSL elements with the same beam shaping element.

 Preferably, the second arrangement of solid state lighting elements comprises a plurality of individually addressable spatial arrangements of solid state lighting elements
20 for generating light beams having different beam angles with the second beam shaping element, for example. This further increases the functionality of the lighting device, as a range of different beam angles may be produced with the (first or) second beam shaping element by engaging different spatial arrangements of the SSL elements of said second arrangement.

25 In an example embodiment, the spatial arrangements of solid state lighting elements are ring-shaped and centered on an optical axis of the tubular housing in order to achieve light beams having different beam angles in which the luminous distribution across a light spot generated by projecting such a light beam onto a surface is largely homogenous.

30 In an embodiment, the lighting device further comprises an orientation sensor arranged to detect an orientation of the tubular housing and/or the body and enable

selection of one of the first configuration and the second configuration based on said detected orientation. This ensures that upon aiming the lighting device at a target location, the correct arrangement of solid state lighting devices, i.e. the first or the second arrangement, can be automatically selected, which improves user friendliness of the lighting device.

To this end, the lighting device may further comprise a driver for the light engine arrangement, wherein the driver is responsive to the orientation sensor and is configured to enable one of the first arrangement of solid state lighting elements and the second arrangement of solid state elements based on the detected orientation of the housing with the orientation sensor.

In a preferred embodiment, the first beam shaping element is arranged to generate a narrow light beam and the second beam shaping element is arranged to generate a wide light beam. For instance, the first range of beam angles may be $6-18^\circ$ and the second range of beam angles may be $18-60^\circ$. In case the beam shaping elements are lenses, e.g. Fresnel or TIR lenses, the second range of beam angles in an embodiment is $18-36^\circ$.

The lighting device in some embodiments may be a spotlight, which for example is useful in application domains such as retail lighting in which such a spotlight may be used to generate both narrow beam angles and wide beam angles depending on the selected mode of operation of the spotlight, thereby potentially obviating the need to remove the spotlight from a mounted location and replacing it with another spotlight.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention are described in more detail and by way of non-limiting examples with reference to the accompanying drawings, wherein:

FIG. 1 schematically depicts a cross-sectional view of a lighting device according to an embodiment in a first configuration;

FIG. 2 schematically depicts a cross-sectional view of a lighting device according to an embodiment in a second configuration;

FIG. 3 schematically depicts an aspect of a light engine arrangement of a lighting device according to an embodiment;

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FIG. 4 schematically depicts an aspect of a light engine arrangement of a lighting device according to another embodiment;

FIG. 5 depicts a series of images of a light spot generated with a lighting device according to an embodiment in a first configuration;

5 FIG. 6 depicts an image of a light spot generated with a lighting device according to an embodiment in a second configuration;

FIG. 7 schematically depicts a cross-sectional view of a lighting device according to an alternative embodiment;

10 FIG. 8 schematically depicts a cross-sectional view of a lighting device according to an alternative embodiment in a first configuration;

FIG. 9 schematically depicts a cross-sectional view of a lighting device according to an alternative embodiment in a second configuration;

FIG. 10 schematically depicts a cross-sectional view of a lighting device according to yet another alternative embodiment;

15 FIG. 11 schematically depicts a perspective view of a lighting device according to an embodiment;

FIG. 12 schematically depicts an exploded perspective view of a lighting device according to an embodiment;

20 FIG. 13 schematically depicts another exploded perspective view of a lighting device according to an embodiment; and

FIG. 14 schematically depicts another cross-sectional view of a lighting device according to an embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENTS

25 It should be understood that the Figures are merely schematic and are not drawn to scale. It should also be understood that the same reference numerals are used throughout the Figures to indicate the same or similar parts.

30 FIG. 1 schematically depicts a lighting device 100 according to a first embodiment of the present invention. The lighting device 100 may take the form of a luminaire such as a spotlight, or any other suitable form. The lighting device 100 comprises a tubular housing 110 having a first beam shaping element 112 and a second

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beam shaping element 114 at opposing ends of the housing 110. The beam shaping elements 112, 114 each may take any suitable shape, such as for example the form of a lens such as a Fresnel lens or a TIR lens, or a reflector. In a particular embodiment, the first beam shaping element 112 and the second beam shaping element 114 are both
5 lenses, e.g. Fresnel lenses. The beam shaping elements 112 and 114 may be different types of lenses, e.g. a Fresnel lens and a TIR lens, or one of the beam shaping elements 112, 114 may be a lens and the other of the beam shaping elements 112, 114 may be a reflector. Any suitable combination of beam shaping elements may be contemplated.

The tubular housing 110 may have any suitable shape, such as a cylindrical shape,
10 which has the advantage that circular beam shaping elements, e.g. circular lenses, 112, 114 may be used at the opposing ends of the tubular housing 110, which is a particularly cost-effective embodiment of the lighting device 100. In the context of the present application, a tubular housing 110 may have a circular cross-section or a rectangular (e.g. square) cross-section. Inside the housing 110 a body 120 is mounted carrying a light
15 engine arrangement, such as a board 122 onto which one or more SSL elements 124, e.g. LEDs, are mounted. Other suitable types of light sources may be used. For example, the board 122 carrying one or more SSL elements 134 may be a COB (Chip on Board) or CSP (Chip Scale Package). The first arrangement of SSL elements 124 preferably is centred on the optical axis 111 of the tubular housing 110. As will be explained in further
20 detail below, the tubular housing 110 is rotatably mounted in a holder, here embodied by a surface mount 130 for mounting the lighting device 100 against a surface such as a wall or ceiling, and a bracket 140 in which the tubular housing 110 is mounted, e.g. using a mounting member 141 such as a screw or a bolt, which bracket 140 may be rotatably mounted on the surface mount 130. The housing 110 may be rotatably mounted in the
25 bracket 140 such as to facilitate the aiming of the lighting device 100 at a target location once the lighting device 100 is mounted on a surface with the surface mount 130. A driver 132 of the light engine arrangement may be located in any suitable location within the lighting device 100, such as within the tubular housing 110 or within the surface mount 130.

30 The first beam shaping element 112 typically is different to the second beam shaping element 114. In an embodiment, the first beam shaping element 112 is shaped

such as to produce a light beam 113 having a narrow beam angle and the second beam shaping element 114 is shaped such as to produce a light beam 115 having a wide beam angle. The first beam shaping element 112 and the second beam shaping element 114 may be any suitable type of non-imaging optical element, e.g. lens or reflector made of any suitable material, e.g. a Fresnel lens, a TIR lens or the like made of glass or an optical grade polymer or polymer blend. The body 120 is rotatably mounted within the tubular housing 110 as will be explained in more detail below such that in a first configuration a luminous output 125 of the first arrangement of SSL elements 124 is aimed at the first beam shaping element 112 as schematically depicted in FIG. 1, and in a second configuration the luminous output 125 of the first arrangement of SSL elements 124 is aimed at the second beam shaping element 114 as schematically depicted in FIG. 2. To change between the first and second configuration of the lighting device 100, the body 120 is rotated in the tubular housing 110 and the tubular housing is rotated relative to the surface mount 130, e.g. by rotating the bracket 140 on the surface mount 130 or by 180° rotation of the housing 120 within the bracket 140, such that the first beam shaping element 112 and the second beam shaping element 114 have interchanged their positions in space. In other words, in the first configuration the light beam 113 produced with the first beam shaping element 112 and in the second configuration the light beam 115 produced with the second beam shaping element 114 may be aimed at the same target location by internal rotation of the body 120 within the tubular housing 110 and rotation of the tubular housing 110 relative to the surface mount 130. In other words, the first beam shaping element 112 and the second beam shaping element 114 may be interchangeable in space by such rotation. It should be understood that in this context, 'interchangeable in space' does not require that the location in space of the first beam shaping element 112 is exactly assumed by the second beam shaping element 114 through the aforementioned rotation of the housing 110. It merely intends to state that by such rotation, both the first beam shaping element 112 and the second beam shaping element 114 may be aimed at the same target location to be illuminated. In other words, through such rotation the first end and the opposing second end of the tubular housing 110 may swap places in space, i.e. may be aimed at the same target location to be illuminated.

In a preferred embodiment, the first arrangement of SSL elements 124 comprises a plurality of SSL elements 124 arranged in a plurality of individually addressable spatial arrangements 124, 124' on the board 122 as schematically depicted in FIG. 3. The respective spatial arrangements 124, 124' may be centered on the optical axis 111 of the tubular housing 110. In an example embodiment schematically depicted in FIG. 4, the plurality of SSL elements 124 may be configured to perform a plurality of individually addressable and spatially distinct annular arrangements 224, 224', 224'' and 224'''.

Any suitable number of individually addressable and spatially distinct annular arrangements of SSL elements 124 may be contemplated. The purpose of the individually addressable and spatially distinct arrangements of SSL elements 124 is to produce light beams having different beam angles with a single lens, i.e. with the first beam shaping element 112 or the second beam shaping element 114. By producing different spatially distributed light beams 125 with such spatially distinct individually addressable arrangements of SSL elements 124, such different spatially distributed light beams 125 are shaped into light beams with different beam angles, e.g. beam angles in a range of 6-18° with the first beam shaping element, e.g. lens 112, such as beams with beam angles of 6°, 12° or 18° and beam angles in a range of 18-60°, preferably in a range of 18-36° with the second beam shaping element, e.g. a lens 114, such as beams with beam angles of 24°, 30° or 36°. The wide beam may have a beam angle of up to 60° in some embodiments, e.g. where the second beam shaping element 114 is a reflector. In an embodiment, the SSL elements 124 of different spatial arrangements may be mounted at different heights on the board 122 such as to alter the distance between the SSL elements 124 of the different spatial arrangements and the beam shaping element at which the first arrangement of SSL elements 124 is aimed to facilitate the generation of light beams with different beam angles with this beam shaping element, e.g. the first beam shaping element 112 or the second beam shaping element 114.

FIG. 5 shows images of different light beams generated with the first beam shaping element 112 in this manner and FIG. 6 shows an image of a wide angle (30°) beam generated with the second beam shaping element 114. The images in FIG. 5 from left to right correspond to light beams having beam angles of 6, 12 and 18° respectively.

FIG. 7 schematically depicts another embodiment of the lighting device 100 in which the body 120 carries a second arrangement of SSL elements 128, e.g. mounted on a further board 126, on a side or surface of the body 120 opposing the side or surface on which the first arrangement of SSL elements 124 is mounted. The first arrangement of SSL elements 124 and the second arrangement of SSL elements 128 may be identical, i.e. comprise the same type of SSL elements that are laid out in the same spatial arrangements on the boards 122 and 126 respectively, for example. Alternatively, the first arrangement of SSL elements 124 may be different to the second arrangement of SSL elements 128 as previously explained. The luminous distribution 125 produced by the first arrangement of SSL elements 124 may be aimed at the first beam shaping element 112 and the luminous distribution 129 produced by the second arrangement of SSL elements 128 may be aimed at the second beam shaping element 114. The first arrangement of SSL elements 124 and the second arrangement of SSL elements 128 may be controlled by the same driver 132 or may be controlled by a driver dedicated to the particular arrangement of SSL elements.

In this embodiment, switching between the first configuration of the lighting device 100 as schematically depicted in FIG. 8 in which the first arrangement of SSL elements 124 cooperates with the first beam shaping element 112 to produce a light beam 113 having a narrow beam angle and the second configuration of the lighting device 100 as schematically depicted in FIG. 9 in which the second arrangement of SSL elements 128 cooperates with the second beam shaping element 114 to produce a light beam 115 having a wide beam angle may be achieved in any suitable manner, such as by rotation of the tubular housing 110 relative to the surface mount 130 to interchange the positions of the first beam shaping element 112 and the second beam shaping element 114 in space. As previously explained, such rotation may be achieved by rotation of the bracket 140 in which the tubular housing 110 is mounted in a horizontal plane relative to the surface mount 130 and/or by rotation of the tubular housing 110 in a vertical plane in the bracket 140. Although the inclusion of an additional arrangement of SSL elements within the tubular housing 110 increases the cost of the lighting device 100, because the body 120 does not need to be rotatable within the tubular housing 110, the tubular housing 110 may be a more compact design, which may be advantageous where a particularly small form

factor lighting device 100 is required. Of course, alternatively the body 120 may still be rotatable within the tubular housing 120 as previously explained, e.g. where the first arrangement 124 of SSL elements is different to the second arrangement 128 of SSL elements.

5 The lighting device 100 may be switched between the first configuration in which a narrow beam is produced with the first beam shaping element 112 and the second configuration in which a wide beam is produced with the second beam shaping element 114 in any suitable manner. For example, the tubular housing 110 and/or the body 120 may be manually rotated in order to interchange the first beam shaping element 112 and
10 the second beam shaping element 114 in space and/or to rotate the body 120 within the tubular housing 110 as previously explained.

 Alternatively, the lighting device 100 may comprise a motor (not shown) communicatively coupled to a communication module (not shown) such as a wireless communication module, which motor may be adapted to rotate the tubular housing 110
15 and/or the body 120 in response to a configuration switch command received by the communication module in order to switch the lighting device 100 between the first configuration and the second configuration. Such a configuration switch command may be produced in any suitable manner, for example using a dedicated remote control device capable of communicating with the communication module using any suitable
20 communication protocol, e.g. any suitable wireless communication protocol, or a handheld or a portable computing device such as a smart phone, tablet computer or the like configured with a software program (app) through which such a configuration switch command may be generated.

 Similarly, in case of the first arrangement of SSL elements 124 and/or the second
25 arrangement of SSL elements 128 being divided into a plurality of individually addressable and spatially distinct groups of SSL elements, such groups of SSL elements may be selected manually, e.g. using a user interface (not shown) on the lighting device 100 or remotely through a dedicated remote controller or a handheld portable computing device configured to act as such a remote controller. As will be readily understood by the
30 skilled person, the driver 132 may be configured to activate a particular spatial arrangement of SSL elements in response to a spatial arrangement selection signal, e.g. a

beam angle selection signal, received from such a remote controller, e.g. through the communication module.

In the embodiment of the lighting device 100 as schematically depicted in FIG. 10, the lighting device 100 further comprises an orientation sensor 134 for sensing the orientation of the tubular housing 110 and/or the body 120. To this end, the orientation sensor 134 may be placed in or on the tubular housing 110 or in or on the body 120. The one or more drivers of the first and second arrangements 124, 128 of SSL elements, e.g. the driver 132, are responsive to the orientation sensor 134 such that the driver arrangement can activate either the first arrangement of SSL elements 124 or the second arrangement of SSL elements 128 based on the detected orientation of the tubular housing 110 or the body 120 such that the arrangement of SSL elements that is aimed at the target location may be automatically activated.

FIG. 11-14 schematically depict an embodiment of the lighting device 100 in which the body 120 is rotatable within the tubular housing 110. In this embodiment, the bracket 140 further contains a rotation axle 150 that is affixed to the surface mount 130. The rotation axle 150 extends through the bracket 140 and connects to the body 120 within the housing 110 such that the body 120 is mounted on the rotation axle 150, as can be seen more clearly in FIG. 14. As can be seen in the magnified portion of FIG. 12, the arrangement of the rotation axle 150 and the body 120 terminates in a hexagonal nut 151 having an inner thread for engaging with a flanged bolt 154 having a central hexagonal opening dimensioned to snugly fit over the hexagonal nut 151. To this end, the hexagonal nut 151 extends through an opening 117 in the tubular housing 110 such that the flanged bolt 154 may be fitted onto the hexagonal nut. The hexagonal nut 151 may form part of the body 120, as can be seen in FIG. 14 for example, or may form part of the rotation axle 150 in case this axle extends through the body 120. A fixing screw 152 and an optional washer 153 may be used to secure the flanged bolt 154 onto the hexagonal nut 151, thereby securing the tubular housing 110 on the arrangement of the rotation axle 150 and the body 120, such that the flanged bolt acts as a spacer between the fixing screw 152 and the housing 110.

Around the opening 117, the tubular housing 110 may further comprise an arcuate channel 118, e.g. a(n approximately) semi-circular channel, into which a pin 155

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protruding from the flanged bolt 154 may fall. The pin 155 may be moved through the arcuate channel 118 by rotation of the rotation axle 150 relative to the surface mount 130 and bracket 140 using the flanged bolt 154, such that the body 120, e.g. a heat sink or the like, is rotated relative to the housing 110 in order to rotate the first arrangement of SSL elements 124 from aiming at the first beam shaping element 112 such as a first lens in a first configuration of the lighting device 100 to aiming at the second beam shaping element 114 such as a second lens in a second configuration of the lighting device 100, or vice versa. The opposing end points of the arcuate channel 118 where the pin 155 runs into the tubular housing 110 may define the first configuration and the second configuration respectively.

FIG. 13 schematically depicts an exploded view of the lighting device 100 according to this embodiment. The tubular housing 110 contains the first beam shaping element 112 and the second beam shaping element 114, here Fresnel lenses, at opposite ends of the housing 110, which may be kept in place in any suitable manner, e.g. using end caps 212 and 214 respectively. Within the tubular housing 110, the body 120 such as a heatsink carrying the board 122 with the arrangement of SSL elements 124 (not shown in FIG. 13) is mounted as previously explained. A cable sleeve 220 may extend from the body 120 through which the connections (wires) between the driver 132 and the first arrangement of SSL elements 124 may be fed. The cable sleeve 220 may be fitted within the cavity 156 of the rotation axle 150, i.e. the rotation axle 150 may fit over the cable sleeve 220.

The bracket 140 through which the rotation axle 150 extends may be rotatably mounted on the surface mount 130, which may contain a mounting plate 130b and a cover 130a for mating with the mounting plate 130b, e.g. using suitable fixing members such as screws 230 extending through the mounting plate 130b and engaging with threaded posts 232 on the inner surface of the cover 230a, as is well-known per se. As previously explained, the driver 132 of the light engine arrangement of the lighting device 100 may be housed in the surface mount 130, e.g. on the cover 130a or the mounting plate 130b. The bracket 140 may be a U-shaped bracket that is secured on the housing such a fixing member 141 such as a screw with a plastic head having a ribbed edge for enabling manual fixation of the fixing member 141 onto the tubular housing 110,

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e.g. into a threaded hole 145 within the tubular housing 110. A washer 143 may be located in between the bracket 140 and the housing 110 such that the fixing member 141 extends through the bracket 140 and the washer 143 before entering the threaded hole 145. It will be understood by the skilled person that such fixings are shown by way of
5 non-limiting example only and that any suitable type of fixing may be used for the various components of the lighting device 100.

As previously explained, the tubular housing 110 may be secured against the rotation axle 150 and/or the body 120 by the fixing screw 152 extending through the washer 153 and the flanged bolt 154 and engaging with the hexagonal nut 155 (not
10 visible in FIG. 13) of the rotational axle 150 or the body 120. The fixing screw 152 may comprise a wave spring to introduce friction between the flanged bolt 154 and the hexagonal nut 155 such that upon rotation of the body 120 in the housing 110, the body 120 maintains its orientation within the tubular housing 110, i.e. cannot accidentally rotate within the tubular housing 110 by translation of the pin 155 in the channel 118.

15 It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. The word "comprising" does not exclude the presence of elements or steps other than
20 those listed in a claim. The word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. The invention can be implemented by means of hardware comprising several distinct elements. In the device claim enumerating several means, several of these means can be embodied by one and the same item of hardware. The mere fact that certain measures are recited in mutually different dependent claims
25 does not indicate that a combination of these measures cannot be used to advantage.

CLAIMS

1. A lighting device (100) comprising:

a tubular housing (110) having a first beam shaping element (112) at a first end
5 and a second beam shaping element (114) at a second end opposing said first end, the first beam shaping element being different to the second beam shaping element;

a holder (130, 140) of said tubular housing, the tubular housing being rotatably
mounted on said holder such that the first beam shaping element and the second beam
shaping element are interchangeable in space through rotation of said tubular housing
10 relative to said holder; and

a light engine arrangement (124, 128) within said tubular housing arranged to
generate a first beam (113) having a beam angle in a first range of beam angles with the
first beam shaping element and generate a second beam (115) having a beam angle in a
second range of beam angles different to the first range of beam angles with the second
15 beam shaping element;

wherein the lighting device is operable in a first configuration in which the light
engine arrangement generates the first beam (113) only and a second configuration in
which the light engine arrangement generates the second beam (115) only;

wherein the light engine arrangement comprises a body (120) carrying one or
20 more light sources (124) within said tubular housing (110), and wherein said body (120)
is rotatable within the tubular housing (110) such that aim of the one or more light
sources (124) can be redirected from the first beam shaping element (112) to the second
beam shaping element (114) or vice versa.

25 2. The lighting device (100) of claim 1, wherein the tubular housing (110) has a
circular or square cross-section.

3. The lighting device (100) of claim 1 or 2, wherein the first beam shaping element
(112) and the second beam shaping element (114) are individually selected from a group
30 of non-imaging optical elements consisting of a Fresnel lens, a total internal reflection
lens and a reflector.

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4. The lighting device (100) of any of claims 1-3, wherein said holder (130, 140) comprises a surface mount (130) and a bracket (140) extending from said surface mount, wherein the bracket (140) is rotatably mounted on said surface mount (130), optionally
5 wherein said tubular housing (110) is rotatably mounted in said bracket (140).

5. The lighting device (100) of claim 4, wherein said bracket (140) further comprises an axle (150) extending normally from a surface (135) of said surface mount (130) and into said tubular housing (110), and wherein said body (120) is mounted on said axle and
10 is rotatable through said axle (150) within the tubular housing (110).

6. The lighting device of claim 5, wherein the tubular housing (110) is secured on said axle (150) and/or said body (120) through a spacer (154) comprising a protruding pin (155) mating with an arcuate channel (118) in said tubular housing (110) to define a
15 range of rotation of the body (120) within said tubular housing.

7. The lighting device (100) of any of claims 1-5, further comprising a motor for rotating the tubular housing (110) relative to said holder (130, 140) and a communication module, wherein said motor is responsive to said communication module.

20

8. The lighting device (100) of any of claims 1-6, wherein the light engine arrangement (124, 128) comprises a first arrangement (124) of solid state lighting elements.

25 9. The lighting device (100) of claim 8, wherein the light engine arrangement (124, 128) further comprises a second arrangement (128) of solid state lighting elements on the body (120), said second arrangement of solid state lighting elements opposing the first arrangement (124) of solid state lighting elements. .

30 10. The lighting device (100) of claim 8 or 9, wherein the first arrangement (124) and/or the second arrangement (128) of solid state lighting elements comprises a plurality

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of individually addressable spatial arrangements (224, 224', 224'', 224''') of solid state lighting elements for generating light beams having different beam angles with the first beam shaping element (112) and/or the second beam shaping element (114).

5 11. The lighting device (100) of claim 8 or 10, wherein said spatial arrangements (224, 224', 224'', 224''') are ring-shaped and centered on an optical axis (111) of the tubular housing (110).

12. The lighting device (100) of any of claims 9-11, further comprising an orientation
10 sensor (134) arranged to:

detect an orientation of the tubular housing (110) and/or an orientation of the body (120); and

enable selection of one of the first configuration and the second configuration based on said detected orientation.

15

13. The lighting device (100) of claim 12, further comprising a driver (132) for the light engine arrangement (124, 128), wherein the driver is responsive to the orientation sensor (134) and is configured to enable one of the first arrangement (124) of solid state lighting elements and the second arrangement (128) of solid state elements based on the
20 detected orientation of the housing (110) with the orientation sensor.

14. The lighting device (100) of any of claims 1-13, wherein the first range of beam angles is 6-18° and the second range of beam angles is 18-60°.

25 15. The lighting device (100) of any of claims 1-14, wherein the lighting device is a spotlight.

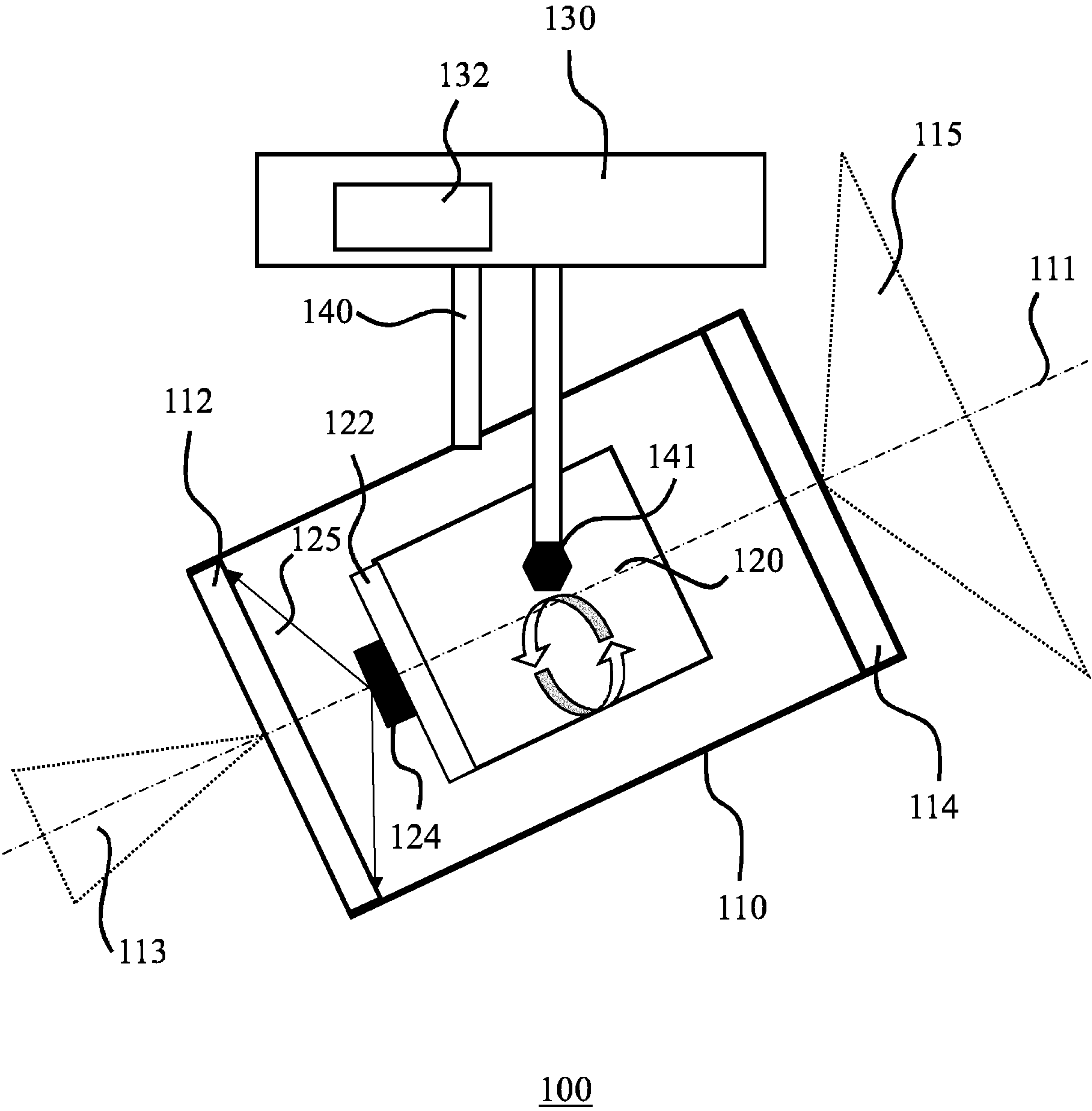


FIG. 1

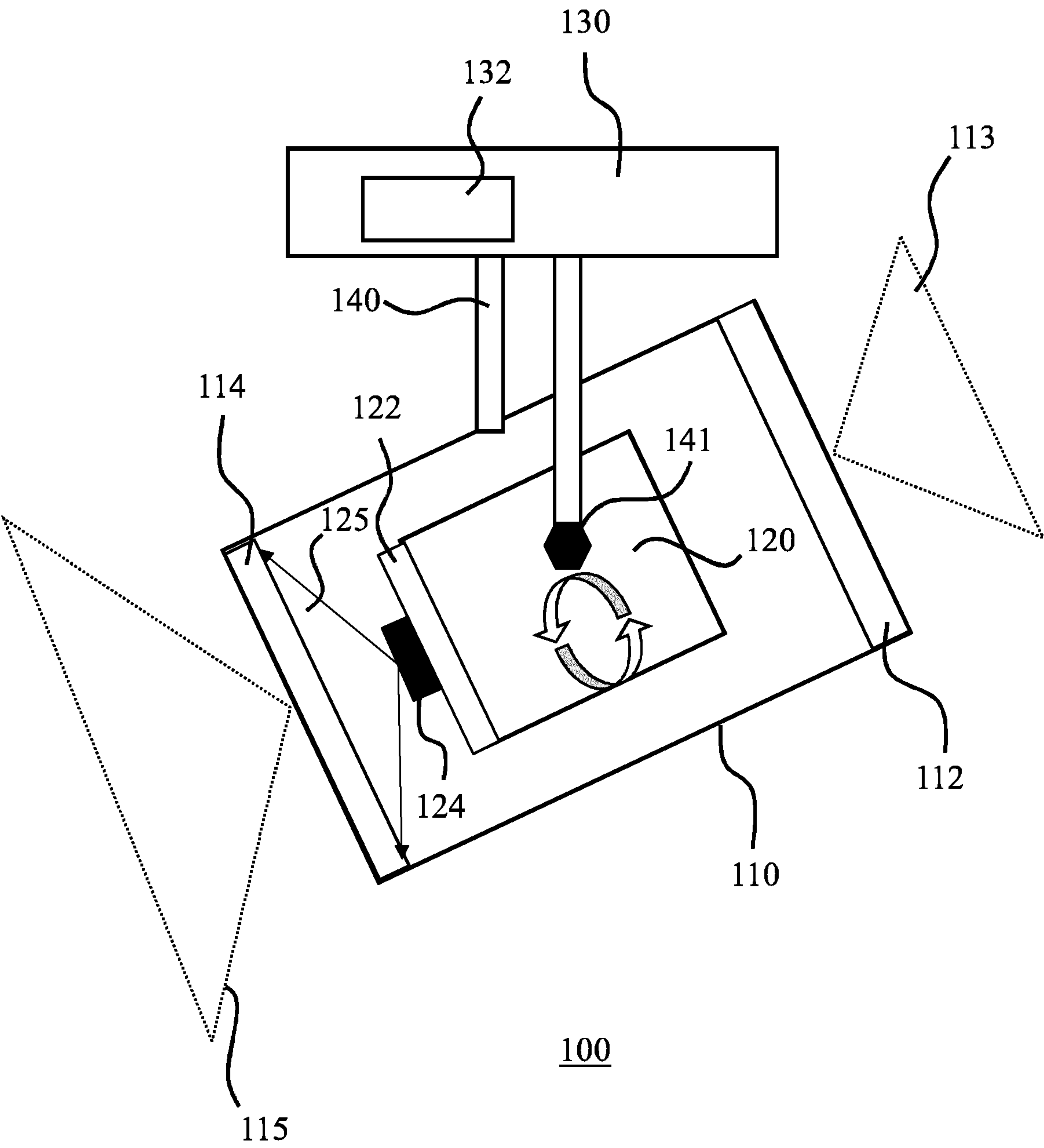


FIG. 2

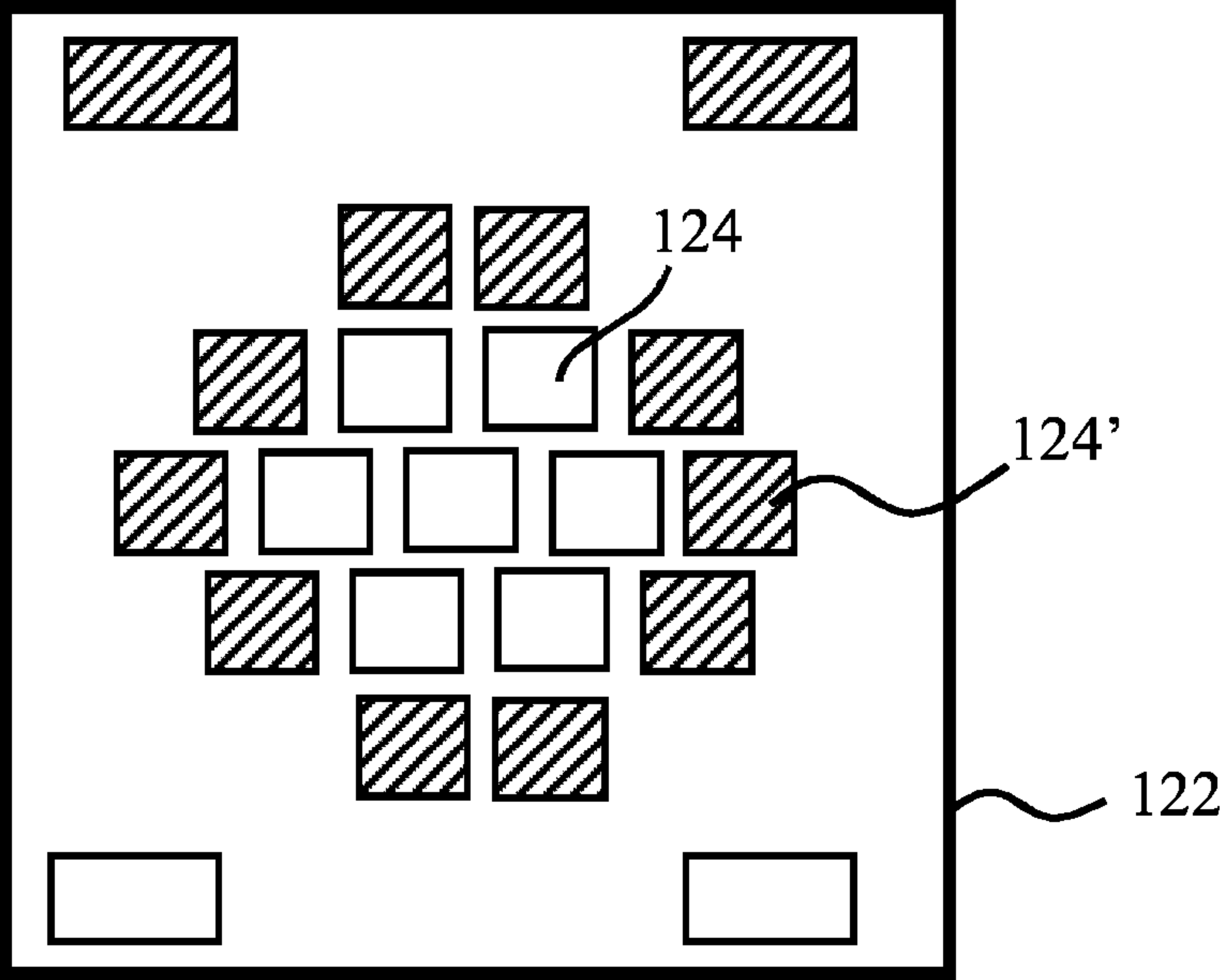


FIG. 3

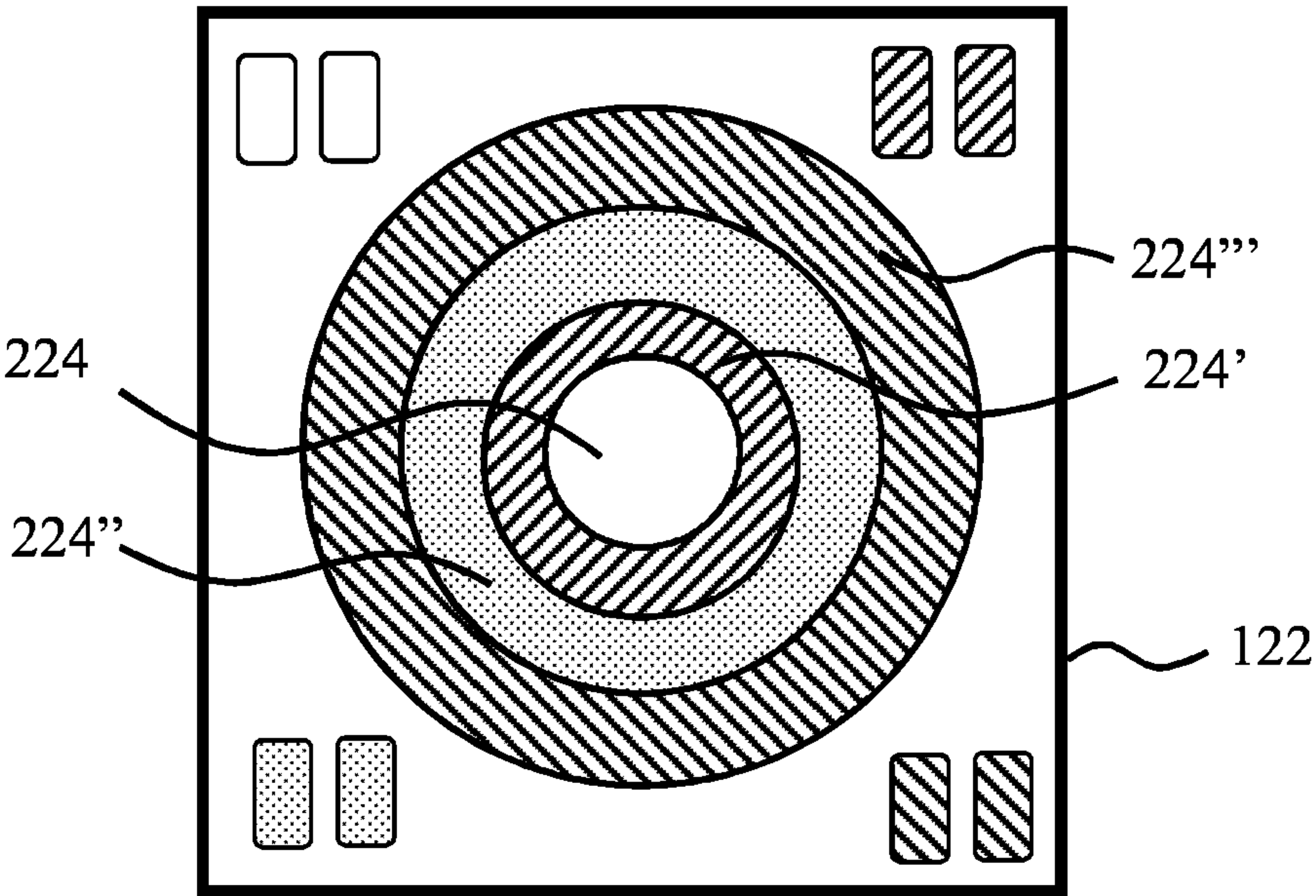


FIG. 4

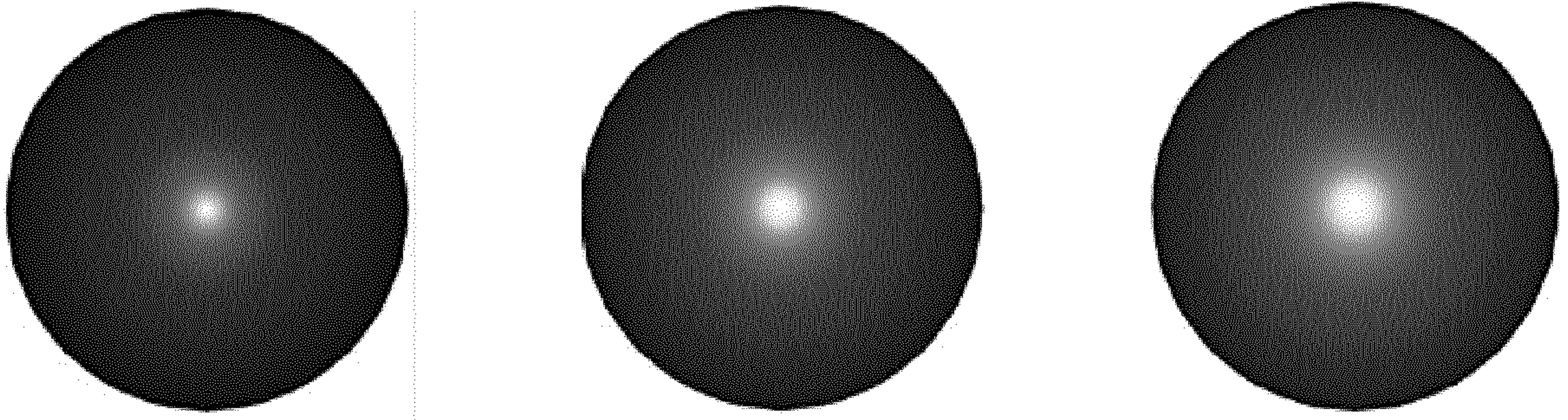


FIG. 5

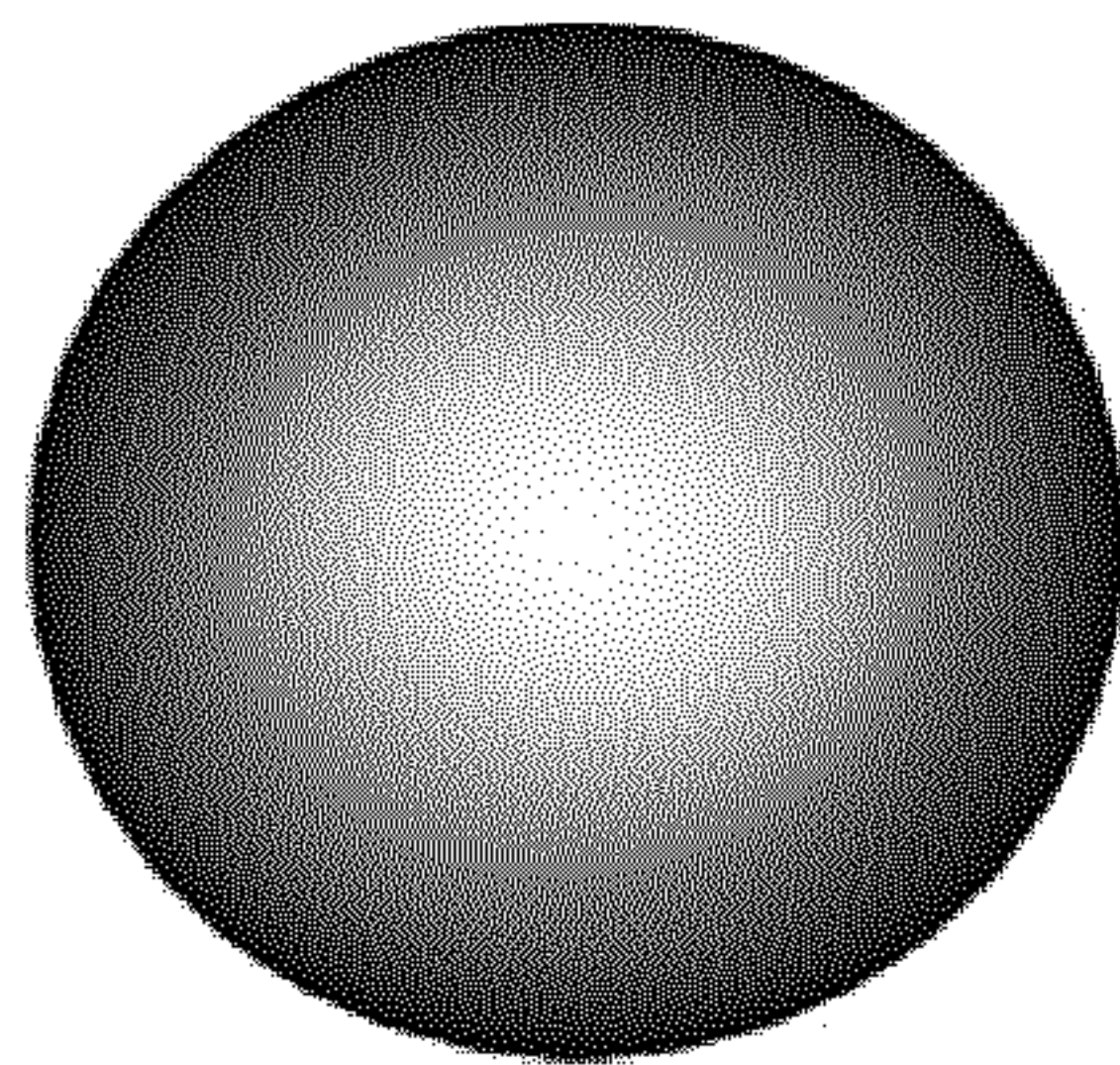


FIG. 6

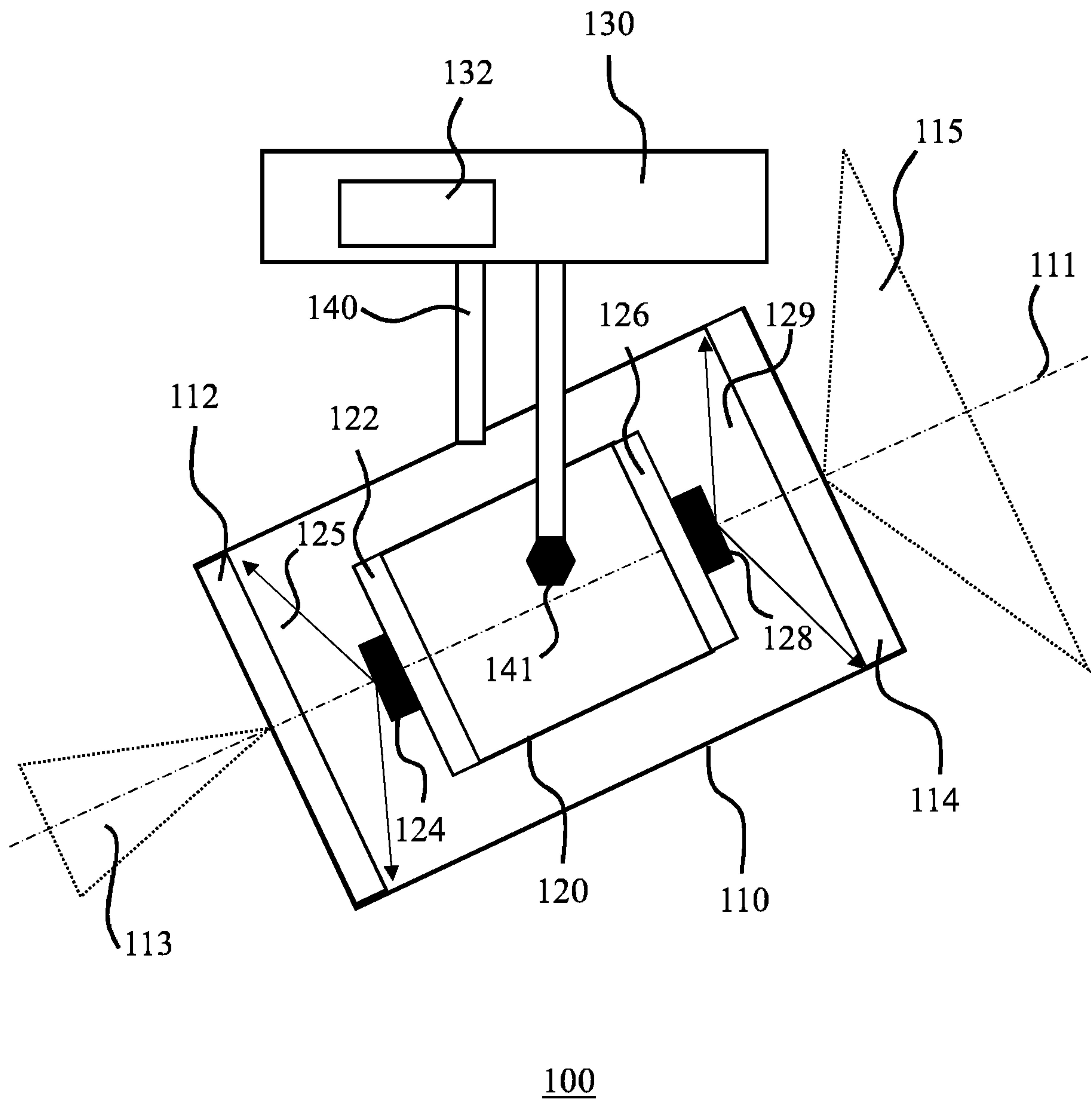


FIG. 7

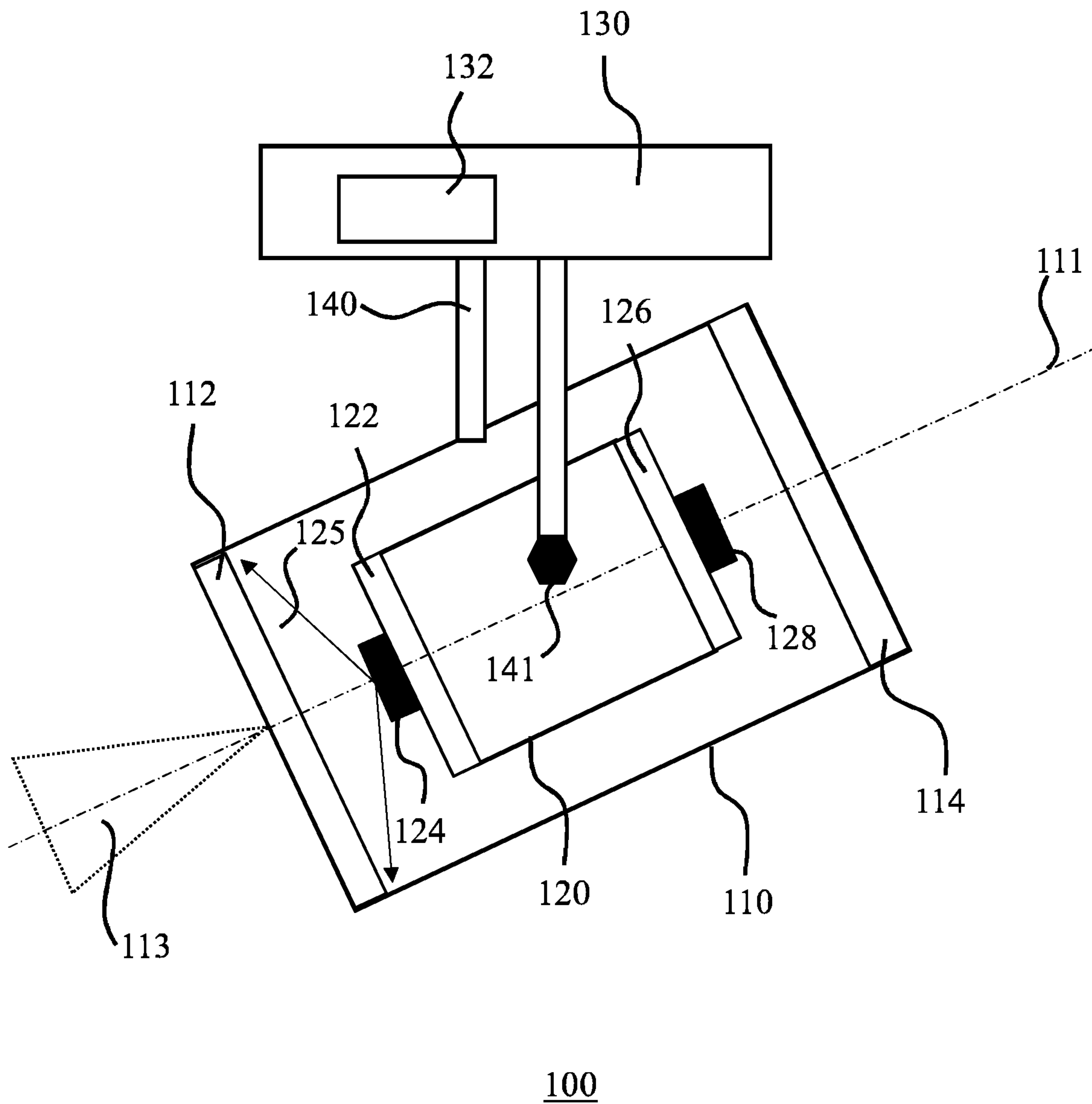


FIG. 8

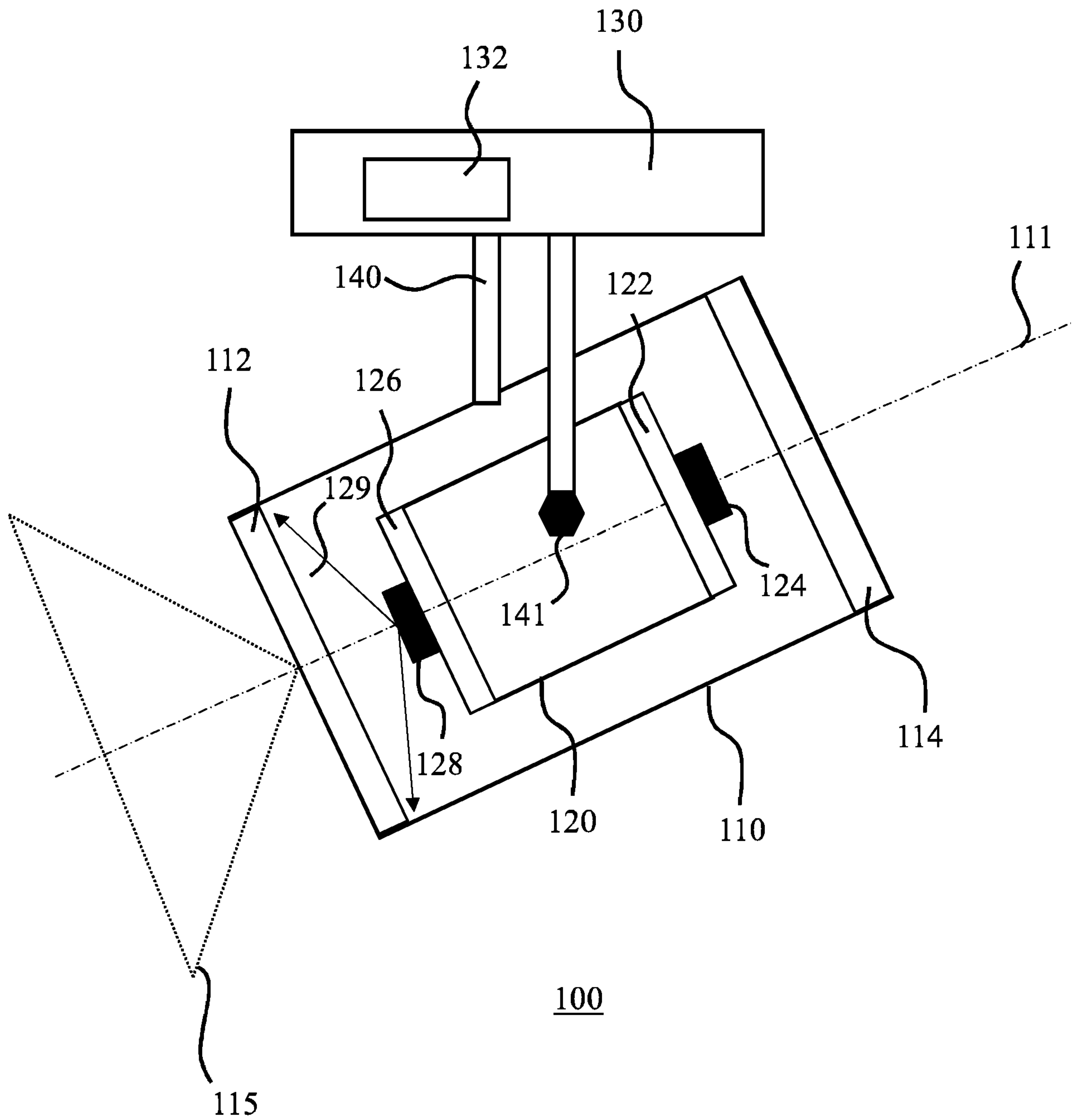


FIG. 9

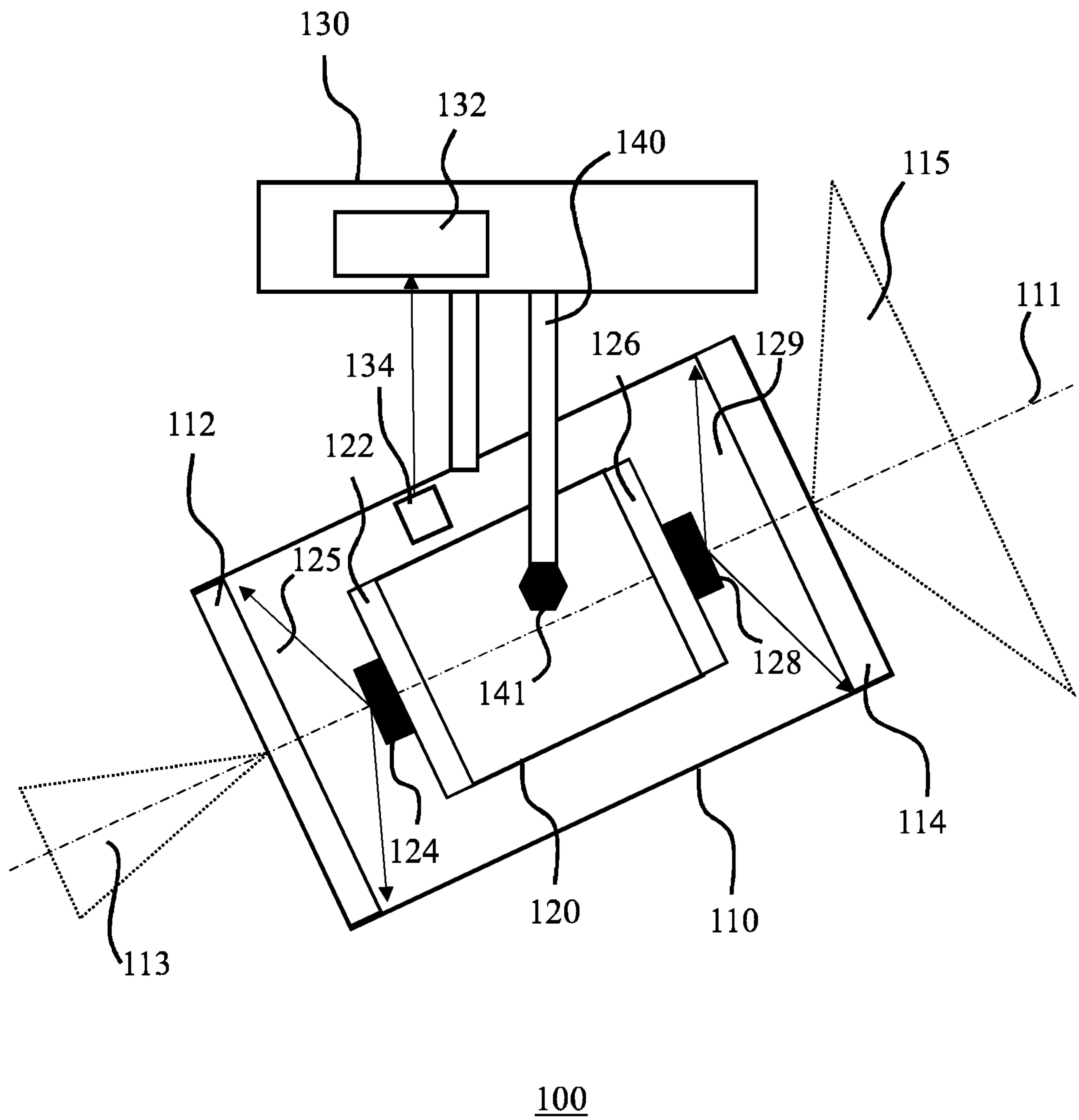


FIG. 10

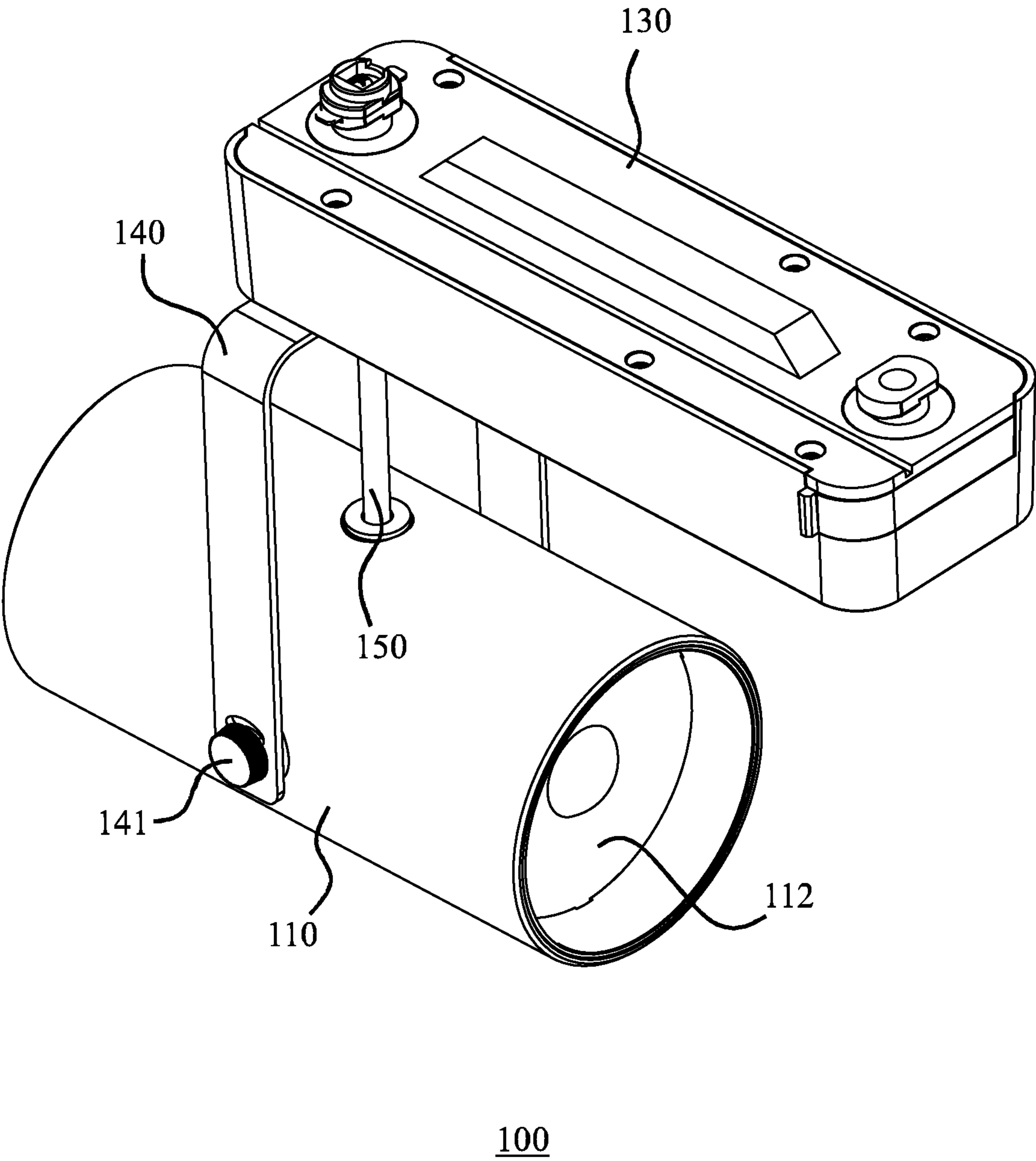


FIG. 11

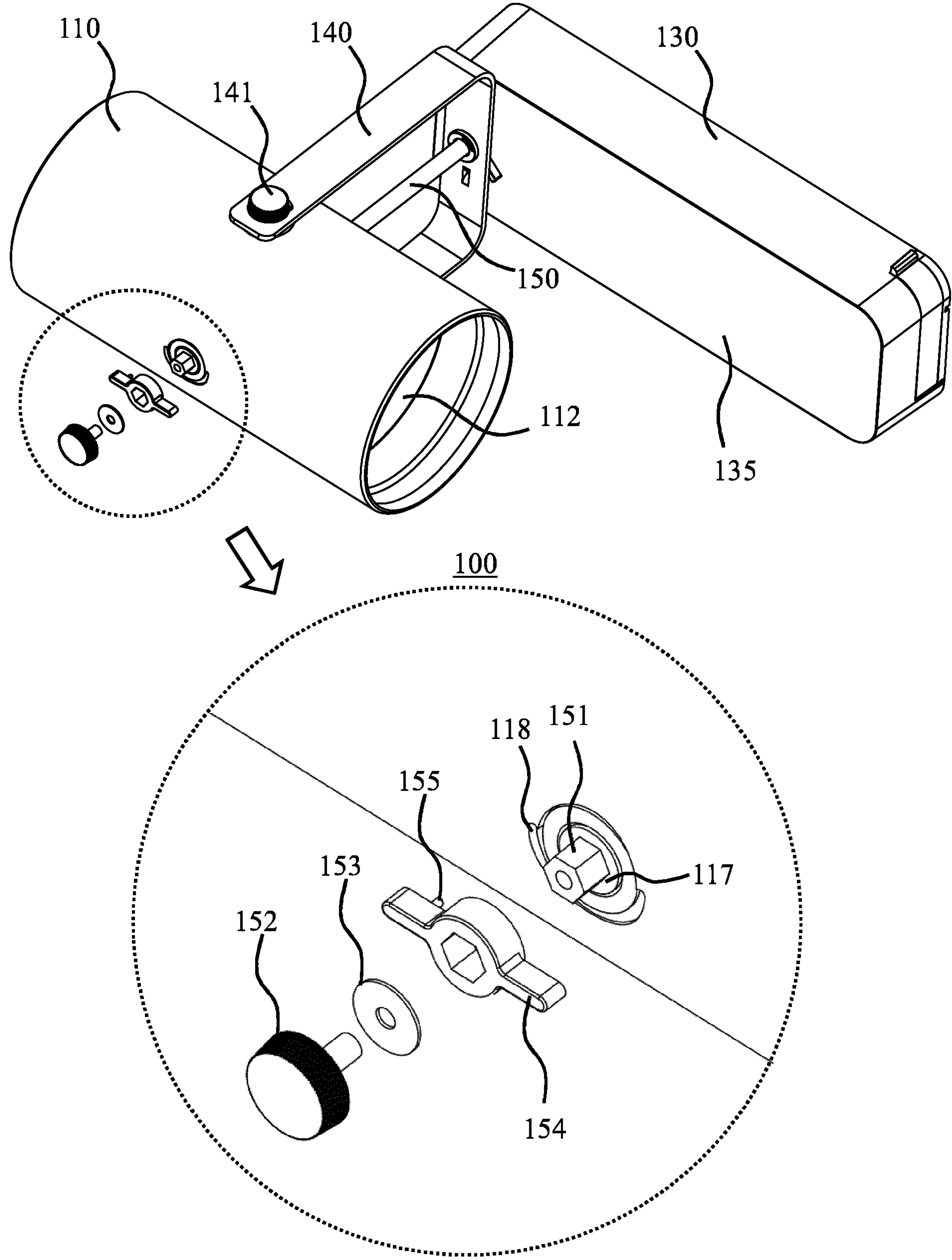


FIG. 12

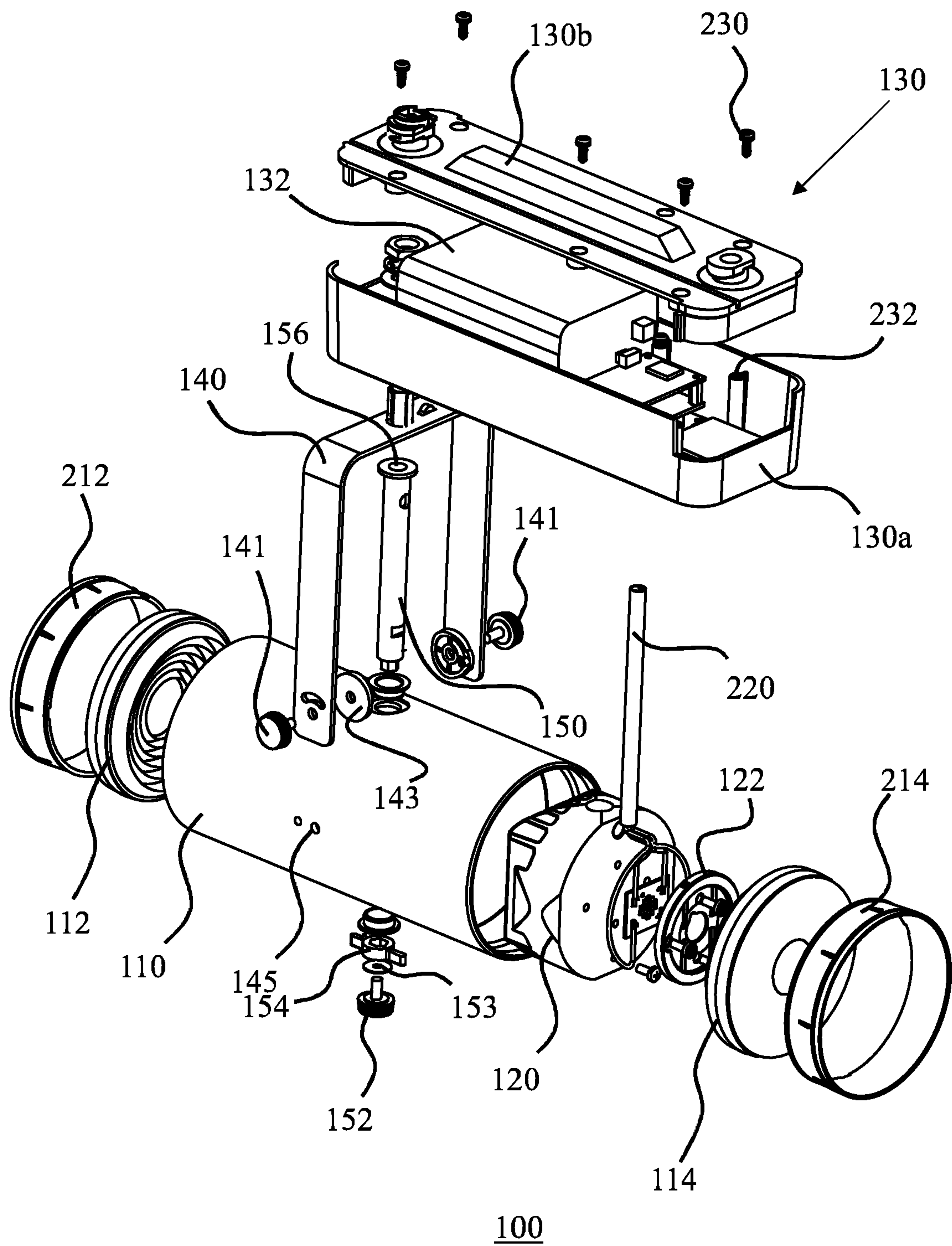


FIG. 13

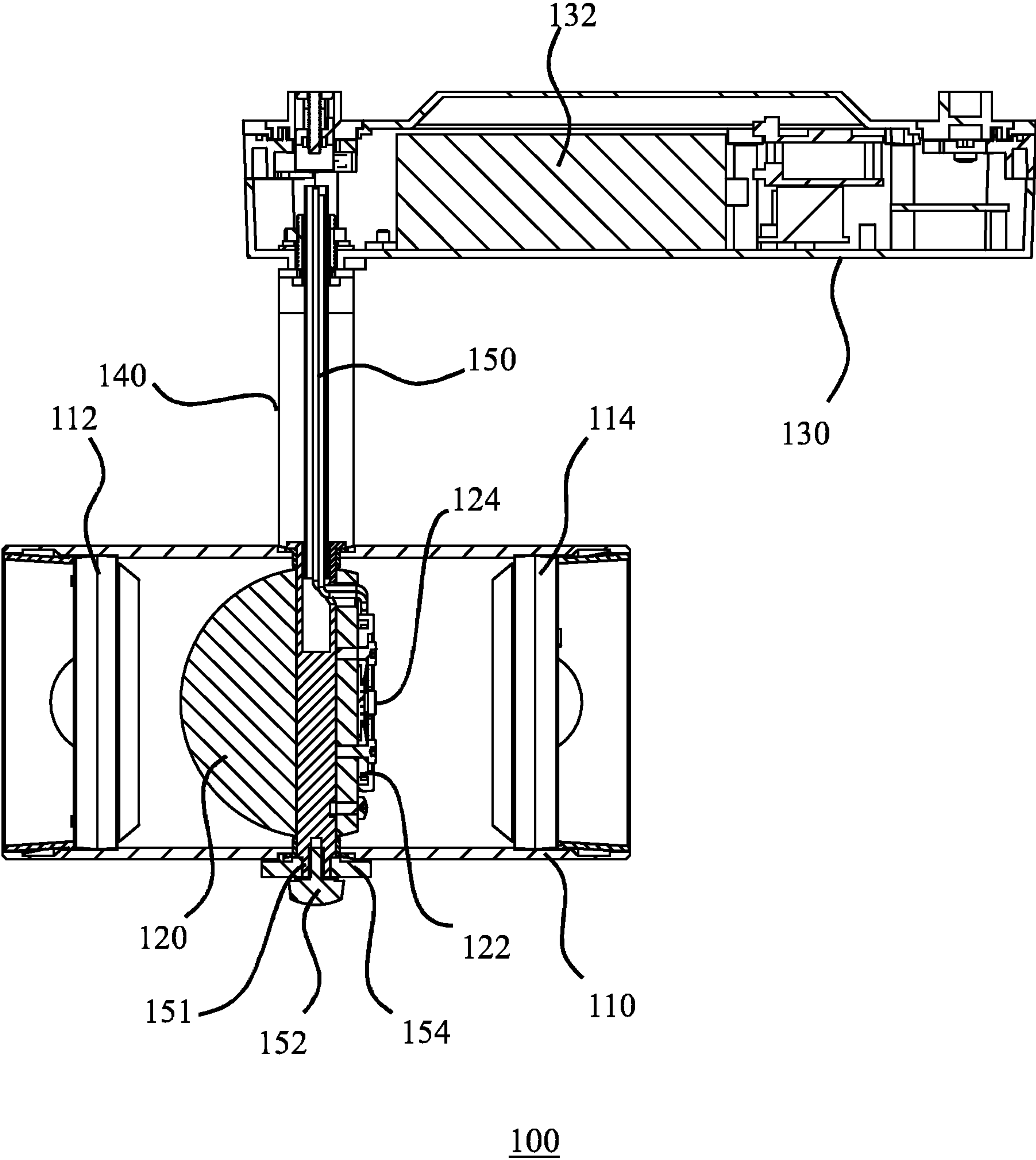


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2020/081569

A. CLASSIFICATION OF SUBJECT MATTER

INV. F21V14/06 F21V21/15 F21V21/30 F21V14/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F21V

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KR 101 758 782 B1 (JEON KI HO [KR]) 18 July 2017 (2017-07-18)	1,5,8
Y	paragraph [0001] paragraph [0019] paragraph [0043] paragraph [0051] - paragraph [0053] figures 3-5, 6a-6h -----	2-4,6-15
Y	WO 2010/027160 A2 (KIM DONG CHEN [KR]; KANG YOUNG-SOO [KR]; PARK JONG-WOOK [KR]) 11 March 2010 (2010-03-11)	2-4,7,8, 12,13,15
A	paragraph [0001] paragraph [0008] paragraph [0017] paragraph [0023] paragraph [0026] - paragraph [0028] paragraph [0030] figures 1-4 ----- -/-	1,5,6, 9-11,14



Further documents are listed in the continuation of Box C.



See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search

29 January 2021

Date of mailing of the international search report

08/02/2021

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Authorized officer

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/081569

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Y	US 7 641 366 B1 (SIBALICH GREGORY L [US] ET AL) 5 January 2010 (2010-01-05) figure 5 -----	6
Y	EP 2 324 282 B1 (MARTIN PROFESSIONAL AS [DK]) 6 December 2017 (2017-12-06) paragraph [0007] -----	9
Y	WO 2019/201634 A1 (SIGNIFY HOLDING BV [NL]) 24 October 2019 (2019-10-24) page 1, line 12 - line 14 page 1, line 26 - line 29 figures 4,6 -----	10,11,14
Y	WO 2011/127481 A2 (LITEPANELS LTD [GB]; BAXTER KEVIN C [US] ET AL.) 13 October 2011 (2011-10-13) page 7, line 31 - line 32 page 8, line 1 -----	14

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			EP 2324282 A1 25-05-2011
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			EP 3781975 A1 24-02-2021
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