Patent Application

【Application Classification】 patent application

【Applicant】

【Organization Name】 Korea Photonics Technology Institute

【Patent Customer Number】 2-2004-013098-4

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【Agent's Code】 9-2000-000174-3

【Registration number of general power of attorney】 2010-081325-3.

【Title of Invention】 Apparatus for determining the wind speed and direction using FBG sensor

【English Title of Invention】 Apparatus for determining the wind speed and direction using FBG sensor

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【Application Language】 korean language

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【Department Name】 Ministry of Trade, Industry and Energy

【Research Managing Organization】 energy technology evaluation institute

【Title of Research】 POWER STANDARDIZATION AND CERTIFICATION SUPPORT

【Title of Research Project】 Standardization and Authentication-Based Construction of Optical Convergence Technology in Electric Power Industry

【Contribution Rate】 1/1

【Host Organization】	Korea Photonics Technology Institute
【Research Period】	2016.06.01 ~ 2021.03.31

【Purport】

Submit it to the Commissioner of the Korean Intellectual Property Office as above.The agent Woo Gwang-je (signature or person)

【Official Fee】

【Application Fee】	0 page 46,000 won
【Additional Application Fee】	24 pages 0 won
【Priority Fee】	0 case 0 won
【Examination Fee】	0 term 0 won
【Total】	46,000 won
【Reason for Reduction】	Secure Information
【Fee after Reduction and Exemption】	23,000 won

【Description of the Invention】

【Title of Invention】

APPARATUS FOR MEASURING WIND SPEED AND DIRECTION USING FBG SENSOR

【Technical Field】

【0001】The present invention relates to a wind speed and an anemometer capable of sensing the intensity and direction of wind by using a fiber Bragg gratings (FBG) sensor which is an optical fiber sensor.

【0002】

【Background Technique】

【0003】In general, a windmill-type anemometer is used as a device for measuring the wind direction and wind speed.

【0004】The windmill type anemometer uses a principle in which a rotation speed of a satire is proportional to a wind speed, and has a structure in which the windmill is attached to a front end of a streamlined body having a vertical tail wing.

【0005】In addition, the windmill type anemometer is configured such that a small-sized generator of direct current or alternating current is mounted on a rotary shaft of the windmill, and a wind speed is measured through electromotive force generated by the small-sized generator.

【0006】In addition, the windmill-type anemometer has a disadvantage in that the structure is complicated because the wind direction is measured by detecting the rotational position of the anemometer according to the wind direction.

【0007】Meanwhile, unlike a method of using a windmill, a strain gauge type wind direction and wind speed measuring device for detecting an electrical resistance value interlocked when an elastic plate is deformed according to the strength and direction of wind is disclosed in Korean Patent No. 10-1168568.

【0008】However, both the wind direction and wind speed measurement methods are methods for detecting electrical signals, and due to the characteristics of being installed to be exposed to the outside, the measurement accuracy may be lowered due to the influence of electrical noise generated from the outside, and in particular, there is a disadvantage in that electrical components may be damaged or damaged due to lightning or rainwater.

【0009】

【Citation List】

【Patent Literature】

【0010】**(Patent literature 0001)** Document 1. Korean Patent Application Publication No. 10-1168568, entitled “MEASURING DEVICE FOR WIND DIRECTION AND WIND SPEED”

(Patent literature 0002) Document 2. Korean Patent Application Publication No. 10-2018-0052962, “Measurement Device Using Optical Fiber Grating Sensor”

(Patent literature 0003) Document 3. Korean Patent Laid-Open Publication No. 10-2017-0021583, “Sensor of Wind Speed and Wind Direction Using Optical Fiber Grid”

(Patent literature 0004) Document 4. Korean Patent Application Publication No. 10-1600573, “Optical fiber Bragg grating-based sensor and observation system using the same”

【Content of Invention】

【Problem to solve】

【0011】DISCLOSURE Technical Problem Accordingly, the present invention has been made keeping in mind the above problems occurring in the prior art, and an object of the present invention is to provide a measuring device capable of accurately measuring a wind direction and a wind speed using an FBG sensor having a simple structure while measuring the wind direction and the wind speed using an optical signal.

【0012】

【Solution to the Problem】

【0013】According to the present invention, the apparatus for measuring a wind direction and a wind speed comprises: a frame (101) of which a cross section is a square pipe shape The respective installed measuring unit(110) in four page of the frame(101) it is comprised of the FBG sensor(113) receiving the tensile force according to the displacement of the detector(111) connected in the structure in which one side is connected in each detector(111) and the detector(111) which is installed at the hole(104) of the frame(101) and displaces to the horizontal direction and the other side may not displace And the optical fiber which is connected to the FBG sensor(113) and communicates the incident beam and reflection beam It is composed.

【0014】In this case, the FBG sensor 113 may be coupled to a spring 112 coupled to a non-displaceable structure to receive an elastic tensile force of the spring 112 according to the displacement of the detector 111.

【0015】In addition, the spring 112 may be configured to adjust elasticity.

【0016】Moreover, the guide(105) guiding the horizontal direction sliding of the detector(111) It is characterized in that it further comprises.

【0017】In addition, the detection devices 111 installed on the four surfaces of the frame 101 may be installed to face the north, east, south, and west, respectively.

【0018】Moreover, the optical detecting part receiving a message the reflected beam transmitted in each measuring unit(110) And the output unit calculating the speed of wind and direction of the wind to the wavelength change at each measuring unit(110) detected from the optical detecting part It is characterized in that it further comprises.

【0019】

【Effect of Invention】

【0020】According to the present invention configured as described above, the wind direction and the wind speed are measured by the optical signal using the FBG sensor, so that constraints on the installation environment can be greatly alleviated and an accurate measurement value can be obtained without external electrical influence.

【0021】In addition, production, maintenance, and repair are very easy due to a simple structure.

【0022】

【Description of Drawings】

【0023】FIGS. 1 and 2 are views illustrating a principle of measuring a wavelength change using an FBG sensor.

FIG. 3 is a perspective view illustrating an apparatus for measuring a wind direction and a wind speed according to the present invention.

FIG. 4 is a view illustrating an internal structure of an apparatus for measuring a wind direction and a wind speed according to the present invention.

FIG. 5 is an enlarged view of a measuring unit of the measuring device.

FIG. 6 is a view illustrating a state in which any one measurement unit measures a wind speed.

FIGS. 7 and 8 are views illustrating a state in which a measurement device measures a wind direction and a wind speed.

FIG. 9 is a view illustrating a wavelength detected by each measurement unit of the measurement device.

【Detailed Description for the Implementation of the Invention】

【0024】Hereinafter, the present invention will be described in detail with reference to exemplary embodiments of the present invention and the accompanying drawings, and it is assumed that the same reference numerals in the drawings refer to the same elements.

【0025】It will be further understood that when an element is referred to as being “including” another element in the detailed description or claims of the present invention, it should not be construed as being limited to the element unless specifically stated to the contrary, and may further include other elements.

【0026】As used herein, the terms “top,” “bottom,” “bottom,” “front,” “rear,” “below,” and the like, are for ease of description only and refer to the orientation of components as illustrated in the figures.

【0027】FBG (Fiber Bragg Gratings) is made in a periodic pattern by exposing a single mode optical fiber core part to ultraviolet rays, and makes it in a transverse direction in which a beam progresses. The portion exposed to ultraviolet rays increases the refractive index of the optical fiber core, and this portion is called a grating.

【0028】The optical fiber grating is used to measure a physical quantity such as an external temperature, deformation, pressure, etc. of an incident optical signal according to a change in temperature or strain from a wavelength change of the optical signal reflected from the optical fiber grating.

【0029】The basic concept of the measuring device according to the present invention is that, as shown in FIG. 1, the FBG sensor 10 is fixed to a fixture 12 that does not change due to external influence, a spring 13 is fastened to an end of the FBG sensor 10, and the spring 13 is fastened to a position changing tool 14 that physically reacts due to external influence.

【0030】When the position variable member 14 is displaced (e.g., the position variable member 14 is changed from the second position to the first position) in a state in which the spring 13 applies a predetermined elastic force to the FBG sensor 10, the elastic force of the spring 13 acting on the FBG sensor 10 is changed.

【0031】Since the period of the grating is changed due to the tension or compression of the FBG sensor 10 due to the elastic change of the spring 13 acting on the FBG sensor 10, the wavelength of the optical signal reflected from the grating of the FBG sensor 10 is changed as shown in FIG. 2, and the optical detection unit and the calculation unit of the measurement device (not shown) analyze the change to measure the external force (wind speed) by displacing the position variable member 14.

【0032】

【0033】The apparatus for measuring a wind direction and a wind speed using an FBG sensor according to the present invention uses the above-described principle, and as shown in FIG. 3, a frame 101 is formed in a hexahedral shape, and a measurement unit 110 capable of measuring a wind speed is configured on each of four surfaces of front, rear, left, and right sides except for upper and lower surfaces.

【0034】The measurement units 110 formed on the four surfaces of the frame 101 operate as a ipsilateral measurement unit 110_E, a west measurement unit 110_W, a south measurement unit 110_S, and a north measurement unit 110_N, respectively.

【0035】To this end, when the measurement device 110 is installed, the ipsilateral measurement unit 110_E is installed to face the ipsilateral side, the west measurement unit 110_W is installed to face the west side, the south measurement unit 110_S is installed to face the south side, and the north measurement unit 110_N is installed to face the north side.

【0036】The measurement unit 110 constituting each of the east measurement unit 110_E, the west measurement unit 110_W, the south measurement unit

110_S, and the north measurement unit 110_N is configured as shown in FIG. 5.

【0037】The detector(111) is inserted into the hole(104) formed in the frame(101).

【0038】The sensing unit 111 is easily moved in the horizontal direction by wind, which is an external force. To this end, the sensing unit 111 is preferably formed of a material having a very light weight so as to be easily displaced.

【0039】In addition, the sensing unit 111 is fastened to one end of the FBG sensor 113 by a fixture 114, and the other end of the FBG sensor 113 is fastened to a fixed structure (for example, the frame 111 of the present invention) through a spring 112.

【0040】The structure for fastening and fixing the FBG sensor 113 through the spring 112 means a portion that does not move when wind blows, that is, when an external force is applied, such as the frame 101 or the ground.

【0041】The measurement unit 110 configured as described above operates as follows.

【0042】When the wind blows, the sensing element 111 slides into the frame 101 by wind pressure, and the FBG sensor 113 fastened to the sensing element 111 by the fixture 114 slides into the frame 101 in conjunction with the sensing element 111.

【0043】In this case, it is preferable that the guide 105 is installed to allow the sensing element 111 to accurately slide only in the horizontal direction by the wind pressure, so that the sensing element 111 is moved only in the horizontal direction by the wind pressure to accurately obtain the measured value.

【0044】Since the guide uses several conventional guides (e.g., LM guides, etc.) for guiding the slide movement, a detailed description thereof will be omitted.

【0045】When the FBG sensor 113 slides into the frame 101 and is displaced, a tensile force is applied to the FBG sensor 113 by the spring 112, the wavelength of the beam incident from the optical fiber 115 is changed by the period change of the grating of the FBG sensor 113 to which the tensile force is applied, and the change of the wavelength of the beam reflected from the FBG sensor 113 is measured by a light detection unit (not shown) and calculated by a calculation unit to calculate the wind speed of the wind in which the sensing unit 111 slides.

【0046】As shown in FIG. 6A, when the wind blows in a direction perpendicular to the sensing port 111 of the measuring unit 110, all of the measured wind pressures are measured as wind speeds. As shown in FIG. 6B, when the wind blows in a direction inclined by an angle θ with respect to the sensing port 111, the measured wind pressures are measured as “wind speeds×sin θ”.

【0047】As illustrated in FIG. 6B, the wind speed and the wind direction of the wind blowing at an angle inclined at a predetermined angle with respect to the sensing unit 111 may be measured and calculated together with one measurement unit 110 and another measurement unit 110 adjacent thereto to measure the wind speed and the wind direction. This will be described in detail later.

【0048】In the measurement device 100 according to the present invention, as shown in FIG. 4, holes 104 are formed in four surfaces of a frame 101 having a rectangular cross-section, and measurement units 110 are installed in the four holes, respectively.

【0049】In this case, the detection holes 111 of each measurement unit 110 should be installed so as to face the east, west, south, and north directions, respectively.

【0050】As described above, the measurement units 110 installed in the east, west, south, and north directions include the east measurement unit 110_E, the west measurement unit 110_W, the south measurement unit 110_S, and the north measurement unit 110_N, respectively.

【0051】In addition, each of the optical fibers 115 connected to the FBG sensor 113 of the ipsilateral measurement unit 110_E, the west measurement unit 110_W, the south measurement unit 110_S, and the north measurement unit 110_N is connected to the optical fiber 103 connected to the optical detector (not shown) through the coupler 102.

【0052】The beam incident through the optical fiber 103 is incident on the optical fiber 115 of the east measurement unit 110_E, the west measurement unit 110_W, the south measurement unit 110_S, and the north measurement unit 110_N through the coupler 102, and the beam reflected from the grating (the reflected beam is reflected by changing the wavelength as shown in FIG. 9) by the FBG sensor 113 is measured and calculated through the optical fiber 103 through the light detection unit (not shown) and the calculation unit (not shown) to measure the wind speed and the wind direction.

【0053】7 is a state in which a north wind is blowing toward the measurement device 100 according to the present invention.

【0054】At this time, the sensing tool 111 of the east side measuring unit 110_E, the west side measuring unit 110_W, and the south side measuring unit 110_S does not slide in the horizontal direction, but only the sensing tool 111 of the north side measuring unit 110_N slides into the frame 101.

【0055】Therefore, since the sensing elements 111 of the ipsilateral measurement unit 110_E, the western measurement unit 110_W, and the southern measurement unit 110_S do not slide, incident optical signals thereof are received by the optical detection unit without a change in wavelength.

【0056】In addition, while only the detection port 111 of the north side measurement unit 110_N slides, the wavelength of the optical signal incident on the north side measurement unit 110_N is changed and is detected by the optical detection unit.

【0057】The other measurement unit does not change the wavelength of the incident beam, and only the north measurement unit 110_N senses the change in the wavelength of the incident beam, and the calculation unit determines that the current wind blowing direction is north wind, and the wind speed at this time is as follows.

【0058】

【0059】wind speed = k × Δλ N

【0060】

【0061】Δλ_N is a wavelength change in the north measurement unit 110_N, and k is a proportional constant that reflects the characteristics of the spring 112, friction when the position of the sensing surface 111 is changed, and the like.

【0062】

【0063】8 is a state in which northeast wind is blowing toward the measurement device 100 according to the present invention.

【0064】In this state, wavelength changes in the north measurement unit 110_N and the ipsilateral measurement unit 110_E are measured. Since there is a wavelength change in the north side measurement unit 110_N and the east side measurement unit 110_E at the same time, the calculation unit determines that it is northeast wind, and the wind speed at this time is as follows.

【0065】

【0066】The speed of wind = k × (Δλ N + Δλ E)

【0067】

【0068】Δλ_N is a wavelength change in the north side measurement unit 110_N, Δλ_E is a wavelength change in the east side measurement unit 110_E, and the proportional constant k is a proportional constant that reflects the characteristics of the spring 112, friction when the position of the sensing surface 111 is changed, and the like.

【0069】In addition, when the wind direction is precisely measured like the north-northeast wind, the north measurement unit 110_N and the east measurement unit 110_E may measure the precise wind direction by comparing the magnitude of each wavelength change amount.

【0070】 In addition, when the wind stops, the sensing element 111 returns to the initial position due to the elasticity of the spring 112.

【0071】 The spring 112 constituting the measurement unit 110 may be configured to adjust the elasticity of the spring 112 according to the environment of the place where the measurement device 100 is installed.

【0072】 According to the present invention configured as described above, the wind direction and the wind speed are measured by the optical signal using the FBG sensor, so that constraints on the installation environment can be greatly alleviated and an accurate measurement value can be obtained without external electrical influence.

【0073】 Meanwhile, in general, since the lattice period of the FBG is changed by the temperature, correction thereof is required. However, in the present invention, since four sensors are used and the four sensors are under the same temperature change condition, temperature correction is not required.

【0074】 In addition, production, maintenance, and repair are very easy due to a simple structure.

【0075】 The technical idea of the present invention has been described through the above-described embodiment.

【0076】 It will be apparent to those skilled in the art that various changes and modifications may be made to the above-described embodiments without departing from the spirit and scope of the present invention.

【0077】 It will be apparent to those skilled in the art that various changes and modifications may be made without departing from the spirit and scope of the invention as defined by the appended claims.

【0078】 The above embodiments described with reference to the accompanying drawings have been described for the purpose of describing the present invention, and the scope of the present invention is not limited to these embodiments.

【0079】

【Reference Signs List】

【0080】100 : measure system

101 : Frame

102 : Coupler

103 : Optical fiber

104 : Hall

105 : Guide

110 : The measuring unit

110_E : ipsilateral measurement unit

110_W : Western Measurement

110 S : The south side measuring unit

110 N : The north side measuring unit

111 : Detector

112 : Spring

113 : FBG Sensor

114 : Fixture

115 : Optical fiber

【Claims】

【Claim 1】

The cross section is the frame(101) of the square pipe shape

The respective installed measuring unit(110) in four page of the frame(101) it is comprised of the FBG sensor(113) receiving the tensile force according to the displacement of the detector(111) connected in the structure in which one side is connected in each detector(111) and the detector(111) which is installed at the hole(104) of the frame(101) and displaces to the horizontal direction and the other side may not displace and

The optical fiber which is connected to the FBG sensor(113) and communicates the incident beam and reflection beam The present invention relates to an apparatus for measuring a wind direction and a wind speed using an FBG sensor.

【Claim 2】

The method according to claim 1, wherein:

The FBG sensor (113) is coupled to a spring (112) coupled to a non-displaceable structure to receive an elastic tensile force of the spring (112) according to the displacement of the sensing unit (111).

【Claim 3】

The method according to claim 2, wherein:

The spring 112 is configured to be elastically adjustable.

【Claim 4】

The method according to claim 1, wherein:

The guide(105) guiding the horizontal direction sliding of the detector(111) and an FBG sensor for measuring a wind direction and a wind speed.

【Claim 5】

The method according to claim 1, wherein:

The sensing units (111) installed on four surfaces of the frame (101) are installed to face the north, the east, the south, and the west, respectively.

【Claim 6】

The method according to claim 1, wherein:

The optical detecting part receiving the reflected beam transmitted from each measuring unit(110) and

The output unit computing the speed of wind and direction of the wind to the wavelength change at each measuring unit(110) detected from the optical detecting part and an FBG sensor for measuring a wind direction and a wind speed.

【Abstract】

【Summary】

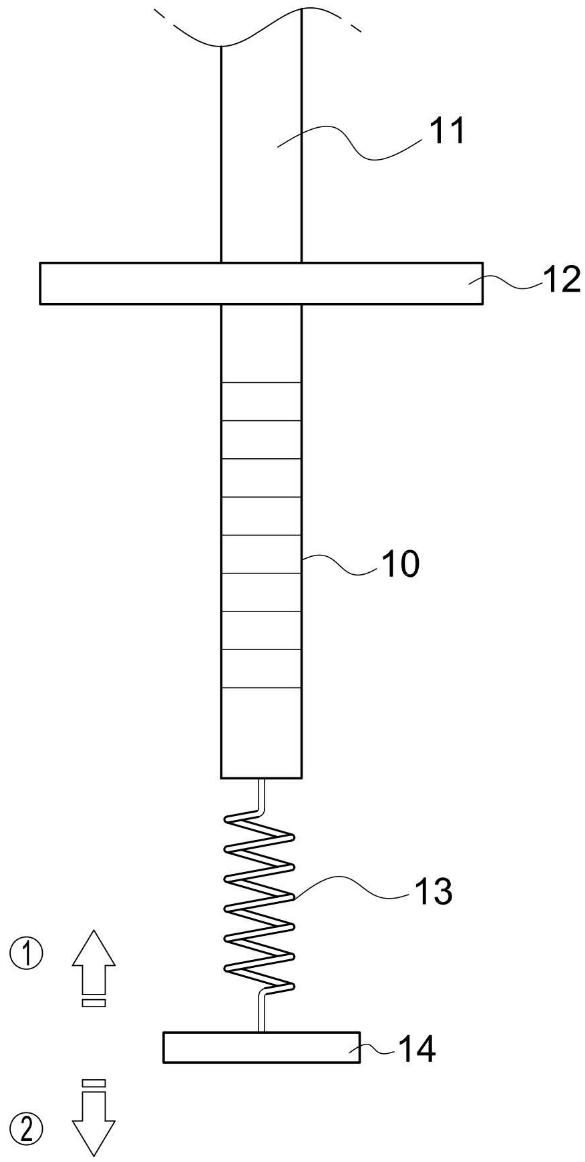
The present invention relates to a wind speed and an anemometer capable of sensing the intensity and direction of wind by using a fiber Bragg gratings (FBG) sensor which is an optical fiber sensor.

【Representative Drawing】

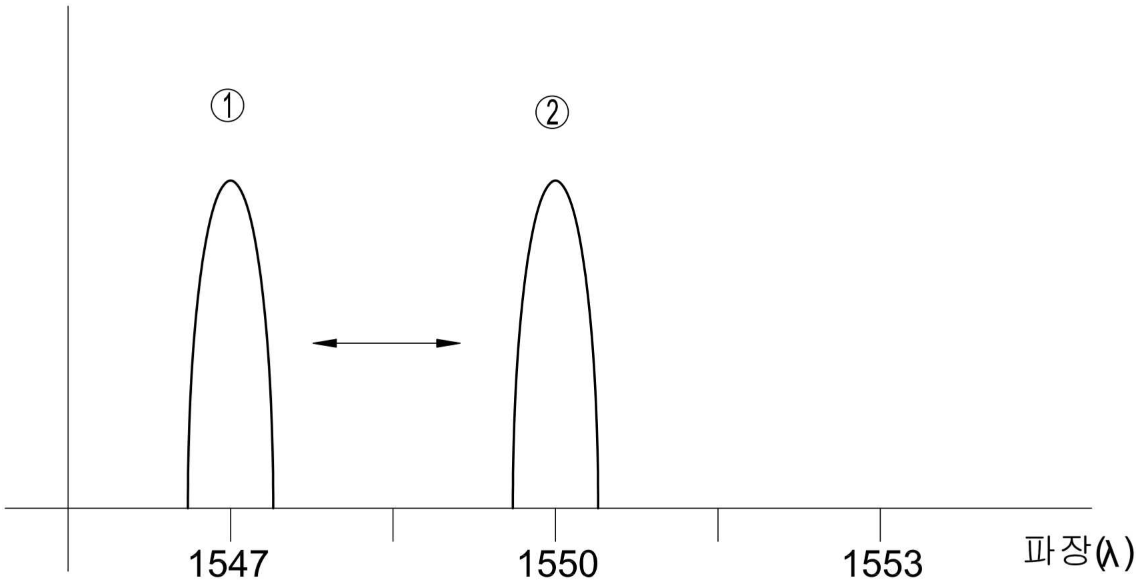
Figure3

【Drawings】

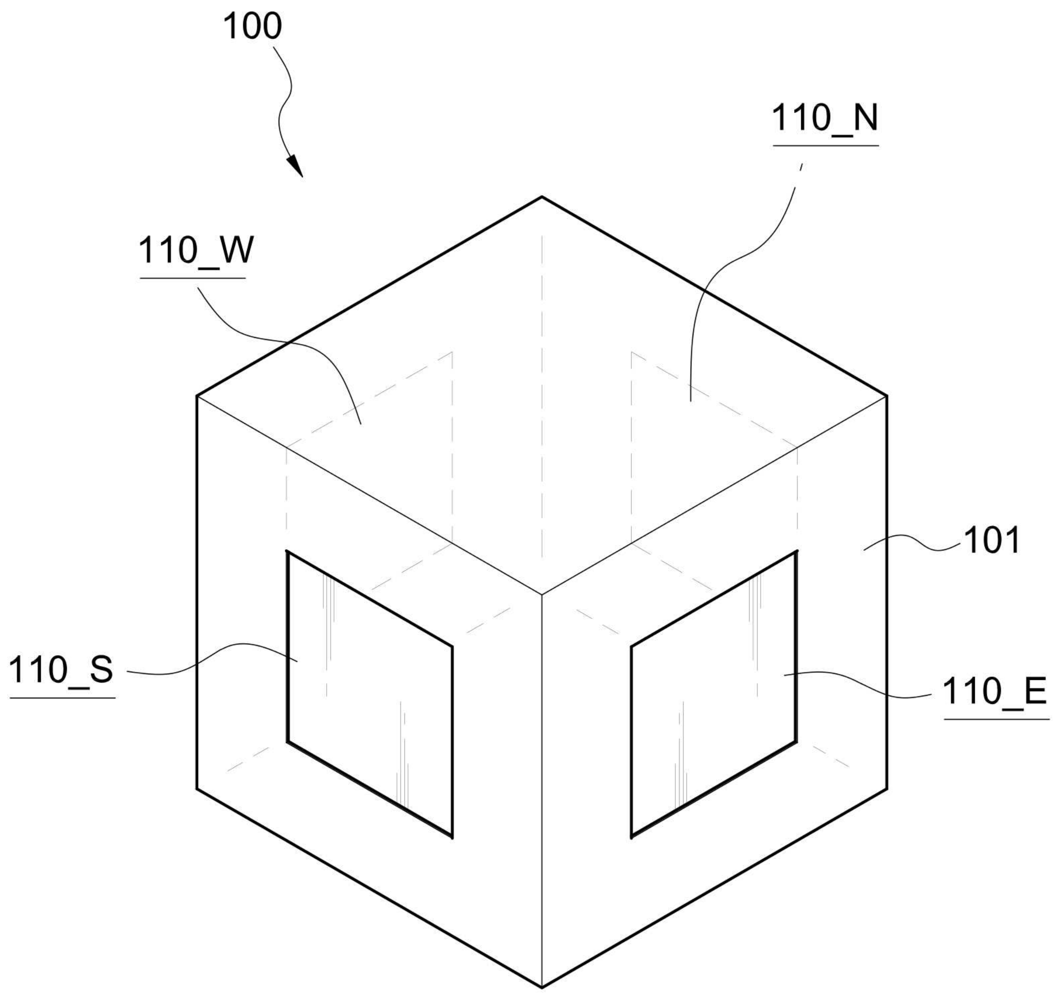
【Figure 1】



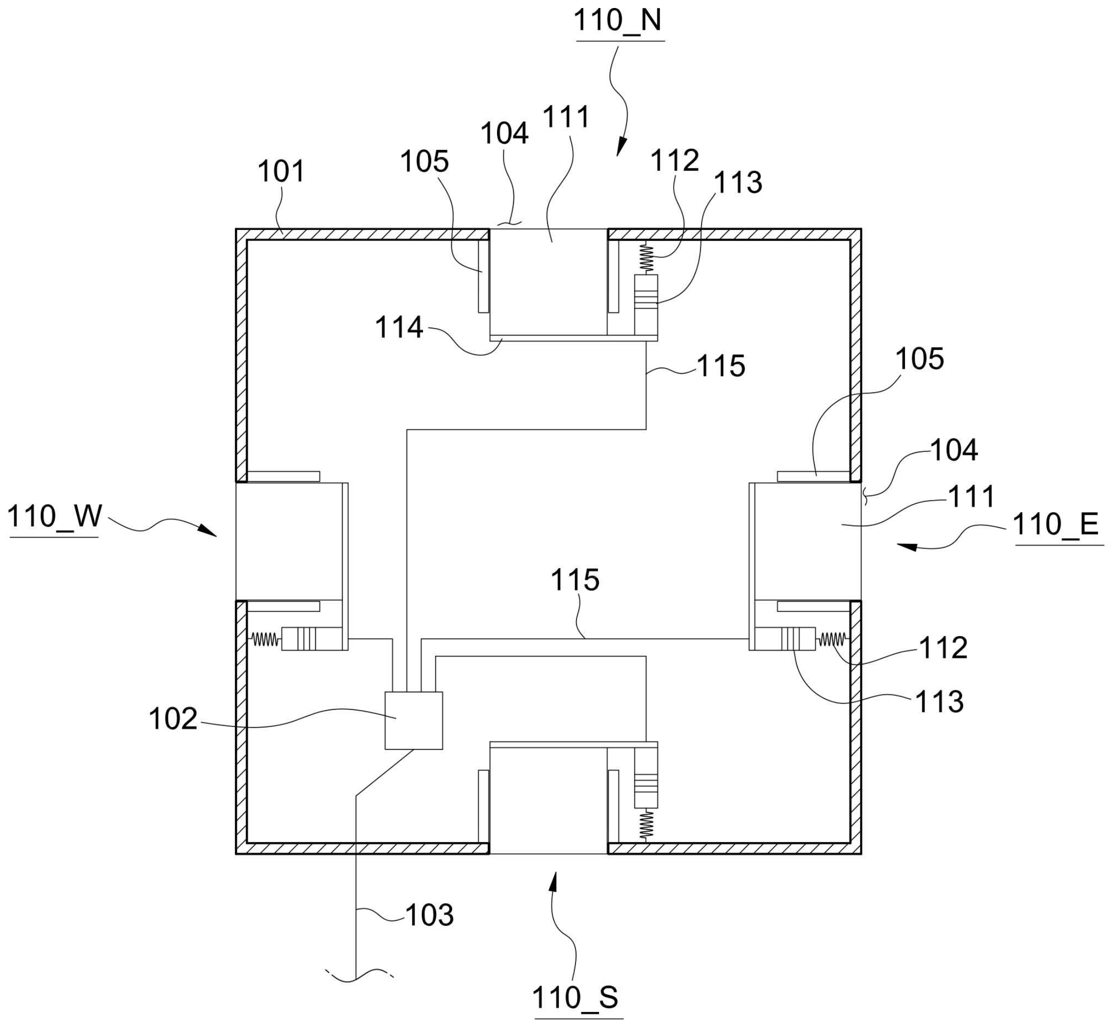
【Figure 2】



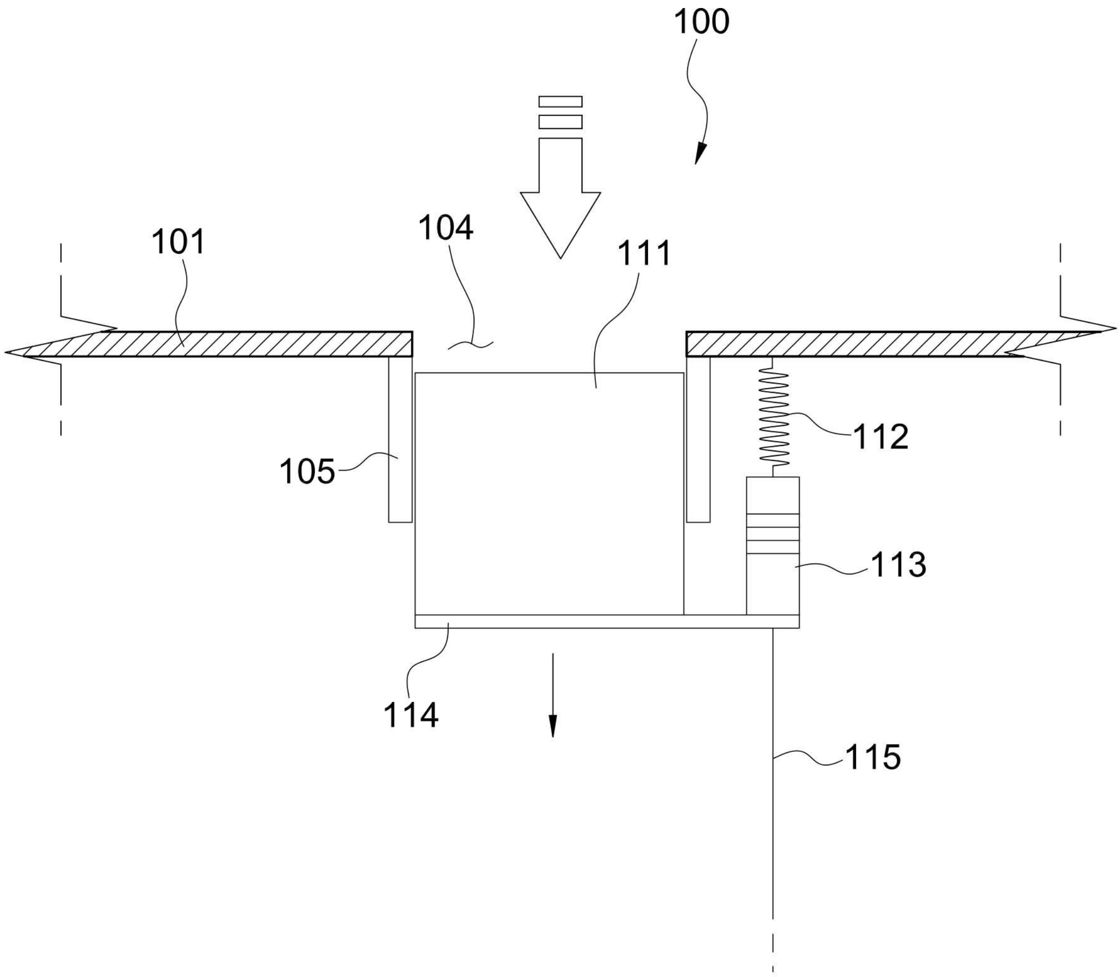
【Figure 3】



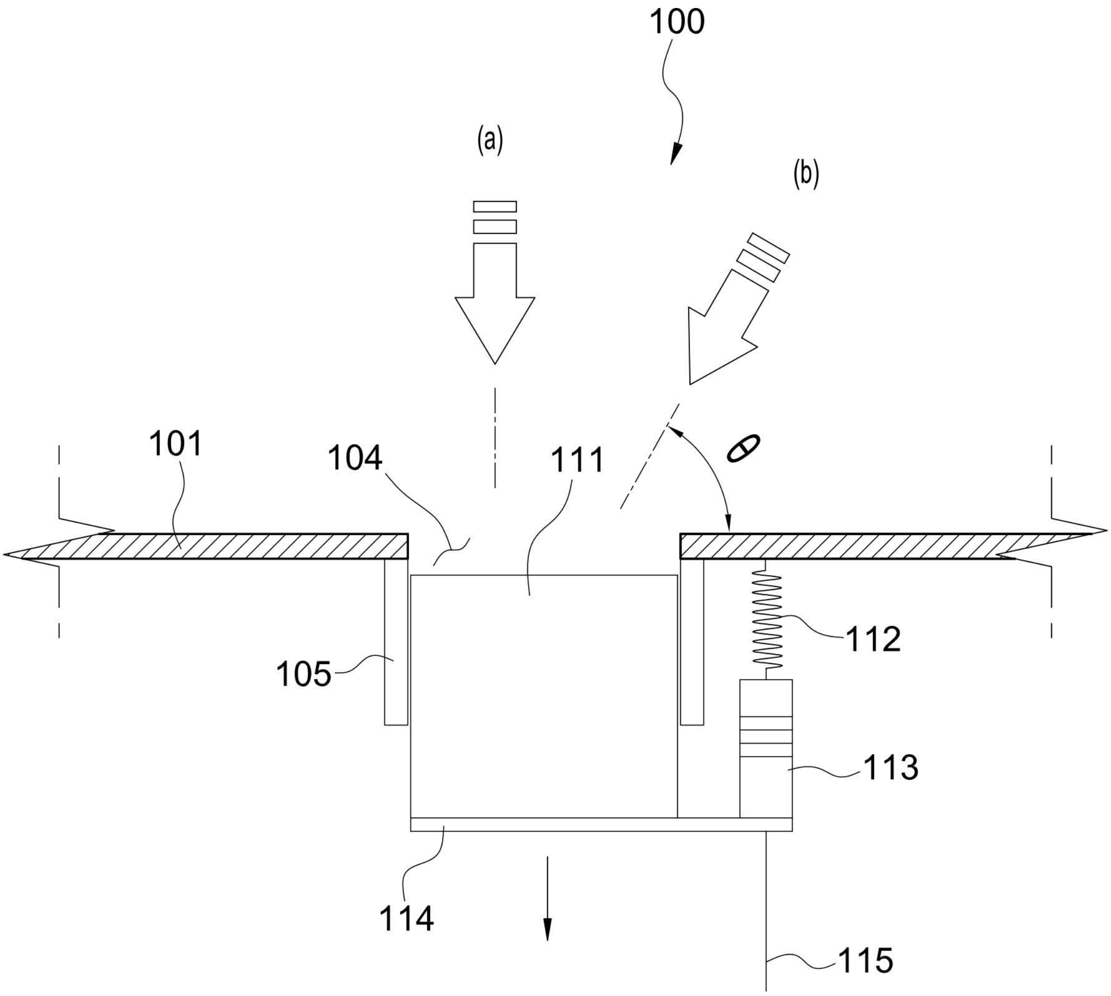
【Figure 4】


110_N
111
104
105
101
112
113
114
115
105
104
111
110_E
110_W
115
112
113
102
103
110_S

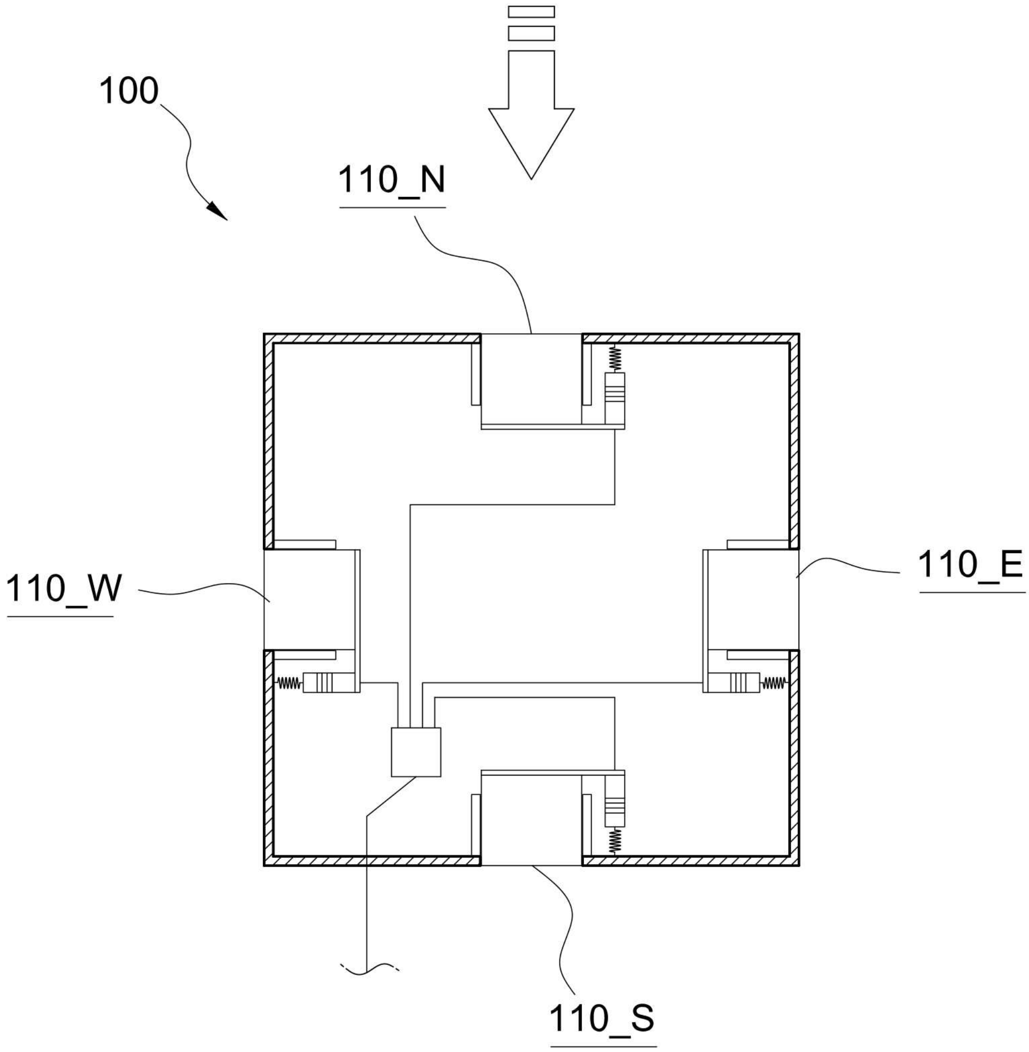
【Figure 5】



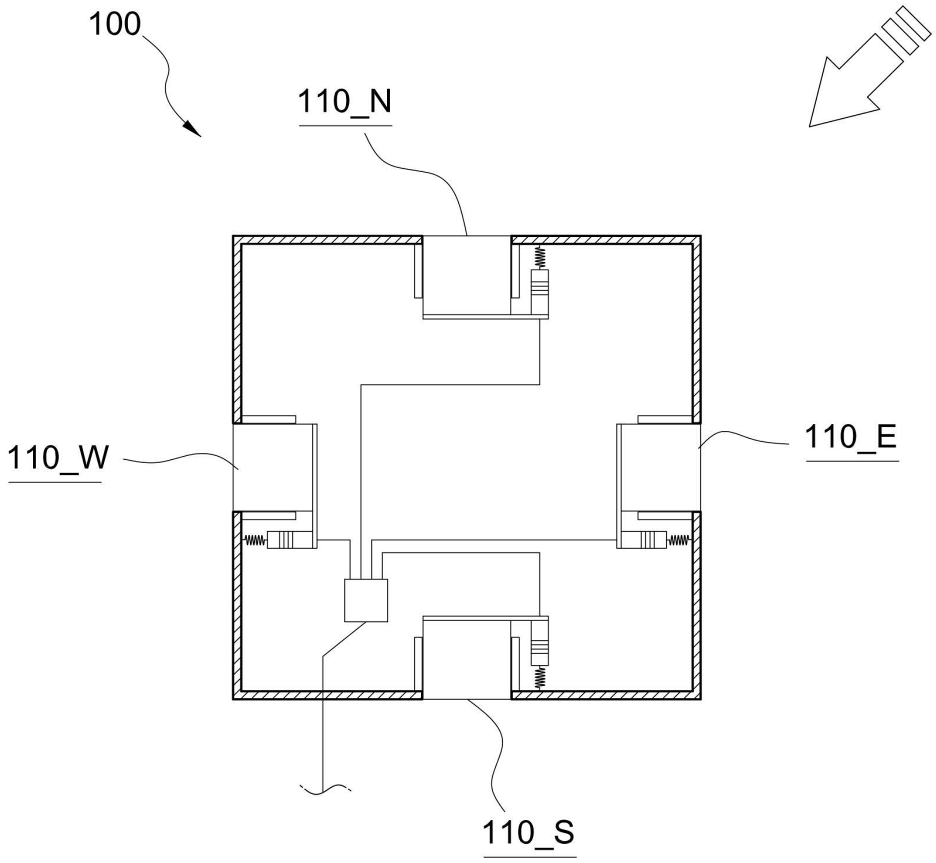
【Figure 6】



【Figure 7】



【Figure 8】



【Figure 9】