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(54) **VIBRATION DETECTING DEVICE**

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(57) **ABSTRACT**

According to one embodiment, a vibration detecting device includes a housing, a vibration sensor, a circuit board, a flexible wiring member, and an elastic member. The vibration sensor is accommodated in the housing. The circuit board is accommodated in the housing, and is provided with a first electric component configured to process a detection signal of the vibration sensor. The wiring member electrically connects the vibration sensor and the circuit board to each other. The elastic member contains a polymer material, and is accommodated in the housing as being in contact with the housing and the circuit board, and being detachable from the housing. The circuit board is held by the housing through the elastic member.

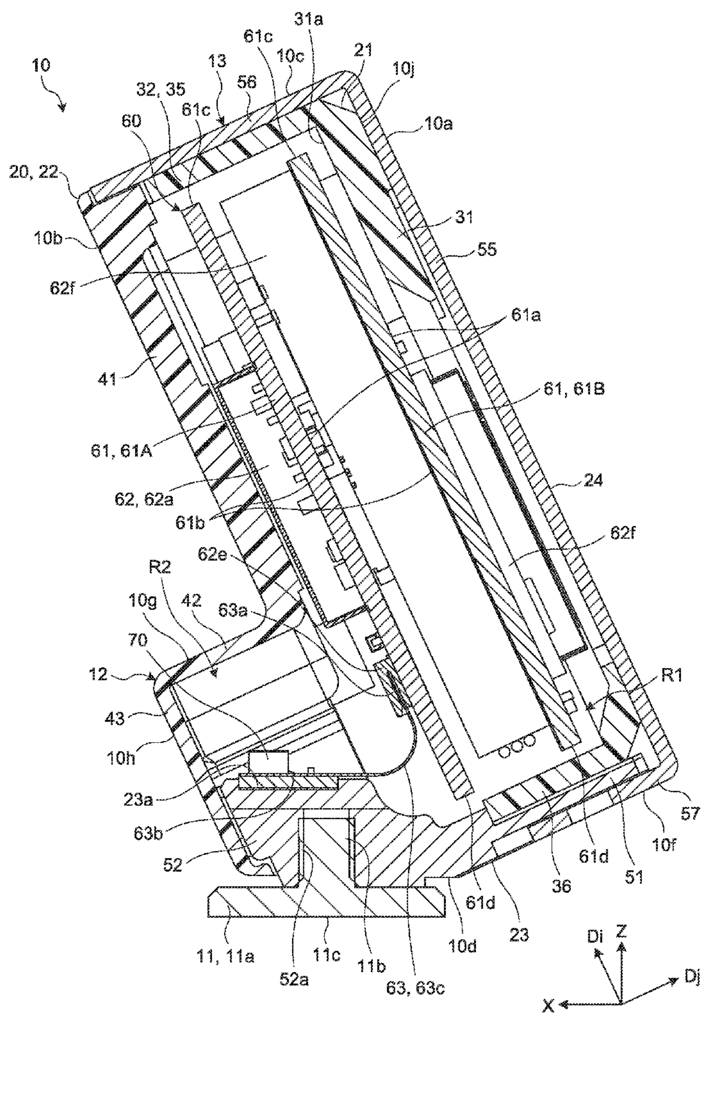
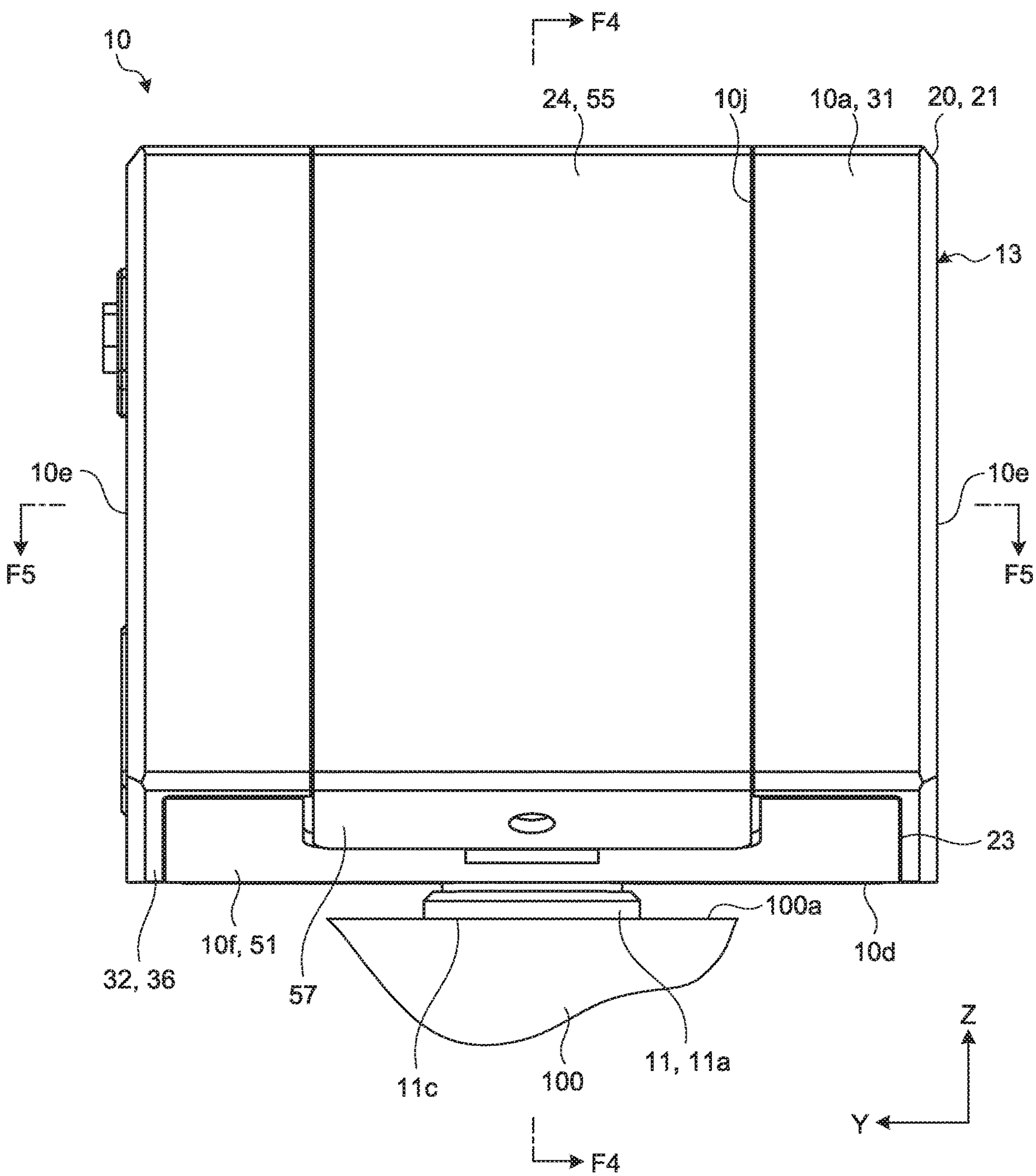


FIG.1



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10j
10a, 31
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10e
10e
F5
F5
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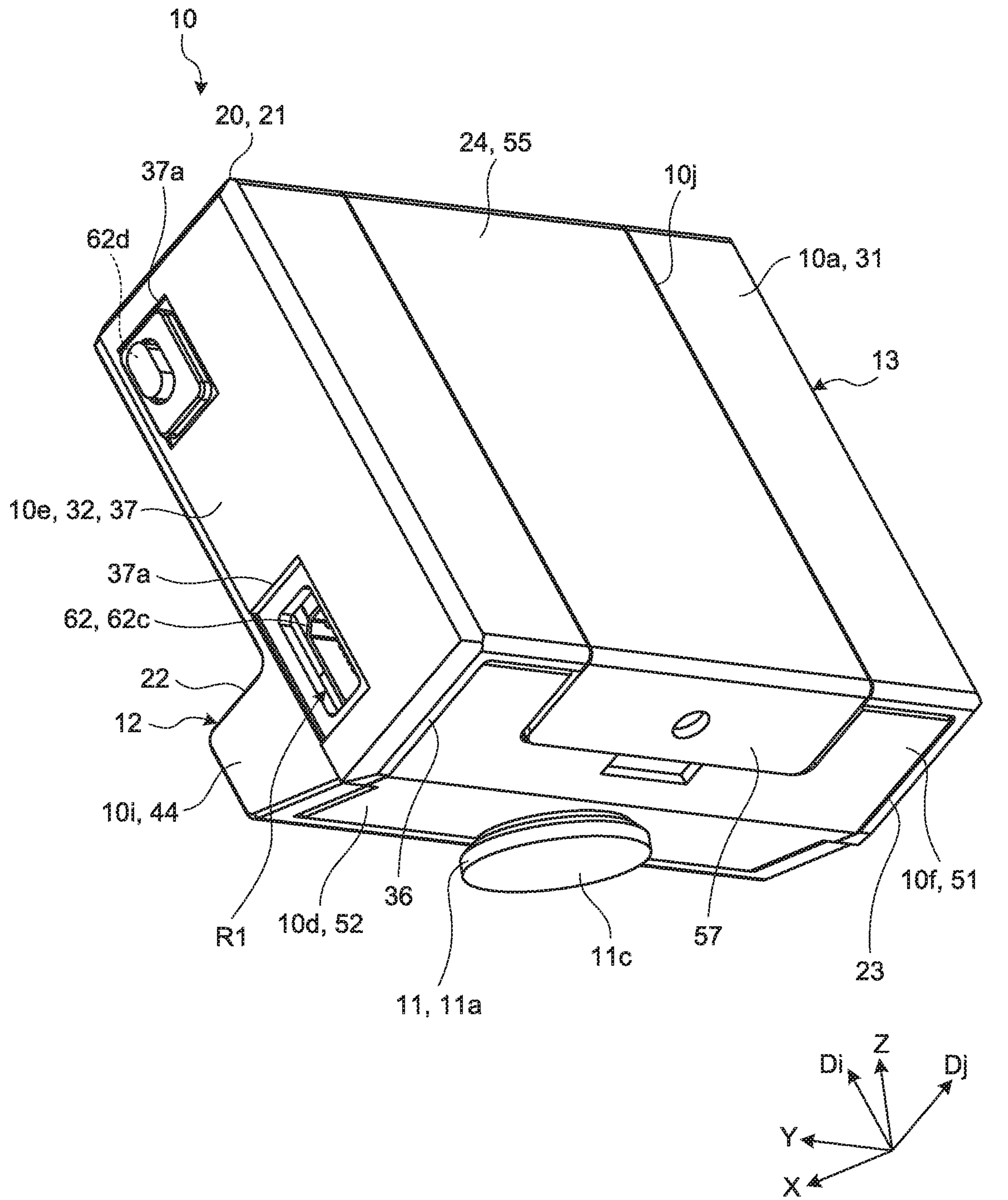
57
100
11, 11a
11c
Z
Y
F4

FIG.2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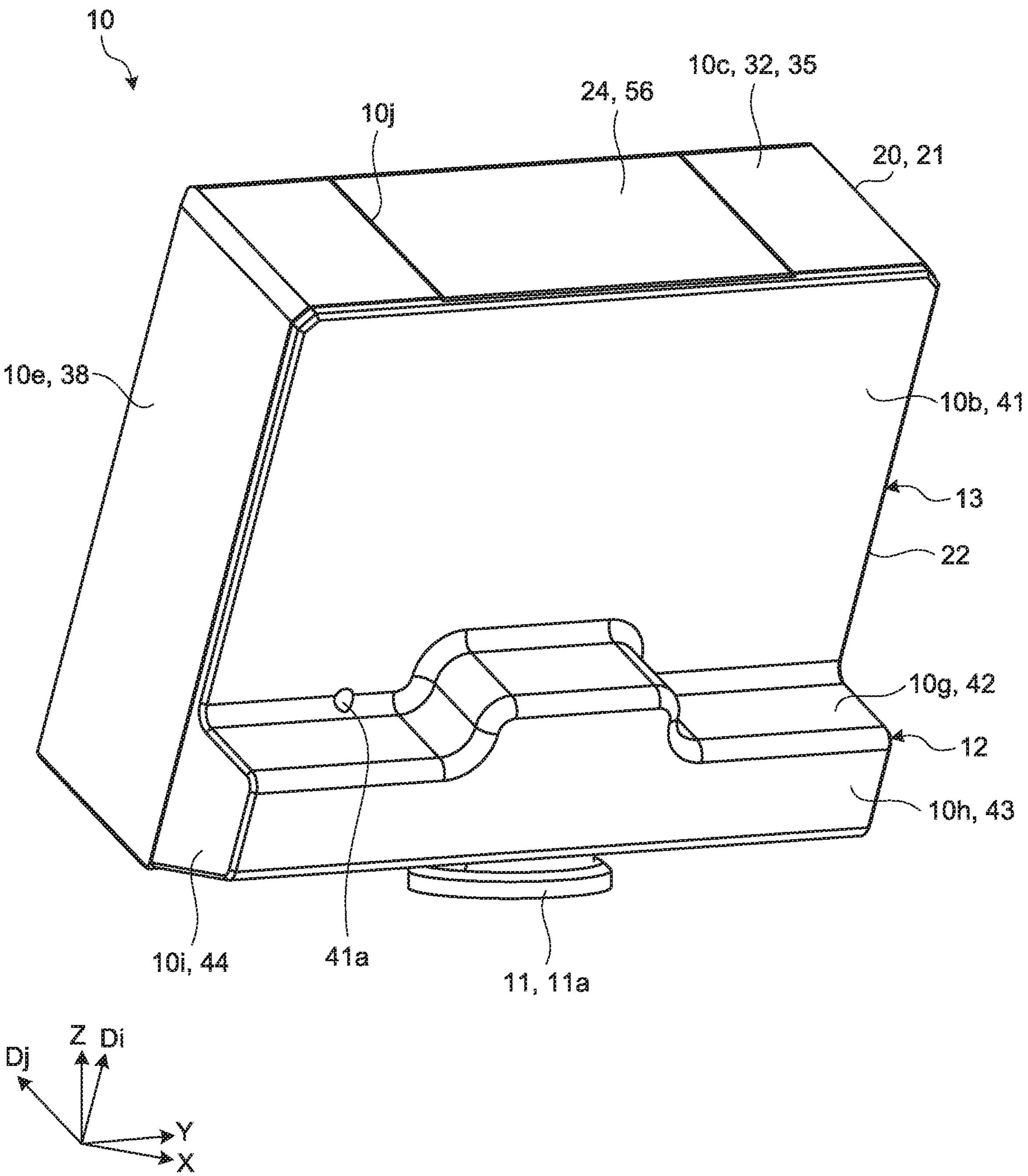
Y
X

FIG.3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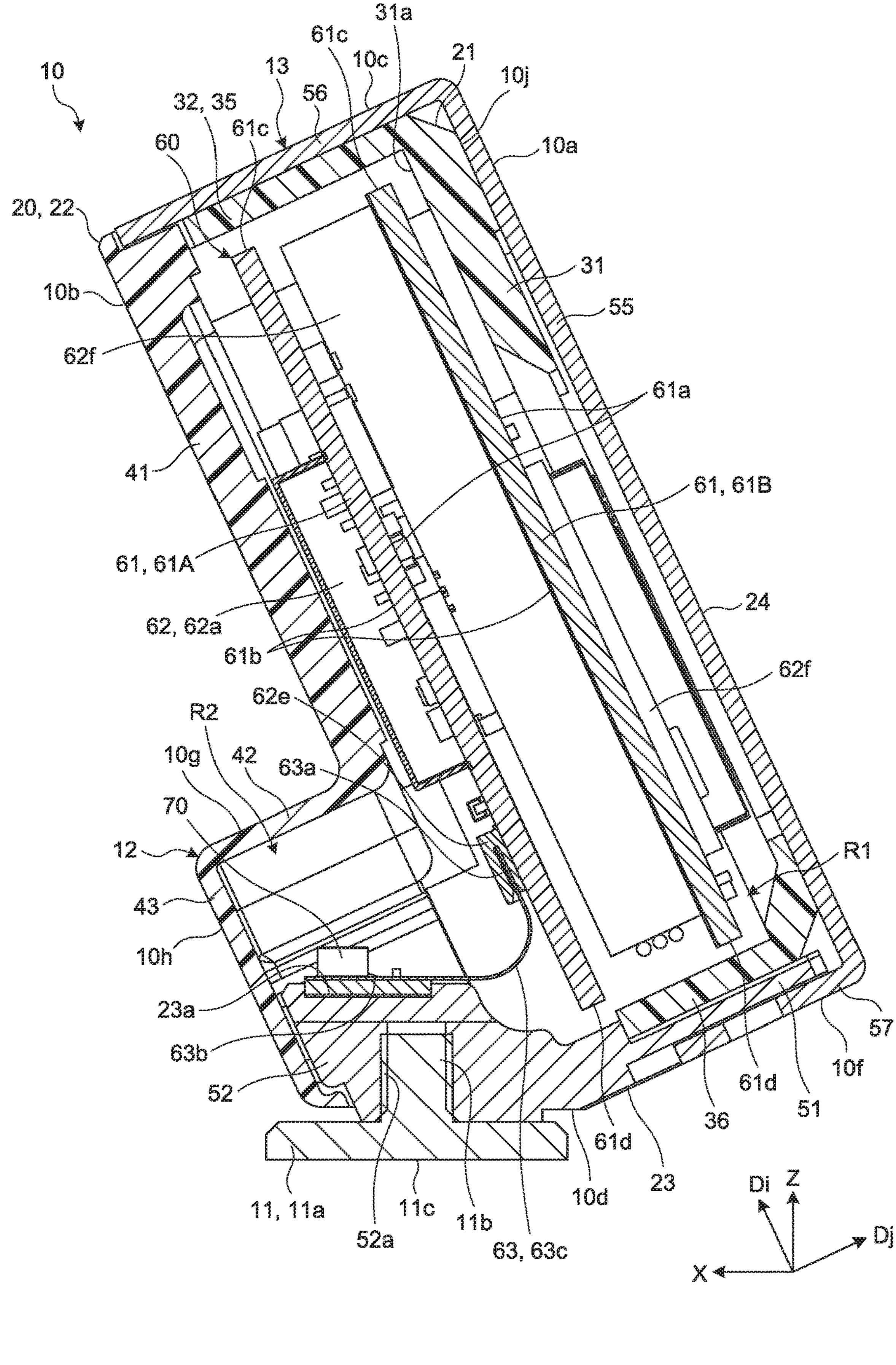
41a
11, 11a
Z
Di
Dj
Y
X

FIG.4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62, 62a
61b
24
62f
62e
R2
10g
42
63a
70
12
43
10h
R1
23a
63b
52
52a
11b
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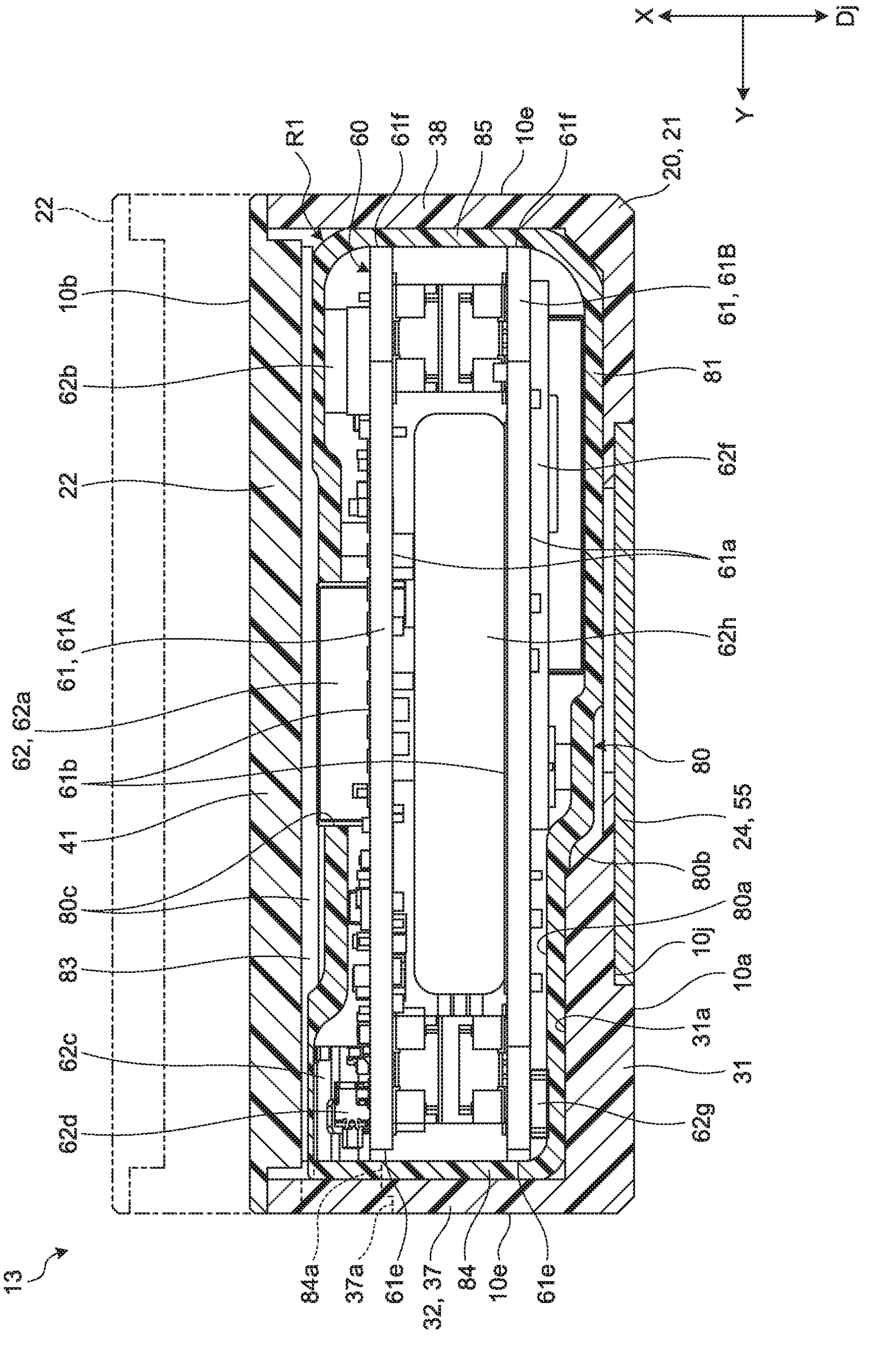
Dj
X

FIG.5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62d
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81
62f
61a
62h
80
24, 55
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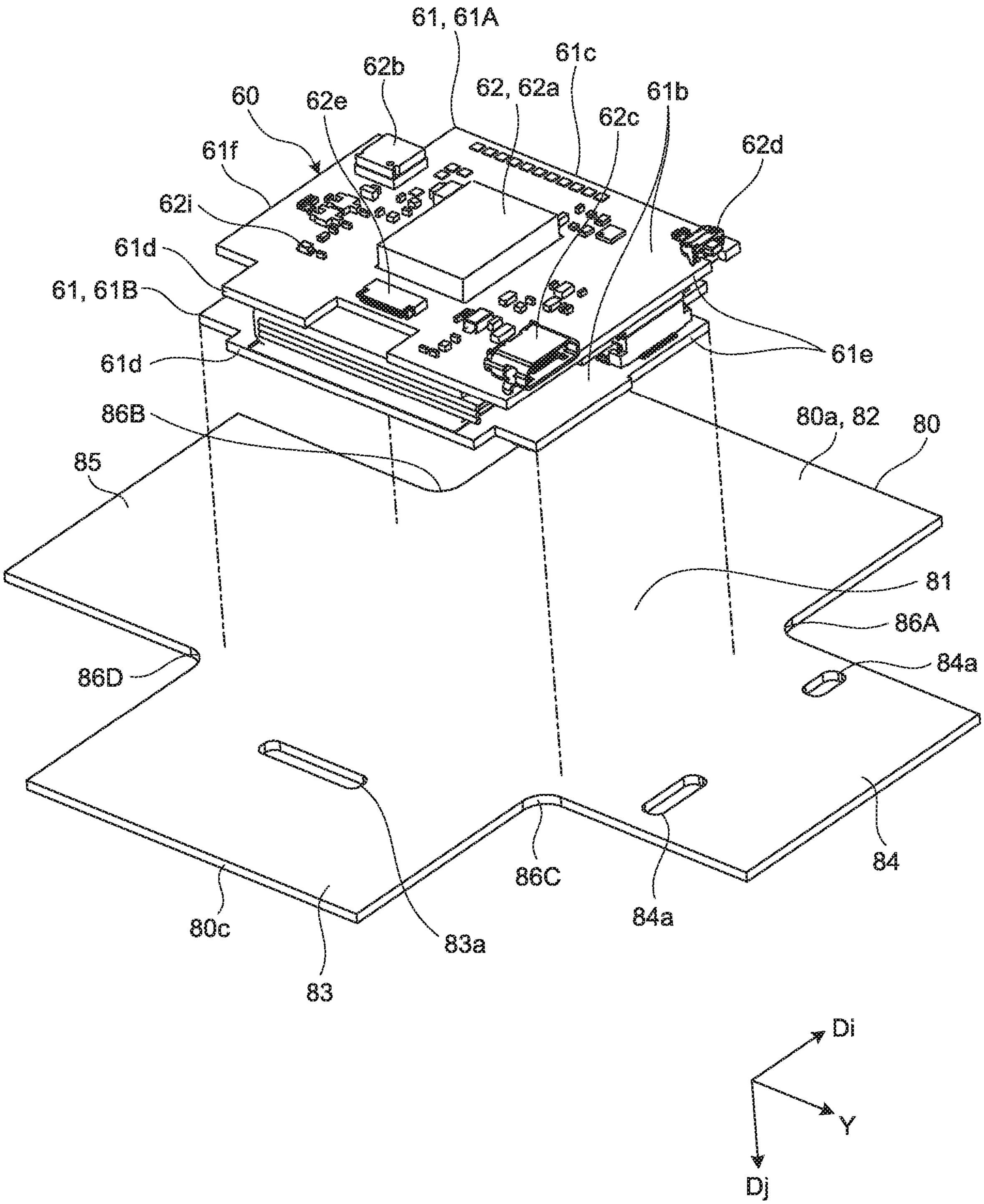
84
10e
61e

FIG.6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86B
80a, 82
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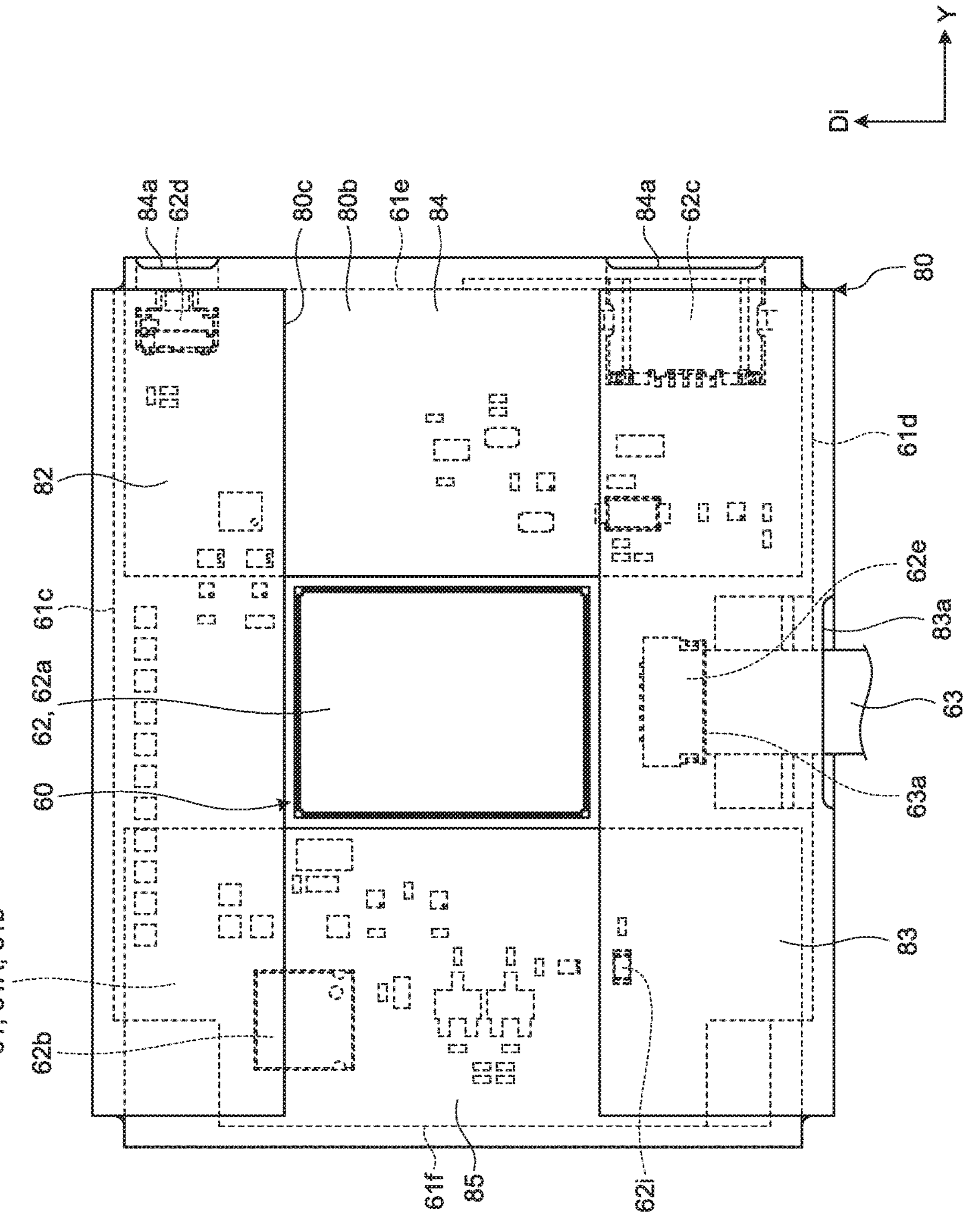
Di
Y
Dj

FIG.7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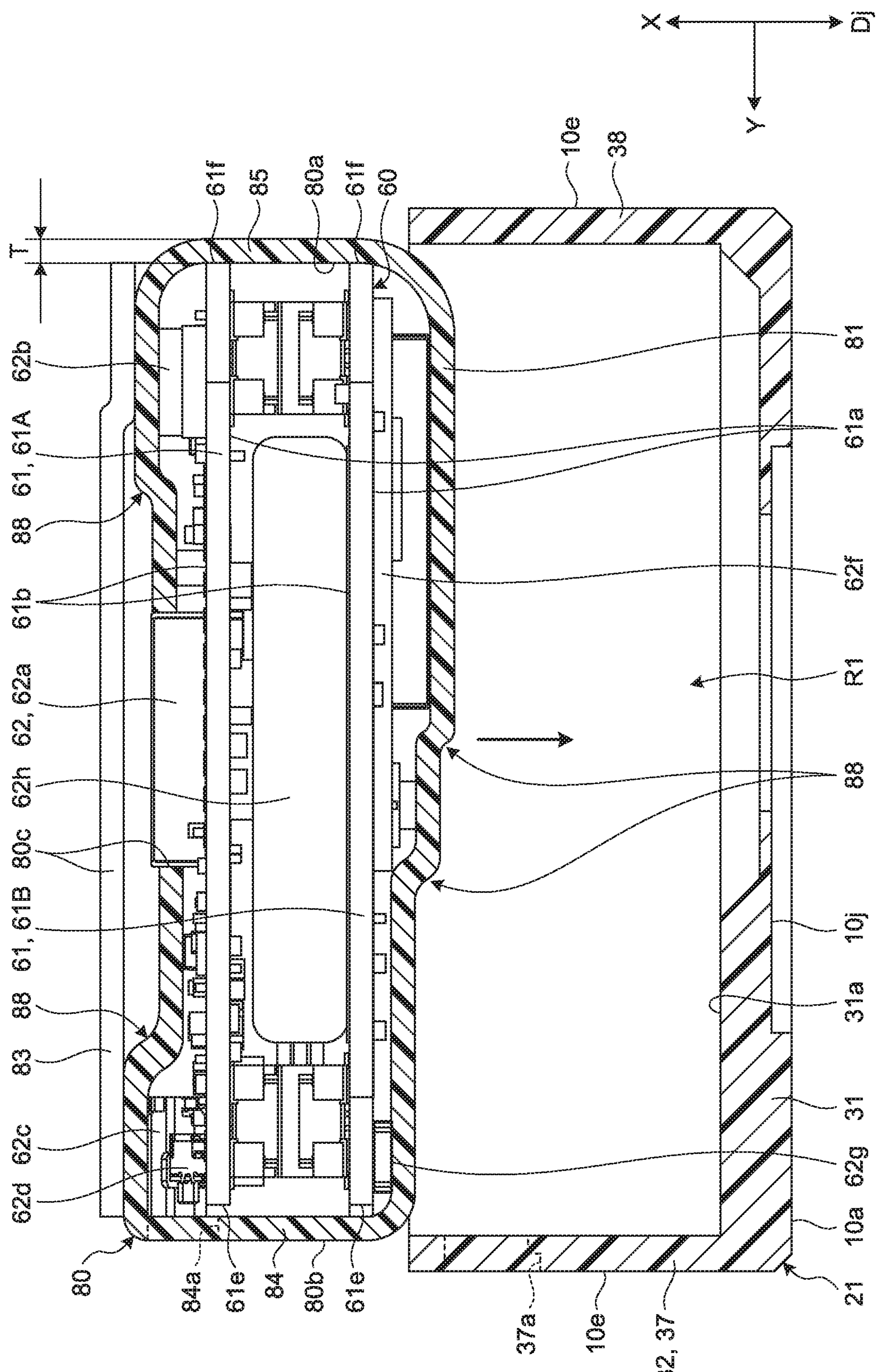
61c
82

FIG.8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31a
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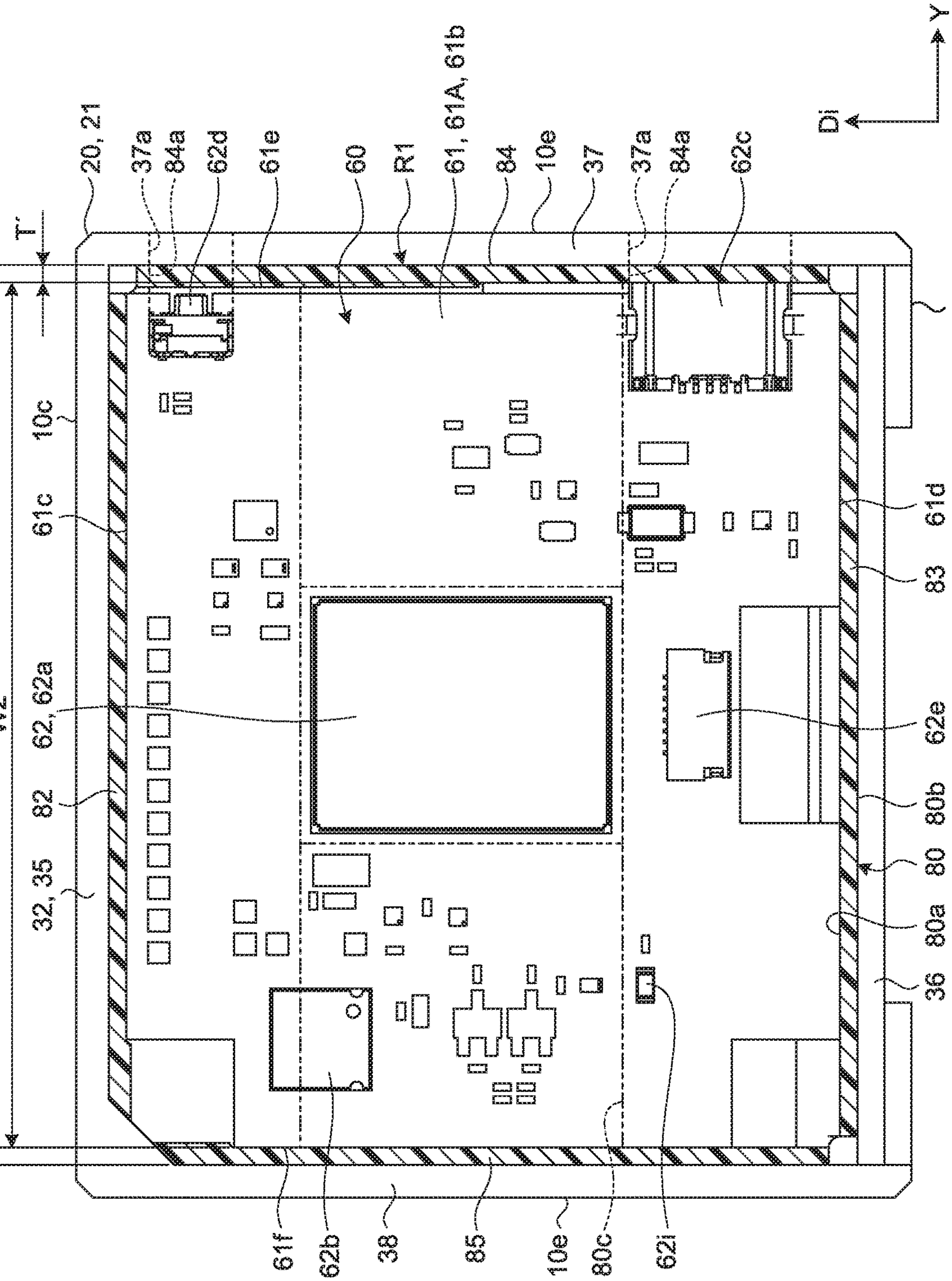
10e
32, 37
21

FIG.9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T
W1
W2
10c
61c
62, 62a
82
32, 35
10d
61d
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80a
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61f
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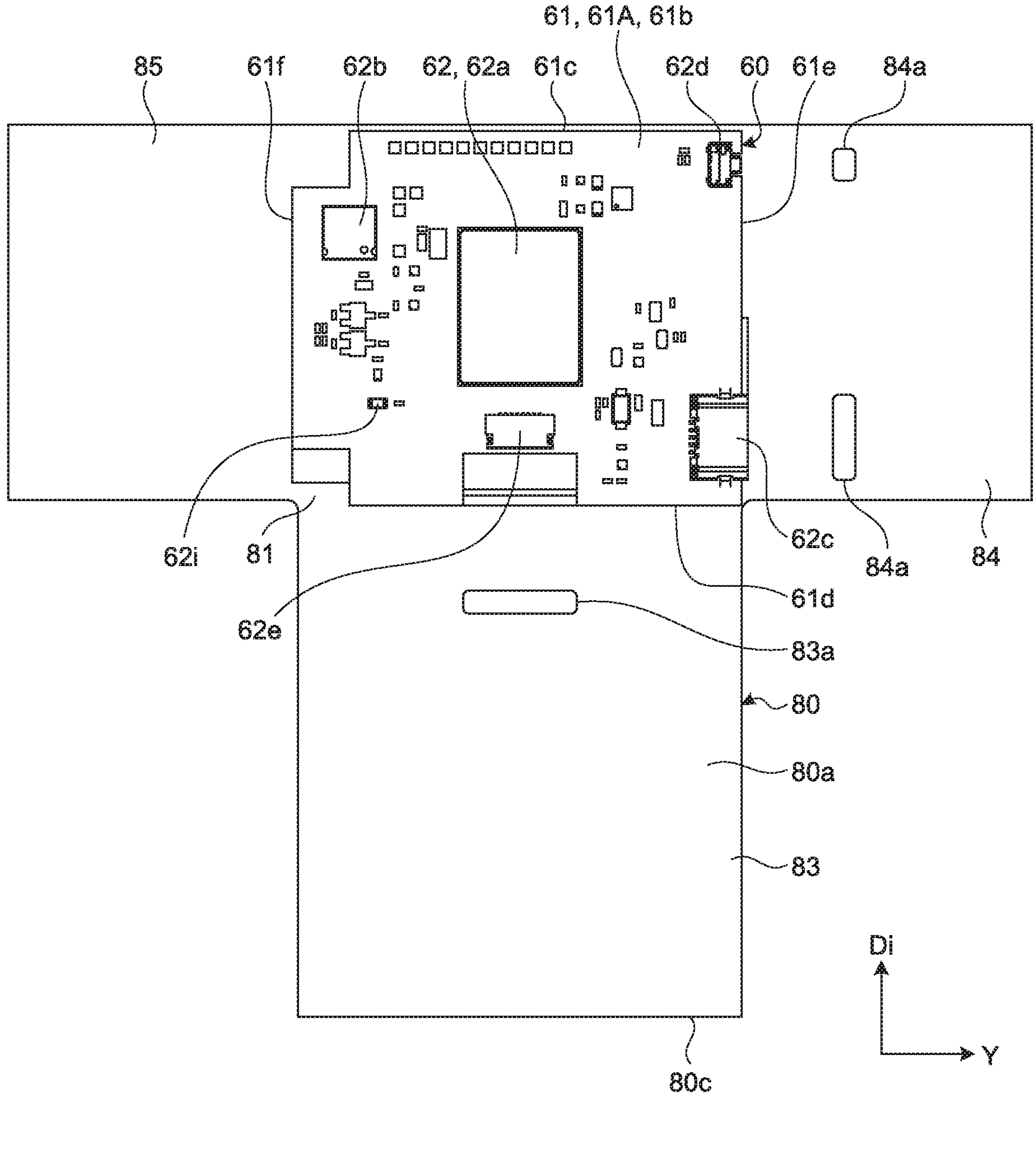
10e
80c
62i

FIG.10



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80c
Di
Y

FIG.11

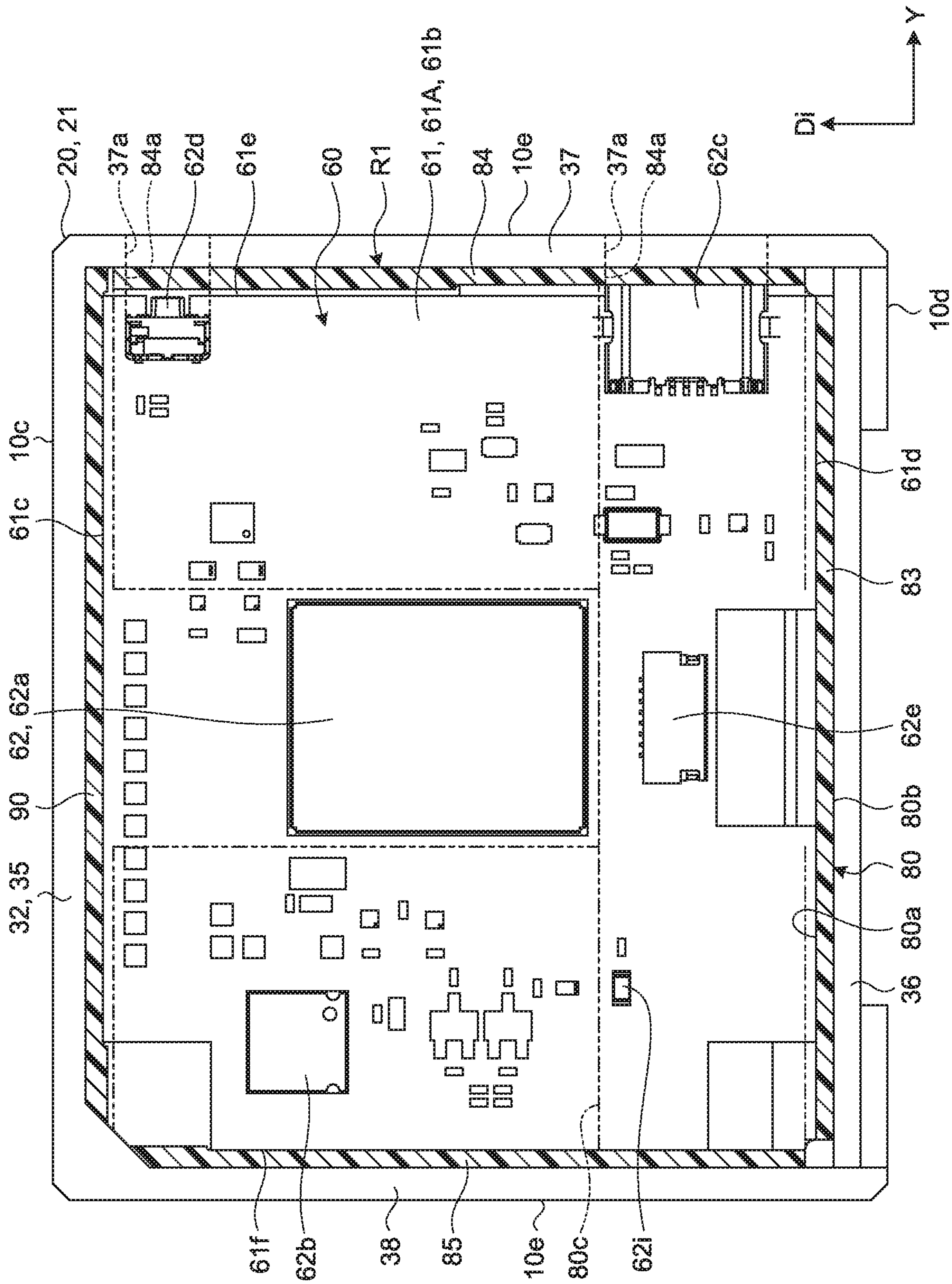
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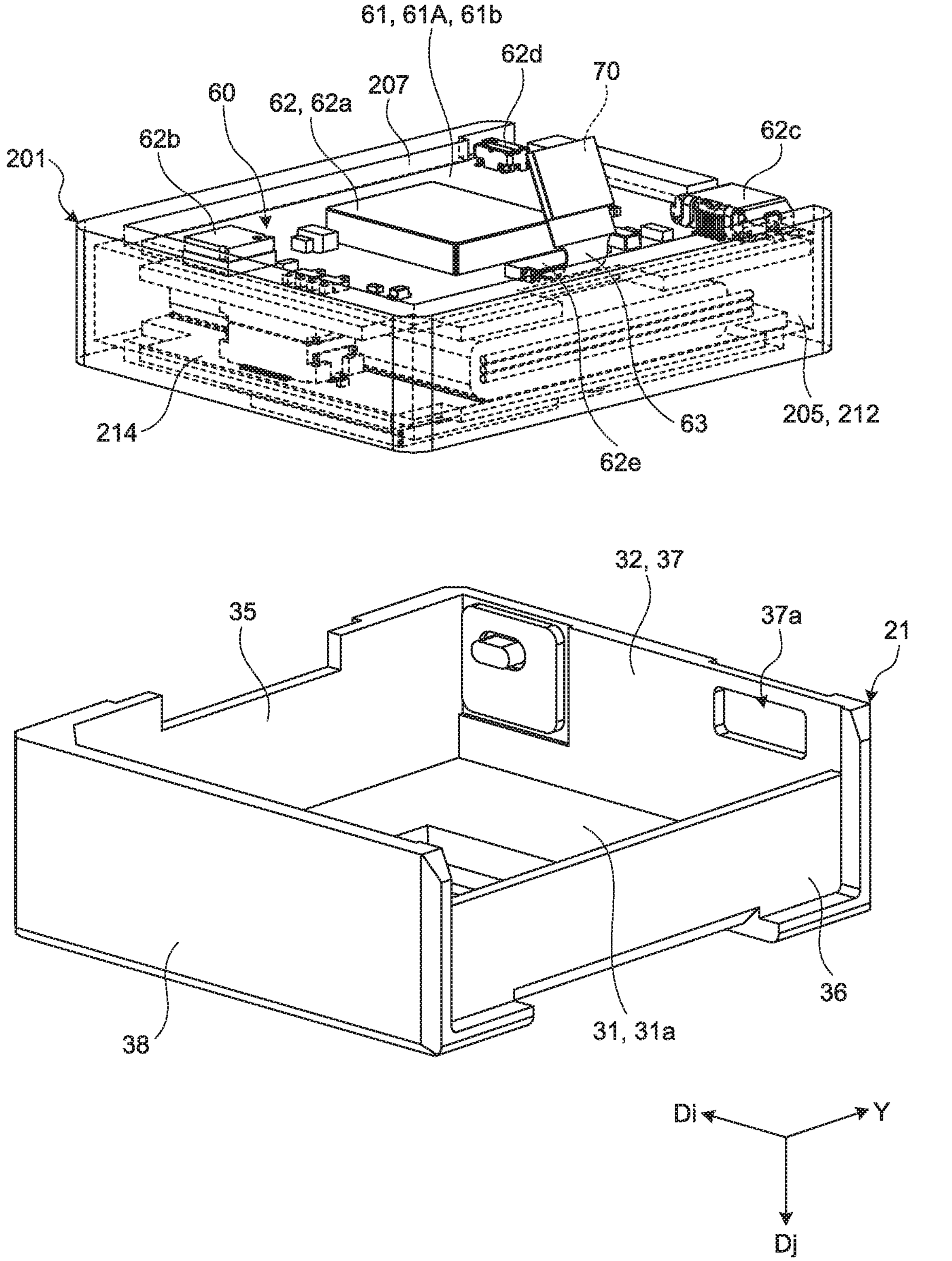
FIG.12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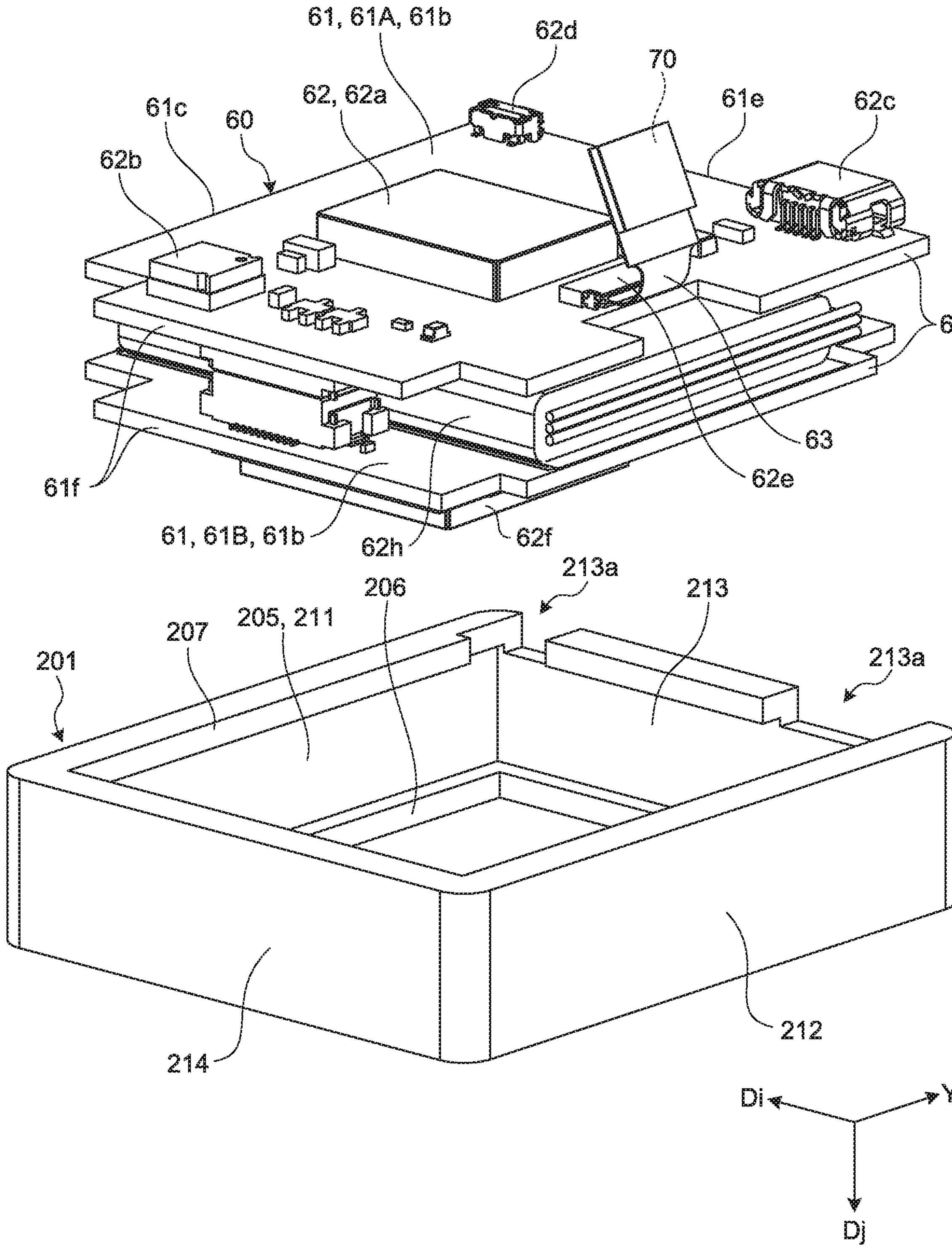
31, 31a
Di
Y
Dj

FIG.13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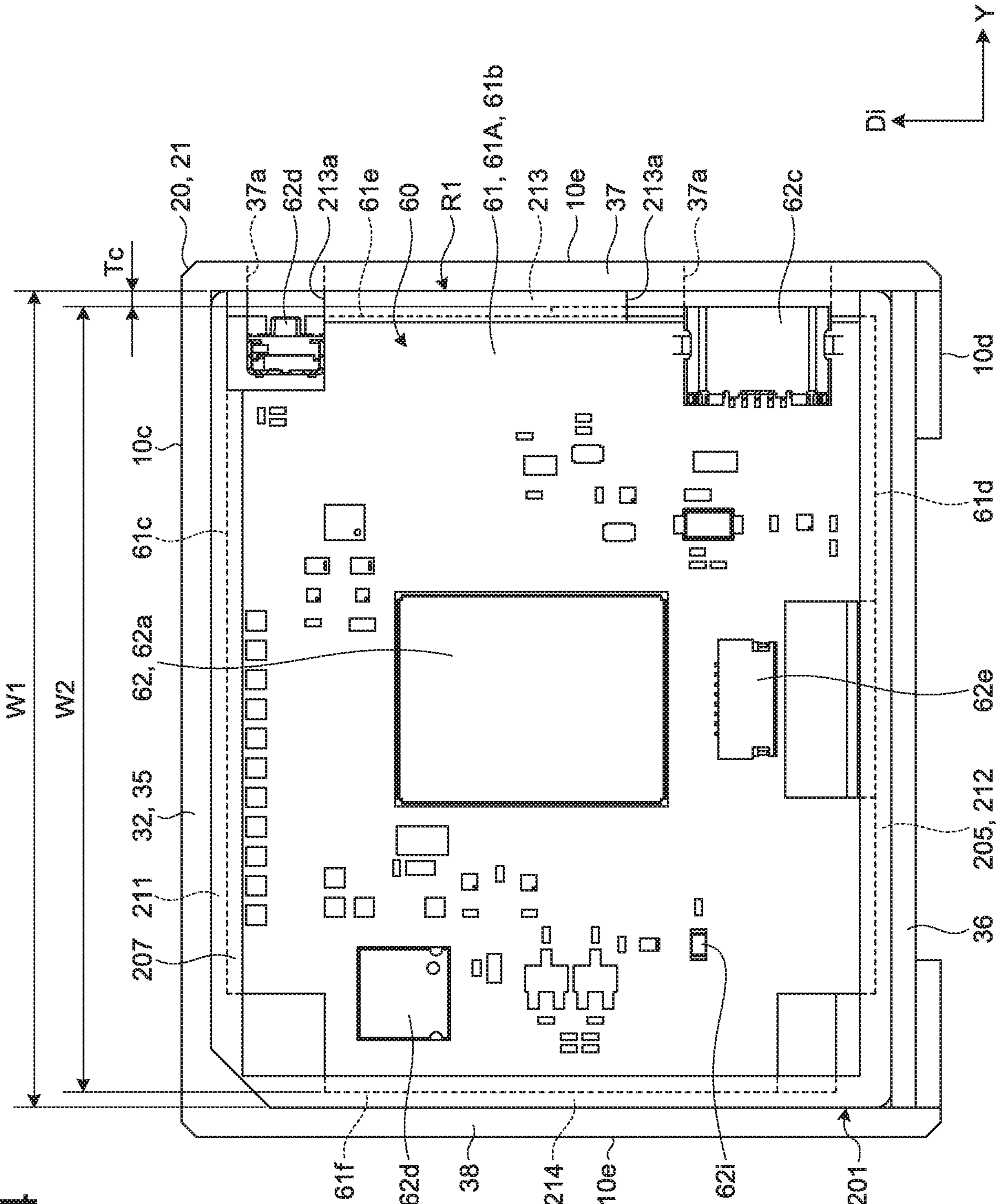
Di
Y
Dj

FIG.14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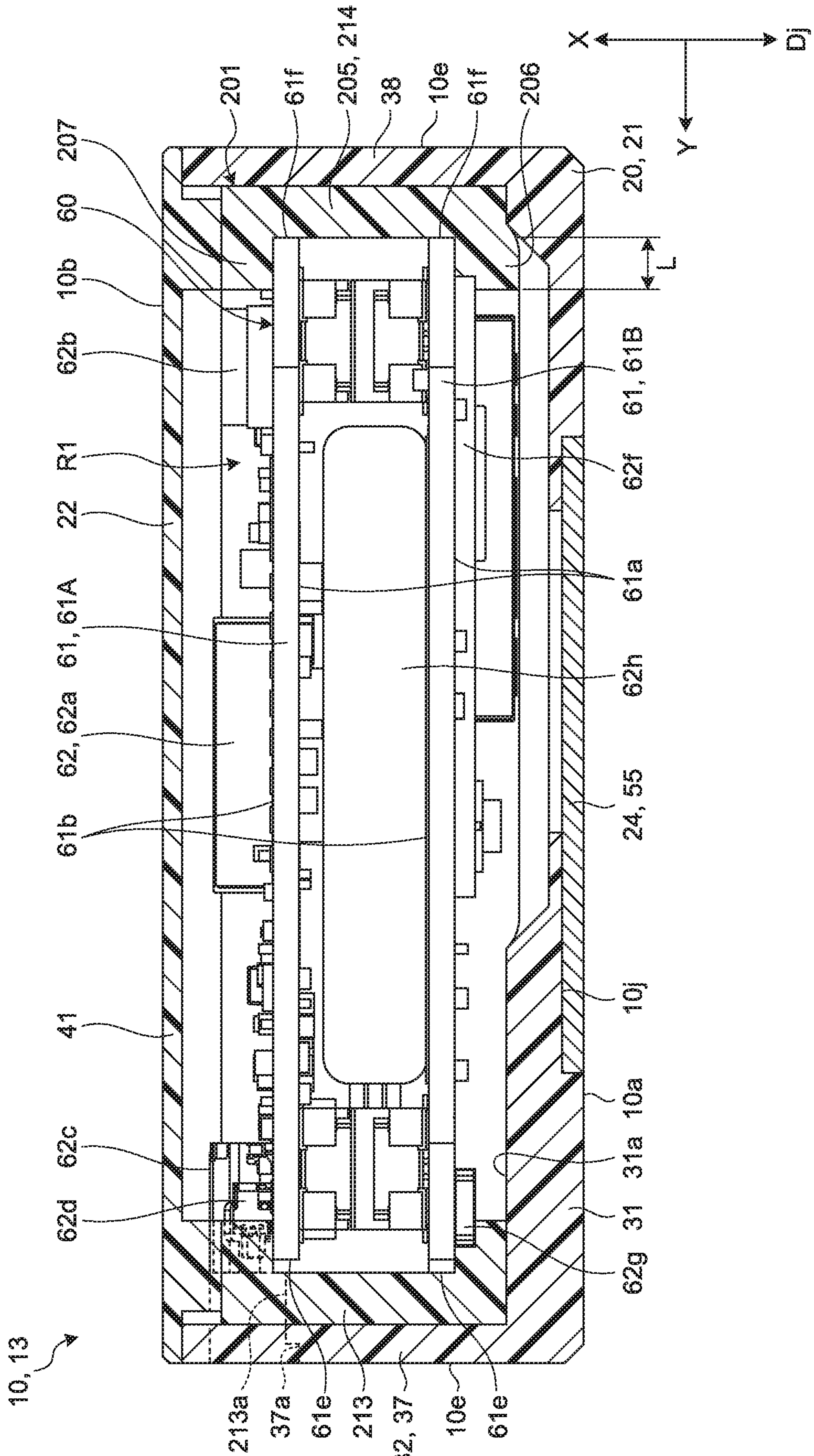
10c
Y
Di

FIG.15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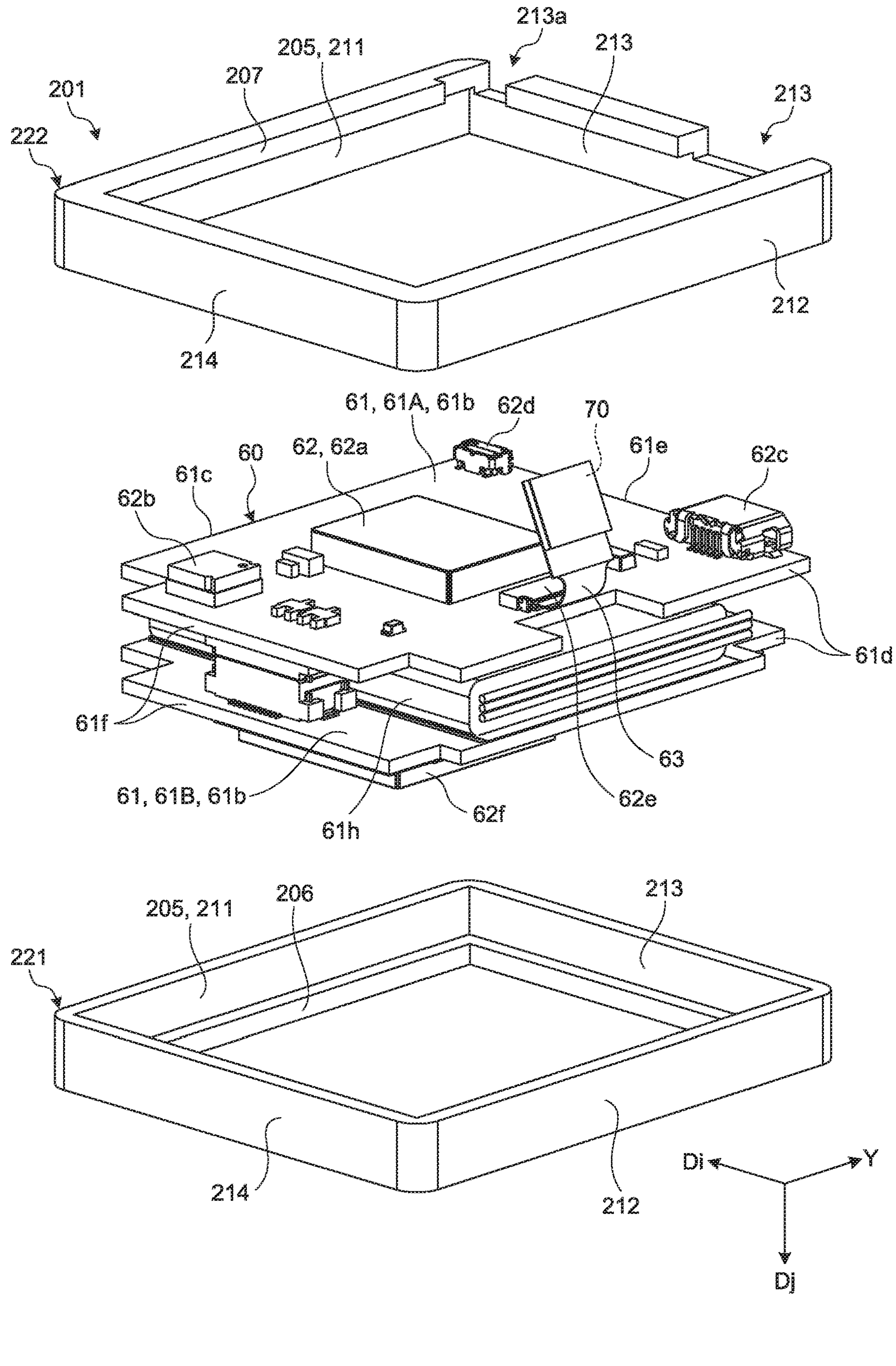
Dj
Y

FIG.16



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61h
205, 211
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221
214
212
Di
Y
Dj

VIBRATION DETECTING DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2019-122088, filed on Jun. 28, 2019; the entire contents of which are incorporated herein by reference.

FIELD

[0002] Embodiments described herein relate generally to a vibration detecting device.

BACKGROUND

[0003] Conventionally, vibration detecting devices are known, which detect vibration with a vibration sensor attached to an intended object.

[0004] It is beneficial to provide a vibration detecting device of a novel structure with less inconvenience.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. **1** is an exemplary front view illustrating a vibration detecting device according to a first embodiment;

[0006] FIG. **2** is an exemplary perspective view illustrating the vibration detecting device of the first embodiment;

[0007] FIG. **3** is an exemplary perspective view illustrating the vibration detecting device of the first embodiment, from an angle different from that of FIG. **2**;

[0008] FIG. **4** is an exemplary sectional view illustrating the vibration detecting device of the first embodiment, which is taken along a line F**4**-F**4** of FIG. **1**;

[0009] FIG. **5** is an exemplary sectional view illustrating the vibration detecting device of the first embodiment, which is taken along a line F**5**-F**5** of FIG. **1**;

[0010] FIG. **6** is an exemplary perspective view illustrating a board assembly and a sheet in the first embodiment;

[0011] FIG. **7** is an exemplary front view illustrating the board assembly wrapped with the sheet in the first embodiment;

[0012] FIG. **8** is an exemplary sectional view illustrating the board assembly wrapped with the sheet together with a front case **21** in the first embodiment;

[0013] FIG. **9** is an exemplary sectional view illustrating the board assembly and the sheet accommodated in the front case in first embodiment;

[0014] FIG. **10** is an exemplary plan view illustrating a board assembly and a sheet according to a second embodiment;

[0015] FIG. **11** is an exemplary sectional view illustrating the board assembly and the sheet accommodated in a front case, according to a modification of the second embodiment;

[0016] FIG. **12** is an exemplary perspective view illustrating a front case, a board assembly, and a buffer member, according to a third embodiment, in an exploded manner;

[0017] FIG. **13** is an exemplary perspective view illustrating the board assembly and the buffer member in the third embodiment, in an exploded manner;

[0018] FIG. **14** is an exemplary back view illustrating the board assembly and the buffer member accommodated in the front case in the third embodiment;

[0019] FIG. **15** is a sectional view illustrating a vibration detecting device according to the third embodiment; and

[0020] FIG. **16** is an exemplary perspective view illustrating a board assembly and a buffer member according to a fourth embodiment, in an exploded manner.

DETAILED DESCRIPTION

[0021] In general, according to one embodiment, a vibration detecting device includes a housing, a vibration sensor, a circuit board, a flexible wiring member, and an elastic member. The vibration sensor is accommodated in the housing. The circuit board is accommodated in the housing, and is equipped with a first electric component. The first electric component is configured to process a detection signal of the vibration sensor. The wiring member electrically connects the vibration sensor and the circuit board to each other. The elastic member contains a polymer material, and is accommodated in the housing in contact with the housing and the circuit board, and is detachable from the housing. The circuit board is held by the housing through the elastic member.

First Embodiment

[0022] First, an explanation will be given of a first embodiment with reference to FIGS. **1** to **9**. In the present specification, a plurality of expressions may be used in terms of a constituent element according to an embodiment and description on the element. The constituent elements and description thereof are merely exemplary, and are not limited by the expressions given in the present specification. A constituent element may be identified with a name different from that in the present specification. Further, a constituent element may be described by using an expression different from that in the present specification.

[0023] FIG. **1** is an exemplary front view illustrating a vibration detecting device **10** according to the first embodiment. FIG. **2** is an exemplary perspective view illustrating the vibration detecting device **10** of the first embodiment. FIG. **3** is an exemplary perspective view illustrating the vibration detecting device **10** of the first embodiment, from an angle different from that of FIG. **2**.

[0024] As illustrated in FIG. **1**, the vibration detecting device **10** is attached to a surface **100***a* of an intended object **100**, to detect vibration of the object **100**, for example. As illustrated in FIGS. **1** to **3**, the vibration detecting device **10** includes an attachment **11**, a base **12**, and an overhang **13**.

[0025] As illustrated in the respective figures, in the present specification, an X-axis, a Y-axis, and a Z-axis are defined for the sake of convenience. The X-axis, the Y-axis, and the Z-axis are orthogonal to one another. The X-axis is along the depth of the vibration detecting device **10**. The Y-axis is along the width of the vibration detecting device **10**. The Z-axis is along the height of the vibration detecting device **10**.

[0026] Further, in the present specification, an X direction, a Y direction, and a Z direction are defined. The X direction is along the X-axis, and includes a +X direction indicated by the arrow of the X-axis, and a −X direction opposite to the arrow of the X-axis. The Y direction is along the Y-axis, and includes a +Y direction indicated by the arrow of the Y-axis, and a −Y direction opposite to the arrow of the Y-axis. The Z direction is along the Z-axis, and includes a +Z direction indicated by the arrow of the Z-axis, and a −Z direction opposite to the arrow of the Z-axis.

[0027] Further, in the present specification, a Di direction and a Dj direction are defined. The Di direction, the Dj direction, and the Y direction are orthogonal to one another. The Di direction is a direction in which the overhang **13** extends, and includes a +Di direction indicated by an arrow Di, and a −Di direction as the direction opposite to the arrow Di. The Dj direction is the thickness direction of the overhang **13**, and is orthogonal to the Di direction. The Dj direction includes a +Dj direction indicated by an arrow Dj, and a −Dj direction opposite to the arrow Dj.

[0028] In this embodiment, the surface **100***a* of the object **100** is a substantially flat surface that is orthogonal to the Z-axis and faces in the +Z direction. However, the surface **100***a* is not limited to this example. For example, the vibration detecting device **10** may be attached to a curved surface **100***a*.

[0029] In the examples of the respective figures, the +Z direction is vertically upward, the −Z direction is vertically downward, and the X direction and the Y direction are horizontal directions. However, the X direction, the Y direction, and the Z direction are not limited to this example. For example, the vibration detecting device **10** may be attached to a surface **100***a* that faces vertically downward, in the horizontal direction, or in another direction. In other words, the positions and orientations of the vibration detecting device **10** and the surface **100***a* of the object **100** to which this vibration detecting device **10** is attached are not limited to specific ones, but may be selectively set from various positions and orientations.

[0030] FIG. **4** is an exemplary sectional view illustrating the vibration detecting device **10** of the first embodiment, which is taken along a line F**4**-F**4** of FIG. **1**. As illustrated in FIG. **4**, the attachment **11** includes a stationary part **11***a* and a male screw **11***b*.

[0031] As illustrated in FIG. **1**, the stationary part **11***a* has a substantially disk shape and is fixed to the surface **100***a* of the object **100**. The stationary part **11***a* has a substantially flat attaching surface **11***c* that is orthogonal to the Z direction and faces in the −Z direction. The attaching surface **11***c* is fixed to the surface **100***a* by, for example, adhesion. The attachment **11** and the vibration detecting device **10** are thereby fixed to the object **100**. The attachment **11** may also be referred to as bracket. As illustrated in FIG. **4**, the male screw **11***b* protrudes from the stationary part **11***a* in the +Z direction.

[0032] The base **12** is detachably connected to the attachment **11**. The base **12** protrudes in the +X direction from the −Di directional end of the overhang part **13**. In other words, the overhang part **13** protrudes in the +Di direction from the −X directional end of the base **12**.

[0033] The base **12** and the overhang **13** together form a substantially L-shape or substantially V-shape. The Di direction is slanted with respect to the Z direction. For example, the angle between the Z direction and the Di direction is an acute angle. Thus, the overhang part **13** extends obliquely from the base **12** with respect to the Z direction in which the attaching surface **11***c* faces.

[0034] The overhang part **13** has a flat rectangular parallelepiped shape. For example, the length (width) of the overhang part **13** in the Y direction is substantially constant. The length (thickness) of the overhang part **13** in the Dj direction is substantially constant. The shape of the overhang **13** is not limited to this example.

[0035] As illustrated in FIGS. **1** to **4**, the vibration detecting device **10** includes outer surfaces, i.e., a front surface **10***a*, a rear surface **10***b*, a top surface **10***c*, a bottom surface **10***d*, lateral surfaces **10***e*, a front lower surface **10***f*, a rear upper surface **10***g*, a rear end surface **10***h*, and rear lateral surfaces **10***i*. Throughout the present specification, expressions representing directions, such as front, rear, upper, lower, top, bottom, and lateral, are used with reference to the accompanying drawings for the sake of convenience, and they are not intended to limit the position and direction of each element. For example, the top surface **10***c* may be located below the bottom surface **10***d* in the vertical direction.

[0036] The front surface **10***a* is located at the end of the overhang **13** in the +Dj direction and is substantially orthogonal to the Dj direction. The rear surface **10***b* is located at the end of the overhang **13** in the −Dj direction and is substantially orthogonal to the Dj direction.

[0037] The top surface **10***c* is located at the end of the overhang **13** in the +Di direction and is substantially orthogonal to the Di direction. The bottom surface **10***d* is located at the end of the base **12** in the −Z direction and is substantially orthogonal to the Z direction. The bottom surface **10***d* is substantially parallel to the surface **100***a* of the object **100** and the attaching surface **11***c* of the attachment **11**.

[0038] The lateral surfaces **10***e* are located at the opposite ends of the overhang **13** in the Y direction and are substantially orthogonal to the Y direction. The front lower surface **10***f* is located at the end of the overhang **13** in the −Di direction and is substantially orthogonal to the Di direction.

[0039] The rear upper surface **10***g* is located at the end of the base **12** in the +Di direction and is substantially orthogonal to the Di direction. The rear end surface **10***h* is located at the end of the base **12** in the −Dj direction and is substantially orthogonal to the Dj direction. The rear lateral surfaces **10***i* are located at the opposite ends of the base **12** in the Y direction and are substantially orthogonal to the Y direction.

[0040] The vibration detecting device **10** includes a housing **20**. The housing **20** includes a front case **21**, a back cover **22**, a bottom frame **23**, and a shield **24**. The front case **21** is an example of a box member. The back cover **22** is an example of a lid member.

[0041] Each of the front case **21** and the back cover **22** is made of a material having electromagnetic-wave transmittivity, such as a synthetic resin material or elastomer. Each of the bottom frame **23** and the shield **24** is made of a metal material having an electromagnetic-wave shielding property, such as an aluminum alloy (aluminum-based material), stainless steel (iron-based material), or magnesium alloy (magnesium-based material). The materials of the front case **21**, the back cover **22**, the bottom frame **23**, and the shield **24** are not limited to this example.

[0042] The front case **21** includes a front wall **31** and a peripheral wall **32**. The front wall **31** is substantially orthogonal to the Dj direction, and forms part of the front surface **10***a* of the vibration detecting device **10**. The front wall **31** includes a substantially flat inner surface **31***a* that faces in the −Dj direction. The peripheral wall **32** has a substantially rectangular frame shape, and protrudes in the −Dj direction from the inner surface **31***a*. The peripheral wall **32** includes an upper wall **35**, a lower wall **36**, a left wall **37**, and a right wall **38**.

[0043] The upper wall **35** protrudes from the end of the inner surface **31***a* in the +Di direction. The upper wall **35** is substantially orthogonal to the Di direction, and forms part of the top surface **10***c* of the vibration detecting device **10**. The lower wall **36** protrudes from the end of the inner surface **31***a* in the −Di direction. The lower wall **36** is substantially orthogonal to the Di direction, and forms part of the front lower surface **10***f*. Thus, the lower wall **36** is separated from the upper wall **35** in the −Di direction along the inner surface **31***a*.

[0044] The left wall **37** protrudes from the end of the inner surface **31***a* in the +Y direction. The left wall **37** is substantially orthogonal to the Y direction, and forms one of the lateral surfaces **10***e* of the vibration detecting device **10**. The right wall **38** protrudes, from the end of the inner surface **31***a* in the −Y direction. The right wall **38** is substantially orthogonal to the Y direction, and forms the other of the lateral surfaces **10***e* of the vibration detecting device **10**. Thus, the right wall **38** is separated from the left wall **37** in the −Y direction along the inner surface **31***a*. The left wall **37** and the right wall **38** connect the opposite ends of the upper wall **35** to the opposite ends of the lower wall **36** in the Y direction.

[0045] The lengths (protruding amounts) of the upper wall **35**, the left wall **37**, and the right wall **38** in the Dj direction are substantially equal to each other. In the Dj direction the length of the lower wall **36** is shorter than the respective lengths of the upper wall **35**, the left wall **37**, and the right wall **38**. The upper wall **35**, the lower wall **36**, the left wall **37**, and the right wall **38** may have the same length or different lengths from one another.

[0046] As described above, the front case **21** has a box shape with an open end in the −Dj direction. Consequently, the front case **21** is provided with a first compartment R1 inside. The first compartment R1 is defined by the front wall **31** and the peripheral wall **32**.

[0047] As illustrated in FIG. **2**, the left wall **37** of the front case **21** is provided with a plurality of first holes **37***a*. Each of the first holes **37***a* is an example of a first opening. Each first hole **37***a* penetrates the left wall **37**, and allows the first compartment R1 to communicate with the outside of the housing **20**. Each first hole **37***a* is not limited to a hole, but may be a cutout, for example.

[0048] As illustrated in FIG. **3**, the back cover **22** includes a rear wall **41**, a rear upper wall **42**, a rear end wall **43**, and rear lateral walls **44**. The rear wall **41** is substantially orthogonal to the Dj direction, and forms the rear surface **10***b* of the vibration detecting device **10**. The rear upper wall **42** protrudes from the end of the rear wall **41** in the −Dj direction. The rear upper wall **42** is substantially orthogonal to the Di direction, and forms the rear upper surface **10***g*. The rear end wall **43** protrudes from the end of the rear upper wall **42** in the −Dj direction. The rear end wall **43** is substantially orthogonal to the Dj direction, and forms the rear end surface **10***h*. The rear lateral walls **44** are connected to the opposite ends of the rear upper wall **42** and the rear end wall **43** in the Y direction. The rear lateral walls **44** are substantially orthogonal to the Y direction, and form the rear lateral surfaces **10***i*.

[0049] The rear wall **41** is provided with a hole **41***a*. The hole **41***a* penetrates the rear wall **41**, and allows the first compartment R1 to communicate with the outside of the housing **20**. The hole **41***a* is not limited to a hole, but may be a cutout, for example.

[0050] The back cover **22** is attached to the −Dj directional end of the peripheral wall **32** by, for example, an adhesive. Consequently, the back cover **22** closes the first compartment R1 inside the front case **21**.

[0051] As illustrated in FIG. **4**, the rear upper wall **42**, the rear end wall **43**, and the rear lateral walls **44** of the back cover **22** have a box shape with open ends in the +Dj direction and the −Z direction. Consequently, the back cover **22** is provided with a second compartment R2 inside. The second compartment R2 is a space defined by the rear upper wall **42**, the rear end wall **43**, and the rear lateral walls **44**. The second compartment R2 communicates with the end of the first compartment R1 in the −Di direction.

[0052] The bottom frame **23** includes a front lower wall **51** and a bottom wall **52**. The front lower wall **51** is substantially orthogonal to the Di direction, and forms part of the front lower surface **10***f* of the vibration detecting device **10**. The bottom wall **52** protrudes in the +X direction from the −Dj directional end of the front lower wall **51**. The bottom wall **52** is substantially orthogonal to the Z direction, and forms the bottom surface **10***d*. The bottom wall **52** is provided with a female screw **52***a* to which the male screw **11***b* of the attachment **11** is detachably fastened.

[0053] The front lower wall **51** of the bottom frame **23** is attached to the lower wall **36** of the front case **21**. Consequently, the bottom frame **23** is attached to the front case **21**, and the bottom wall **52** of the bottom frame **23** closes the second compartment R2 of the back cover **22**.

[0054] The shield **24** is fitted to a groove **10***j* extending in the front surface **10***a*, the top surface **10***c*, and the front lower surface **10***f*. The groove **10***j* and the shield **24** are provided at substantially the center of the front case **21** in the Y direction. The shield **24** includes a front cover wall **55**, an upper cover wall **56**, and a lower cover wall **57**.

[0055] The front cover wall **55** is substantially orthogonal to the Dj direction, and forms part of the front surface **10***a* of the vibration detecting device **10**. The upper cover wall **56** protrudes in the −Dj direction from the +Di directional end of the front cover wall **55**. The upper cover wall **56** is substantially orthogonal to the Di direction, and forms part of the top surface **10***c*. The lower cover wall **57** protrudes in the −Dj direction from the −Di directional end of the front cover wall **55**. The lower cover wall **57** is substantially orthogonal to the Di direction, and forms part of the front lower surface **10***f*.

[0056] The base **12** of the vibration detecting device **10** includes the rear upper wall **42**, the rear end wall **43**, and the rear lateral walls **44** of the back cover **22**, and the bottom wall **52** of the bottom frame **23**. The overhang **13** includes the front wall **31** and the peripheral wall **32** of the front case **21**, the rear wall **41** of the back cover **22**, the front lower wall **51** of the bottom frame **23**, and the front cover wall **55**, the upper cover wall **56**, and the lower cover wall **57** of the shield **24**. The first compartment R1 is provided at the overhang **13** inside the housing **20**, and the second compartment R2 is provided at the base **12** inside the housing **20**.

[0057] The vibration detecting device **10** includes a board assembly **60**. The board assembly **60** includes a plurality of circuit boards **61**, a plurality of electric components **62**, and a flexible printed wiring board (flexible printed circuit board; FPC) **63**. The FPC **63** is an example of a wiring member. The number of circuit boards **61** in the board assembly **60** may be one or three or more. Further, the wiring member is not limited to the FPC **63**, but may be another wiring member with flexibility, such as a flexible flat cable or a plurality of cables.

[0058] Each of the circuit boards **61** is a printed circuit board (PCB), for example. Each circuit board **61** may be another circuit board, such as a FPC. Further, the circuit boards **61** may include a plurality of types of circuit board **61**.

[0059] The circuit boards **61** are electrically connected to each other through, for example, a connector, and are accommodated in the first compartment R**1** inside the housing **20**. Thus, the inner surface **31***a* of the front wall **31** of the front case **21** faces the circuit boards **61**. The peripheral wall **32** surrounds the circuit boards **61**.

[0060] The circuit boards **61** have a substantially rectangular plate shape substantially orthogonal to the Dj direction. The circuit boards **61** may have another shape, such as a circular shape. The circuit boards **61** are arranged with a gap along the thickness (in Dj direction).

[0061] In this embodiment, the circuit boards **61** include a circuit board **61**A and a circuit board **61**B. The circuit board **61**A is closer to the rear wall **41** than the circuit board **61**B is. The circuit boards **61**A and **61**B have substantially the same sizes. The circuit boards **61** may include a plurality of circuit boards **61** having sizes different from each other.

[0062] FIG. **5** is an exemplary sectional view illustrating the vibration detecting device **10** of the first embodiment, which is taken along a line F**5**-F**5** of FIG. **1**. As illustrated in FIGS. **4** and **5**, each of the circuit boards **61** includes a front surface **61***a*, a rear surface **61***b*, an upper end **61***c*, a lower end **61***d*, a left end **61***e*, and a right end **61***f*. The rear surface **61***b* of the circuit board **61**A is an example of a first surface. The front surface **61***a* of the circuit board **61**B is an example of a second surface. The upper end **61***c* of each of the circuit boards **61**A and **61**B is an example of a first end. The lower end **61***d* of each of the circuit boards **61**A and **61**B is an example of a second end. The left end **61***e* of each of the circuit boards **61**A and **61**B is an example of a third end. The right end **61***f* of each of the circuit boards **61**A and **61**B is an example of a fourth end.

[0063] The front surface **61***a* is substantially flat, and faces in the +Dj direction. The rear surface **61***b* is substantially flat, and faces in the −Dj direction. The rear surface **61***b* is opposite to the front surface **61***a*. The front surface **61***a* of the circuit board **61**A faces the rear surface **61***b* of the circuit board **61**B with a gap therebetween. Further, the front surface **61***a* of the circuit board **61**B is opposite the rear surface **61***b* of the circuit board **61**A in the board assembly **60**.

[0064] The upper end **61***c* is the +Di directional end of each circuit board **61**. The +Di direction is along the front surface **61***a*, and is an example of a first direction. The lower end **61***d* is the −Di directional end of each circuit board **61**. The −Di direction is opposite to the +Di direction, and is an example of a second direction. The lower end **61***d* is opposite to the upper end **61***c*. The upper end **61***c* and the lower end **61***d* extend in the Y direction.

[0065] The left end **61***e* is the +Y directional end of each circuit board **61**. The +Y direction is along the front surface **61***a* and orthogonal to the +Di direction, and is an example of a third direction. The left end **61***e* is located between the end of the upper end **61***c* and the end of the lower end **61***d* in the +Y direction.

[0066] The right end **61***f* is the end of each circuit board **61** in the −Y direction. The −Y direction is opposite to the +Y direction, and is an example of a fourth direction. The right end **61***f* is located between the end of the upper end **61***c* in the −Y direction and the end of the lower end **61***d* in the −Y direction. The right end **61***f* is opposite to the left end **61***e*. The left end **61***e* and the right end **61***f* extend in the Di direction.

[0067] The electric components **62** include a micro controller unit (MCU) **62***a*, a first wireless unit **62***b*, an external connector **62***c*, an external operation switch **62***d*, a connector **62***e*, a second wireless unit **62***f*, an antenna **62***g*, and a battery **62***h*. The MCU **62***a* is an example of a first electric component. Each of the external connector **62***c* and the external operation switch **62***d* is an example of a second electric component.

[0068] The MCU **62***a*, the first wireless unit **62***b*, the external connector **62***c*, the external operation switch **62***d*, and the connector **62***e* are mounted on the rear surface **61***b* of the circuit board **61**A. The MCU **62***a* is placed in substantially the center of the rear surface **61***b* in the Y direction. The first wireless unit **62***b* is placed at the end of the rear surface **61***b* in the −Y direction. The external connector **62***c* and the external operation switch **62***d* are arranged at the end of the rear surface **61***b* in the +Y direction. The connector **62***e* is placed at the end of the rear surface **61***b* in the −Di direction.

[0069] The second wireless unit **62***f* and the antenna **62***g* are mounted on the front surface **61***a* of the circuit board **61**B. The antenna **62***g* is placed at the end of the front surface **61***a* in the +Y direction. The battery **62***h* is mounted on the front surface **61***a* of the circuit board **61**A or the rear surface **61***b* of the circuit board **61**B.

[0070] The first wireless unit **62***b* incorporates an antenna, and communicates data in compliance with, for example, the Bluetooth (registered trademark) low energy (BLE) standard. The second wireless unit **62***f* executes data communication via the antenna **62***g* in compliance with, for example, long range wide area network (LoRaWAN) (registered trademark) standard.

[0071] The first wireless unit **62***b* and the antenna **62***g* are covered with the front case **21** and the back cover **22** having electromagnetic-wave transmittivity. Consequently, the wireless communication between the first wireless unit **62***b* and the antenna **62***g* cannot be jammed.

[0072] The MCU **62***a* is covered with the shield **24** through the front case **21**. Consequently, the MCU **62***a* can be prevented from being affected by noise. Further, the shield **24** is located between the first wireless unit **62***b* and the antenna **62***g* in the Y direction to reduce interference between a communication signal of the first wireless unit **62***b* and a communication signal of the antenna **62***g*.

[0073] As illustrated in FIG. **4**, the FPC **63** is connected to the circuit board **61**A through the connector **62***e*. The FPC **63** is accommodated in the first compartment R**1** and the second compartment R**2** inside the housing **20**. In other words, the FPC **63** extends across the first compartment R**1** and the second compartment R**2**.

[0074] The FPC **63** has flexibility and extends between a first end **63***a* and a second end **63***b* in a flexural manner. The first end **63***a* is inside the first compartment R**1**, and is inserted into the connector **62***e*. The second end **63***b* is inside the second compartment R**2**.

[0075] The vibration detecting device **10** further includes a vibration sensor **70**. The vibration sensor **70** is mounted at the second end **63***b* of the FPC **63**. The vibration sensor **70** is accommodated in the second compartment R**2** inside the housing **20**. Further, the FPC **63** electrically connects the vibration sensor **70** to the circuit board **61**A.

[0076] For example, the vibration sensor **70** is a shock sensor. The vibration sensor **70** may be another vibration sensor, such as a piezoelectric vibration sensor, micro electro mechanical systems (MEMS) vibration sensor, or triaxial acceleration sensor.

[0077] The vibration sensor **70** outputs a detection signal to the MCU **62***a* through the FPC **63**. The MCU **62***a* processes the detection signal of the vibration sensor **70**, and controls the first wireless unit **62***b* and the second wireless unit **62***f* to wirelessly transmit a signal in accordance with this detection signal. The MCU **62***a* is not limited to this example.

[0078] At least one of the vibration sensor **70** and the second end **63***b* is directly or indirectly attached to a mounting surface **23***a* of the bottom frame **23** with, for example, an adhesive or a sealing material. The mounting surface **23***a* is located in the second compartment R**2**. Specifically, in the second compartment R**2**, the periphery of the vibration sensor **70** is covered by the adhesive or sealing material and thereby fixed so as not to move. Further, the adhesive or sealing material around the vibration sensor **70** work to reduce transmission of vibration to the vibration sensor **70** from parts or elements other than the mounting surface **23***a*.

[0079] The FPC **63** includes a bend **63***c* between the first end **63***a* and the second end **63***b*. The FPC **63** is separated from the housing **20** at least in the vicinity of the bend **63***c*. Thereby, the FPC **63** is changeable in shape (position, radius of curvature, etc.) at the bend **63***c*, and can restrict transmission of vibration from the housing **20** to the vibration sensor **70** through the FPC **63**.

[0080] As illustrated in FIG. **5**, the vibration detecting device **10** further includes a flexible sheet **80**. The sheet **80** is an example of an elastic member. FIG. **4** omits depicting the sheet **80**. The sheet **80** can be of a plate form, layer form, or film form, and be a member spreadable to be orthogonal to or intersect with a desired direction. The sheet **80** may also be referred to as buffer material.

[0081] For example, the sheet **80** is made of a gel, such as αGEL (registered trademark). In other words, the sheet **80** is made of a polymer material. The sheet **80** may be made of another gel, a synthetic resin such as silicone or elastomer, a sponge, or another polymer material having flexibility. The sheet **80** is substantially transparent, for example, but may have a color.

[0082] The sheet **80** is flexible and stretchable. Specifically, the sheet **80** is lower in longitudinal elastic modulus and in shear elastic modulus (rigidity modulus) than the housing **20** and the circuit boards **61**, and is easily stretchable and bendable. The sheet **80** is not limited to this example.

[0083] The sheet **80** is bent to wrap around the circuit boards **61**, and is accommodated together with the circuit boards **61** in the first compartment R**1** inside the housing **20**. The sheet **80** is in contact with the housing **20** and the circuit boards **61** and separable or detachable therefrom. The sheet **80** is interposed between the housing **20**, and each of the rear surface **61***b* of the circuit board **61**A, the front surface **61***a* of the circuit board **61**B, and the upper end **61***c*, the lower end **61***d*, the left end **61***e*, and the right end **61***f* of each of the circuit boards **61**A and **61**B. Consequently, the circuit boards **61** are held by the housing **20** through the sheet **80** at positions separated from the housing **20**.

[0084] FIG. **6** is an exemplary perspective view illustrating the board assembly **60** and the sheet **80** in the first embodiment. As illustrated in FIG. **6**, the sheet **80** of this embodiment, when spread, has a substantially cross shape, and includes a base **81**, an upper extension **82**, a lower extension **83**, a left extension **84**, and a right extension **85**. The sheet **80** may have another shape.

[0085] The base **81** has a substantially rectangular shape, and covers the front surface **61***a* of the circuit board **61**B. The base **81** has substantially the same size as the circuit board **61**B. The base **81** may be smaller or larger than the circuit board **61**B.

[0086] The upper extension **82** extends from the end of the base **81** in the +Di direction. Being bent, the upper extension **82** covers the upper end **61***c* of each of the circuit boards **61**A and **61**B and part of the rear surface **61***b* of the circuit board **61**A. The lower extension **83** extends from the end of the base **81** in the –Di direction. Being bent, the lower extension **83** covers the lower end **61***d* of each of the circuit boards **61**A and **61**B and part of the rear surface **61***b* of the circuit board **61**A.

[0087] The left extension **84** extends from the end of the base **81** in the +Y direction. Being bent, the left extension **84** covers the left end **61***e* of each of the circuit boards **61**A and **61**B and part of the rear surface **61***b* of the circuit board **61**A. The right extension **85** extends from the end of the base **81** in the –Y direction. Being bent, the right extension **85** covers the right end **61***f* of each of the circuit boards **61**A and **61**B and part of the rear surface **61***b* of the circuit board **61**A.

[0088] The lower extension **83** is provided with an insertion hole **83***a*. The insertion hole **83***a* penetrates the lower extension **83**. Further, the left extension **84** is provided with a plurality of second holes **84***a*. Each of the second holes **84***a* is an example of a second opening. Each second hole **84***a* penetrates the left extension **84**. The insertion hole **83***a* and the second holes **84***a* is not limited to holes, but may be cutouts, for example.

[0089] The corner **86**A between the upper extension **82** and the left extension **84**, the corner **86**B between the upper extension **82** and the right extension **85**, the corner **86**C between the lower extension **83** and the left extension **84**, and the corner **86**D between the lower extension **83** and the right extension **85** are finished by round chamfering and has a substantially arc shape. Thus, the corners **86**A, **86**B, **86**C, and **86**D can be prevented from cracking.

[0090] FIG. **7** is an exemplary front view illustrating the board assembly **60** wrapped with the sheet **80** in the first embodiment. The FPC **63** extends between the circuit board **61**A and the vibration sensor **70** through the insertion hole **83***a*. The external connector **62***c* and the external operation switch **62***d* are exposed outside the housing **20** through the second holes **84***a* of the sheet **80** and the first holes **37***a* of the housing **20**. The first holes **37***a* may be closed by a cover or another component. Further, the external connector **62***c* and the external operation switch **62***d* are separated from the housing **20**.

[0091] Owing to the substantially transparent sheet **80**, for example, the circuit boards **61** are visible from outside the housing **20** through the hole **41***a* of FIG. **3** and the sheet **80**.

For example, as illustrated in FIG. **6**, the light of an LED **62***i* mounted on the circuit board **61**A is visible from outside the housing **20** through the hole **41***a* and the sheet **80**.

[0092] As illustrated in FIGS. **5** and **6**, the sheet **80** further includes a first surface **80***a*, a second surface **80***b*, and an edge **80***c*. The first surface **80***a* is an example of a surface. The first surface **80***a* faces the circuit boards **61**. The second surface **80***b* is opposite to the first surface **80***a*, and faces the housing **20**. The edge **80***c* is the edge of the sheet **80** in the directions along the first surface **80***a*. Each of the base **81**, the upper extension **82**, the lower extension **83**, the left extension **84**, and the right extension **85** includes part of the first surface **80***a*, the second surface **80***b*, and the edge **80***c*.

[0093] The sheet **80** having the above-described shape is produced, for example, by cutting part of a substantially rectangular material. The sheet **80** is not limited to this example, but may be produced in the above shape without cutting.

[0094] Next, an exemplary explanation will be given of part of an assembling method of the vibration detecting device **10**. The assembling method of the vibration detecting device **10** is not limited to the following method, but the vibration detecting device **10** may be assembled by another method. First, as illustrated in FIG. **6**, the board assembly **60** excluding the FPC **63** is assembled. Alternatively, the board assembly **60** including the FPC **63** may be assembled.

[0095] Then, the upper extension **82**, the lower extension **83**, the left extension **84**, and the right extension **85** of the sheet **80** are bent to wrap around the circuit boards **61**. As illustrated in FIG. **7**, the sheet **80** wraps around the circuit boards **61** with the MCU **62***a* exposed. The MCU **62***a* may be covered with the sheet **80**.

[0096] FIG. **8** is an exemplary sectional view illustrating the board assembly **60** wrapped with the sheet **80** together with the front case **21** in the first embodiment. As illustrated in FIG. **8**, the sheet **80** includes a plurality of bends **88** to be in contact with the circuit boards **61** and a plurality of electric components **62**. Specifically, being bent at the bends **88**, the sheet **80** can be in contact with the circuit boards **61** and a plurality of electric components **62** different in thickness.

[0097] The sheet **80** includes mutually overlapping portions. For example, part of the lower extension **83** and part of the left extension **84** are overlapped with each other. Part of the lower extension **83** and part of the right extension **85** are overlapped with each other. Part of the upper extension **82** and part of the left extension **84** are overlapped with each other. Part of the upper extension **82** and part of the right extension **85** are overlapped with each other.

[0098] Of the sheet **80**, one part and another part of the overlapping portions are in direct contact with each other without an adhesive or a double-sided adhesive tape. Because of this, one part and another part of the overlapping portions of the sheet **80** are separable or detachable from each other. One part and another part of the overlapping portions of the sheet **80** may separably stick to each other by the stickiness of the sheet **80**.

[0099] Then, the circuit boards **61** and the sheet **80** are press-fitted into the first compartment R**1** of the front case **21**. Consequently, the sheet **80** is interposed between the housing **20** and each of the front surface **61***a* of the circuit board **61**B and the upper end **61***c*, the lower end **61***d*, the left end **61***e*, and the right end **61***f* of each of the circuit boards **61**A and **61**B.

[0100] FIG. **9** is an exemplary sectional view illustrating the board assembly **60** and the sheet **80** accommodated in the front case **21** in first embodiment. The edge **80***c* of the upper extension **82**, the lower extension **83**, the left extension **84**, and the right extension **85**, which is indicated by a two-dot chain line in FIG. **9**, is not fixed, therefore, free. That is, by pressing the upper extension **82**, the lower extension **83**, the left extension **84**, and the right extension **85** with a jig, for example, the sheet **80** is restricted from separating from the board assembly **60** due to the restoring force.

[0101] Then, the FPC **63** is inserted into the connector **62***e* through the insertion hole **83***a*. The bottom frame **23** is attached to the front case **21**. The FPC **63** and the vibration sensor **70** are attached to the bottom frame **23**.

[0102] Then, as indicated by a two-dot chain line in FIG. **5**, the back cover **22** is attached to the front case **21**. The back cover **22** is fixed to the front case **21** while the upper extension **82**, the lower extension **83**, the left extension **84**, and the right extension **85** are pressed against the circuit boards **61**. In the example of FIG. **5**, the back cover **22** is moved in the +Dj direction for attachment to the front case **21**. However, for example, the back cover **22** may be rotated around the Y-axis and attached to the front case **21**.

[0103] The edge **80***c* of the upper extension **82**, the lower extension **83**, the left extension **84**, and the right extension **85** extends between the circuit boards **61** and the back cover **22**. Thus, the back cover **22** works to press the upper extension **82**, the lower extension **83**, the left extension **84**, and the right extension **85** to restrict the the sheet **80** from moving away from the board assembly **60** by the restoring force.

[0104] As illustrated in FIG. **9**, in the Y direction the distance W**1** (the width of the first compartment R**1**) between the left wall **37** and the right wall **38** is larger than the distance (width) W**2** between the left end **61***e* and the right end **61***f* of each circuit board **61**.

[0105] As illustrated in FIG. **8**, in the natural, uncompressed state, the distance (thickness) T between the first surface **80***a* and the second surface **80***b* of the sheet **80** is larger than a half of the difference between the width W**1** and the width W**2**. Specifically, the relationship between the thickness T, and the width W**1** and the width W**2** can be expressed by the following Formula 1:

$$T>1/2(W1-W2).$$

[0106] Due to the dimensional difference described above, while the board assembly **60** and the sheet **80** are accommodated in the first compartment R**1**, the sheet **80** is compressed between the circuit boards **61** and the housing **20**. Thus, the sheet **80** extends between the circuit boards **61** and the housing **20** in a compressed state. The sheet **80** may include a non-compressible part.

[0107] As illustrated in FIG. **9**, when compressed, the sheet **80** decreases in thickness to a thickness T' about 80% of the thickness T in the natural state, for example. The thickness T' is not limited to this example, but the thickness T' of the sheet **80** is set to exhibit desired vibration absorbing performance.

[0108] The dimensional difference described above is not limited to the one between the width W**1** between the left wall **37** and the right wall **38** and the width W**2** between the left end **61***e* and the right end **61***f* of each circuit board **61**. The sheet **80** is compressed between the rear surface **61***b* of the circuit board **61**A and the back cover **22**, between the front surface **61***a* of the circuit board **61**B and the front wall **31**, and between the peripheral wall **32**, and the upper end **61***c*, the lower end **61***d*, the left end **61***e*, and the right end **61***f* of each of the circuit boards **61**A and **61**B.

[0109] Due to the stretching properties, the sheet **80** can be deformed in accordance with the shape of the gap between each circuit board **61** and the housing **20**. Consequently, the sheet **80** can come into contact with each circuit board **61**, each electric component **62**, and the housing **20** in a larger contact area.

[0110] In the housing **20** the circuit boards **61** are held by the housing **20** through the bent sheet **80** wrapping around these circuit boards **61**. Specifically, the front wall **31** supports the front surface **61***a* of the circuit board **61**B through the sheet **80**, the peripheral wall **32** supports the upper end **61***c*, the lower end **61***d*, the left end **61***e*, and the right end **61***f* of each of the circuit boards **61**A and **61**B through the sheet **80**, and the rear wall **41** supports the rear surface **61***b* of the circuit board **61**A through the sheet **80**. Consequently, the movement of the circuit boards **61** is restricted.

[0111] The sheet **80** is in direct contact with the housing **20**, each circuit board **61**, and each electric component **62** without an adhesive or a double-sided adhesive tape. Thus, the sheet **80** is in contact with the housing **20**, each circuit board **61**, and each electric component **62**, and separable (detachable) therefrom. The sheet **80** may separably stick to the housing **20**, each circuit board **61**, and each electric component **62** by the stickiness of the sheet **80**.

[0112] As described above, the circuit boards **61** are not fixed to the housing **20** with screws, pins, a double-sided tape, adhesive, or filler, but are held by the housing **20** through the sheet **80** with spacing from the housing **20**. That is, the circuit boards **61** are movable relative to the housing **20** by elastic deformation of the sheet **80**.

[0113] The sheet **80** attenuates vibration and restrains transmission of vibration between the circuit boards **61** and the housing **20**. Thus, vibration of the housing **20** can be avoided from being transmitted to the vibration sensor **70** through the circuit boards **61** and the FPC **63**. Further, the circuit boards **61** are restrained from being vibrated due to resonance.

[0114] Then, the shield **24** is attached to the front case **21** and the bottom frame **23**, and the attachment **11** is attached to the bottom frame **23**. This completes the assembly of the vibration detecting device **10**.

[0115] The board assembly **60** may be taken out of the housing **20** after production of the vibration detecting device **10**. In this case, the back cover **22** is detached from the front case **21** to open the sheet **80**, enabling extraction of the board assembly **60** from the housing **20**. That is, in the vibration detecting device **10**, the board assembly **60** can be detached from the housing **20** without removal work of adhesive or filler.

[0116] In the vibration detecting device **10** according to the first embodiment described above, the circuit boards **61** are held by the housing **20** through the sheet **80**. That is, the sheet **80** spreads between the housing **20** and the circuit boards **61** to be able to reduce transmission of vibration between the housing **20** and the circuit boards **61**, and attenuate vibration of the circuit boards **61**. This can suppress vibration noise due to vibration of the housing **20** transmitted through the circuit boards **61** and/or resonance of the circuit boards **61** from entering the vibration sensor **70**, thereby reducing occurrence of malfunctions or failures in the vibration detecting device **10**. Further, since the vibration absorbing member is in the form of a sheet, the circuit boards **61** can be more easily detached from the housing **20** than a vibration absorbing material filled in-between the circuit boards **61** and the housing **20**, for example. In addition, the circuit boards **61** can be equipped with a member with a hole, such as the external connector **62***c*, and/or a movable member, such as the external operation switch **62***d*. Further, the sheet **80** includes the bends, so that the sheet **80** can be easily set in close contact with the circuit boards **61** and the housing **20**.

[0117] The sheet **80** contains a gel. Specifically, the sheet **80** is lower in shear elastic modulus (rigidity modulus) and is higher in viscosity than a buffer material, such as elastomer or sponge. Consequently, the sheet **80** exhibits higher stretching property to efficiently absorb and attenuate vibration and to spread between the housing **20** and the circuit boards **61** without a gap. This can prevent vibration noise from entering the vibration sensor **70**.

[0118] The sheet **80** contains αGEL. Consequently, the sheet **80** can efficiently absorb and attenuate vibration and spread between the housing **20** and the circuit boards **61** without a gap. Thus, vibration noise is restrained from entering the vibration sensor **70**.

[0119] The sheet **80** is bent to wrap around the circuit boards **61**, spreading between the housing **20**, and each of the front surfaces **61***a*, the rear surfaces **61***b*, the left ends **61***e*, and the right ends **61***f*. This can restrain the circuit boards **61** from coming into contact with the housing **20**, and suppress vibration noise due to vibration of the housing **20** transmitted through the circuit boards **61** and/or resonance of the circuit boards **61** from entering the vibration sensor **70**.

[0120] The sheet **80** spreads between the circuit boards **61** and the housing **20** in a compressed state. Specifically, the distance between the circuit boards **61** and the housing **20** is smaller than the thickness of the sheet **80** in the natural state. Consequently, the restoring force of the sheet **80** serves to hold the circuit boards **61**, and reduce vibration of the circuit boards **61**.

[0121] The housing **20** is provided with the first holes **37***a*, and the sheet **80** is provided with the second holes **84***a*. The external connector **62***c* is mounted on the circuit boards **61**, and is exposed outside the housing **20** through one of the first holes **37***a* and one of the second holes **84***a*. Consequently, the external connector **62***c* is usable from outside the housing **20**. For example, the external connector **62***c* is operable or viewable from outside, and/or another component such as a plug is insertable into the external connector **62***c*.

[0122] The front case **21** of the housing **20** includes the inner surface **31***a* that faces the circuit boards **61**, and the peripheral wall **32** that protrudes from the inner surface **31***a* and surrounds the circuit boards **61**. The back cover **22** is attached to an end of the peripheral wall **32** to close the inside of the front case **21** and to press part of the sheet **80** against one of the circuit boards **61**. The back cover **22** presses the sheet **80** in this manner, eliminating the necessity to attach the sheet **80** to the housing **20**, the circuit boards **61**, or another part of the sheet **80** and reducing hindrance to the vibration absorption and attenuation by the sheet **80**.

[0123] The sheet **80** includes the first surface **80***a* that faces the circuit boards **61**, and the edge **80***c* in the directions along the first surface **80***a*. This edge **80***c* is located between the circuit boards **61** and the back cover **22**. Specifically, the back cover **22** works to press part of the sheet **80** including the edge **80***c* against one of the circuit boards **61**. Consequently, the back cover **22** can be attached to the end of the peripheral wall **32**, while pressing the vicinity of the edge **80***c* of the sheet **80**, which is to move away from the circuit boards **61** by the restoring force, against one of the circuit boards **61**. This facilitates the assembly of the vibration detecting device **10**.

[0124] The sheet **80** includes mutually directly contacting, overlapping portions and is in direct contact with the housing **20** and the circuit boards **61**. Specifically, the overlapping portions of the sheet **80** are not fixed to each other with a double-sided tape or an adhesive. The contacting part of the sheet **80** with the housing **20** and the circuit boards **61** are not fixed to the housing **20** and the circuit boards **61** with a double-sided tape or an adhesive. Thus, the vibration absorption and attenuation by the sheet **80** cannot be hindered by fixation.

Second Embodiment

[0125] Next, an explanation will be given of a second embodiment with reference to FIGS. **10** to **11**. In the following description of second to fourth embodiments, the constituent elements having functions substantially the same as those of constituent elements previously described are denoted by reference symbols the same as those for the constituent elements previously described, and, further, their description will be omitted in some cases. Furthermore, a plurality of constituent elements denoted by the same reference symbols are not necessarily the same in all the functions and properties, but may be different in function and/or property as needed for the respective embodiments.

[0126] FIG. **10** is an exemplary plan view illustrating a board assembly **60** and a sheet **80** according to the second embodiment. As illustrated in FIG. **10**, the sheet **80** of the second embodiment have a substantially T-shape in an unfolded state. In this case, the lower extension **83** serves to cover the upper end **61***c* and the lower end **61***d* of each of the circuit boards **61**A and **61**B and the front surface **61***a* of the circuit board **61**A.

[0127] FIG. **11** is an exemplary sectional view illustrating the board assembly **60** and the sheet **80** accommodated in a front case **21**, according to a modification of the second embodiment. As illustrated in FIG. **11**, the lower extension **83** may cover the lower end **61***d* of each of the circuit boards **61**A and **61**B and part of the front surface **61***a* of the circuit board **61**A, and another buffer material **90** may cover the upper end **61***c* of each of the circuit boards **61**A and **61**B.

[0128] The buffer material **90** is made of a gel, a synthetic resin, such as silicone or elastomer, a sponge, or another material. The buffer material **90** is interposed between the upper end **61***c* of each of the circuit boards **61**A and **61**B and the upper wall **35** of the housing **20**. The upper wall **35** holds the upper end **61***c* of each of the circuit boards **61**A and **61**B through the buffer material **90**.

[0129] In the second embodiment, the shape of the sheet **80** is not limited to the cross shape of the first embodiment. The sheet **80** may be substantially T-shaped as illustrated in FIG. **10**, or may be substantially I-shaped, substantially L-shaped, substantially rectangular, or of another shape.

[0130] The sheet **80** has a shape different from the rectangular shape and is bent to wrap around the circuit boards **61**. This serves to reduce the overlapping part of the sheet **80** and to prevent increase in the thickness of the sheet **80**.

[0131] Further, another buffer material **90** may be interposed between the circuit boards **61** and the housing **20**. In this case, the sheet **80** and the buffer material **90** attenuate vibration and restrain transmission of vibration between the housing **20** and the circuit boards **61**.

Third Embodiment

[0132] Next, an explanation will be given of a third embodiment with reference to FIGS. **12** to **15**. FIG. **12** is an exemplary perspective view illustrating a front case **21**, a board assembly **60**, and a buffer member **201**, according to the third embodiment, in an exploded manner. FIG. **13** is an exemplary perspective view illustrating the board assembly **60** and the buffer member **201** in the third embodiment, in an exploded manner. FIG. **14** is an exemplary back view illustrating the board assembly **60** and the buffer member **201** accommodated in the front case **21** in the third embodiment.

[0133] In the third embodiment, the vibration detecting device **10** includes the buffer member **201** in place of the sheet **80**. The buffer member **201** is an example of an elastic member. The vibration detecting device **10** may include both of the sheet **80** and the buffer member **201**.

[0134] The buffer member **201** is made of, for example, translucent silicone rubber. Thus, the buffer member **201** is made of a polymer material. The buffer member **201** may be made of a gel, a synthetic resin, such as elastomer, a sponge, or another polymer material.

[0135] The silicone rubber as the material of the buffer member **201** is, for example, SH0010U or SH0020U of KCC Corporation, or TSE221-3U of Momentive Performance Materials Worldwide LLC. The material of the buffer member **201** is not limited to this example. The buffer member **201** is made of, for example, silicone rubber having a hardness of 20° or less. As the buffer member **201** is made of silicon rubber having low hardness, the buffer member **201** can easily attenuate vibration and easily restrain transmission of vibration, between the housing **20** and the circuit boards **61**. The hardness of the buffer member **201** is not limited to this example.

[0136] The buffer member **201** is detachably attached to the board assembly **60** including the circuit boards **61**. In other words, the buffer member **201** and the board assembly **60** mutually hold the other so as to be separable therefrom. The buffer member **201** may be simply set in contact with the board assembly **60** without being attached to the board assembly **60**.

[0137] FIG. **15** is a sectional view illustrating the vibration detecting device **10** according to the third embodiment. As illustrated in FIG. **15**, the buffer member **201** includes a frame wall **205**, a first protrusion **206**, and a second protrusion **207**.

[0138] As illustrated in FIG. **14**, the frame wall **205** has a substantially rectangular frame shape. The frame wall **205** is not limited to this example, but may have another shape, such as a circular frame shape, in accordance with the shapes of the circuit boards **61**. The frame wall **205** includes a first wall **211**, a second wall **212**, a third wall **213**, and a fourth wall **214** in a unified manner.

[0139] The first wall **211** is located at the end of the frame wall **205** in the +Di direction, and extends in the Y direction. The second wall **212** is located at the end of the frame wall

205 in the −Di direction, and extends in the Y direction. The third wall **213** is provided between the end of the first wall **211** in the +Y direction and the end of the second wall **212** in the +Y direction, and extends in the Di direction. The fourth wall **214** is provided between the end of the first wall **211** in the −Y direction and the end of the second wall **212** in the −Y direction, and extends in the Di direction.

[0140] As illustrated in FIG. **15**, the first to fourth walls **211** to **214** have a band shape having a wider width in the Dj direction. As illustrated in FIG. **14**, the first wall **211** covers the upper end **61***c* of each of the circuit boards **61**A and **61**B. The second wall **212** covers the lower end **61***d* of each of the circuit boards **61**A and **61**B. The third wall **213** covers the left end **61***e* of each of the circuit boards **61**A and **61**B. The fourth wall **214** covers the right end **61***f* of each of the circuit boards **61**A and **61**B. The upper end **61***c*, the lower end **61***d*, the left end **61***e*, and the right end **61***f* of each of the circuit boards **61**A and **61**B may be exposed without being covered by the buffer member **201** partly.

[0141] The first wall **211** is in contact with the upper end **61***c* of each of the circuit boards **61**A and **61**B. The second wall **212** is in contact with the lower end **61***d* of each of the circuit boards **61**A and **61**B. The third wall **213** is in contact with the left end **61***e* of each of the circuit boards **61**A and **61**B. The fourth wall **214** is in contact with the right end **61***f* of each of the circuit boards **61**A and **61**B. The first to fourth walls **211** to **214** may be separated from the circuit boards **61**A and **61**B partly or slightly.

[0142] The circuit boards **61**A and **61**B of the board assembly **60** are located between the first wall **211** and the second wall **212**, and are held by the first wall **211** and the second wall **212**. In other words, the first wall **211** and the second wall **212** are in contact with the upper end **61***c* and the lower end **61***d* of each of the circuit boards **61**A and **61**B, and thereby restrict the movement of the board assembly **60** in the Di direction.

[0143] The circuit boards **61**A and **61**B of the board assembly **60** are located between the third wall **213** and the fourth wall **214**, and are held by the third wall **213** and the fourth wall **214**. In other words, the third wall **213** and the fourth wall **214** are in contact with the left end **61***e* and the right end **61***f* of each of the circuit boards **61**A and **61**B, and thereby restrict the movement of the board assembly **60** in the Y direction.

[0144] As illustrated in FIG. **15**, the first protrusion **206** protrudes inward in the frame wall **205**, from the end of the frame wall **205** in the +Dj direction. Accordingly, the first protrusion **206** has a substantially rectangular frame shape. The first protrusion **206** may protrude from at least one of the first to fourth walls **211** to **214**.

[0145] The second protrusion **207** protrudes inward in the frame wall **205**, from the end of the frame wall **205** in the −Dj direction. Accordingly, the second protrusion **207** has a substantially rectangular frame shape. The second protrusion **207** may protrude from at least one of the first to fourth walls **211** to **214**.

[0146] The protruding length L of the first protrusion **206** from the frame wall **205** is smaller than the length of the frame wall **205** in the Dj direction. Similarly, the protruding length of the second protrusion **207** from the frame wall **205** is smaller than the length of the frame wall **205** in the Dj direction. The Dj direction is orthogonal to the front surface **61***a* of each circuit board **61**. The length of the first protrusion **206** and the length of the second protrusion **207** are substantially equal to each other, but may be different from each other.

[0147] The first protrusion **206** and the second protrusion **207** are short, and thus can be easily and elastically deformed. Accordingly, the board assembly **60** can be easily accommodated into the inside of the frame wall **205**, accompanied by deformation of the first protrusion **206** or the second protrusion **207**. Thus, the buffer member **201** can be elastically attached to the board assembly **60**.

[0148] The second protrusion **207** is short, and is separated from the connector **62***e* and the FPC **63**. Consequently, the second protrusion **207** does not need a hole like the insertion hole **83***a* of the sheet **80**. Further, the first protrusion **206** exposes the front surface **61***a* of the circuit board **61**B and electric components **62** mounted on this front surface **61***a*. The second protrusion **207** exposes the rear surface **61***b* of the circuit board **61**A and electric components **62** mounted on this rear surface **61***b*. The first protrusion **206** and the second protrusion **207** are not limited to this example.

[0149] The first protrusion **206** is in contact with the front surface **61***a* of the circuit board **61**B. The first protrusion **206** may be further in contact with electric components **62** mounted on the front surface **61***a* of the circuit board **61**B. The first protrusion **206** may be separated from the front surface **61***a* of the circuit board **61**B partly or slightly.

[0150] The second protrusion **207** is in contact with the rear surface **61***b* of the circuit board **61**A. The second protrusion **207** may be further in contact with electric components **62** mounted on the rear surface **61***b* of the circuit board **61**A. The second protrusion **207** may be separated from the rear surface **61***b* of the circuit board **61**A partly or slightly.

[0151] The circuit boards **61**A and **61**B of the board assembly **60** are located between the first protrusion **206** and the second protrusion **207**, and are held by the first protrusion **206** and the second protrusion **207**. In other words, the first protrusion **206** and the second protrusion **207** are in contact with the front surface **61***a* of the circuit board **61**B and the rear surface **61***b* of the circuit board **61**A, and thereby restrict the movement of the board assembly **60** in the Dj direction.

[0152] As illustrated in FIG. **13**, the third wall **213** is provided with a plurality of openings **213***a*. Each of the openings **213***a* is an example of a second opening. Each opening **213***a* is a cutout at the end of the third wall **213** in the −Dj direction. Each opening **213***a* may be a hole. The external connector **62***c* and the external operation switch **62***d* are exposed outside the housing **20** through the openings **213***a* of the buffer member **201** and the first holes **37***a* of the housing **20**.

[0153] As illustrated in FIGS. **14** and **15**, the buffer member **201** is attached to the board assembly **60**, and is accommodated in the housing **20**. The buffer member **201** is in contact with the housing **20** and the circuit boards **61**, so as to be separable (detachable) therefrom.

[0154] The buffer member **201** is interposed between the housing **20** and each of the rear surface **61***b* of the circuit board **61**A, the front surface **61***a* of the circuit board **61**B, and the upper end **61***c*, the lower end **61***d*, the left end **61***e*, and the right end **61***f* of each of the circuit boards **61**A and **61**B. Consequently, the circuit boards **61** are held by the housing **20** through the buffer member **201** at positions separated from the housing **20**.

[0155] As illustrated in FIG. **14**, the frame wall **205** is interposed between the housing **20** and each of the upper end **61***c*, the lower end **61***d*, the left end **61***e*, and the right end **61***f* of each of the circuit boards **61**A and **61**B. The frame wall **205** surrounds the circuit boards **61**A and **61**B, and is surrounded by the peripheral wall **32** of the front case **21**.

[0156] The first wall **211** is interposed between the upper end **61***c* of each of the circuit boards **61**A and **61**B and the upper wall **35** of the front case **21**. The second wall **212** is interposed between the lower end **61***d* of each of the circuit boards **61**A and **61**B and the lower wall **36** of the front case **21**. Consequently, the front case **21** holds the circuit boards **61** in the Di direction such that vibration in the Di direction can be attenuated by the buffer member **201**.

[0157] The third wall **213** is interposed between the left end **61***e* of each of the circuit boards **61**A and **61**B and the left wall **37** of the front case **21**. The fourth wall **214** is interposed between the right end **61***f* of each of the circuit boards **61**A and **61**B and the right wall **38** of the front case **21**. Consequently, the front case **21** holds the circuit boards **61** in the Y direction such that vibration in the Y direction can be attenuated by the buffer member **201**.

[0158] As illustrated in FIG. **15**, the first protrusion **206** is interposed between the front surface **61***a* of the circuit board **61**B and the front wall **31** of the front case **21**. The second protrusion **207** is interposed between the rear surface **61***b* of the circuit board **61**A and the rear wall **41** of the back cover **22**. Consequently, the housing **20** holds the circuit boards **61** in the Dj direction such that vibration in the Dj direction can be attenuated by the buffer member **201**.

[0159] At least some of the electric components **62** mounted on the front surface **61***a* of the circuit board **61**B and the rear surface **61***b* of the circuit board **61**A are exposed without being covered by the buffer member **201**. However, the buffer member **201** holds the board assembly **60** at a position such that the electric components **62** are separated from the housing **20**. Thus, vibration of the housing **20** can be hardly transmitted to the vibration sensor **70** through the electric components **62**, the circuit boards **61**, and the FPC **63**.

[0160] Next, an exemplary explanation will be given of part of an assembling method of the vibration detecting device **10**. The assembling method of the vibration detecting device **10** is not limited to the following method, but may be performed by using another method. First, as illustrated in FIG. **13**, the board assembly **60** is assembled. The FPC **63** may be assembled to the board assembly **60** later.

[0161] Then, the board assembly **60** is accommodated into the inside of the frame wall **205**, accompanied by deformation of the first protrusion **206** or the second protrusion **207**. Consequently, the buffer member **201** is attached to the board assembly **60**.

[0162] Then, as illustrated in FIG. **14**, the circuit boards **61** and the buffer member **201** are press-fitted into the first compartment R**1** of the front case **21**. Consequently, the buffer member **201** is interposed between the housing **20** and each of the front surface **61***a* of the circuit board **61**B and the upper end **61***c*, the lower end **61***d*, the left end **61***e*, and the right end **61***f* of each of the circuit boards **61**A and **61**B.

[0163] The material of the buffer member **201** has hardness such that the buffer member **201** can be easily attached to the board assembly **60**, and the buffer member **201** and the substrate assembly **60** can be easily accommodated in the front case **21**. For example, the buffer member **201** has hardness such that the buffer member **201** can be hardly peeled off from the board assembly **60** due to its own weight and/or can be hardly peeled off from the board assembly **60** when being press-fitted into the housing **20**.

[0164] Then, the bottom frame **23** is attached to the front case **21**. Further, the FPC **63** and the vibration sensor **70** are attached to the bottom frame **23**.

[0165] Then, as illustrated in FIG. **15**, the back cover **22** is attached to the front case **21**. The back cover **22** is fixed to the front case **21** while pressing the second protrusion **207** against the rear surface **61***b* of the circuit board **61**A.

[0166] In the natural uncompressed state, the thickness of the buffer member **201** is larger than a half of the difference between the width W**1** of the first compartment R**1** and the width W**2** of each circuit board **61**, which are illustrated in FIG. **14**. Consequently, when the board assembly **60** and the buffer member **201** are accommodated in the first compartment R**1**, the buffer member **201** is compressed between the circuit boards **61** and the housing **20**. Specifically, the buffer member **201** is interposed between the circuit boards **61** and the housing **20**, in a compressed state. The buffer member **201** may have a non-compressible part.

[0167] The thickness Tc of the compressed buffer member **201** is, for example, about 50 to 80% of the thickness of the buffer member **201** in the natural state. The thickness Tc is not limited to this example, but is set for the buffer member **201** to have desired vibration absorbing performance.

[0168] The dimensional difference described above is not limited by the width W**1** between the left wall **37** and the right wall **38** and the width W2 between the left end **61***e* and the right end **61***f* of each circuit board **61**. The buffer member **201** is compressed between the rear surface **61***b* of the circuit board **61**A and the back cover **22**, between the front surface **61***a* of the circuit board **61**B and the front wall **31**, and between the peripheral wall **32** and the upper end **61***c*, the lower end **61***d*, the left end **61***e*, and the right end **61***f* of each of the circuit boards **61**A and **61**B.

[0169] As the buffer member **201** is elastic, the buffer member **201** can be deformed in accordance with the shape of the gap between each circuit board **61** and the housing **20**. Consequently, the buffer member **201** can come into contact with each circuit board **61**, each electric component **62**, and the housing **20**, while enlarging the contact area.

[0170] In the housing **20** the circuit boards **61** are held by the housing **20** through the buffer member **201** attached to these circuit boards **61**. Specifically, the front wall **31** supports the front surface **61***a* of the circuit board **61**B through the first protrusion **206**, the peripheral wall **32** supports the upper end **61***c*, the lower end **61***d*, the left end **61***e*, and the right end **61***f* of each of the circuit boards **61**A and **61**B through the frame wall **205**, and the rear wall **41** supports the rear surface **61***b* of the circuit board **61**A through the second protrusion **207**. Consequently, the movement of each circuit board **61** is restricted.

[0171] The buffer member **201** is in direct contact with the housing **20**, each circuit board **61**, and each electric component **62**, without an adhesive or double-sided adhesive tape interposed therebetween. Thus, the buffer member **201** is in contact with the housing **20**, each circuit board **61**, and each electric component **62**, so as to be separable (detachable) therefrom.

[0172] As described above, each circuit board **61** is not fixed to the housing **20** with screws, pins, a double-sided tape, adhesive, filler, or the like, but is held by the housing **20** through the buffer member **201** with spacing from the housing **20**. Thus, each circuit board **61** can move relative to the housing **20** by elastic deformation of the buffer member **201**.

[0173] The buffer member **201** attenuates vibration and restrains transmission of vibration, between the circuit boards **61** and the housing **20**. Thus, vibration of the housing **20** can be hardly transmitted to the vibration sensor **70** through the circuit boards **61** and the FPC **63**. Further, the circuit boards **61** are restrained from being vibrated due to resonance.

[0174] Then, the shield **24** is attached to the front case **21** and the bottom frame **23**, and the attachment **11** is attached to the bottom frame **23**. As a result, the vibration detecting device **10** is assembled.

[0175] The board assembly **60** may be taken out of the housing **20** after the vibration detecting device **10** is produced. In this case, the back cover **22** is detached from the front case **21**, and the board assembly **60** is detached from the buffer member **201**, accompanied by deformation of the first protrusion **206** or the second protrusion **207**. Accordingly, in the vibration detecting device **10**, the board assembly **60** can be detached from the housing **20**, without an operation of removing the adhesive or filler.

[0176] In the vibration detecting device **10** according to the third embodiment described above, the circuit boards **61** are held by the housing **20** through the buffer member **201**. That is, the buffer member **201** spreads between the housing **20** and the circuit boards **61** to be able to restrain transmission of vibration between the housing **20** and the circuit boards **61**, and attenuate vibration of the circuit boards **61**. Thus, the buffer member **201** serves to restrain vibration noise due to vibration of the housing **20** transmitted through the circuit boards **61** and/or resonance of the circuit boards **61** from entering the vibration sensor **70**. Further, the buffer member **201** is detachable from the housing **20**, so that the circuit boards **61** can be more easily detached from the housing **20** than a vibration absorbing material filled in-between the circuit boards **61** and the housing **20**, for example. In addition, the circuit boards **61** can be equipped with a member with a hole, such as the external connector **62***c*, and/or a movable member, such as the external operation switch **62***d*.

[0177] The buffer member **201** is detachably attached to the circuit boards **61**. Consequently, the circuit boards **61** and the attached buffer member **201** can be handled as one subassembly. The circuit boards **61** with the attached buffer member **201** can be accommodated in the housing **20**. This facilitates the assembly of the vibration detecting device **10**.

[0178] The buffer member **201** is interposed between the housing **20** and each of the front surfaces **61***a*, the rear surfaces **61***b*, the left ends **61***e*, and the right ends **61***f*. This can restrict the circuit boards **61** from coming into contact with the housing **20**, and vibration noise due to vibration of the housing **20** transmitted through the circuit boards **61** and/or resonance of the circuit boards **61** from entering the vibration sensor **70**.

[0179] The buffer member **201** includes, in a unified manner, the frame wall **205** that covers the upper ends **61***c*, the lower ends **61***d*, the left ends **61***e*, and the right ends **61***f*. The frame wall **205** stands between the housing **20**, and the upper ends **61***c*, the lower ends **61***d*, the left ends **61***e*, and the right ends **61***f*. Because of this, the buffer member **201** can cover the ends of the circuit boards **61** from substantially all the directions, preventing the circuit boards **61** from coming into contact with the housing **20**. This can avoid vibration noise due to vibration of the housing **20** transmitted through the circuit boards **61** and/or resonance of the circuit boards **61** from entering the vibration sensor **70**. Further, since the buffer member **201** is integrated with the frame wall **205**, the buffer member **201** can be easily handled during the assembly of the vibration detecting device **10**.

[0180] The buffer member **201** includes the first protrusion **206** and the second protrusion **207** that protrude from the frame wall **205**. The length L of the first protrusion **206** from the frame wall **205** is smaller than the length of the frame wall **205** in the Dj direction orthogonal to the front surface **61***a*. That is, the first protrusion **206** of a relatively short length is elastically deformable easily. Thus, the circuit boards **61** can be easily inserted into the inside of the frame wall **205** by the elastic deformation of the first protrusion **206**.

[0181] The buffer member **201** contains silicone rubber. Thus, it is possible to produce, at a lower cost, the buffer member **201** serving to reduce transmission of vibration between the housing **20** and the circuit boards **61**, and attenuate vibration of the circuit boards **61**. Further, owing to the silicone rubber with no viscosity or less viscosity than gel, the buffer member **201** can be easily detached from the circuit boards **61**. Further, the silicon rubber is higher in strength than gel, therefore, it is less likely to be damaged. Thus, the buffer member **201** is reusable.

[0182] The buffer member **201** for holding the circuit boards **61** is higher in rigidity than the sheet **80**. That is, the buffer member **201** is less likely to vary in shape, and easily attachable to the circuit boards **61**. Thus, the buffer member **201** can be downsized, reducing the manufacturing cost.

[0183] The buffer member **201** spreads between the circuit boards **61** and the housing **20** in a compressed state. Specifically, the distance between the circuit boards **61** and the housing **20** is smaller than the thickness of the buffer member **201** in the natural state. Thereby, the restoring force of the buffer member **201** works to hold the circuit boards **61**, and restrict the circuit boards **61** from vibrating.

[0184] The housing **20** is provided with the first holes **37***a*, and the buffer member **201** is provided with the openings **213***a*. The external connector **62***c* is mounted on the circuit boards **61**, and is exposed outside the housing **20** through one of the first holes **37***a* and one of the openings **213***a*. Consequently, the external connector **62***c* is usable from outside the housing **20**. For example, the external connector **62***c* is operable or viewable from outside, and/or another component is insertable into the external connector **62**.

Fourth Embodiment

[0185] Next, an explanation will be given of a fourth embodiment with reference to FIG. **16**. FIG. **16** is an exemplary perspective view illustrating a board assembly **60** and a buffer member **201** according to the fourth embodiment, in an exploded manner. As illustrated in FIG. **16**, the fourth embodiment differs from the third embodiment in that the buffer member **201** includes a plurality of members.

[0186] The buffer member **201** includes a front member **221** and a rear member **222**. The front member **221** includes a frame wall **205** and a first protrusion **206**. The rear member **222** includes a frame wall **205** and a second protrusion **207**. In other words, each of the front member **221** and the rear member **222** includes a first wall **211**, a second wall **212**, a third wall **213**, and a fourth wall **214**.

[0187] The front member **221** and the rear member **222** are set in contact with each other, and thereby form the buffer member **201**. For example, the front member **221** and the rear member **222** are fitted to each other. The front member **221** and the rear member **222** may be separated from each other.

[0188] As described in the fourth embodiment, the buffer member **201** may include a plurality of members. In FIG. **16**, the buffer member **201** includes the two members separable in the Dj direction, but the buffer member **201** is not limited to this example. For example, the buffer member **201** may include two members separable in the Y direction or Di direction, or may include three or more members.

[0189] According to at least one of the first to fourth embodiments, the circuit board is held by the housing through an elastic member. Thus, the elastic member is interposed between the housing and the circuit board, and can restrain transmission of vibration between the housing and the circuit board and attenuate vibration of the circuit board. It is thus possible to prevent vibration noise due to vibration of the housing transmitted through the circuit board and/or resonance of the circuit board from entering the vibration sensor. Further, the elastic member is detachable from the housing, so that the circuit board can be more easily detached from the housing than a vibration absorbing material filled in-between the circuit board and the housing, for example. In addition, the circuit board can be equipped with a member with a hole, such as a connector, and/or a movable member, such as a switch.

[0190] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

What is claimed is:

1. A vibration detecting device comprising:
a housing;
a vibration sensor accommodated in the housing;
a circuit board accommodated in the housing and equipped with a first electric component, the first electric component configured to process a detection signal of the vibration sensor;
a flexible wiring member that electrically connects the vibration sensor and the circuit board to each other; and
an elastic member containing a polymer material, and accommodated in the housing in contact with the housing and the circuit board, and being detachable from the housing,
wherein the circuit board is held by the housing through the elastic member.

2. The vibration detecting device according to claim **1**, wherein
the elastic member is detachably attached to the circuit board.

3. The vibration detecting device according to claim **1**, wherein
the circuit board includes:
a first surface,
a second surface opposite to the first surface,
a first end in a first direction along the first surface, and
a second end in a second direction opposite to the first direction, and
the elastic member is interposed between the housing and each of the first surface, the second surface, the first end, and the second end.

4. The vibration detecting device according to claim **3**, wherein
the circuit board includes:
a third end in a third direction orthogonal to the first direction along the first surface, and
a fourth end in a fourth direction opposite to the third direction,
the elastic member includes a frame wall in a unified manner, the frame wall that covers the first end, the second end, the third end, and the fourth end, and
the frame wall is interposed between the housing and each of the first end, the second end, the third end, and the fourth end.

5. The vibration detecting device according to claim **4**, wherein
the elastic member includes:
a first protrusion that protrudes from the frame wall and is interposed between the first surface and the housing, and
a second protrusion that protrudes from the frame wall and is interposed between the second surface and the housing, and
the first protrusion from the frame wall is smaller in length than the frame wall in a direction orthogonal to the first surface.

6. The vibration detecting device according to claim **5**, wherein
the circuit board includes a first board and a second board electrically connected to the first board,
the first board includes the first surface, a third surface opposite to the first surface, the first end, the second end, the third end, and the fourth end, and
the second board includes the second surface and a fourth surface facing the third surface.

7. The vibration detecting device according to claim **6**, wherein
the second board includes:
a fifth end in the first direction,
a sixth end in the second direction,
a seventh end in the third direction, and
an eighth end in the fourth direction,
the second board is separated from the first board, and
the frame wall is interposed between the housing and each of the fifth end, the sixth end, the seventh end, and the eighth end, and covers a space between the first board and the second board.

8. The vibration detecting device according to claim **7**, wherein
the elastic member comprises a first member including the first protrusion, and a second member including the second protrusion, and

the frame wall includes a first frame wall of the first member, and a second frame wall of the second member.

9. The vibration detecting device according to claim **5**, further comprising

a connector that is mounted on the first surface with spacing from the frame wall and the first protrusion, and is exposed outside the elastic member,

wherein the wiring member is electrically connected to the circuit board through the connector.

10. The vibration detecting device according to claim **1**, wherein the elastic member contains silicone rubber.

11. The vibration detecting device according to claim **1**, wherein

the elastic member comprises a flexible sheet, and

the circuit board is held by the housing through the sheet.

12. The vibration detecting device according to claim **11**, wherein the sheet is formed of a gel.

13. The vibration detecting device according to claim **12**, wherein the sheet is formed of αGEL (registered trademark).

14. The vibration detecting device according to claim **11**, wherein

the circuit board includes a first surface, a second surface opposite to the first surface, a first end in a first direction along the first surface, and a second end in a second direction opposite to the first direction, and

the sheet is bent to wrap around the circuit board, and is interposed between the housing and each of the first surface, the second surface, the first end, and the second end.

15. The vibration detecting device according to claim **11**, wherein

the housing comprises a box member and a lid member,

the box member includes an inner surface facing the circuit board, and a peripheral wall that protrudes from the inner surface and surrounds the circuit board, and

the lid member is attached to an end of the peripheral wall such that the lid member closes an inside of the box member and presses part of the sheet against the circuit board.

16. The vibration detecting device according to claim **15**, wherein

the sheet includes a surface facing the circuit board, and an edge in a direction along the surface, and

the edge is located between the circuit board and the lid member.

17. The vibration detecting device according to claim **11**, wherein

the sheet includes mutually directly contacting, overlapping portions, and is in direct contact with the housing and the circuit board.

18. The vibration detecting device according to claim **1**, wherein

the elastic member is interposed between the circuit board and the housing in a compressed state.

19. The vibration detecting device according to claim **1**, wherein

the housing is provided with a first opening,

the elastic member is provided with a second opening, and

the circuit board is equipped with a second electric component that is exposed outside the housing through the first opening and the second opening.

20. The vibration detecting device according to claim **1**, wherein

the housing is provided with a hole,

the circuit board has a light emitting component mounted thereon, and

the elastic member covers the light emitting component, and allows light to pass through.

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