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(54) **TRANSMISSION DEVICE AND PLUG-IN UNIT**

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CPC ***H01L 23/40*** (2013.01); ***G02B 6/3807*** (2013.01); ***H01L 23/36*** (2013.01)

(57) **ABSTRACT**

A transmission device includes a first substrate on which a heat generation component is arranged, a heat sink that is placed on the heat generation component, a second substrate that is arranged above a surface of the first substrate on which the heat generation component is arranged and a pressing mechanism that presses the heat sink against the heat generation component arranged on the first substrate from the second substrate side.

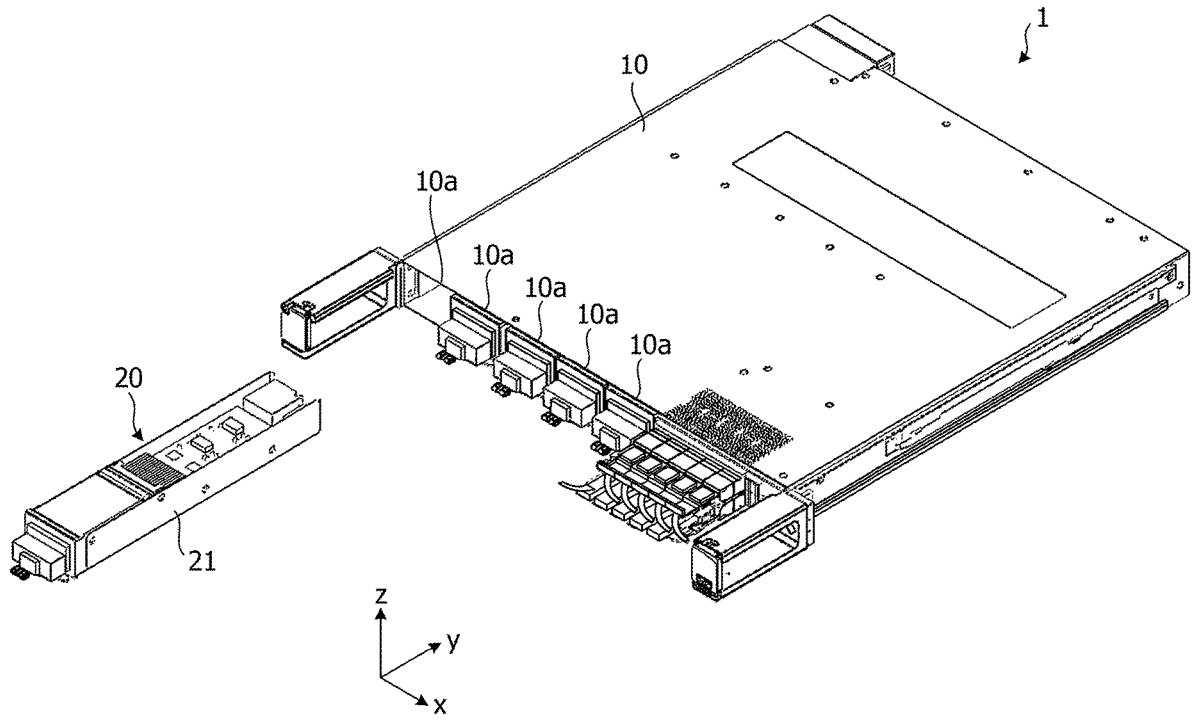


FIG. 1

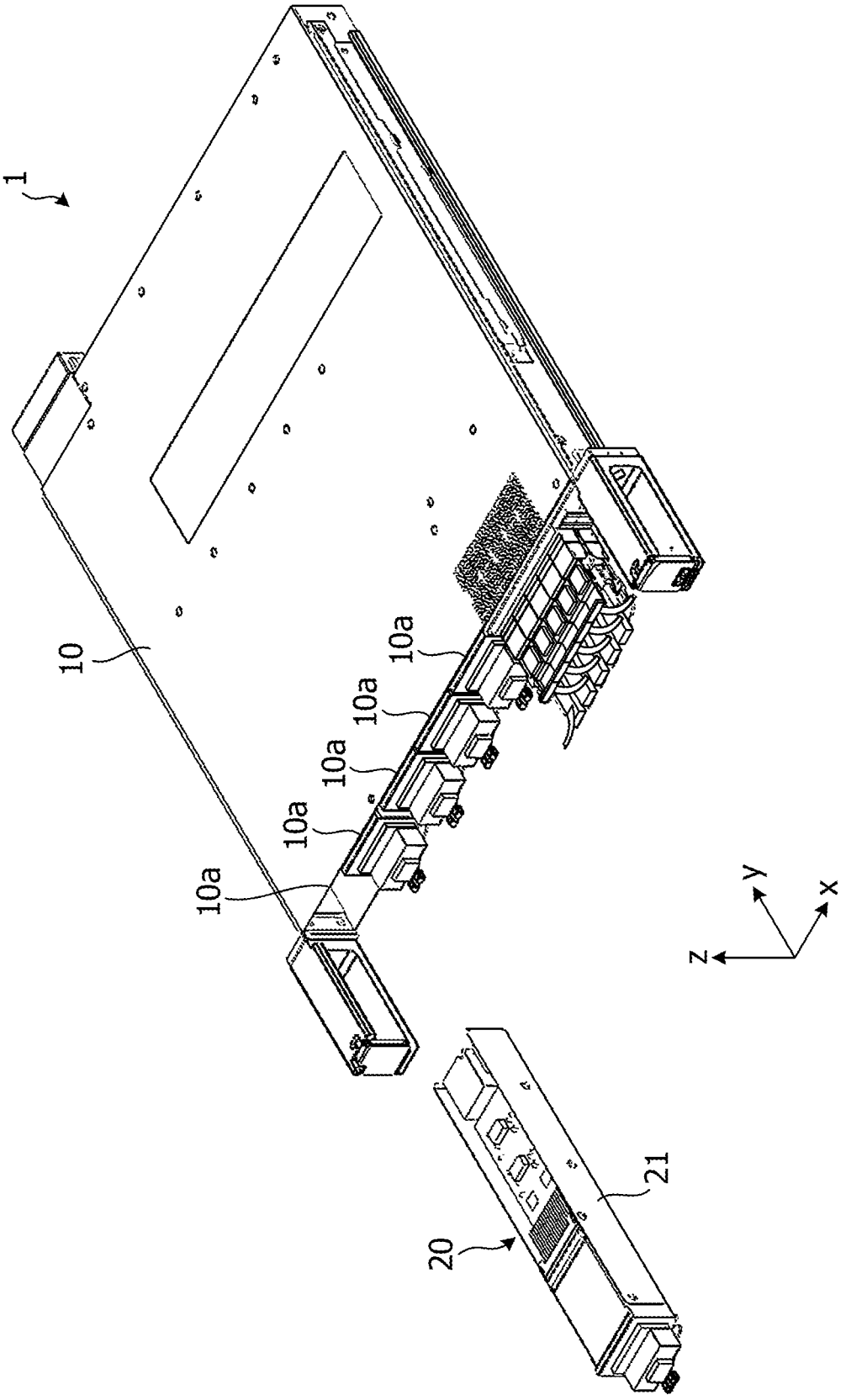


FIG. 2

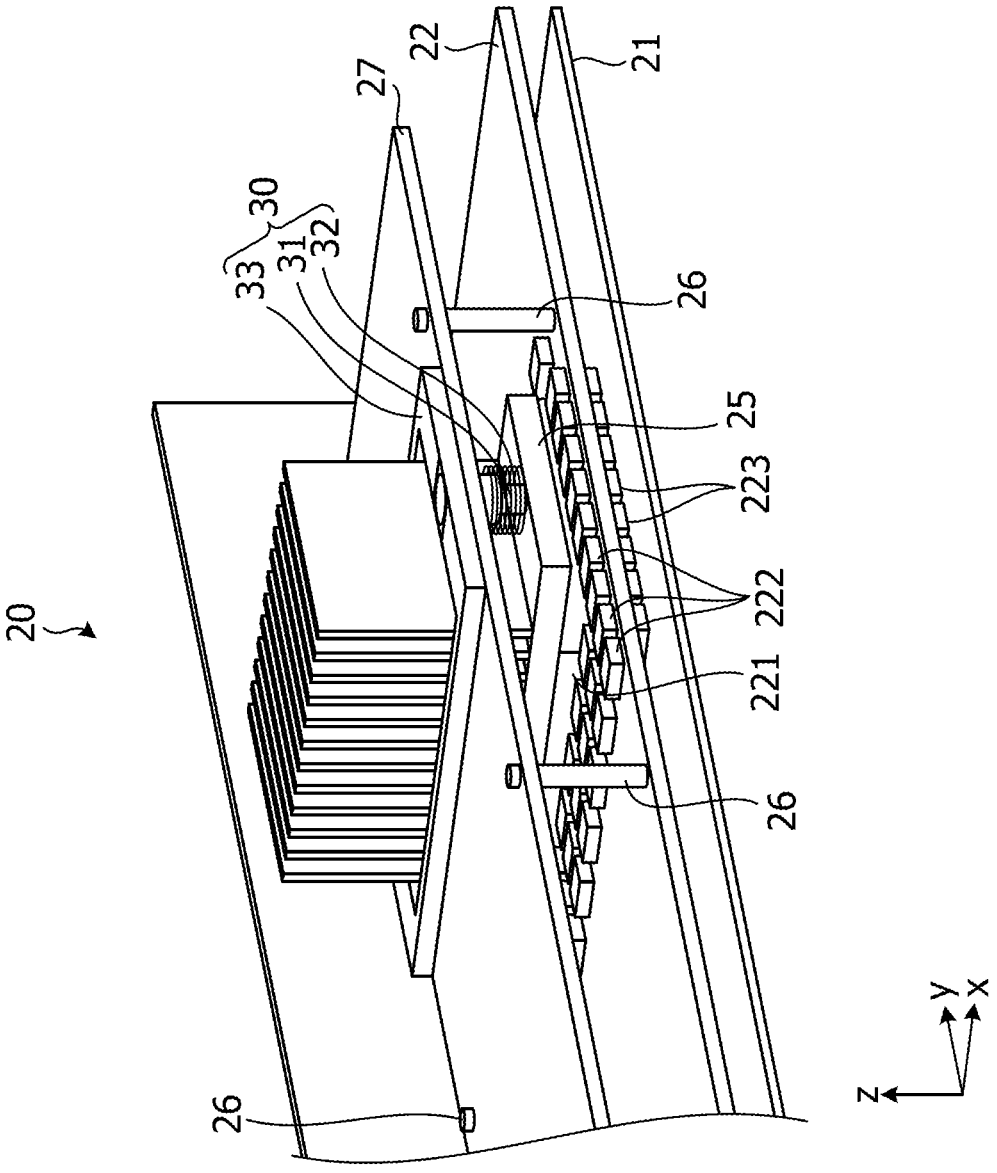


FIG. 3

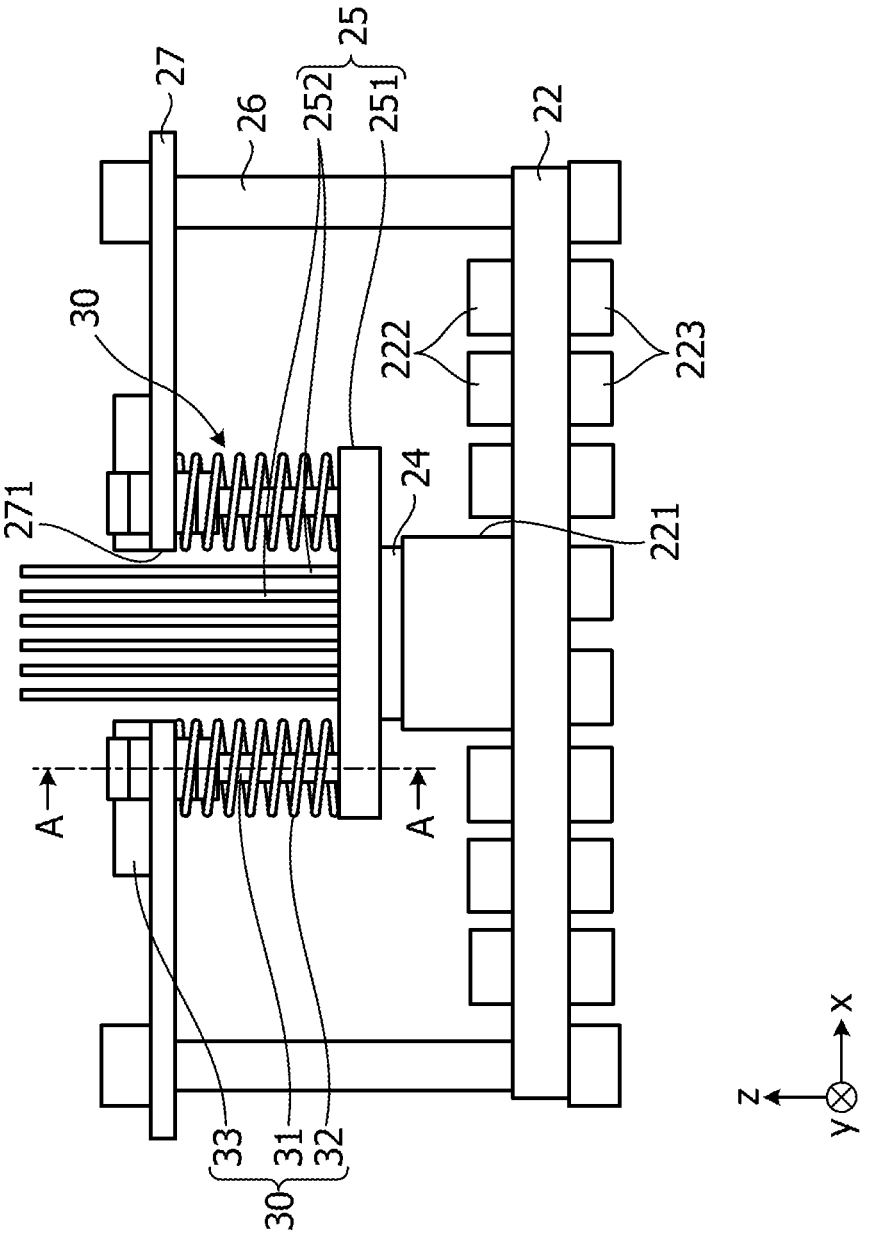


FIG. 4

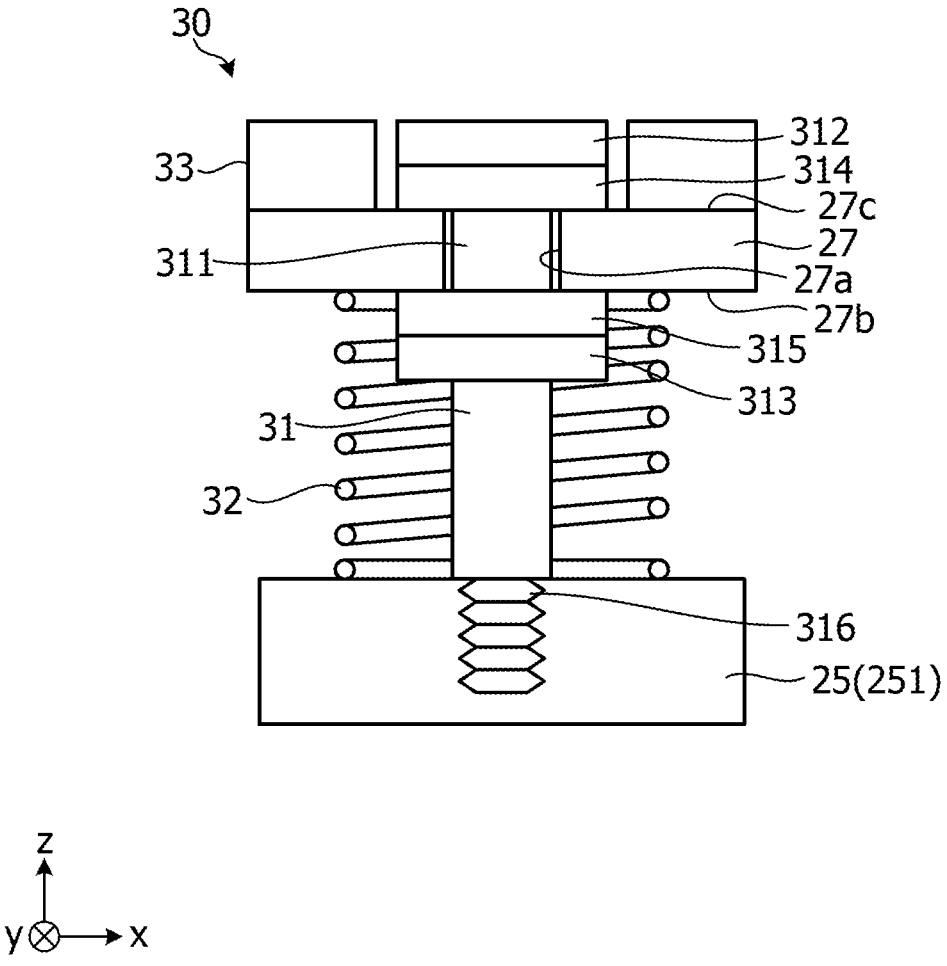


FIG. 5

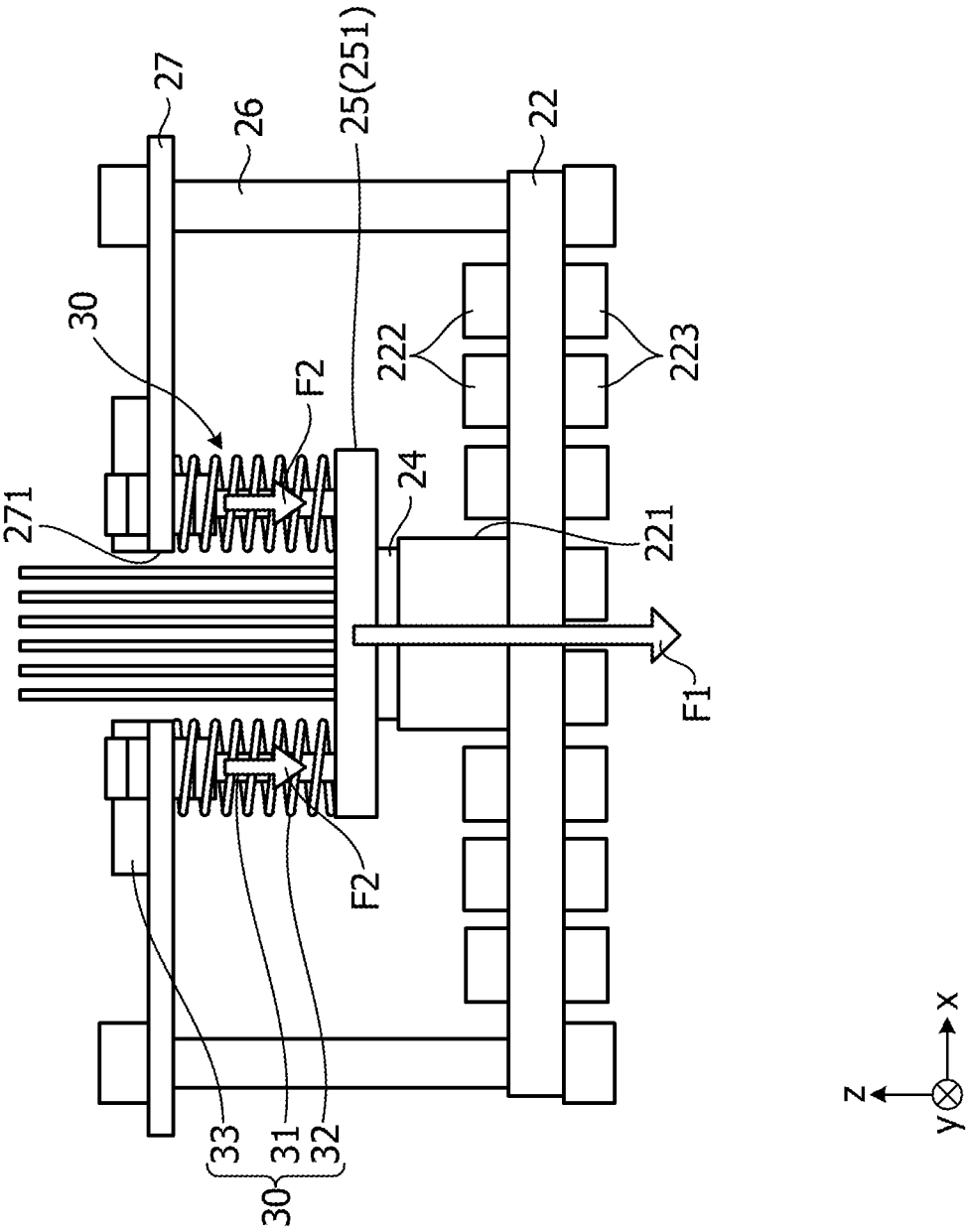


FIG. 6

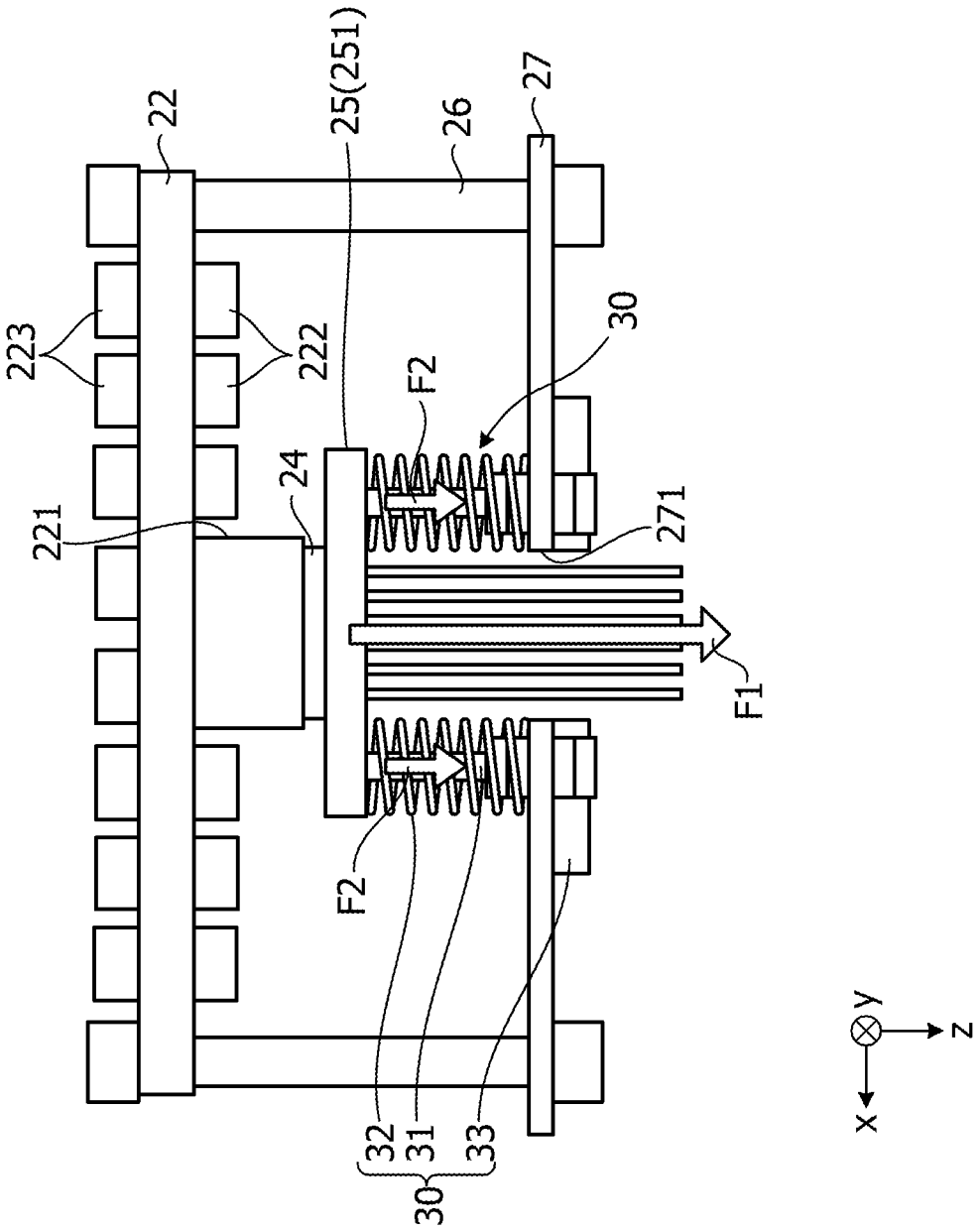


FIG. 7

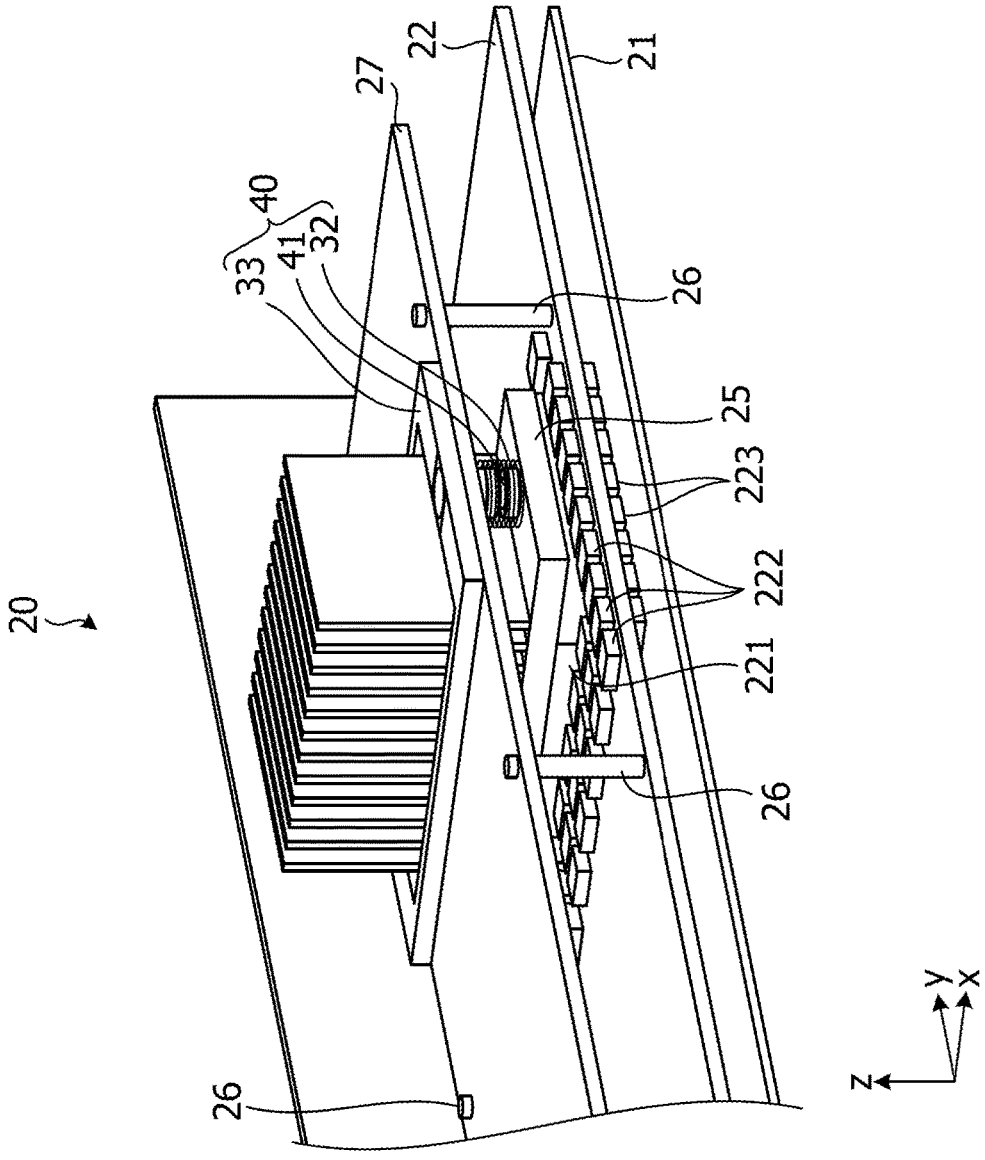
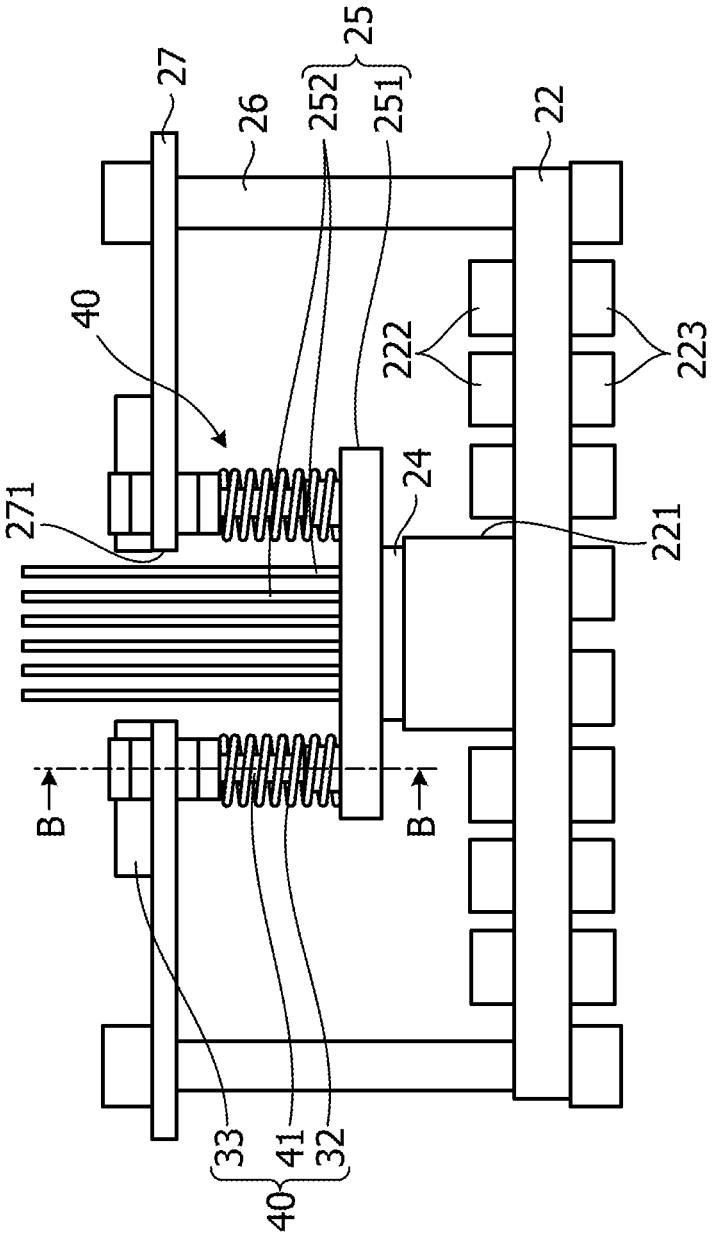


FIG. 8



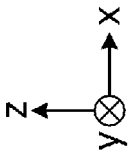


FIG. 9

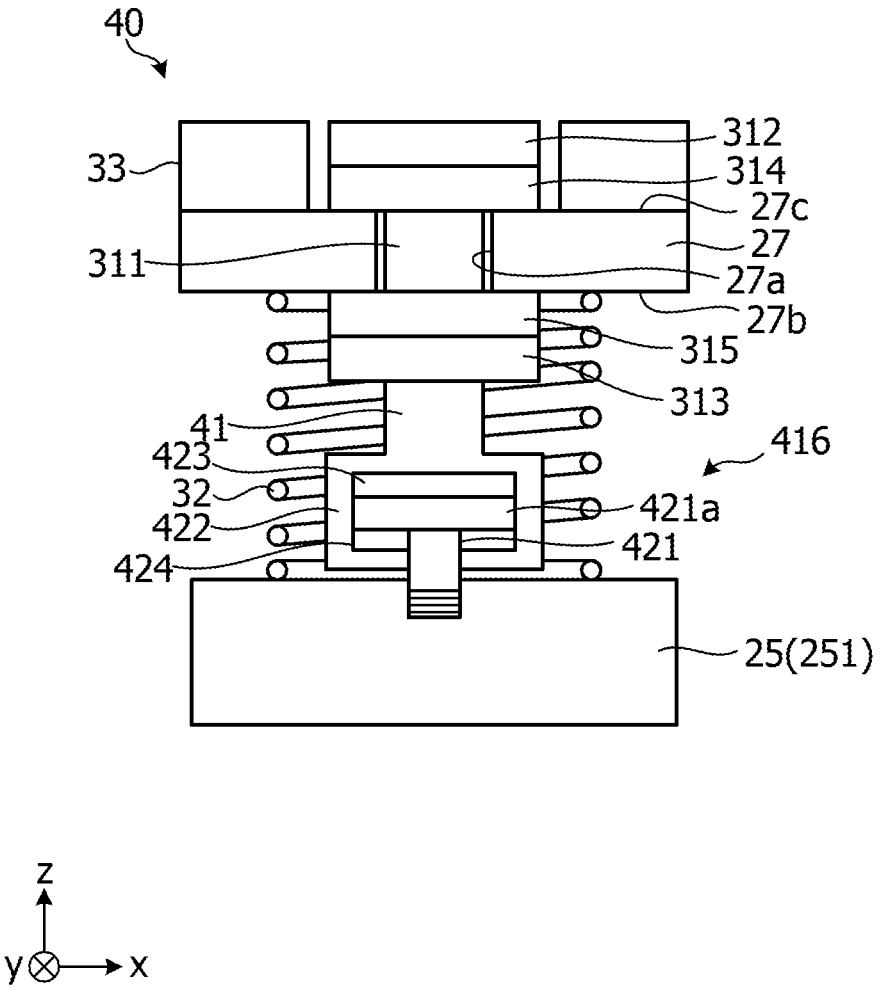

40
312
33
314
27c
27
311
27a
27b
315
313
41
416
423
32
421a
422
421
424
25(251)
z
y
x

FIG. 10

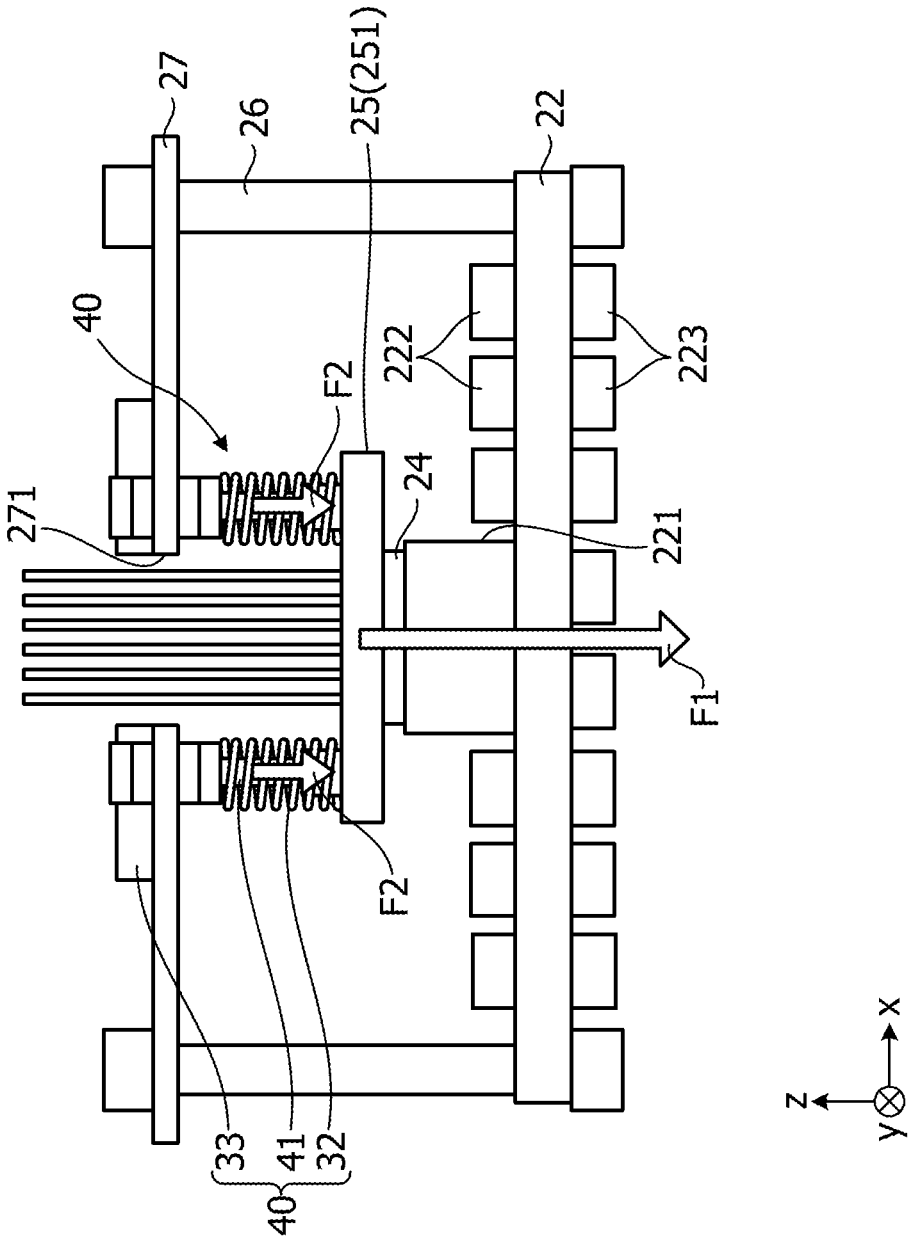


FIG. 11

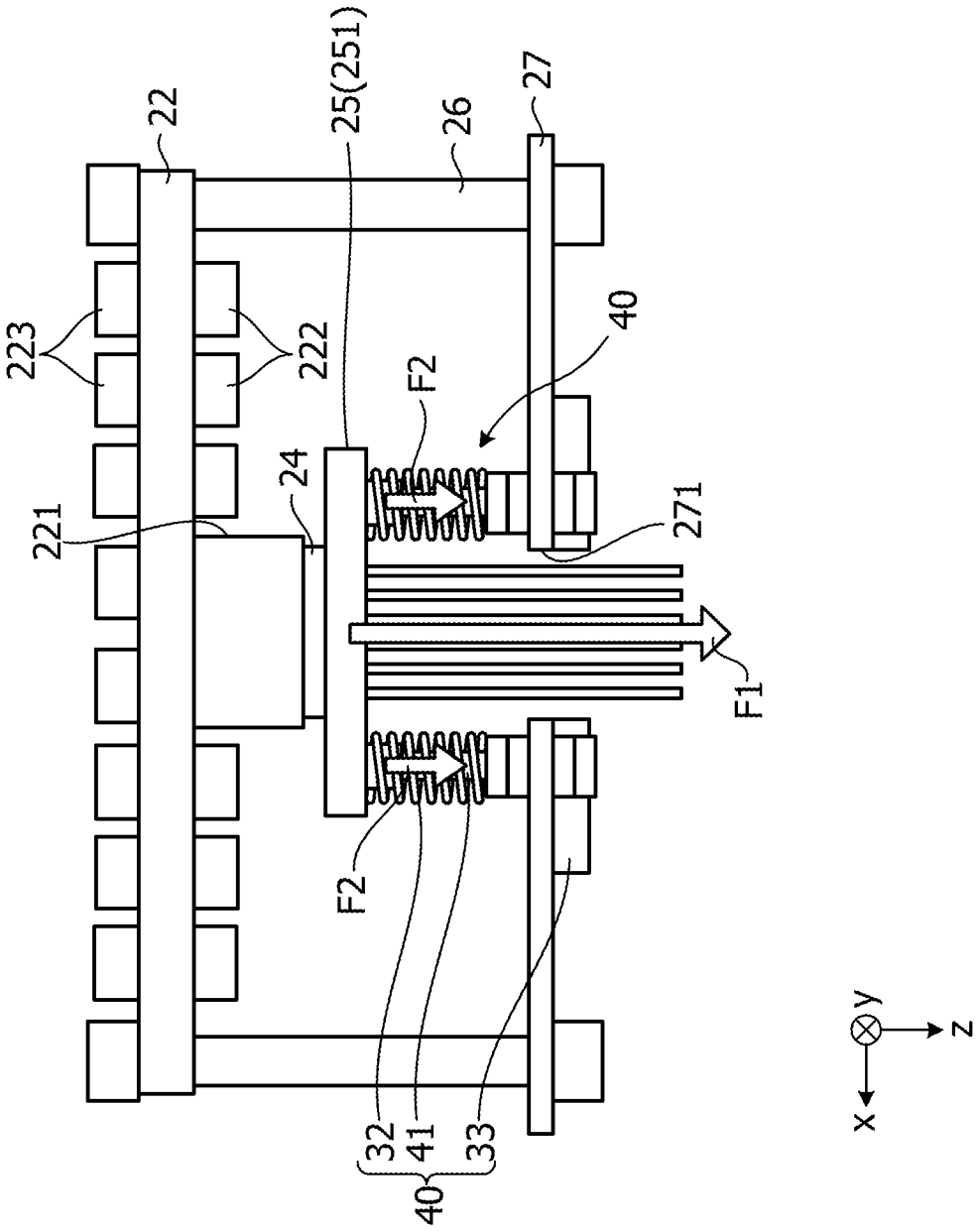


FIG. 12

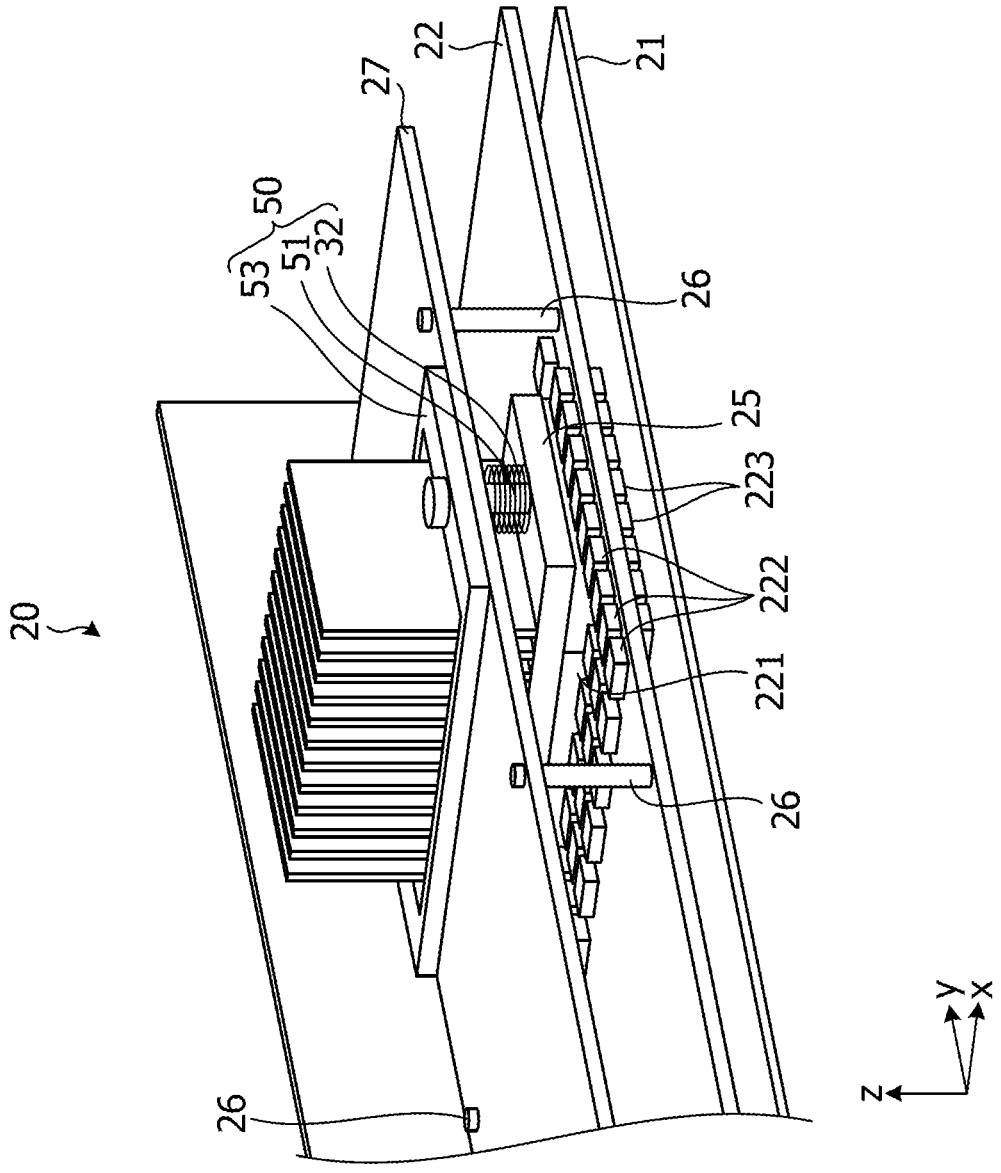


FIG. 13

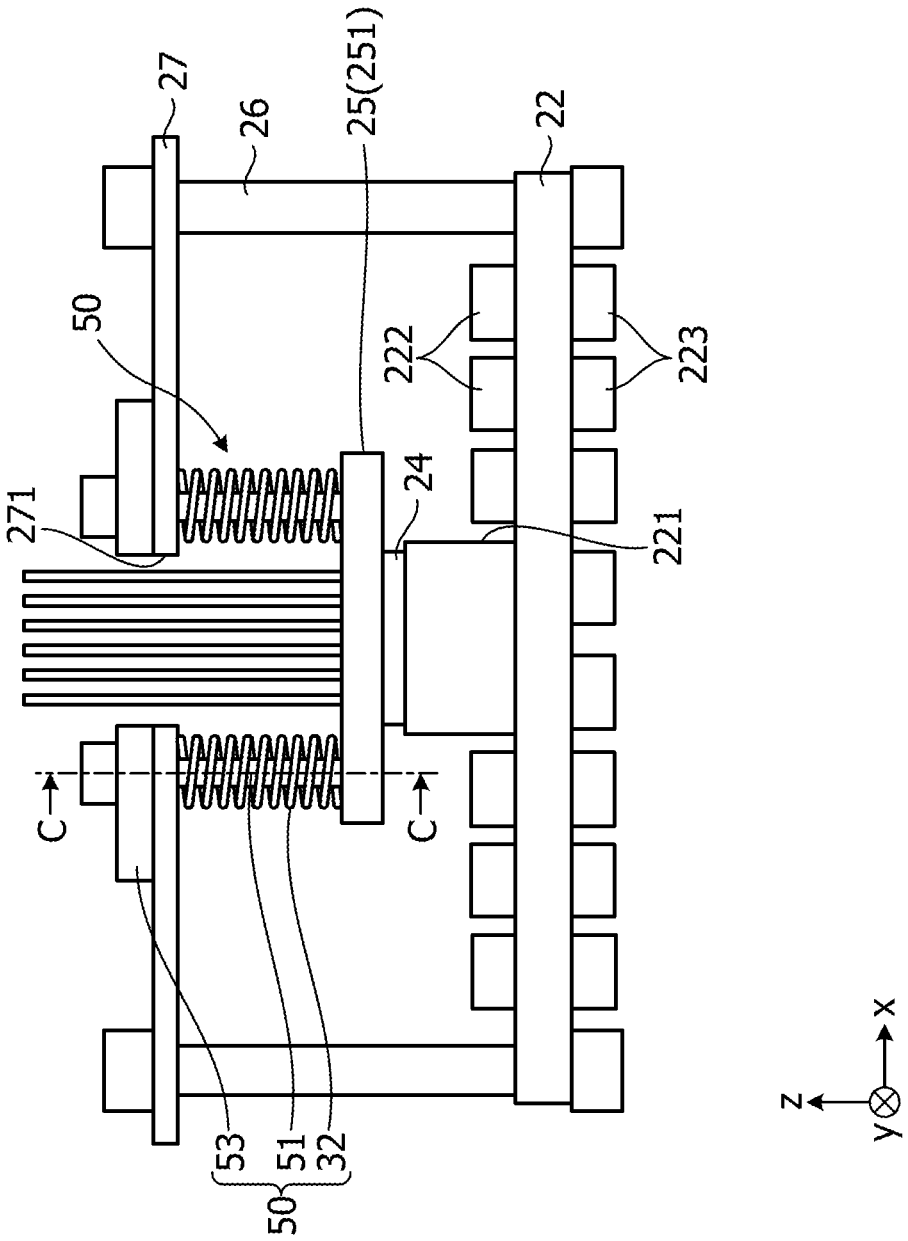
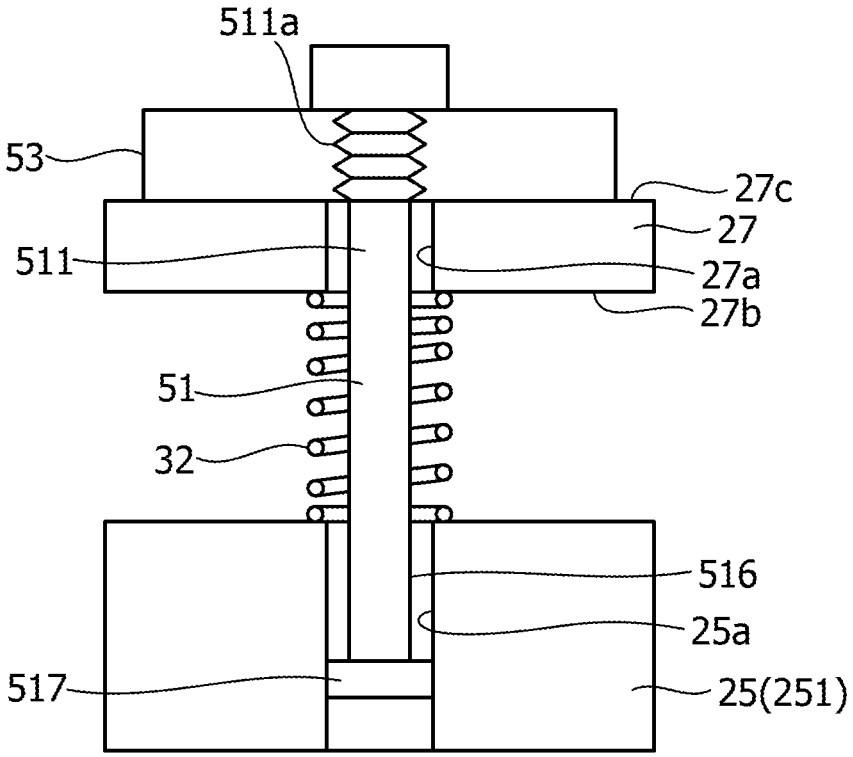


FIG. 14



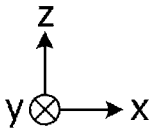
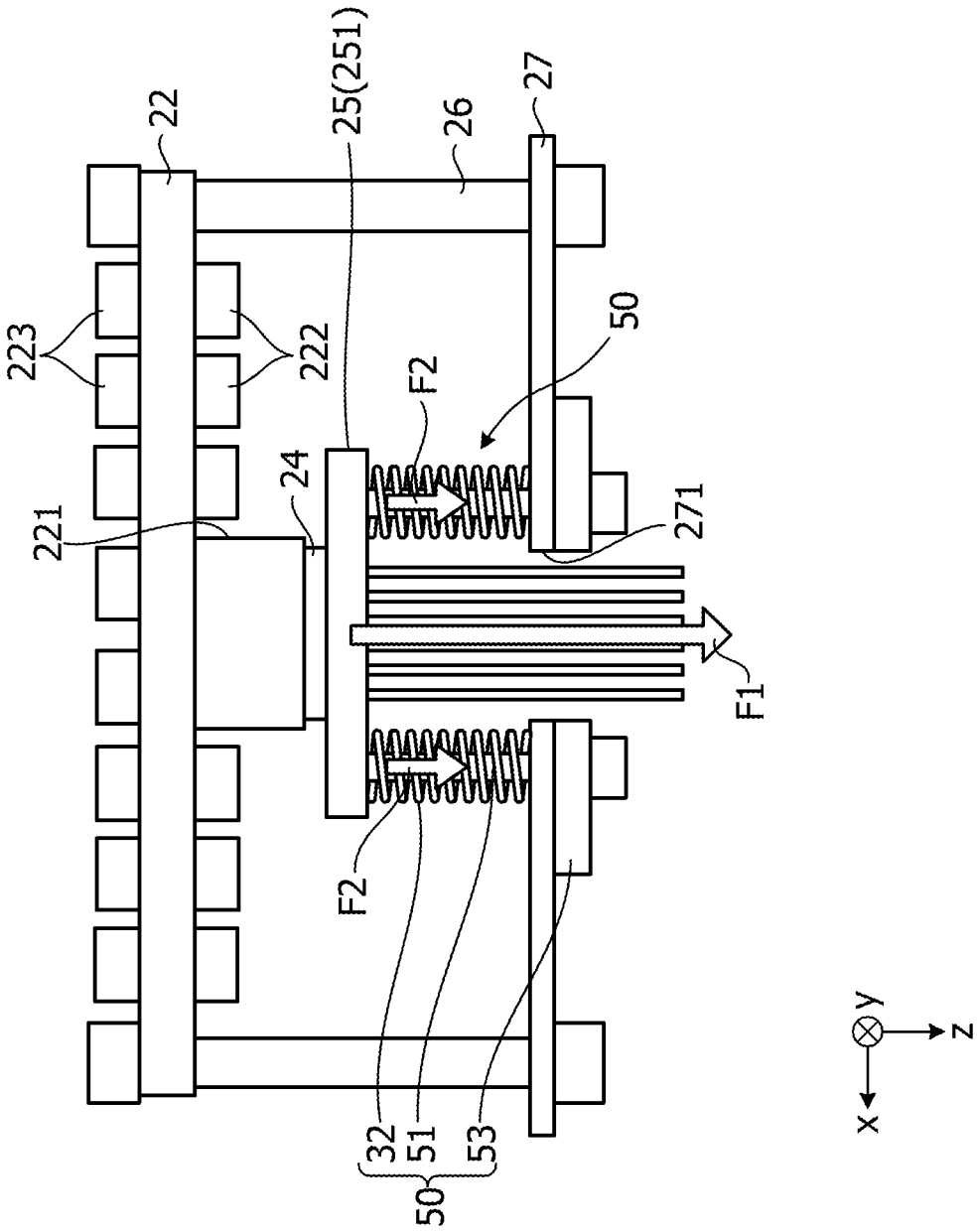


FIG. 15



TRANSMISSION DEVICE AND PLUG-IN UNIT

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is based upon and claims the benefit of priority of the prior Japanese Patent Application No. 2018-136164, filed on Jul. 19, 2018, the entire contents of which are incorporated herein by reference.

FIELD

[0002] The embodiments discussed herein are related to a transmission device and a plug-in unit.

BACKGROUND

[0003] In a plug-in unit (PIU) to which an optical transmission line is connectable and a blade-type transmission device into which the PIU is inserted, an electronic component as a heat generation component is mounted in a space in a housing. Heat generated from the heat generation component causes operation abnormality to occur in the PIU and the transmission device. For this reason, a heat sink for prompting heat dissipation is attached to the heat generation component in many cases.

[0004] When the heat sink is attached to the heat generation component, for example, a base member is arranged on a substrate on which the heat generation component is arranged so as to surround the heat generation component and the heat sink is fastened to the base member, so that the heat sink is pressed against the heat generation component. It is, however, difficult to ensure a region for mounting another component around the heat generation component when the base member is arranged around the heat generation component.

[0005] Therefore, various techniques of pressing the heat sink against the heat generation component without arranging the base member around the heat generation component have been studied. For example, there is an existing technique in which a pair of columns is provided at positions interposing a heat generation component on a substrate on which the heat generation component is arranged and a heat sink is pressed against the heat generation component from a beam member bridged between the pair of columns with a bolt member interposed therebetween.

[0006] Japanese Laid-open Patent Publication No. 2013-55176 is an example of related art.

[0007] However, in the above-described existing technique, the pair of columns is arranged around the heat generation component and a sufficient region for mounting another component is therefore not ensured around the heat generation component.

[0008] In view of the above-described circumstances, it is desirable to provide a transmission device and a plug-in unit capable of ensuring a sufficient region for mounting another component around a heat generation component against which a heat sink is pressed.

SUMMARY

[0009] According to an aspect of the embodiments, an apparatus includes a transmission device includes a first substrate on which a heat generation component is arranged, a heat sink that is placed on the heat generation component, a second substrate that is arranged above a surface of the first substrate on which the heat generation component is arranged and a pressing mechanism that presses the heat sink against the heat generation component arranged on the first substrate from the second substrate side.

[0010] The object and advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the claims.

[0011] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are not restrictive of the invention.

BRIEF DESCRIPTION OF DRAWINGS

[0012] FIG. **1** is a perspective view illustrating an appearance of a transmission device according to a first embodiment;

[0013] FIG. **2** is a perspective view illustrating an example of the internal configuration of a PIU according to the first embodiment;

[0014] FIG. **3** is a front view illustrating an example of the internal configuration of the PIU according to the first embodiment;

[0015] FIG. **4** is a side cross-sectional view illustrating an example of the configuration of a pressing mechanism according to the first embodiment;

[0016] FIG. **5** is a view (part **1**) for explaining a function of a first buffer member;

[0017] FIG. **6** is a view (part **2**) for explaining the function of the first buffer member;

[0018] FIG. **7** is a perspective view illustrating an example of the internal configuration of a PIU according to a second embodiment;

[0019] FIG. **8** is a front view illustrating an example of the internal configuration of the PIU according to the second embodiment;

[0020] FIG. **9** is a side cross-sectional view illustrating an example of the configuration of a pressing mechanism according to the second embodiment;

[0021] FIG. **10** is a view (part **1**) for explaining functions of the first buffer member and a second buffer member;

[0022] FIG. **11** is a view (part **2**) for explaining the functions of the first buffer member and the second buffer member;

[0023] FIG. **12** is a perspective view illustrating an example of the internal configuration of a PIU according to a third embodiment;

[0024] FIG. **13** is a front view illustrating an example of the internal configuration of the PIU according to the third embodiment;

[0025] FIG. **14** is a side cross-sectional view illustrating an example of the configuration of a pressing mechanism according to the third embodiment; and

[0026] FIG. **15** is a view for explaining a function of a third buffer member.

DESCRIPTION OF EMBODIMENTS

[0027] Hereinafter, embodiments of a transmission device and a plug-in unit disclosed by the present application will be described in detail with reference to the drawings. The embodiments do not limit the disclosed technique. In the embodiments, the same reference numerals denote components having the same functions and overlapped description thereof is omitted.

First Embodiment

[0028] [Configuration of Transmission Device **1**]

[0029] FIG. **1** is a perspective view illustrating an appearance of a transmission device **1** according to a first embodiment. The transmission device **1** illustrated in FIG. **1** is, for example, a blade-type transmission device that is attached to a rack (not illustrated) in a detachable manner. A plug-in unit (PIU) **20** to which an optical transmission line is connectable is inserted into the transmission device **1**. The transmission device **1** has a housing **10**. The housing **10** is a box body having a bottom plate, a top plate opposing the bottom plate, a pair of opposing side walls, a front surface, and a rear surface. Hereinafter, the bottom plate and the top plate of the housing **10** are parallel to an xy plane, the pair of side walls of the housing **10** is parallel to an yz plane, and the front surface and the rear surface of the housing **10** are parallel to an xz plane. An x direction is referred to as a width direction of the housing **10**, a y direction is referred to as a depth direction of the housing **10**, and a z direction is referred to as a height direction of the housing **10**. A direction indicated by an arrow of a z axis is referred to as an upward direction and a direction opposite to the direction indicated by the arrow of the z axis is referred to as a downward direction. A direction indicated by an arrow of a y axis is referred to as a back side and a direction opposite to the direction indicated by the arrow of the y axis is referred to as a front side. The surface of the housing **10** on the front side is the front surface of the housing **10** and the surface of the housing **10** on the back side is the rear surface of the housing **10**.

[0030] As illustrated in FIG. **1**, a plurality of slots **10***a* is formed in the front surface of the housing **10**. In the example illustrated in FIG. **1**, five slots **10***a* are formed. The PIU **20** is inserted into each of the slots in the front surface of the housing **10**. Insertion of the PIU **20** into each of the slots in the front surface of the housing **10** causes the PIU **20** to be electrically connected to a printed circuit board arranged in the housing **10**.

[0031] [Configuration of PIU **20**]

[0032] FIG. **2** is a perspective view illustrating an example of an internal configuration of the PIU **20** according to the first embodiment. FIG. **3** is a front view illustrating an example of the internal configuration of the PIU **20** according to the first embodiment.

[0033] As illustrated in FIG. **1** and FIG. **2**, the PIU **20** has a housing **21** that may be inserted into and removed from the housing **10**. In FIG. **3**, the housing **21** is omitted for the convenience of explanation. As illustrated in FIG. **2** and FIG. **3**, a main substrate **22** as a printed circuit board is fixed in the housing **21**. A heat generation component **221** as an electronic component generating heat in operation is arranged on the upper surface of the main substrate **22**. A plurality of electronic components **222** having lower heating values than the heat generation component **221** is arranged in a region surrounding the heat generation component **221** on the upper surface of the main substrate **22**. A plurality of electronic components **223** having lower heating values than the heat generation component **221** is arranged on the lower surface of the main substrate **22**. The main substrate **22** is an example of a first substrate.

[0034] A heat sink **25** is placed on the upper surface of the heat generation component **221** with a heat conductive sheet **24** interposed therebetween. The heat sink **25** has a main body portion **251** and fin portions **252**. The heat sink **25** is disposed along the upper surface of the heat generation component **221**. The fin portions **252** are provided so as to stand from the upper surface of the main body portion **251**, passes through a cavity **271** in a sub substrate **27**, which will be described later, and extends to the upper side of the sub substrate **27**. With this configuration, the heat sink **25** may enlarge heat dissipation areas of the fin portions **252** as large as possible to thereby dissipate heat generated from the heat generation component **221** efficiently.

[0035] The sub substrate **27** as a printed circuit board is arranged above the upper surface of the main substrate **22**, for example, above the surface of the main substrate **22** on which the heat generation component **221** is arranged. The sub substrate **27** is arranged above the surface of the main substrate **22** on which the heat generation component **221** is arranged by being supported by column members **26** standing from the main substrate **22**. The sub substrate **27** is electrically connected to the main substrate **22** with a cable (not illustrated) or the like. The cavity **271** through which the fin portions **252** of the heat sink **25** are inserted is formed in the sub substrate **27**. The sub substrate **27** is an example of a second substrate.

[0036] The PIU **20** includes pressing mechanisms **30**. The pressing mechanisms **30** are mechanisms that press the heat sink **25** against the heat generation component **221** arranged on the upper surface of the main substrate **22** from the side of the sub substrate **27** arranged above the upper surface of the main substrate **22**. The pressing mechanisms **30** are arranged on the sub substrate **27** at each of the two positions interposing the fin portions **252** of the heat sink **25** therebetween. Although the arrangement positions of the pressing mechanisms **30** are two, the number of arranged pressing mechanisms **30** is not limited to two and may be equal to or more than three.

[0037] [Configuration of Pressing Mechanisms **30**]

[0038] FIG. **4** is a side cross-sectional view illustrating an example of the configuration of the pressing mechanism **30** according to the first embodiment. The side cross-sectional view illustrated in FIG. **4** corresponds to a cross-sectional view cut along arrows A-A in FIG. **3**. As illustrated in FIG. **2** to FIG. **4**, the pressing mechanisms **30** include columnar members **31**, springs **32**, and reinforcing plates **33**.

[0039] The columnar member **31** has a base end **311** arranged on the sub substrate **27**, extends to the lower side of the sub substrate **27**, and is engaged with the heat sink **25**.

[0040] The spring **32** is provided so as to be wound around the outer circumference of the columnar member **31**. The spring **32** abuts against a lower surface **27***b* of the sub substrate **27**, which opposes the main substrate **22**, and the heat sink **25** (main body portion **251**) to press the heat sink **25** against the heat generation component **221** along the extension direction of the columnar member **31** with elastic force. The pressing mechanism **30** may thereby press the heat sink **25** against the heat generation component **221** from the sub substrate **27** side without arranging other members such as, a base member, a column, or the like, around the heat generation component **221** on the main substrate **22**. As a result, a region for mounting another component (for example, electronic components **222**) may be sufficiently ensured around the heat generation component **221** against which the heat sink **25** is pressed. The spring **32** is an example of an elastic member.

[0041] The reinforcing plate **33** covers at least a region of an upper surface **27***c* of the sub substrate **27** on the opposite

side to the main substrate **22**, which correspond to the spring **32**. In the embodiment, the reinforcing plate **33** covers not only the region of the upper surface **27***c* of the sub substrate **27**, which corresponds to the spring **32**, but also an overall region thereof around the cavity **271**. Coverage of the region of the upper surface **27***c* of the sub substrate **27**, which corresponds to the spring **32**, by the reinforcing plate **33** suppresses deflection of the sub substrate **27** with the elastic force of the spring **32**.

[0042] An arrangement mode of the columnar member **31** on the sub substrate **27** and an engagement mode between the columnar member **31** and the heat sink **25** will be described in detail with reference to FIG. **4**. A hole **27***a* through which the base end **311** of the columnar member **31** is inserted is formed in the sub substrate **27**. A screw groove (not illustrated) is formed in the base end **311** of the columnar member **31**. The columnar member **31** is fixed to the sub substrate **27** by mounting an upper nut member **312** and a lower nut member **313** as a pair of nut members on the base end **311** inserted through the hole **27***a* of the sub substrate **27** so as to interpose the sub substrate **27** therebetween.

[0043] Buffer members are inserted through between each of the upper nut member **312** and the lower nut member **313** and the sub substrate **27**. For example, an upper buffer member **314** is inserted through between the upper nut member **312** and the upper surface **27***c* of the sub substrate **27** and a lower buffer member **315** is inserted through between the lower nut member **313** and the lower surface **27***b* of the sub substrate **27**. The upper buffer member **314** and the lower buffer member **315** have functions of absorbing force which acts on the heat sink **25** in the gravity direction (up-down direction in FIG. **4**) and is transmitted to the columnar member **31**. The functions of the upper buffer member **314** and the lower buffer member **315** will be described in detail later. The upper buffer member **314** and the lower buffer member **315** are examples of a first buffer member.

[0044] The columnar member **31** includes a screw portion **316** which is engaged with a screw hole formed in the heat sink **25**. Engagement between the screw portion **316** and the screw hole formed in the heat sink **25** avoids positional deviation between the columnar member **31** and the heat sink **25** and the elastic force of the spring **32** is efficiently transmitted to the heat sink **25** along the extension direction of the columnar member **31**.

[0045] Next, the functions of the upper buffer members **314** and the lower buffer members **315** as the first buffer member will be described with reference to FIG. **5** and FIG. **6**. FIG. **5** is a view (part **1**) for explaining the function of the first buffer member. FIG. **5** illustrates a mode in which the PIU **20** falls on the ground in a state where the upper surface of the main substrate **22** (for example, surface of main substrate **22** on which heat generation component **221** is arranged) faces the direction on the opposite side to the ground. When the PIU **20** falls on the ground in the mode illustrated in FIG. **5**, force F**1** acts on the heat sink **25** in the gravity direction (downward direction in FIG. **5**). The force F**1** is transmitted, as forces F**2**, to the columnar members **31** engaged with the heat sink **25** and the upper nut members **312** mounted on the base ends **311** of the columnar members **31**. When the forces F**2** are transmitted to the upper nut members **312**, the upper buffer members **314** inserted through between the upper nut members **312** and the upper surface **27***c* of the sub substrate **27** elastically contract and absorb the forces F**2**. The upper buffer members **314** may thereby suppress movement of the heat sink **25** in the gravity direction (downward direction in FIG. **5**). As a result, impact that is applied to the heat generation component **221** from the heat sink **25** is relieved.

[0046] FIG. **6** is a view (part **2**) for explaining the function of the first buffer member. FIG. **6** illustrates a mode in which the PIU **20** falls on the ground in a state where the upper surface of the main substrate **22** (for example, surface of main substrate **22** on which heat generation component **221** is arranged) faces the direction of the ground. When the PIU **20** falls on the ground in the mode illustrated in FIG. **6**, force F**1** acts on the heat sink **25** in the gravity direction (downward direction in FIG. **6**). The force F**1** is transmitted, as forces F**2**, to the columnar members **31** engaged with the heat sink **25** and the lower nut members **313** mounted on the base ends **311** of the columnar members **31**. When the forces F**2** are transmitted to the lower nut members **313**, the lower buffer members **315** inserted through between the lower nut members **313** and the lower surface **27***b* of the sub substrate **27** elastically contract and absorb the forces F**2**. The lower buffer members **315** may thereby suppress movement of the heat sink **25** in the gravity direction (downward direction in FIG. **6**) and avoid contraction of the springs **32** with the movement of the heat sink **25**. As a result, the phenomenon (so-called bumping) that the heat sink **25** and the heat generation component **221** collide with each other with restoration of the springs **32** is avoided.

[0047] As described above, the transmission device **1** and the PIU **20** according to the embodiment include the pressing mechanisms **30** that press the heat sink **25** against the heat generation component **221** arranged on the upper surface of the main substrate **22** from the sub substrate **27** side arranged above the upper surface of the main substrate **22**.

[0048] With the configurations of the transmission device **1** and the PIU **20**, the heat sink **25** may be pressed against the heat generation component **221** from the sub substrate **27** side without arranging a base member and another member such as a column around the heat generation component **221** on the main substrate **22**. As a result, the region for mounting another component (for example, electronic components **222**) may be sufficiently ensured around the heat generation component **221** against which the heat sink **25** is pressed.

[0049] In the transmission device **1** and the PIU **20** according to the embodiment, the pressing mechanisms **30** include the columnar members **31** and the springs **32**. The columnar members **31** have the base ends **311** arranged on the sub substrate **27**, extend to the lower side of the sub substrate **27**, and are engaged with the heat sink **25**. The springs **32** are provided on the outer circumferences of the columnar members **31** and abut against the lower surface **27***b* of the sub substrate **27**, which opposes the main substrate **22**, and the heat sink **25** to press the heat sink **25** against the heat generation component **221** along the extension direction of the columnar members **31**.

[0050] The configurations of the transmission device **1** and the PIU **20** enable the heat sink **25** to be stably pressed against the heat generation component **221**.

[0051] In the transmission device **1** and the PIU **20** according to the embodiment, the columnar members **31** are fixed to the sub substrate **27** by mounting the upper nut members **312** and the lower nut members **313** on the base ends **311**

inserted through the holes **27***a* of the sub substrate **27** so as to interpose the sub substrate **27** therebetween. The upper buffer members **314** are inserted through between the upper nut members **312** and the upper surface **27***c* of the sub substrate **27** and the lower buffer members **315** are inserted through between the lower nut members **313** and the lower surface **27***b* of the sub substrate **27**.

[0052] The configurations of the transmission device **1** and the PIU **20** enable the upper buffer members **314** and the lower buffer members **315** to absorb the force which acts on the heat sink **25** in the gravity direction and is transmitted to the columnar members **31** in falling of the PIU **20**. As a result, the impact that is applied to the heat generation component **221** from the heat sink **25** is relieved and the bumping is avoided.

Second Embodiment

[0053] A second embodiment relates to variations of the columnar members in the pressing mechanisms in the first embodiment.

[0054] [Configuration of PIU **20**]

[0055] FIG. **7** is a perspective view illustrating an example of an internal configuration of a PIU **20** according to the second embodiment. FIG. **8** is a front view illustrating an example of the internal configuration of the PIU **20** according to the second embodiment.

[0056] As illustrated in FIG. **7** and FIG. **8**, the PIU **20** includes pressing mechanisms **40**.

[0057] [Configuration of Pressing Mechanisms **40**]

[0058] FIG. **9** is a side cross-sectional view illustrating an example of the configuration of the pressing mechanism **40** according to the second embodiment. The side cross-sectional view illustrated in FIG. **9** corresponds to a cross-sectional view cut along arrows B-B in FIG. **8**. As illustrated in FIG. **7** and FIG. **8**, the pressing mechanisms **40** include columnar members **41**, the springs **32**, and the reinforcing plates **33**.

[0059] The columnar members **41** have the base ends **311** arranged on the sub substrate **27**, extend to the lower side of the sub substrate **27**, and are engaged with the heat sink **25**.

[0060] An engagement mode between the columnar member **41** and the heat sink **25** will be described in detail with reference to FIG. **9**. The columnar member **41** includes a screw portion **416** which is engaged with a screw hole formed in the heat sink **25**. The screw portion **416** has a screw main body portion **421** and a screw case portion **422**.

[0061] The screw main body portion **421** is engaged with the screw hole formed in the heat sink **25**. The screw case portion **422** accommodates therein a head **421***a* of the screw main body portion **421** so as to be movable in the up-down direction.

[0062] Buffer members are inserted through between each of the upper surface and the lower surface of the head **421***a* of the screw main body portion **421** and inner wall surfaces of the screw case portion **422**. For example, upper buffer member **423** is inserted through between the upper surface of the head **421***a* of the screw main body portion **421** and inner wall surfaces of the screw case portion **422**, and lower buffer member **424** is inserted through between the lower surface of the head **421***a* of the screw main body portion **421** and the inner wall surfaces of the screw case portion **422**. The upper buffer member **423** and the lower buffer member **424** have functions of absorbing force which acts on the heat sink **25** in the gravity direction (up-down direction in FIG. **9**) and is transmitted to the screw main body portion **421**. The upper buffer member **423** and the lower buffer member **424** are examples of a second buffer member.

[0063] Next, the functions of the upper buffer members **423** and the lower buffer members **424** as the second buffer member will be described with reference to FIG. **10** and FIG. **11**. FIG. **10** is a view (part **1**) for explaining the functions of the first buffer member and the second buffer member. FIG. **10** illustrates a mode in which the PIU **20** falls on the ground in a state where the upper surface of the main substrate **22** (for example, surface of main substrate **22** on which heat generation component **221** is arranged) faces the direction on the opposite side to the ground. When the PIU **20** falls on the ground in the mode illustrated in FIG. **10**, force F**1** acts on the heat sink **25** in the gravity direction (downward direction in FIG. **10**). The force F**1** is transmitted, as forces F**2**, to the screw main body portions **421** engaged with the screw holes in the heat sink **25**, the columnar members **41**, and the upper nut members **312** mounted on the base ends **311** of the columnar members **41**. When the forces F**2** are transmitted to the screw main body portions **421**, the lower buffer members **424** inserted through between the lower surfaces of the heads **421***a* of the screw main body portions **421** and the inner wall surfaces of the screw case portions **422** elastically contract and absorb the forces F**2**. When the forces F**2** are transmitted to the upper nut members **312**, the upper buffer members **314** inserted through between the upper nut members **312** and the upper surface **27***c* of the sub substrate **27** elastically contract and absorb the forces F**2**. The upper buffer members **314** and the lower buffer members **424** may thereby suppress movement of the heat sink **25** in the gravity direction (downward direction in FIG. **10**). As a result, impact that is applied to the heat generation component **221** from the heat sink **25** is relieved.

[0064] FIG. **11** is a view (part **2**) for explaining the functions of the first buffer member and the second buffer member. FIG. **11** illustrates a mode in which the PIU **20** falls on the ground in a state where the upper surface of the main substrate **22** (for example, surface of main substrate **22** on which heat generation component **221** is arranged) faces the direction of the ground. When the PIU **20** falls on the ground in the mode illustrated in FIG. **11**, force F**1** acts on the heat sink **25** in the gravity direction (downward direction in FIG. **11**). The force F**1** is transmitted, as forces F**2**, to the screw main body portions **421** engaged with the screw holes in the heat sink **25**, the columnar members **41**, and the lower nut members **313** mounted on the base ends **311** of the columnar members **41**. When the forces F**2** are transmitted to the screw main body portions **421**, the upper buffer members **423** inserted through between the upper surfaces of the heads **421***a* of the screw main body portions **421** and the inner wall surfaces of the screw case portions **422** elastically contract and absorb the forces F**2**. When the forces F**2** are transmitted to the lower nut members **313**, the lower buffer members **315** inserted through between the lower nut members **313** and the lower surface **27***b* of the sub substrate **27** elastically contract and absorb the forces F**2**. The lower buffer members **315** and the upper buffer members **423** may thereby suppress movement of the heat sink **25** in the gravity direction (downward direction in FIG. **11**) and avoid contraction of the springs **32** with the movement of the heat sink **25**. As a result, the phenomenon (so-called bumping) that the

heat sink **25** and the heat generation component **221** collide with each other with restoration of the springs **32** is avoided.

[0065] As described above, in the transmission device **1** and the PIU **20** according to the embodiment, the pressing mechanisms **40** include the columnar members **41** and the springs **32**. The columnar members **41** have the screw portions **416**. The screw portions **416** have the screw main body portions **421** and the screw case portions **422**. The screw main body portion **421** is engaged with the screw hole formed in the heat sink **25**. The screw case portions **422** accommodate therein the heads **421***a* of the screw main body portions **421** so as to be movable in the up-down direction. For example, the upper buffer members **423** are inserted through between the upper surfaces of the heads **421***a* of the screw main body portions **421** and the inner wall surfaces of the screw case portions **422**, and the lower buffer members **424** are inserted through between the lower surfaces of the heads **421***a* of the screw main body portions **421** and the inner wall surfaces of the screw case portions **422**.

[0066] The configurations of the transmission device **1** and the PIU **20** enable the upper buffer members **423** and the lower buffer members **424** to absorb the force which acts on the heat sink **25** in the gravity direction and is transmitted to the screw main body portions **421** in falling of the PIU **20**. As a result, the impact that is applied to the heat generation component **221** from the heat sink **25** is relieved and the bumping is avoided.

Third Embodiment

[0067] A third embodiment relates to variations of the columnar members and the reinforcing plates in the pressing mechanisms in the first embodiment.

[0068] [Configuration of PIU **20**]

[0069] FIG. **12** is a perspective view illustrating an example of the internal configuration of a PIU **20** according to the third embodiment. FIG. **13** is a front view illustrating an example of the internal configuration of the PIU **20** according to the third embodiment.

[0070] As illustrated in FIG. **12** and FIG. **13**, the PIU **20** includes pressing mechanisms **50**.

[0071] [Configuration of Pressing Mechanisms **50**]

[0072] FIG. **14** is a side cross-sectional view illustrating an example of the configuration of the pressing mechanism **50** according to the third embodiment. The side cross-sectional view illustrated in FIG. **14** corresponds to a cross-sectional view cut along arrows C-C in FIG. **13**. As illustrated in FIG. **12** to FIG. **14**, the pressing mechanisms **50** include columnar members **51**, the springs **32**, and reinforcing plates **53**.

[0073] The columnar members **51** have base ends **511** arranged on the sub substrate **27**, extend to the lower side of the sub substrate **27**, and are engaged with the heat sink **25**.

[0074] The reinforcing plates **53** cover at least regions of the upper surface **27***c* of the sub substrate **27** on the opposite side to the main substrate **22**, which correspond to the springs **32**.

[0075] An arrangement mode of the columnar member **51** on the sub substrate **27** and an engagement mode between the columnar member **51** and the heat sink **25** will be described in detail with reference to FIG. **14**. A hole **27***a* through which a base end **511** of the columnar member **51** is inserted is formed in the sub substrate **27**. A screw groove **511***a* corresponding to a screw hole of the reinforcing plate **53** is formed in the base end **511** of the columnar member **51**. The columnar member **51** is fixed to the sub substrate **27** by fixing of the base end **511** to the reinforcing plate **53**.

[0076] The columnar member **51** has a tip portion **516** which is engaged with a recess **25***a* formed in the heat sink **25**. Engagement between the tip portion **516** of the columnar member **51** and the recess **25***a* avoids positional deviation between the columnar member **51** and the heat sink **25** and the elastic force of the spring **32** is efficiently transmitted to the heat sink **25** along the extension direction of the columnar member **51**.

[0077] A buffer member **517** is inserted through between the tip portion **516** of the columnar member **51** and the bottom surface of the recess **25***a*. The buffer member **517** has a function of absorbing force which acts on the heat sink **25** in the gravity direction (up-down direction in FIG. **14**) and is transmitted to the columnar member **51**. The buffer member **517** is an example of a third buffer member.

[0078] Next, the function of the buffer members **517** as the third buffer member will be described with reference to FIG. **15**. FIG. **15** is a view for explaining the function of the third buffer member. FIG. **15** illustrates a mode in which the PIU **20** falls on the ground in a state where the upper surface of the main substrate **22** (for example, the surface of the main substrate **22** on which the heat generation component **221** is arranged) faces the direction of the ground. When the PIU **20** falls on the ground in the mode illustrated in FIG. **15**, force F**1** acts on the heat sink **25** in the gravity direction (downward direction in FIG. **15**). The force F**1** is transmitted, as forces F**2**, to the tip portions **516** of the columnar members **51** engaged with the recesses **25***a* in the heat sink **25**. When the forces F**2** are transmitted to the tip portions **516** of the columnar members **51**, the buffer members **517** inserted through between the tip portions **516** of the columnar members **51** and the bottom surfaces of the recesses **25***a* elastically contract and absorb the forces F**2**. The buffer members **517** may thereby suppress movement of the heat sink **25** in the gravity direction (downward direction in FIG. **14**) and avoid contraction of the springs **32** with the movement of the heat sink **25**. As a result, the phenomenon (so-called bumping) that the heat sink **25** and the heat generation component **221** collide with each other with restoration of the springs **32** is avoided.

[0079] As described above, in the transmission device **1** and the PIU **20** according to the embodiment, the pressing mechanisms **50** include the columnar members **51**, the springs **32**, and the reinforcing plates **53**. The reinforcing plates **53** cover at least the regions of the upper surface **27***c* of the sub substrate **27** on the opposite side to the main substrate **22**, which correspond to the springs **32**. The columnar members **51** are fixed to the sub substrate **27** by fixing of the base ends **511** to the reinforcing plates **53**. The columnar members **51** have the tip portions **516** which are engaged with the recesses **25***a* formed in the heat sink **25**. The buffer members **517** are inserted through between the tip portions **516** of the columnar members **51** and the bottom surfaces of the recesses **25***a*.

[0080] The configurations of the transmission device **1** and the PIU **20** enable the buffer members **517** to absorb the force which acts on the heat sink **25** in the gravity direction and is transmitted to the columnar members **51** in falling of the PIU **20**. As a result, the bumping is avoided.

[0081] All examples and conditional language provided herein are intended for the pedagogical purposes of aiding the reader in understanding the invention and the concepts

contributed by the inventor to further the art, and are not to be construed as limitations to such specifically recited examples and conditions, nor does the organization of such examples in the specification relate to a showing of the superiority and inferiority of the invention. Although one or more embodiments of the present invention have been described in detail, it should be understood that the various changes, substitutions, and alterations could be made hereto without departing from the spirit and scope of the invention.

What is claimed is:

1. A transmission device comprising:
a first substrate on which a heat generation component is arranged;
a heat sink that is placed on the heat generation component;
a second substrate that is arranged above a surface of the first substrate on which the heat generation component is arranged; and
a pressing mechanism that presses the heat sink against the heat generation component arranged on the first substrate from the second substrate side.

2. The transmission device according to claim **1**, wherein
the pressing mechanism includes:
a columnar member that has a base end arranged on the second substrate, extends to a lower side of the second substrate, and is engaged with the heat sink; and
an elastic member that is provided on an outer circumference of the columnar member, abuts against a lower surface of the second substrate, which opposes the first substrate, and the heat sink, and presses the heat sink against the heat generation component along an extension direction of the columnar member.

3. The transmission device according to claim **2**, wherein
a hole through which the base end of the columnar member is inserted is formed in the second substrate,
the columnar member is fixed to the second substrate by mounting a pair of nut members on the base end of the columnar member, which has been inserted through the hole of the second substrate, so as to interpose the second substrate, and
a first buffer member is inserted through between each of the pair of nut members and the second substrate.

4. The transmission device according to claim **2**, wherein
the columnar member includes a screw portion which is engaged with a screw hole formed in the heat sink.

5. The transmission device according to claim **4**, wherein
the screw portion has a screw main body portion which is engaged with the screw hole formed in the heat sink, a screw case portion which accommodates a head of the screw main body portion, and a second buffer member which is inserted through between each of an upper surface and a lower surface of the head of the screw main body portion and an inner wall surface of the screw case portion.

6. The transmission device according to claim **2**, wherein
the pressing mechanism further includes a reinforcing plate which covers at least a region of an upper surface of the second substrate on an opposite side to the first substrate, which corresponds to the elastic member.

7. The transmission device according to claim **2**, wherein
the pressing mechanism further includes a reinforcing plate which covers at least a region of an upper surface of the second substrate on an opposite side to the first substrate, which corresponds to the elastic member,
the columnar member is fixed to the second substrate by fixing of the base end of the columnar member to the reinforcing plate,
the second substrate has a hole through which the base end of the columnar member is inserted,
the columnar member has a tip portion which is engaged with a recess formed in the heat sink, and
a third buffer member is inserted through between the tip portion of the columnar member and a bottom surface of the recess.

8. A plug-in unit comprising:
a first substrate on which a heat generation component is arranged;
a heat sink that is placed on the heat generation component;
a second substrate that is arranged above a surface of the first substrate on which the heat generation component is arranged; and
a pressing mechanism that presses the heat sink against the heat generation component arranged on the first substrate from the second substrate side.

9. The plug-in unit according to claim **8**, wherein
the pressing mechanism includes:
a columnar member that has a base end arranged on the second substrate, extends to a lower side of the second substrate, and is engaged with the heat sink; and
an elastic member that is provided on an outer circumference of the columnar member, abuts against a lower surface of the second substrate, which opposes the first substrate, and the heat sink, and presses the heat sink against the heat generation component along an extension direction of the columnar member.

10. The plug-in unit according to claim **9**, wherein
a hole through which the base end of the columnar member is inserted is formed in the second substrate,
the columnar member is fixed to the second substrate by mounting a pair of nut members on the base end of the columnar member, which has been inserted through the hole of the second substrate, so as to interpose the second substrate, and
a first buffer member is inserted through between each of the pair of nut members and the second substrate.

11. The plug-in unit according to claim **9**, wherein
the columnar member includes a screw portion which is engaged with a screw hole formed in the heat sink.

12. The plug-in unit according to claim **11**, wherein
the screw portion has a screw main body portion which is engaged with the screw hole formed in the heat sink, a screw case portion which accommodates a head of the screw main body portion, and a second buffer member which is inserted through between each of an upper surface and a lower surface of the head of the screw main body portion and an inner wall surface of the screw case portion.

13. The plug-in unit according to claim **9**, wherein
the pressing mechanism further includes a reinforcing plate which covers at least a region of an upper surface of the second substrate on an opposite side to the first substrate, which corresponds to the elastic member.

14. The plug-in unit according to claim **9**, wherein
the pressing mechanism further includes a reinforcing plate which covers at least a region of an upper surface of the second substrate on an opposite side to the first substrate, which corresponds to the elastic member,

the columnar member is fixed to the second substrate by fixing of the base end of the columnar member to the reinforcing plate,

the second substrate has a hole through which the base end of the columnar member is inserted,

the columnar member has a tip portion which is engaged with a recess formed in the heat sink, and

a third buffer member is inserted through between the tip portion of the columnar member and a bottom surface of the recess.

* * * * *