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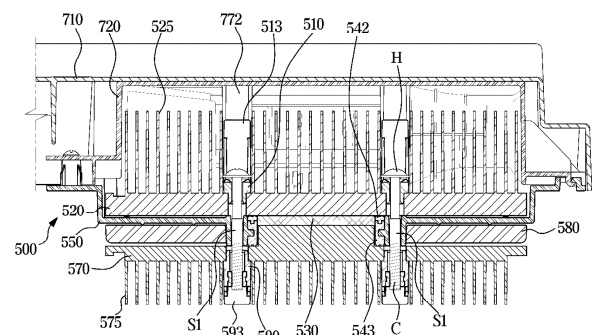
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(54) **REFRIGERATOR**

(57) A refrigerator including a thermoelectric module that includes a module plate having an opening, a first heat sink, a second heat sink, a thermoelectric element to be disposed in the opening so that one surface of the thermoelectric element contacts the first heat sink and another surface of the thermoelectric element, opposite the one surface, contacts the second heat sink, a fastening member that is configured to couple the first heat sink and the second heat sink to the module plate by being passed through the first heat sink, the module plate, and the second heat sink, having a head portion and a connecting portion having a diameter smaller than the head portion, a washer member supported between the head portion and the first heat sink, and a nut member to which the connecting portion is fastened and that is supported by the second heat sink.

FIG. 17



Description

[Technical Field]

[0001] The present disclosure relates to a refrigerator, and more particularly, to a refrigerator having a thermoelectric element to cool a storage compartment.

[Background Art]

[0002] A refrigerator is a home appliance that has a main body having a storage compartment and a cold air supply device provided to supply cold air to the storage compartment to keep items fresh.

[0003] As the cold air supply device of the refrigerator, a thermoelectric module that causes heating and cooling actions through the Peltier effect of a thermoelectric element may be used. The thermoelectric element has a heat generating portion formed on one side and a heat absorbing portion formed on the opposite side, and when current is applied to the thermoelectric element, the heating action may occur in the heat generating portion and a heating absorbing action may occur in the heat absorbing portion.

[0004] The thermoelectric module may include a heat dissipation sink in contact with the heat generating portion, a cooling sink in contact with the heat absorbing portion, and a module plate supporting the heat dissipation sink and the cooling sink to increase the efficiency of the heating action and the heat absorbing action of the thermoelectric element.

[Disclosure]

[Technical Problem]

[0005] One aspect of the present disclosure discloses a thermoelectric module having an improved structure to increase the efficiency of a cooling action through a thermoelectric element and a refrigerator including the same.

[0006] Another aspect of the present disclosure discloses a thermoelectric module having an improved structure so that assembly convenience is increased, and a refrigerator including the same.

[0007] Technical problems to be solved in the present document are not limited to the technical problems mentioned above, and other technical problems that are not mentioned will be clearly understood by those of ordinary skill in the art to which the present invention belongs from the following description.

[Technical Solution]

[0008] In accordance with one embodiment of the present disclosure, a refrigerator includes a storage compartment and a thermoelectric module to cool the storage compartment. The thermoelectric module may include a

module plate having an opening, a first heat sink to be provided on one surface of the module plate, a second heat sink to be provided on another surface of the module plate, a thermoelectric element to be disposed in the opening so that while the thermoelectric element is disposed in the opening, one side of the thermoelectric element contacts the first heat sink and another surface of the thermoelectric element, opposite the one surface contacts the second heat sink, a fastening member, configured to couple the first heat sink and the second heat sink to the module plate by being passed through the first heat sink, the module plate, and the second heat sink, having a head portion and a connecting portion having a diameter smaller than the head portion, a washer member supported between the head portion and the first heat sink, and a nut member to which the connecting portion is fastened and that is supported by the second heat sink.

[0009] The first heat sink may include a through-hole through which the fastening member passes, and the washer member may include an insertion portion protruding toward through-hole and insertable into the through-hole.

[0010] The washer member may be formed of a material having lower thermal conductivity than a metal to reduce heat transfer between the fastening member and the first heat sink.

[0011] The washer member may include a washer through-hole through which the fastening member passes.

[0012] The washer member may include a boss protruding around the washer through-hole.

[0013] The washer member may include a flow guide protruding to control a flow of air.

[0014] The first heat sink may include a first sink base and a plurality of first fins protruding along a direction perpendicular to one surface of the first sink base, a plurality of first channels may be formed between the plurality of first fins, and the plurality of first channels may include first basic channels and at least one first wide channel having a greater width than the first basic channels.

[0015] The washer member may be disposed in the at least one first wide channel.

[0016] The second heat sink may include a through-hole through which the fastening member passes.

[0017] The nut member may include an insertion portion protruding toward the through-hole and insertable into the through-hole.

[0018] The nut member may include a nut body formed of a material having lower thermal conductivity than a metal to reduce heat transfer between the fastening member and the second heat sink and a nut, having screw threads formed on an inner circumferential surface to fasten the fastening member, formed of a metal material, provided inside the nut body.

[0019] The nut member may include a nut through-hole into which the fastening member is insertable.

[0020] The nut member may include a boss protruding around the nut through-hole.

[0021] The nut member may include a flow guide protruding to control a flow of air.

[0022] The second heat sink may include a second sink base and a plurality of second fins protruding along a direction perpendicular to one surface of the second sink base, a plurality of second channels may be formed between the plurality of second fins, and the plurality of second channels may include second basic channels and at least one second wide channel having a greater width than the second basic channels.

[0023] The nut member may be disposed in the at least one second wide channel.

[0024] In accordance with embodiment aspect of the present disclosure in another aspect, a refrigerator includes a module plate having an opening, a heat dissipation sink provided on one side of the module plate, a cooling sink provided on the other side of the module plate, a thermoelectric element having a heat generating portion and a heat absorbing portion, in which the heat generating portion and the heat absorbing portion are disposed in the opening so that the heat generating portion is in contact with the heat dissipation sink and the heat absorbing portion is in contact with the cooling sink, a fastening member configured to couple the heat dissipation sink and the cooling sink to the module plate by being passed through the heat dissipation sink, the module plate, and the cooling sink, a washer member provided between the head portion and the heat to prevent contact between the fastening member and the heat dissipation sink, and a nut member provided between the connecting portion and the cooling sink to prevent contact between the fastening member and the cooling sink.

[0025] The heat dissipation sink may include a first through-hole through which the fastening member passes, and the washer member may include: a washer body supported by the heat dissipation sink and an insertion portion protruding from one surface of the washer body to be inserted into the first through-hole of the heat dissipation sink.

[0026] The washer member may include a flow guide protruding from the other surface of the washer body to control a flow of air.

[0027] The cooling sink may include a second through-hole through which the fastening member passes, and the nut member may include: a nut body supported by the cooling sink; and an insertion portion protruding from one surface of the nut body to be inserted into the second through-hole of the cooling sink.

[0028] The nut member may include a flow guide protruding from the other surface of the nut body to control a flow of air.

[Advantageous Effects]

[0029] According to one embodiment of the present disclosure, by coupling a heat dissipation sink and a

cooling sink to a module plate through a fastening member, it is possible to improve convenience of assembly and coupling strength of a thermoelectric module.

[0030] According to one embodiment of the present disclosure, since a heat dissipation sink and a cooling sink can be brought into close contact with a thermoelectric element by a fastening force of a fastening member, it is possible to increase the efficiency of a cooling action through the thermoelectric element.

[0031] According to one embodiment of the present disclosure, since heat transfer through a fastening member can be minimized, it is possible to increase the efficiency of a cooling action through a thermoelectric element.

[0032] The effects obtainable from the present disclosure are not limited to the effects mentioned above, and other effects that have not been mentioned may be clearly understood by those of ordinary skill in the art to which the present disclosure belongs from the following description.

[Description of Drawings]

[0033]

FIG. 1 is a view illustrating a refrigerator according to one embodiment of the present disclosure.

FIG. 2 is a view illustrating a state where doors of the refrigerator are open according to one embodiment of the present disclosure.

FIG. 3 is a view illustrating a storage compartment of the refrigerator according to one embodiment of the present disclosure.

FIG. 4 is a schematic cross-sectional side view of the refrigerator according to one embodiment of the present disclosure.

FIG. 5 is a cross-sectional view along line I-I of FIG. 2 according to one embodiment of the present disclosure.

FIG. 6 is a view illustrating a top cover and a thermoelectric module assembly separated from a main body of the refrigerator according to one embodiment of the present disclosure.

FIG. 7 is a view illustrating a heat dissipation duct cover, a heat dissipation duct body, an extension duct, and a thermoelectric module according to one embodiment of the present disclosure.

FIG. 8 is a bottom perspective view illustrating the heat dissipation duct cover, the heat dissipation duct body, and the thermoelectric module according to one embodiment of the present disclosure.

FIG. 9 is an exploded perspective view illustrating the thermoelectric module according to one embodiment of the present disclosure.

FIG. 10 is an exploded bottom perspective view illustrating the thermoelectric module according to one embodiment of the present disclosure.

FIG. 11 is a view illustrating a heat dissipation sink according to one embodiment of the present disclosure.

FIG. 12 is a view illustrating a cooling sink according to one embodiment of the present disclosure.

FIG. 13 is a perspective view illustrating a washer member according to one embodiment of the present disclosure.

FIG. 14 is a bottom perspective view illustrating the washer member according to one embodiment of the present disclosure.

FIG. 15 is a perspective view illustrating a nut member according to one embodiment of the present disclosure.

FIG. 16 is a bottom perspective view illustrating the nut member according to one embodiment of the present disclosure.

FIG. 17 is a cross-sectional view of a heat dissipation duct and the thermoelectric module according to one embodiment of the present disclosure.

FIG. 18 is an enlarged cross-sectional view of a fastening member in FIG. 17 and its surroundings according to one embodiment of the present disclosure.

FIG. 19 is another cross-sectional view of the heat dissipation duct and the thermoelectric module according to one embodiment of the present disclosure.

FIG. 20 is an enlarged cross-sectional view of a fastening member according to one embodiment of the present disclosure and its surroundings.

FIG. 21 is an enlarged cross-sectional view of the fastening member according to one embodiment of the present disclosure and its surroundings.

FIG. 22 is an enlarged cross-sectional view of the fastening member according to one embodiment of the present disclosure and its surroundings.

FIG. 23 is an enlarged cross-sectional view of the

fastening member according to one embodiment of the present disclosure and its surroundings.

FIG. 24 is an enlarged cross-sectional view of the fastening member according to one embodiment of the present disclosure and its surroundings.

[Modes of the Invention]

[0034] Various embodiments of the disclosure and terms used herein are not intended to limit the technical features described herein to specific embodiments, and should be understood to include various modifications, equivalents, or substitutions of the corresponding embodiments.

[0035] In describing of the drawings, similar reference numerals may be used for similar or related elements.

[0036] The singular form of a noun corresponding to an item may include one or more of the items unless clearly indicated otherwise in a related context.

[0037] In the disclosure, phrases, such as "A or B", "at least one of A and B", "at least one of A or B", "A, B or C", "at least one of A, B and C", and "at least one of A, B, or C" may include any one or all possible combinations of the items listed together in the corresponding phrase among the phrases.

[0038] As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0039] Terms such as "1st", "2nd", "primary", or "secondary" may be used simply to distinguish an element from other elements, without limiting the element in other aspects (e.g., importance or order).

[0040] Further, as used in the disclosure, the terms "front", "rear", "top", "bottom", "side", "left", "right", "upper", "lower", and the like are defined with reference to the drawings, and are not intended to limit the shape and position of any element.

[0041] It will be understood that when the terms "includes", "comprises", "including", and/or "comprising" are used in the disclosure, they specify the presence of the specified features, figures, steps, operations, components, members, or combinations thereof, but do not preclude the presence or addition of one or more other features, figures, steps, operations, components, members, or combinations thereof.

[0042] When a given element is referred to as being "connected to", "coupled to", "supported by" or "in contact with" another element, it is to be understood that it may be directly or indirectly connected to, coupled to, supported by, or in contact with the other element. When a given element is indirectly connected to, coupled to, supported by, or in contact with another element, it is to be understood that it may be connected to, coupled to, supported by, or in contact with the other element through a third element.

[0043] It will also be understood that when an element is referred to as being "on" another element, it may be

directly on the other element or intervening elements may also be present.

[0044] A refrigerator according to an embodiment of the disclosure may include a main body.

[0045] The "main body" may include an inner case, an outer case positioned outside the inner case, and an insulation provided between the inner case and the outer case.

[0046] The "inner case" may include a case, a plate, a panel, or a liner forming a storage compartment (also referred to as a storage room). The inner case may be formed as one body, or may be formed by assembling a plurality of plates together. The "outer case" may form an appearance of the main body, and be coupled to an outer side of the inner case such that the insulation is positioned between the inner case and the outer case.

[0047] The "insulation" may insulate an inside of the storage compartment from an outside of the storage compartment to maintain inside temperature of the storage compartment at appropriate temperature without being influenced by an external environment of the storage compartment. According to an embodiment of the disclosure, the insulation may include a foaming insulation. The foaming insulation may be molded by fixing the inner case and the outer case with jigs, etc. and then injecting and foaming urethane foam as a mixture of polyurethane and a foaming agent between the inner case and the outer case.

[0048] According to an embodiment of the disclosure, the insulation may include a vacuum insulation in addition to a foaming insulation, or may be configured only with a vacuum insulation instead of a forming insulation. The vacuum insulation may include a core material and a cladding material accommodating the core material and sealing the inside with vacuum or pressure close to vacuum. However, the insulation is not limited to the above-mentioned foaming insulation or vacuum insulation, and may include various materials capable of being used for insulation.

[0049] The "storage compartment" may include a space defined by the inner case. The storage compartment may further include the inner case defining the space corresponding to the storage compartment. The storage compartment may store a variety of items, such as food, medicines, cosmetics, and the like, and the storage compartment may be configured to be open on at least one side for insertion and removal of the items.

[0050] The refrigerator may include one or more storage compartments. In a case in which two or more storage compartments are formed in the refrigerator, the respective storage compartments may have different purposes of use, and may be maintained at different temperatures. To this end, the respective storage compartments may be partitioned by a partition wall including an insulation.

[0051] The storage compartment may be maintained within an appropriate temperature range according to a purpose of use, and may include a "refrigerating com-

partment", a "freezing compartment", and a "temperature conversion compartment" according to purposes of use and/or temperature ranges. The refrigerating compartment may be maintained at an appropriate temperature to keep food refrigerating, and the freezing compartment may be maintained at an appropriate temperature to keep food frozen. The "refrigerating" may be keeping food cold without freezing the food, and for example, the refrigerating compartment may be maintained within a range of 0 degrees Celsius to 7 degrees Celsius. The "freezing" may be freezing food or keeping food frozen, and for example, the freezing compartment may be maintained within a range of -20 degrees Celsius to -1 degrees Celsius. The temperature conversion compartment may be used as either a refrigerating compartment or a freezing compartment according to or regardless of a user's selection.

[0052] The storage compartment may also be referred to by various terms, such as "vegetable compartment", "freshness compartment", "cooling compartment", and "ice-making compartment", in addition to "refrigerating compartment", "freezing compartment", and "temperature conversion compartment", and the terms, such as "refrigerating compartment", "freezing compartment", "temperature conversion compartment", etc., as used below are to be understood as representing storage compartments having the corresponding purposes of use and the corresponding temperature ranges.

[0053] The refrigerator according to an embodiment of the disclosure may include at least one door configured to open or close the open side of the storage compartment. The respective doors may be provided to open and close one or more storage compartments, or a single door may be provided to open and close a plurality of storage compartments. The door may be rotatably or slidably mounted to the front of the main body.

[0054] The "door" may seal the storage compartment in a closed state. The door, like the main body, may include an insulation to insulate the storage compartment in a closed state.

[0055] According to an embodiment, the door may include an outer door plate forming the front surface of the door, an inner door plate forming the rear surface of the door and facing the storage compartment, an upper cap, a lower cap, and a door insulation provided therein.

[0056] A gasket may be provided on the edge of the inner door plate to seal the storage compartment by coming into close contact with the front surface of the main body when the door is closed. The inner door plate may include a dyke that protrudes rearward to allow a door basket for storing items to be fitted.

[0057] According to an embodiment, the door may include a door body and a front panel that is detachably coupled to the front of the door body and forming the front surface of the door. The door body may include an outer door plate forming the front surface of the door body, an inner door plate forming the rear surface of the door body and facing the storage compartment, an upper cap, a

lower cap, and a door insulator provided therein.

[0058] The refrigerator may be classified as French Door Type, Side-by-side Type, Bottom Mounted Freezer (BMF), Top Mounted Freezer (TMF), or Single Door Refrigerator according to the arrangement of the doors and the storage compartments.

[0059] The refrigerator according to an embodiment of the disclosure may include a cold air supply device for supplying cold air to the storage compartment.

[0060] The "cold air supply device" may include a machine, an apparatus, an electronic device, and/or a combination system thereof, capable of generating cold air and guiding the cold air to cool the storage compartment.

[0061] According to an embodiment of the disclosure, the cold air supply device may generate cold air through a cooling cycle including compression, condensation, expansion, and evaporation processes of refrigerants. To this end, the cold air supply device may include a refrigeration cycle device having a compressor, a condenser, an expander, and an evaporator to drive the refrigeration cycle. According to an embodiment of the disclosure, the cold air supply device may include a semiconductor, such as a thermoelectric element. The thermoelectric element may cool the storage compartment by heating and cooling actions through the Peltier effect.

[0062] The refrigerator according to an embodiment of the disclosure may include a machine compartment in which at least some components belonging to the cold air supply device are installed.

[0063] The "machine compartment" may be partitioned and insulated from the storage compartment to prevent heat generated by the components installed in the machine compartment from being transferred to the storage compartment. To dissipate heat from the components installed in the machine compartment, the machine compartment may communicate with outside of the main body.

[0064] The refrigerator according to an embodiment of the disclosure may include a dispenser provided on the door to provide water and/or ice. The dispenser may be provided on the door to allow access by the user without opening the door.

[0065] The refrigerator according to an embodiment of the disclosure may include an ice-making device that produces ice. The ice-making device may include an ice-making tray that stores water, an ice-moving device that separates ice from the ice-making tray, and an ice-bucket that stores ice produced in the ice-making tray.

[0066] The refrigerator according to an embodiment of the disclosure may include a controller for controlling the refrigerator.

[0067] The "controller" may include a memory for storing and/or recording data and/or programs for controlling the refrigerator, and a processor for outputting control signals for controlling the cold air supply device, etc. in accordance with the programs and/or data stored in the memory.

[0068] The memory may store or record various information, data, instructions, programs, and the like necessary for operation of the refrigerator. The memory may store temporary data generated while generating control signals for controlling components included in the refrigerator. The memory may include at least one of a volatile memory or a non-volatile memory, or a combination thereof.

[0069] The processor may control the overall operation of the refrigerator. The processor may control the components of the refrigerator by executing programs stored in memory. The processor may include a separate neural processing unit (NPU) that performs an artificial intelligence (AI) model operation. In addition, the processor may include a central processing unit (CPU), a graphics processor (GPU), and the like. The processor may generate a control signal to control the operation of the cold air supply device. For example, the processor may receive temperature information of the storage compartment from a temperature sensor and generate a cooling control signal to control an operation of the cold air supply device based on the temperature information of the storage compartment.

[0070] Furthermore, the processor may process a user input of a user interface and control an operation of the user interface in accordance with the programs and/or data memorized/stored in the memory. The user interface may be provided with an input interface and an output interface. The processor may receive the user input from the user interface. In addition, the processor may transmit a display control signal and image data for displaying an image on the user interface to the user interface in response to the user input.

[0071] The processor and memory may be provided integrally or may be provided separately. The processor may include one or more processors. For example, the processor may include a main processor and at least one sub-processor. The memory may include one or more memories.

[0072] The refrigerator according to an embodiment of the disclosure may include a processor and a memory for controlling all of the components included in the refrigerator, and may include a plurality of processors and a plurality of memories for individually controlling the components of the refrigerator. For example, the refrigerator may include a processor and a memory for controlling the operation of the cold air supply device in accordance with to an output of the temperature sensor. In addition, the refrigerator may be separately provided with a processor and a memory for controlling the operation of the user interface in accordance with the user input.

[0073] A communication module may communicate with external devices, such as servers, mobile devices, and other home appliances via a nearby access point (AP). The AP may connect a local area network (LAN) to which a refrigerator or a user device is connected to a wide area network (WAN) to which a server is connected. The refrigerator or the user device may be connected to

the server via the WAN.

[0074] The input interface may include keys, a touch screen, a microphone, and the like. The input interface may receive the user input and pass the received user input to the processor.

[0075] The output interface may include a display, a speaker, and the like. The output interface may output various notifications, messages, information, and the like generated by the processor.

[0076] Hereinafter, various embodiments according to the disclosure will be described in detail with reference to the accompanying drawings.

[0077] FIG. 1 is a view illustrating a refrigerator according to one embodiment of the present disclosure. FIG. 2 is a view illustrating a state where doors of the refrigerator are open according to one embodiment of the present disclosure. FIG. 3 is a view illustrating a storage compartment of the refrigerator according to one embodiment of the present disclosure. FIG. 4 is a schematic cross-sectional side view of the refrigerator according to one embodiment of the present disclosure. FIG. 5 is a cross-sectional view along line I-I of FIG. 2. FIG. 6 is a view illustrating a top cover and a thermoelectric module assembly separated from a main body of the refrigerator according to one embodiment of the present disclosure. FIG. 7 is a view illustrating a heat dissipation duct cover, a heat dissipation duct body, an extension duct, and a thermoelectric module according to one embodiment of the present disclosure. FIG. 8 is a bottom perspective view illustrating the heat dissipation duct cover, the heat dissipation duct body, and the thermoelectric module according to one embodiment of the present disclosure.

[0078] Referring to FIGS. 1 to 8, a refrigerator 1 may include a main body 100, storage compartments 11, 12, and 13 formed inside the main body 100, and doors 21, 22, 23, and 24 provided to open and close the storage compartments 11, 12, and 13.

[0079] The main body 100 may include an inner case 170, an outer case 180 coupled to an outer side of the inner case 170, and an insulating material 190 provided between the inner case 170 and the outer case 180. The inner case 170 may form the storage compartments 11, 12, and 13 and the outer case 180 may form an outer appearance of the main body 100. The insulating material 190 may be a urethane foam insulating material.

[0080] In another aspect, the main body 100 may include an upper wall 110, a lower wall 120, a left wall 130, a right wall 140, and a rear wall 150. The upper wall 110, the lower wall 120, the left wall 130, the right wall 140, and the rear wall 150 may form an upper surface 111, a lower surface, a left surface, a right surface, and a rear wall of the main body 100, respectively.

[0081] Each of the upper wall 110, the lower wall 120, the left wall 130, the right wall 140, and the rear wall 150 may be made of the inner case 170, the outer case 180, and the insulating material 190. As one example, the upper surface 111 of the upper wall 110 may be formed by the outer case 180, a lower surface of the upper wall 110

may be formed by the inner case 170, and the insulating material 190 may be provided inside the upper wall 110.

[0082] The upper wall 110 may include a through-hole 115 (FIG. 6). At least a portion of a thermoelectric module assembly 450 to be described below may be disposed inside the through-hole 115. An inner case opening 171 for forming the through-hole 115 may be formed in the inner case 170 forming the upper wall 110. An outer case opening 181 (FIG. 6) for forming the through-hole 115 may be formed in the outer case 180 forming the upper wall 110.

[0083] The upper wall 110 may include a connecting frame 200 (FIGS. 5 and 6) disposed between the inner case 170 and the outer case 180. The connecting frame 200 may connect the inner case opening 171 and the outer case opening 181 and form the through-hole 115 of the upper wall 110. The connecting frame 200 may be formed of a material having low thermal conductivity. The connecting frame 200 may be formed of a resin material.

[0084] The storage compartments 11, 12, and 13 may accommodate items. The storage compartments 11, 12, and 13 may be formed with an open front side so that items may be put in or taken out. The main body 100 may include a horizontal partition wall 160 partitioning the storage compartments 11, 12, and 13 into an upper first storage compartment 11 and lower storage compartments 12 and 13 and a vertical partition wall 161 partitioning the lower storage compartments 12 and 13 into a second storage compartment 12 and a third storage compartment 13. The first storage compartment 11 may be a refrigerating compartment, the second storage compartment 12 may be a freezing compartment, and the third storage compartment 13 may be a variable temperature compartment.

[0085] The doors 21, 22, 23, and 24 may open and close the storage compartments 11, 12, and 13. A first door 21 and a second door 22 may open and close the first storage compartment 11, a third door 23 may open and close the second storage compartment 12, and a fourth door 24 may open and close the third storage compartment 13. The doors 21, 22, 23, and 24 may be rotatably coupled to the main body 100.

[0086] The doors 21, 22, 23, and 24 may be rotatably coupled to the main body 100 by hinges. For example, the first door 21 and the second door 22 may be rotatably coupled to the main body 100 by hinges 31 provided on the upper portion of the main body 100 and hinges provided in the middle of the main body 100, respectively. The hinge 31 may include a hinge pin that vertically protrudes to form a rotation axis of the door. The hinge 31 may be covered by a top cover 300 provided to cover a front portion of the upper surface 111 of the main body 100.

[0087] A rotating bar 40 may be provided on one of the first door 21 and the second door 22 to cover a gap formed between the first door 21 and the second door 22 when the first door 21 and the second door 22 are closed. The rotating bar 40 may be rotatably provided on

any one of the first door 21 or the second door 22. The rotating bar 40 may have a rod shape that is formed to be elongated in a vertical direction. The rotating bar 40 may also be referred to as a pillar, mullion, or the like.

[0088] A guide protrusion 46 may be provided at an upper end of the rotating bar 40, and a rotation guide 119 that guides rotation of the guide protrusion 46 may be provided on an upper portion of the main body 100.

[0089] Each of the doors 21, 22, 23, and 24 may include a gasket 51. The gasket 51 may be pressed against a front surface of the main body 100 when the doors 21, 22, 23, and 24 are closed. The doors 21, 22, 23, and 24 may include a dike 52 that protrudes rearward. The dike 52 may be equipped with a door shelf 53 for storing items. The rotating bar 40 may be rotatably installed on the dike 52.

[0090] Although the number and disposition of the storage compartments and the number and disposition of the doors have been described above, there are no limitations on the number and disposition of the storage compartments and the number and disposition of the doors of the refrigerator according to one embodiment of the present disclosure.

[0091] The refrigerator 1 may include a thermoelectric cooling device 400 provided to cool the storage compartment 11.

[0092] The thermoelectric cooling device 400 may be provided on an upper side of the storage compartment 11 to cool the storage compartment 11. That is, the thermoelectric cooling device may be provided on the upper wall 110 of the main body 100.

[0093] The thermoelectric cooling device 400 may include the thermoelectric module assembly 450. The thermoelectric module assembly 450 may include a thermoelectric module 500 (FIG. 7) and a heat dissipation duct 700.

[0094] The thermoelectric module 500 and the heat dissipation duct 700 may be assembled together to form the thermoelectric module assembly 450. The thermoelectric module assembly 450 may be coupled to the upper wall 110 of the main body 100 in a direction from top to bottom. After the thermoelectric module assembly 450 is coupled to the upper wall 110 of the main body 100 in the direction from top to bottom, a cooling duct 900 to be described below may be coupled to the lower surface of the upper wall 110 of the main body 100 in a direction from bottom to top.

[0095] The thermoelectric module 500 may include a thermoelectric element 530 and a heat sink. The heat sink may include a heat dissipation sink 520 and a cooling sink 570.

[0096] The thermoelectric element 530 may be a semiconductor element that converts thermal energy into electrical energy using the thermoelectric effect, and may also be referred to as a thermoelectric semiconductor element, a Peltier element, or the like.

[0097] The thermoelectric element 530 may include a heat generating portion 531 and a heat absorbing portion

532. When current is applied to the thermoelectric element 530, a heating action may occur in the heat generating portion 531 and a heat absorbing action may occur in the heat absorbing portion 532. The thermoelectric element 530 may have a thin hexahedral shape. The heat generating portion 531 may be provided on one side of the thermoelectric element 530, and the heat absorbing portion 532 may be provided on the opposite side thereof.

[0098] The thermoelectric element 530 may be provided on the upper wall 110 so that the heat generating portion 531 faces above the thermoelectric element 530 and the heat absorbing portion 532 faces below the thermoelectric element 530. That is, the heat generating portion 531 may face the outside of the main body 100, and the heat absorbing portion 532 may face the inside of the storage compartment 11 through the through-hole 115 of the upper wall 110. Accordingly, air that has been warmed through heat exchange with the heat generating portion 531 may be discharged to the outside of the main body 100, and air that has been cooled through heat exchange with the heat absorbing portion 532 may be supplied to the storage compartment 11 to cool the storage compartment 11.

[0099] The thermoelectric module 500 may include the heat dissipation sink 520 that contacts the heat generating portion 531 of the thermoelectric element 530 so that heat exchange between the heat generating portion 531 and the air outside the main body 100 is efficiently performed.

[0100] The heat dissipation sink 520 may contact the heat generating portion 531 to absorb the heat of the heat generating portion 531 and release the heat to the outside of the main body 100. The heat dissipation sink 520 may also be referred to as a hot sink, a heat dissipation heat sink, a hot heat sink, or the like.

[0101] The heat dissipation sink 520 may be formed of a metal material having good thermal conductivity. For example, the heat dissipation sink 520 may be formed of an aluminum or copper material.

[0102] The heat dissipation sink 520 may include a heat dissipation sink base 521 that is in contact with the heat generating portion 531 and a plurality of heat dissipation fins 525 that protrude from the heat dissipation sink base 521 to expand a heat transfer area. The plurality of heat dissipation fins 525 may protrude upward from the heat dissipation sink base 521.

[0103] The thermoelectric module 500 may include the cooling sink 570 that is in contact with the heat absorbing portion 532 so that heat exchange between the heat absorbing portion 532 and the air inside the storage compartment 11 is efficiently performed.

[0104] The cooling sink 570 may be positioned inside the storage compartment 11. The cooling sink 570 may cool the storage compartment 11 by taking away the heat from the storage compartment 11 and transferring the heat to the heat absorbing portion 532. The cooling sink 570 may also be referred to as a cold sink, a cooling sink,

a cooling heat sink, a cold heat sink, a cooling heat sink, or the like.

[0105] The cooling sink 570 may be formed of a metal material having good thermal conductivity. For example, the cooling sink 570 may be formed of an aluminum or copper material.

[0106] The cooling sink 570 may include a cooling sink base 571 that is in contact with the heat absorbing portion 532 and a plurality of cooling fins 575 that protrude from the cooling sink base 571 to expand a heat transfer area. A plurality of cooling fins 575 may protrude downward from the cooling sink base 571. The cooling sink base 571 and the plurality of cooling fins 575 may be integrally formed.

[0107] The thermoelectric module 500 may include a heat dissipation fan 600 that flows air to ensure efficient heat exchange between the heat dissipation sink 520 and the air outside the main body 100.

[0108] The heat dissipation fan 600 may be provided to blow air toward the heat dissipation sink 520. The heat dissipation fan 600 may be provided to be positioned level with the heat dissipation sink 520.

[0109] The heat dissipation fan 600 may be a centrifugal fan that sucks air in an axial direction and discharges the air in radial directions. The centrifugal fan may include a blower fan. A rotating shaft 610 of the heat dissipation fan 600 may be vertically disposed on an upper surface of the upper wall 110. The heat dissipation fan 600 may be installed in a fan case 650.

[0110] The heat dissipation duct 700 may guide air outside the main body 100 to exchange heat with the heat dissipation sink 520, and guide air that has exchanged heat with the heat dissipation sink 520 to be discharged back to the outside of the main body 100.

[0111] The heat dissipation duct 700 may include a heat dissipation duct body 720, a heat dissipation duct cover 710, and an extension duct 740.

[0112] The heat dissipation duct body 720 may be provided on the upper side of the thermoelectric module 500 to cover the heat dissipation fan 600 and the heat dissipation sink 520. An outside air intake port 751 may be formed on an upper surface of a front portion of the heat dissipation duct body 720, and the outside air intake port 751 may be covered by the top cover 300 to be described below.

[0113] The heat dissipation duct cover 710 may be coupled to an upper portion of the heat dissipation duct body 720 to cover an upper side of the heat dissipation duct body 720. To this end, a duct cover coupling portion 711 may be provided on the heat dissipation duct cover 710, and a duct body coupling portion 721 coupled to the duct cover coupling portion 711 may be provided on the heat dissipation duct body 720. The duct cover coupling portion 711 and the duct body coupling portion 721 may be coupled in a hook or inserting manner. The heat dissipation duct cover 710 may include a cover extension portion 715 extending from one side of the heat dissipation duct cover 710 toward the top cover 300.

[0114] The extension duct 740 may be provided in front of the heat dissipation duct body 720 to be connected to the heat dissipation duct body 720. The extension duct 740 may be formed separately from the heat dissipation duct body 720. However, in contrast, the extension duct 740 may be formed integrally with the heat dissipation duct body 720.

[0115] The extension duct 740 may be disposed under the top cover 300 and may be coupled to a lower portion of the top cover 300. To this end, the extension duct 740 may be provided with an extension duct coupling portion 745 coupled to the top cover 300.

[0116] The heat dissipation duct 700 may include outside air exhaust ports 782 and 794 that discharge air that has exchanged heat with the heat dissipation sink 520 outside the main body 100.

[0117] The heat dissipation duct body 720 may include a first outside air exhaust port 782 that discharges the air that has exchanged heat with the heat dissipation sink 520 to the outside of the main body 100.

[0118] The first outside air exhaust port 782 may include a connecting port 784 provided to guide air inside the heat dissipation duct 700 to an interior of the top cover 300. The first outside air exhaust port 782 may include an outside exhaust port 783 separated from the connecting port 784 to discharge the air in the heat dissipation duct 700 to the outside of the top cover 300. A grill may be formed in the outside exhaust port 783 to prevent foreign substances from flowing into the interior of the heat dissipation duct 700 through the outside exhaust port 783.

[0119] The extension duct 740 may include a second outside air exhaust port 794 that discharges the air that has exchanged heat with the heat dissipation sink 520 toward the rotating bar 40. By discharging the air that has exchanged heat with the heat dissipation sink 520 toward the rotating bar 40, condensation may be prevented from occurring on the rotating bar 40.

[0120] However, the heat dissipation duct 700 does not have to include both the first outside air exhaust port 782 and the second outside air exhaust port 794 described above, and the second outside air exhaust port 794 may be omitted. In addition, the first outside air exhaust port 782 of the heat dissipation duct 700 does not have to include both the connecting port 784 and the outside exhaust port 783, and the first outside air exhaust port 792 may include only the outside exhaust port 783.

[0121] A fan accommodation space 762 that accommodates the heat dissipation fan 600 may be formed in the heat dissipation duct body 720. The fan accommodation space 762 may be formed in a bottom surface of the heat dissipation duct body 720. The heat dissipation duct body 720 may include a fan inlet 761 through which air flows into the fan accommodation space 762.

[0122] The heat dissipation duct body 720 may include a sink accommodation space 771 formed on a downstream side of the fan accommodation space 762 to accommodate the heat dissipation sink 520. The heat

dissipation duct body 720 may include a guide vane 772 protruding from the bottom surface of the heat dissipation duct body 720 to control a flow of air. The guide vane 772 may be disposed in a wide heat dissipation channel 528b to be described below among heat dissipation channels 528 formed between the plurality of heat dissipation fins 525. The guide vane 772 may prevent air from flowing into the wide heat dissipation channel 528b and guide air to flow into a basic heat dissipation channel 528a to be described below.

[0123] The reason why the guide vane 772 is provided in the wide heat dissipation channel 528b is that, since a gap between a pair of heat dissipation fins 525 adjacent to the wide heat dissipation channel 528b is wide, an air flow rate and heat exchange efficiency of the air flowing into the wide heat dissipation channel 528b may be reduced.

[0124] The heat dissipation duct body 720 may include a suction space 752 formed on an upper surface of the heat dissipation duct body 720 to guide air sucked through the outside air intake port 751 to the fan accommodation space 762. The upper side of the suction space 752 may be formed to be open, and the open upper side of the suction space 752 may be covered by the heat dissipation duct cover 710. The suction space 752 may be formed on an upstream side of the fan accommodation space 762. The suction space 752 may be connected to the fan accommodation space 762 through the fan inlet 761.

[0125] The heat dissipation duct body 720 may include a first discharge space 781 formed on the upper surface of the heat dissipation duct body 720 to guide the air that has exchanged heat with the heat dissipation sink 520 to the first outside air exhaust port 782. An upper side of the first discharge space 781 is open, and the open upper side of the first discharge space may be covered by the heat dissipation duct cover 710. The first discharge space 781 may be formed on a downstream side of the sink accommodation space 771.

[0126] The heat dissipation duct body 720 may include a second discharge space 791 formed on the upper surface of the heat dissipation duct body 720 to guide the air that has exchanged heat with the heat dissipation sink 520 to the second outside air exhaust port 794. An upper side of the second discharge space 791 is open, and the open upper side of the second discharge space 791 may be covered by the heat dissipation duct cover 710. The second discharge space 791 may be formed on the downstream side of the sink accommodation space 771.

[0127] The extension duct 740 may include an extended discharge space 746 connected to the second discharge space 791 of the heat dissipation duct body 720. The air in the second discharge space 791 may be guided to the second outside air exhaust port 794 through the extended discharge space 746.

[0128] The thermoelectric module assembly 450 may be coupled to the upper wall 110 of the main body 100 by

at least one fastening member S2 (FIG. 6). The at least one fastening member S2 may be a mechanical coupling element such as a screw, a bolt, or the like.

[0129] The at least one fastening member S2 may pass through the thermoelectric module assembly 450 and may be coupled to the upper wall 110 of the main body 100.

[0130] According to one embodiment, the at least one fastening member S2 may be coupled to the upper wall 110 of the main body 100 by passing through the heat dissipation duct cover 710, the heat dissipation duct body 720, and a module plate 550. To this end, a coupling hole 719 may be formed in the heat dissipation duct cover 710, a coupling hole 729 may be formed in the heat dissipation duct body 720, and a coupling hole 554 may be formed in the module plate 550. A coupling hole 118 to which the at least one fastening member S2 is coupled may be formed in the upper wall 110 of the main body 100.

[0131] The refrigerator 1 may include the top cover 300 that is coupled to the front portion of the upper surface 111 of the main body 100 to cover the plurality of hinges 31. The top cover 300 may be coupled to the upper wall 110 of the main body 100 through at least one fastening member S3. After the thermoelectric module assembly 450 is coupled to the upper wall 110 of the main body 100, the top cover 300 may be coupled to the upper wall 110 of the main body 100.

[0132] The thermoelectric cooling device 400 may include a dust filter 390 provided to filter foreign substances from the air flowing into the outside air intake port 751. The dust filter 390 may be mounted on the top cover 300 to be slidable in a front-back direction.

[0133] The top cover 300 may include a suction grill portion 350 formed on a top cover upper surface portion 310. The suction grill portion 350 may be positioned on an upper side of the dust filter 390. The suction grill portion 350 may primarily block foreign substances from being sucked into the interior of the heat dissipation duct 700 before the dust filter 390. The suction grill portion 350 may protect the dust filter 390 by preventing an external force from being applied to the dust filter 390.

[0134] The top cover 300 may include front protrusions 313 protruding forward from both ends of the top cover 300 to cover the plurality of hinges 31.

[0135] At least a portion of the air discharged from the heat dissipation duct 700 through the first outside air exhaust port 782 may flow into the top cover 300. The air that has flown into the top cover 300 may be discharged to the outside through a top cover outlet 340 formed in the front protrusion 313 of the top cover 300.

[0136] In this way, the air that has exchanged heat with the heat dissipation sink 520 may heat the upper surface 111 of the main body 100 while passing through the interior of the top cover 300. Accordingly, condensation on an upper front surface of the main body 100 may be prevented.

[0137] The thermoelectric cooling device 400 may include a cooling fan 800 that circulates air to ensure

efficient heat exchange between the cooling sink 570 and the air inside the storage compartment 11. The cooling fan 800 may be disposed inside the cooling duct 900.

[0138] The cooling fan 800 may be provided to blow air toward the cooling sink 570. The cooling fan 800 may be positioned level with the cooling sink 570. The cooling fan 800 may be provided inside the storage compartment 11. The cooling fan 800 may be provided on a lower side of the upper wall 110.

[0139] The cooling fan 800 may be a centrifugal fan that sucks air in the axial direction and discharges the air in the radial directions. A rotating shaft 810 of the cooling fan 800 may be vertically disposed on a bottom surface of the upper wall 110.

[0140] The thermoelectric cooling device 400 may include the cooling duct 900 provided to guide the air flowing by the cooling fan 800. The cooling duct 900 may guide the air inside the storage compartment 11 to exchange heat with the cooling sink 570, and guide the air that has exchanged heat with the cooling sink 570 to be discharged back into the interior of the storage compartment 11.

[0141] The cooling fan 800 may be positioned inside the cooling duct 900. The cooling sink 570 may be positioned inside the cooling duct 900 by passing through an upper surface of the cooling duct 900. The cooling duct 900 may be coupled to the lower surface of the upper wall 110.

[0142] The cooling duct 900 may include an inside air intake port 991 for allowing air inside the storage compartment 11 to flow into the interior of the cooling duct 900, and an outside air exhaust port 992 for allowing the air that has exchanged heat with the cooling sink 570 to be discharged into the interior of the storage compartment 11.

[0143] The refrigerator 1 may include a refrigeration cycle device to cool the storage compartment through a refrigeration cycle. The refrigeration cycle device may include a compressor 2, a condenser (not illustrated), an expansion device (not illustrated), and an evaporator 3. The evaporator 3 may be provided at a rear side of the storage compartments 12 and 13.

[0144] The refrigerator 1 may include evaporator ducts 60 and 70 that guide cold air generated in the evaporator 3. A first evaporator duct 60 may be provided at a rear side of the second storage compartment 12 and the third storage compartment 13. A second evaporator duct 70 may be provided at a rear side of the first storage compartment 11.

[0145] The cold air generated in the evaporator 3 may be sucked into the interior of the first evaporator duct 60 by an evaporator fan 80. The cold air sucked into the interior of the first evaporator duct 60 may be discharged to the second storage compartment 12 or the third storage compartment 13 through a cold air exhaust port (not illustrated) formed in a front surface. In addition, cold air sucked into the interior of the first evaporator duct 60 may be guided to an inner flow path 78 of the second eva-

porator duct 70. A damper 61 that controls the supply of the cold air inside the first evaporator duct 60 to the second evaporator duct 70 may be provided in the first evaporator duct 60. A connecting duct 90 may be provided between the first evaporator duct 60 and the second evaporator duct 70 to connect the first evaporator duct 60 to the second evaporator duct 70.

[0146] The cold air flowing into the inner flow path 78 of the second evaporator duct 70 may be supplied to the first storage compartment 11 through a cold air exhaust port 72 formed on a front surface of the second evaporator duct 70.

[0147] As described above, according to one embodiment of the present disclosure, the refrigerator may include the thermoelectric cooling device 400 and the refrigeration cycle device, but is not limited thereto, and the refrigerator may include only the thermoelectric cooling device 400.

[0148] FIG. 9 is an exploded perspective view illustrating a thermoelectric module according to one embodiment of the present disclosure. FIG. 10 is an exploded bottom perspective view illustrating the thermoelectric module according to one embodiment of the present disclosure. FIG. 11 is a view illustrating a heat dissipation sink according to one embodiment of the present disclosure. FIG. 12 is a view illustrating a cooling sink according to one embodiment of the present disclosure. FIG. 13 is a perspective view illustrating a washer member according to one embodiment of the present disclosure. FIG. 14 is a bottom perspective view illustrating the washer member according to one embodiment of the present disclosure. FIG. 15 is a perspective view illustrating a nut member according to one embodiment of the present disclosure. FIG. 16 is a bottom perspective view illustrating the nut member according to one embodiment of the present disclosure. FIG. 17 is a cross-sectional view of a heat dissipation duct and the thermoelectric module according to one embodiment of the present disclosure. FIG. 18 is an enlarged cross-sectional view of a fastening member in FIG. 17 and its surroundings. FIG. 19 is another cross-sectional view of the heat dissipation duct and the thermoelectric module according to one embodiment of the present disclosure.

[0149] Referring to FIGS. 9 to 19, a thermoelectric module 500 will be described in detail.

[0150] The thermoelectric module 500 may include a thermoelectric element 530 having a heat generating portion 531 and a heat absorbing portion 532, a heat dissipation sink 520 in contact with the heat generating portion 531 of the thermoelectric element 530, a cooling sink 570 in contact with the heat absorbing portion 532 of the thermoelectric element 530, and a module plate 550 on which the thermoelectric element 530, the heat dissipation sink 520, and the cooling sink 570 are installed.

[0151] The module plate 550 may serve as a frame of the thermoelectric module 500. The module plate 550 may be formed of a resin material having low thermal conductivity. The module plate 550 may support the heat

dissipation sink 520 and the cooling sink 570. The module plate 550 may maintain an interval between the heat dissipation sink 520 and the cooling sink 570. As illustrated in the drawings, the module plate 550 may be formed integrally with the fan case 650 described above. However, it is also possible for the module plate 550 to be provided separately from the fan case 650.

[0152] The module plate 550 may include a module plate opening 551. The thermoelectric element 530 may be disposed inside the module plate opening 551. A vertical length of the module plate opening 551 may be greater than a vertical length of the thermoelectric element 530, and the thermoelectric element 530 may be disposed at an upper end of the module plate opening 551.

[0153] The reason why the thermoelectric element 530 is disposed at the upper end inside the module plate opening 551 in this way is that a heat generation amount of the thermoelectric element 530 may usually be higher than a heat absorption amount, disposing the thermoelectric element 530 at the upper end of the module plate opening 551 may be advantageous for heat dissipation of the heat generating portion 531, and the overall operating efficiency of the thermoelectric element 530 may be increased.

[0154] In this way, since the thermoelectric element 530 is disposed at the upper end of the module plate opening 551, the cooling sink 570 may include a cooling conductor 574 protruding from the cooling sink base 571 for contact with the heat absorbing portion 532 of the thermoelectric element 530. The cooling conductor 574 may be formed integrally with the cooling sink base 571. The cooling conductor 574 may be inserted into the module plate opening 551 to be in contact with the heat absorbing portion 532 of the thermoelectric element 530.

[0155] The thermoelectric module may include an element insulation material 540 that insulates the module plate 550 from the thermoelectric element 530. The element insulation material 540 may be disposed in the module plate opening 551 to prevent the thermoelectric element 530 from coming into contact with the module plate 550. The element insulation material 540 may be provided to surround a side surface of the thermoelectric element 530. The element insulation material 540 may include an element insulation body 543 and an element insulation cover 542 coupled to an upper side of the element insulation body 543. The element insulation material 540 may be formed of a resin material having low thermal conductivity. As one example, the element insulation material 540 may be formed of a silicone material.

[0156] The module plate 550 may include a heat dissipation sink support 552 that supports the heat dissipation sink 520. The heat dissipation sink support 552 may be supported by contacting a bottom surface of the heat dissipation sink base 521.

[0157] The thermoelectric module 500 may include a sink insulation material 580 provided between the mod-

ule plate 550 and the cooling sink 570. The sink insulation material 580 may prevent heat from being transferred between the heat dissipation sink 520 and the cooling sink 570 through the module plate 550. The sink insulation material 580 may include a sink insulation material opening 581.

[0158] The sink insulation material 580 may support an upper surface of the cooling sink 570. However, the sink insulation material 580 may be omitted, and in this case, the cooling sink 570 may be supported by contacting a bottom surface of the module plate 550. Alternatively, the sink insulation material 580 may be provided between the heat dissipation sink 520 and the module plate 550.

[0159] The heat dissipation sink 520 may include the heat dissipation sink base 521 and the plurality of heat dissipation fins 525 protruding from the heat dissipation sink base 521. The bottom surface of the heat dissipation sink base 521 may be supported on the module plate 550.

[0160] The plurality of heat dissipation fins 525 may protrude from an upper surface 522 of the heat dissipation sink base 521. The plurality of heat dissipation fins 525 may protrude in a direction 526 perpendicular to the upper surface 522 of the heat dissipation sink base 521. The plurality of heat dissipation fins 525 may be formed to extend in a direction 527 parallel to the upper surface 522 of the heat dissipation sink base 521.

[0161] Heat dissipation channels 528 may be formed between the plurality of heat dissipation fins 525 adjacent to each other. The heat dissipation channels 528 may include basic heat dissipation channels 528a and at least one wide heat dissipation channel 528b having a greater width than the basic heat dissipation channels 528a. That is, a width W2 of the wide heat dissipation channel 528b may be greater than a width W1 of each of the basic heat dissipation channels 528a (FIG. 18).

[0162] The reason why the heat dissipation sink 520 has the wide heat dissipation channel 528b in this way is that the heat dissipation sink 520 is formed through an extrusion process and for efficiently performing a task of creating a space for installing a washer member 510 to be described below in the heat dissipation sink 520.

[0163] Air A flowing by the heat dissipation fan 600 may exchange heat with the plurality of heat dissipation fins 525 while passing through the heat dissipation channels 528.

[0164] The plurality of cooling fins 575 may protrude from a lower surface 572 of the cooling sink base 571. The plurality of cooling fins 575 may protrude in a direction 576 perpendicular to the lower surface 572 of the cooling sink base 571. The plurality of cooling fins 575 may be formed to extend in a direction 577 parallel to the lower surface 572 of the cooling sink base 571.

[0165] Cooling channels 578 may be formed between the plurality of cooling fins 575 adjacent to each other. The cooling channels 578 may include basic cooling channels 578a and at least one wide cooling channel 578b having a greater width than each of the basic cooling channels 578a.

[0166] The reason why the cooling sink 570 has the wide cooling channel 578b in this way is that the cooling sink 570 is formed through an extrusion process and for efficiently performing a task of creating a space for installing a nut member 590 to be described below in the cooling sink 570.

[0167] Air B flowing by the cooling fan 800 may exchange heat with the plurality of cooling fins 575 while passing through the cooling channels 578.

[0168] The heat dissipation sink 520 and the cooling sink 570 may be coupled to the module plate 550 through a fastening member S1. The fastening member S1 may be a mechanical coupling element, such as a screw, a bolt, or the like. The fastening member S1 may have a head portion H and a connecting portion C having a diameter smaller than the head portion H. The connecting portion C may have a cylindrical shape. A screw thread may be formed on an outer surface of the connecting portion C. The fastening member S1 may be formed of a metal material to have rigidity.

[0169] A heat dissipation sink through-hole 523 may be formed in the heat dissipation sink 520 so that the fastening member S1 may pass therethrough. A plate through-hole 553 may be formed in the module plate 550 so that the fastening member S1 may pass therethrough. A cooling sink through-hole 573 may be formed in the cooling sink 570 so that the fastening member S1 may pass therethrough.

[0170] The thermoelectric module 500 may include the washer member 510 supported between the head portion H of the fastening member S1 and the heat dissipation sink 520. The washer member 510 may be provided between the head portion H of the fastening member S1 and the heat dissipation sink 520 to prevent the fastening member S1 and the heat dissipation sink 520 from coming into contact and reduce the transfer of heat of the heat dissipation sink 520 through the fastening member S1.

[0171] To this end, the washer member 510 may be constituted by a material having lower thermal conductivity than a metal to reduce the heat transfer. As one example, the washer member 510 may be formed of a material such as plastic, silicone, wood, glass, or the like. Furthermore, the washer member 510 may also be constituted by a metal material having lower thermal conductivity than a metal constituting the heat dissipation sink 520 and the cooling sink 570.

[0172] The washer member 510 may include a washer through-hole 518 through which the fastening member S1 passes. The washer member 510 may include a washer body 511. The washer body 511 may be supported on the heat dissipation sink 520.

[0173] The washer member 510 may include a boss 517 protruding around the washer through-hole 518 of one surface 511a of the washer body 511. The boss 517 may guide and support the fastening member S1.

[0174] The washer member 510 may be inserted into the heat dissipation sink 520 and fixed. To this end, the washer member 510 may include an insertion portion 516

protruding from the other surface 511b of the washer body 511. The insertion portion 516 may be inserted into the heat dissipation sink through-hole 523 of the heat dissipation sink 520. The insertion portion 516 may be formed integrally with the washer body 511.

[0175] The insertion portion 516 may include a plurality of insertion legs 516a spaced apart from each other. Slits 516c may be formed between the plurality of insertion legs 516a adjacent to each other. By forming the slits 516c between the plurality of adjacent insertion legs 516a in this way, the insertion portion 516 has elasticity so that the insertion portion 516 may be smoothly inserted into the heat dissipation sink through-hole 523. A fixing rib 516b may be formed on each of the insertion legs 516a to strengthen a coupling force between the insertion portion 516 and the heat dissipation sink through-hole 523. The fixing rib 516b may prevent the insertion portion 516 from rotating within the heat dissipation sink through-hole 523 or from being separated from the heat dissipation sink through-hole 523.

[0176] The washer member 510 may be disposed in the wide heat dissipation channel 528b of the aforementioned heat dissipation sink 520. The washer member 510 may include a flow guide 513 provided to control a flow of air. The flow guide 513 may protrude from one surface 511a of the washer body 511. The flow guide 513 may be provided on each of upstream and downstream sides of the boss 517 in an air flow direction.

[0177] The flow guide 513 may minimize the flow of air through the wide heat dissipation channel 528b. That is, the flow guide 513 may guide air to flow into the basic heat dissipation channels 528a by blocking or narrowing the wide heat dissipation channel 528b. To this end, the flow guide 513 may be provided to have a width WG corresponding to or slightly smaller than the width W2 of the wide heat dissipation channel 528b.

[0178] Since the wide heat dissipation channel 528b in which the washer member 510 is disposed is wider than the other basic heat dissipation channels 528a, the speed of the air passing through the wide heat dissipation channel 528b in which the washer member 510 is disposed may be reduced and the heat exchange efficiency with the surrounding heat dissipation fins 525 may be low. Accordingly, the heat exchange efficiency between the air and the heat dissipation sink 520 may be increased by causing the flow guide 513 to guide the air to flow into the basic heat dissipation channels 528a rather than the wide heat dissipation channel 528b.

[0179] The washer member 510 may include a side surface support 514 formed on a side surface of the flow guide 513 to support and reinforce the flow guide 513. The side surface support 514 may be formed to connect the flow guide 513 to one surface 511a of the washer body 511.

[0180] The washer member 510 may include a body extension portion 512 extending to one side from the washer body 511. The washer member 510 may include an extension support 515 that connects the flow guide

513 and the body extension portion 512 to support and reinforce the flow guide 513.

[0181] A loosening prevention member 502 may be provided between the head portion H of the fastening member S1 and the washer member 510 to prevent the fastening member S1 from loosening.

[0182] The thermoelectric module 500 may include the nut member 590 to which the connecting portion C of the fastening member S1 is fastened. The nut member 590 may be supported on the cooling sink 570. The nut member 590 may be provided between the connecting portion C of the fastening member S1 and the cooling sink 570 to prevent the fastening member S1 and the cooling sink 570 from coming into contact and reduce the transfer of cold air of the cooling sink 570 through the fastening member S1.

[0183] The nut member 590 may include a nut body 591 and a nut 599 provided inside the nut body 591.

[0184] The nut body 591 may be formed of a material capable of reducing heat transfer between the fastening member S1 and the cooling sink 570. That is, the nut body 591 may be constituted by a material having lower thermal conductivity than a metal. As one example, the nut body 591 may be formed of a material such as plastic, silicone, wood, glass, or the like. Furthermore, the nut body 591 may also be constituted by a metal material having lower thermal conductivity than the metal constituting the heat dissipation sink 520 and the cooling sink 570.

[0185] The nut 599 is formed of a metal material, and a screw thread may be formed on an inner circumferential surface of the nut 599 so that the connecting portion C of the fastening member S1 is fastened. The nut member 590 may be formed by an insert injection method in which a resin is injected in a state where the nut 599 is inserted into a mold.

[0186] The nut member 590 may include a nut through-hole 598. The nut member 590 may include the nut body 591. The nut body 591 may be supported on the cooling sink 570.

[0187] The nut member 590 may include a boss 597 protruding around the nut through-hole 598 of one surface of the nut body 591. The boss 597 may support the fastening member S1.

[0188] The nut member 590 may be inserted into and fixed in the cooling sink 570. To this end, the nut member 590 may include an insertion portion 596 protruding from the other surface 591b of the nut body 591. The insertion portion 596 may be inserted into the cooling sink through-hole 573 of the cooling sink 570. The insertion portion 596 may be formed integrally with the nut body 591.

[0189] The insertion portion 596 may include a plurality of insertion legs 596a spaced apart from each other. Slits 596c may be formed between the plurality of insertion legs 596a adjacent to each other. By forming the slits 596c between the plurality of adjacent insertion legs 596a in this way, the insertion portion 596 has elasticity so that the insertion portion 596 may be smoothly inserted into

the cooling sink through-hole 573. A fixing rib 596b may be formed on each of the insertion legs 596a to strengthen a coupling force between the insertion portion 596 and the cooling sink through-hole 573. The fixing rib 596b may prevent the insertion portion 596 from rotating within the cooling sink through-hole 573 or from being separated from the cooling sink through-hole 573.

[0190] The nut member 590 may be disposed in the wide cooling channel 578b of the aforementioned cooling sink 570. The nut member 590 may include a flow guide 593 provided to control a flow of air. The flow guide 593 may protrude from one surface of the nut body 591. The flow guide 593 may be provided on each of upstream and downstream sides of the boss 597 in the air flow direction.

[0191] The flow guide 593 may minimize the flow of air through the wide cooling channel 578b. That is, the flow guide 593 may guide air to flow into the basic cooling channels 578a by blocking or narrowing the wide cooling channel 578b. To this end, the flow guide 593 may be provided to have a width corresponding to or slightly smaller than a width of the wide cooling channel 578b.

[0192] Since the wide cooling channel 578b in which the nut member 590 is disposed is wider than the other basic cooling channels 578a, the speed of the air passing through the wide cooling channel 578b in which the nut member 590 is disposed may be reduced and the heat exchange efficiency with the surrounding cooling fins 575 may be low. Therefore, the heat exchange efficiency between the air and the cooking sink 570 may be increased by causing the flow guide 593 to guide the air to flow into the basic cooling channels 578a rather than the wide cooling channel 578b.

[0193] With this configuration, the fastening member S1 may be fastened to the nut member 590 by passing through the washer through-hole 518 of the washer member 510 and the plate through-hole 553 of the module plate 550, thereby allowing the heat dissipation sink 520 and the cooling sink 570 to be fixed to the module plate 550.

[0194] When the heat dissipation sink 520 and the cooling sink 570 are coupled to the module plate 550 through the fastening member S1, the heat dissipation sink 520 and the cooling sink 570 may be coupled to the module plate 550 through the fastening member S1 in a state where the element insulation material 540 and the thermoelectric element 530 are disposed in the opening 551 of the module plate 550. Accordingly, while the heat dissipation sink 520 and the cooling sink 570 may be fixed to the module plate 550, the thermoelectric element 530 may also be fixed at the same time.

[0195] The heat generating portion 531 of the thermoelectric element 530 may be supported and fixed by the heat dissipation sink 520, the heat absorbing portion 532 of the thermoelectric element 530 may be supported and fixed by the cooling sink 570, and the side surface connecting the heat generating portion 531 and the heat absorbing portion 532 of the thermoelectric element 530 may be supported and fixed by an inner side surface

of the element insulation material 540.

[0196] In this way, the assemblability of the thermoelectric module 500 may be increased by directly coupling the heat dissipation sink 520 and the cooling sink 570 by the fastening member S1. In addition, since the heat dissipation sink 520 and the heat generating portion 531 of the thermoelectric element 530 may be in close contact and the cooling sink 570 and the heat absorbing portion 532 of the thermoelectric element 530 may be in close contact, the heat exchange between the heat dissipation sink 520 and the heat generating portion 531 of the thermoelectric element 530 and the heat exchange between the cooling sink 570 and the heat absorbing portion 532 of the thermoelectric element 530 may be efficiently performed, so that the efficiency of the thermoelectric module 500 may be increased.

[0197] In addition, since the fastening member S1 is prevented from contacting the heat dissipation sink 520 and the cooling sink 570 by the washer member 510 and the nut member 590, the heat exchange through the fastening member S1 is reduced, so that the efficiency of the thermoelectric module 500 may be increased.

[0198] FIG. 20 is an enlarged cross-sectional view of a fastening member according to one embodiment of the present disclosure and its surroundings. FIG. 21 is an enlarged cross-sectional view of the fastening member according to one embodiment of the present disclosure and its surroundings. FIG. 22 is an enlarged cross-sectional view of the fastening member according to one embodiment of the present disclosure and its surroundings. FIG. 23 is an enlarged cross-sectional view of the fastening member according to one embodiment of the present disclosure and its surroundings. FIG. 24 is an enlarged cross-sectional view of the fastening member according to one embodiment of the present disclosure and its surroundings.

[0199] As illustrated in FIG. 20, unlike the above-described embodiment, a fastening member S1 may be coupled to a heat dissipation sink 520 by passing through a cooling sink 570. That is, the fastening member S1 may advance from bottom to top. In this case, a washer member 510 may be disposed toward the cooling sink 570 and a nut member 590 may be disposed toward the heat dissipation sink 520.

[0200] As illustrated in FIG. 21, the nut member 590 may not include a nut inserted therein. That is, a screw thread to which a connecting portion C of the fastening member S1 may be fastened may be formed on an inner circumferential surface of a nut through-hole 598 of the nut member 590.

[0201] As illustrated in FIG. 22, there is no limitation on a width WG2 of a flow guide 2513, and the width WG2 of the flow guide 2513 may be smaller than the width W2 (FIG. 18) of the wide heat dissipation channel 528b. The width WG2 of the flow guide 2513 may correspond to the width W1 (FIG. 18) of the basic heat dissipation channel 528a.

[0202] As illustrated in FIG. 23, a width of a flow guide

3513 may not be uniform. A width WG3 of a portion of the flow guide 3513 close to the washer body 511 may be smaller than a width WG4 of a portion thereof far from the washer body 511.

[0203] As illustrated in FIG. 24, the flow guide may be omitted. In this case, the guide vane 2772 of the heat dissipation duct body 720 may be extended closer to the heat dissipation sink 520. For example, the guide vane 2772 may extend to the vicinity of the washer member 510 or the fastening member S1. The guide vane 2772 may extend to a point closer to the heat dissipation sink 520 than a midpoint between the heat dissipation duct body 720 and the heat dissipation sink 520.

[0204] Although the technical idea of the present invention has been described above through specific embodiments, the scope of the present invention is not limited to the embodiments. Various embodiments that may be modified or changed by a person skilled in the art without departing from the technical spirit of the present invention as stated in the claims are also considered to be within the scope of the rights of the present invention.

Claims

1. A refrigerator comprising:

a storage compartment; and
a thermoelectric module to cool the storage compartment,
wherein the thermoelectric module includes:

a module plate having an opening;
a first heat sink to be provided on one side of the module plate;
a second heat sink to be provided on another side of the module plate;
a thermoelectric element to be disposed in the opening so that while the thermoelectric element is disposed in the opening, one surface of the thermoelectric element contacts the first heat sink and another surface of the thermoelectric element, opposite the one surface, contacts the second heat sink;
a fastening member, configured to couple the first heat sink and the second heat sink to the module plate by being passed through the first heat sink, the module plate, and the second heat sink, having a head portion and a connecting portion having a diameter smaller than the head portion;
a washer member supported between the head portion and the first heat sink; and
a nut member to which the connecting portion is fastened and that is supported by the second heat sink.

2. The refrigerator of claim 1, wherein the first heat sink

- includes a through-hole through which the fastening member passes, and
the washer member includes an insertion portion protruding toward the through-hole and insertable into the through-hole. 5
3. The refrigerator of claim 1, wherein the washer member is formed of a material having lower thermal conductivity than a metal to reduce heat transfer between the fastening member and the first heat sink. 10
4. The refrigerator of claim 1, wherein the washer member includes a washer through-hole through which the fastening member passes. 15
5. The refrigerator of claim 4, wherein the washer member includes a boss protruding around the washer through-hole. 20
6. The refrigerator of claim 1, wherein the washer member includes a flow guide protruding to control a flow of air. 25
7. The refrigerator of claim 6, wherein the first heat sink includes:
a first sink base; and
a plurality of first fins protruding along a direction perpendicular to one surface of the first sink base,
a plurality of first channels between the plurality of first fins, and
the plurality of first channels include first basic channels and at least one first wide channel having a greater width than the first basic channels. 30 35
8. The refrigerator of claim 7, wherein the washer member is disposed in the at least one first wide channel. 40
9. The refrigerator of claim 1, wherein the second heat sink includes a through-hole through which the fastening member passes, and
the nut member includes an insertion portion protruding toward the through-hole and insertable into the through-hole. 45
10. The refrigerator of claim 1, wherein the nut member includes:
a nut body formed of a material having lower thermal conductivity than a metal to reduce heat transfer between the fastening member and the second heat sink; and
a nut, having screw threads formed on an inner circumferential surface to fasten the fastening member, formed of a metal material, provided inside the nut body. 50 55
11. The refrigerator of claim 1, wherein the nut member includes a nut through-hole into which the fastening member is insertable.
12. The refrigerator of claim 1, wherein the nut member includes a boss protruding around a nut through-hole.
13. The refrigerator of claim 1, wherein the nut member includes a flow guide protruding to control a flow of air.
14. The refrigerator of claim 13, wherein the second heat sink includes:
a second sink base; and
a plurality of second fins protruding along a direction perpendicular to one surface of the second sink base,
a plurality of second channels are formed between the plurality of second fins, and
the plurality of second channels include second basic channels and at least one second wide channel having a greater width than the second basic channels.
15. The refrigerator of claim 14, wherein the nut member is disposed in the at least one second wide channel.

FIG. 1

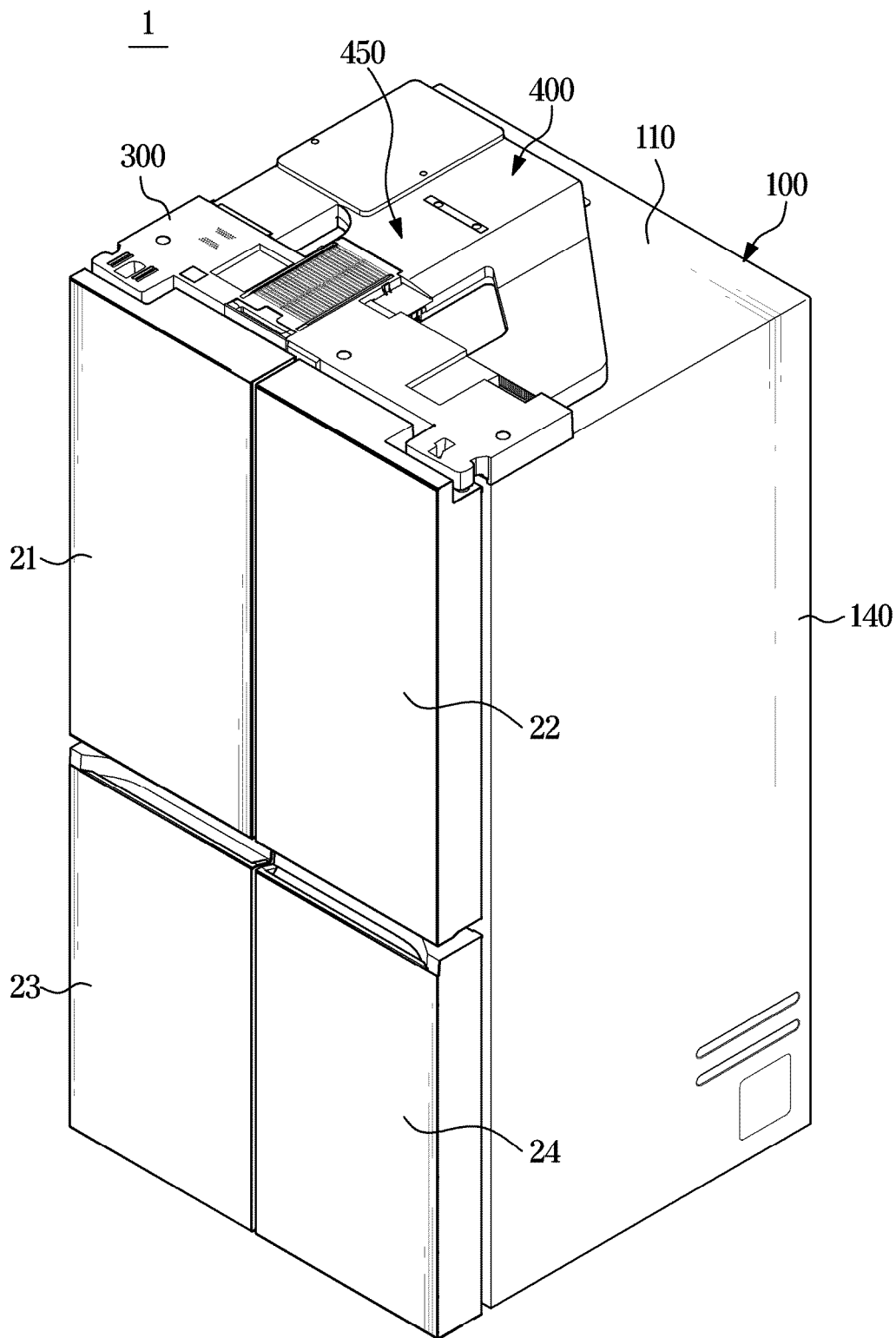


FIG. 2

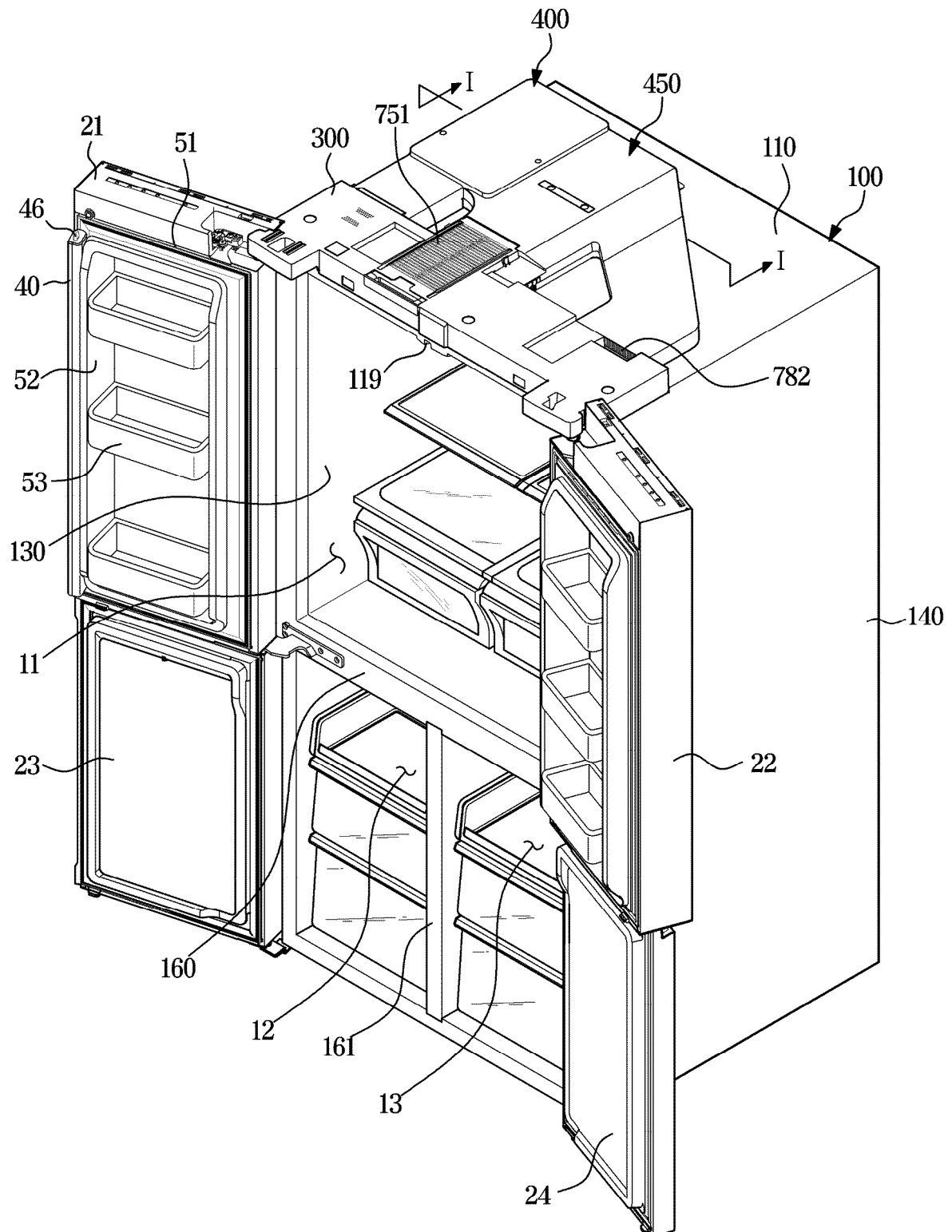


FIG. 3

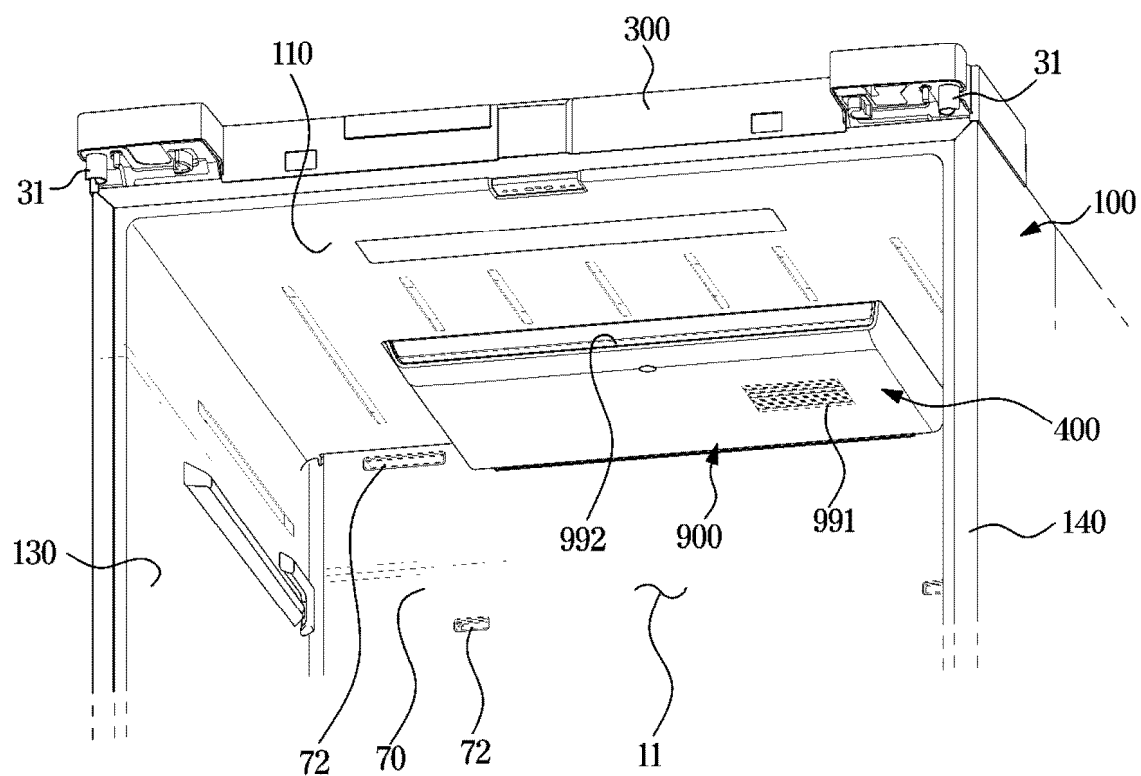


FIG. 4

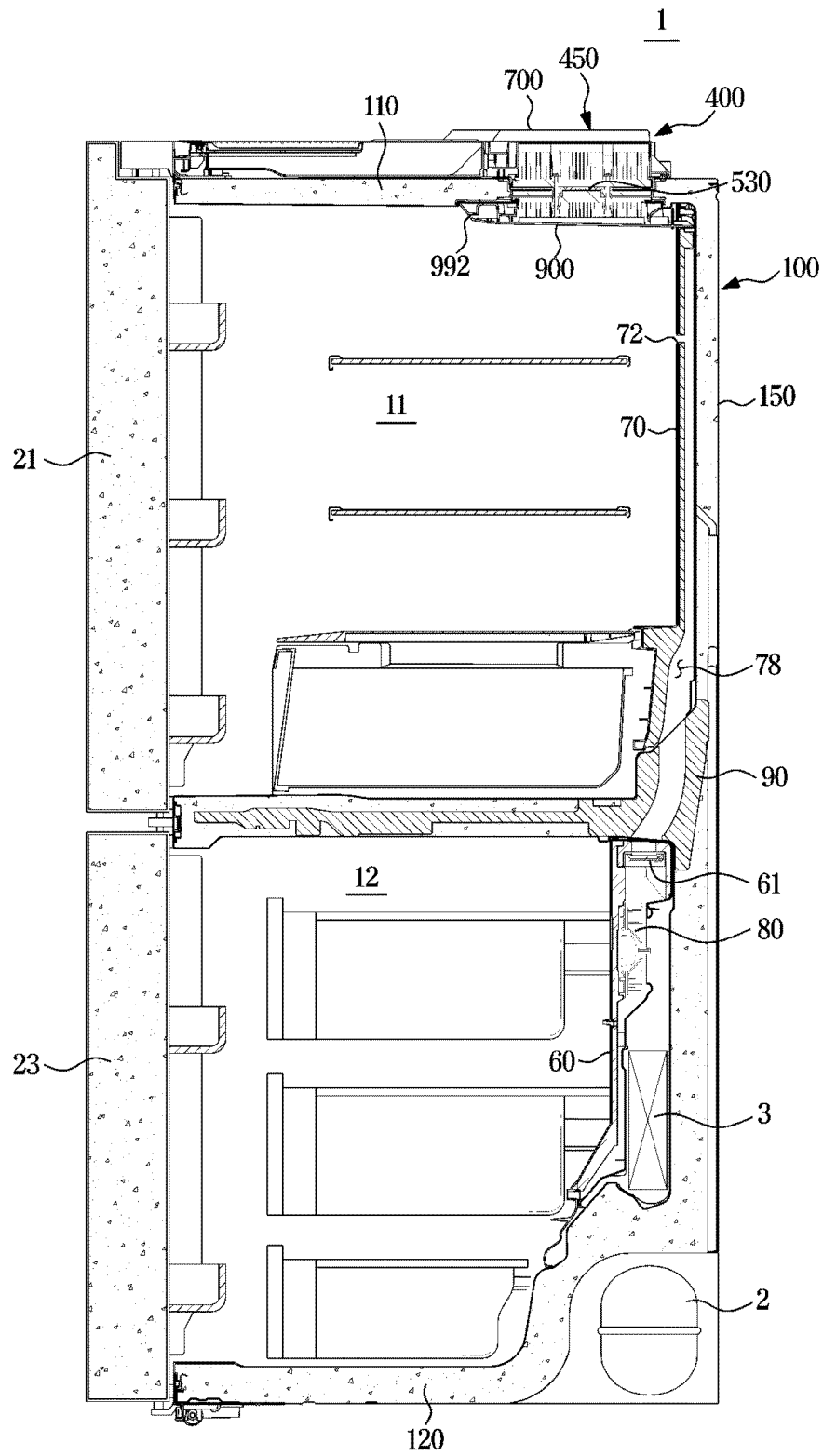


FIG. 5

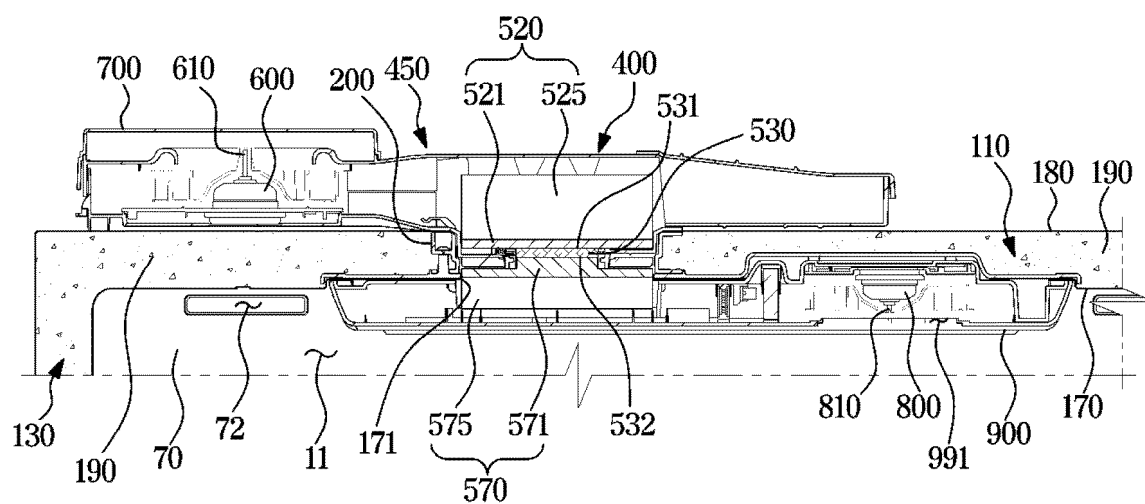


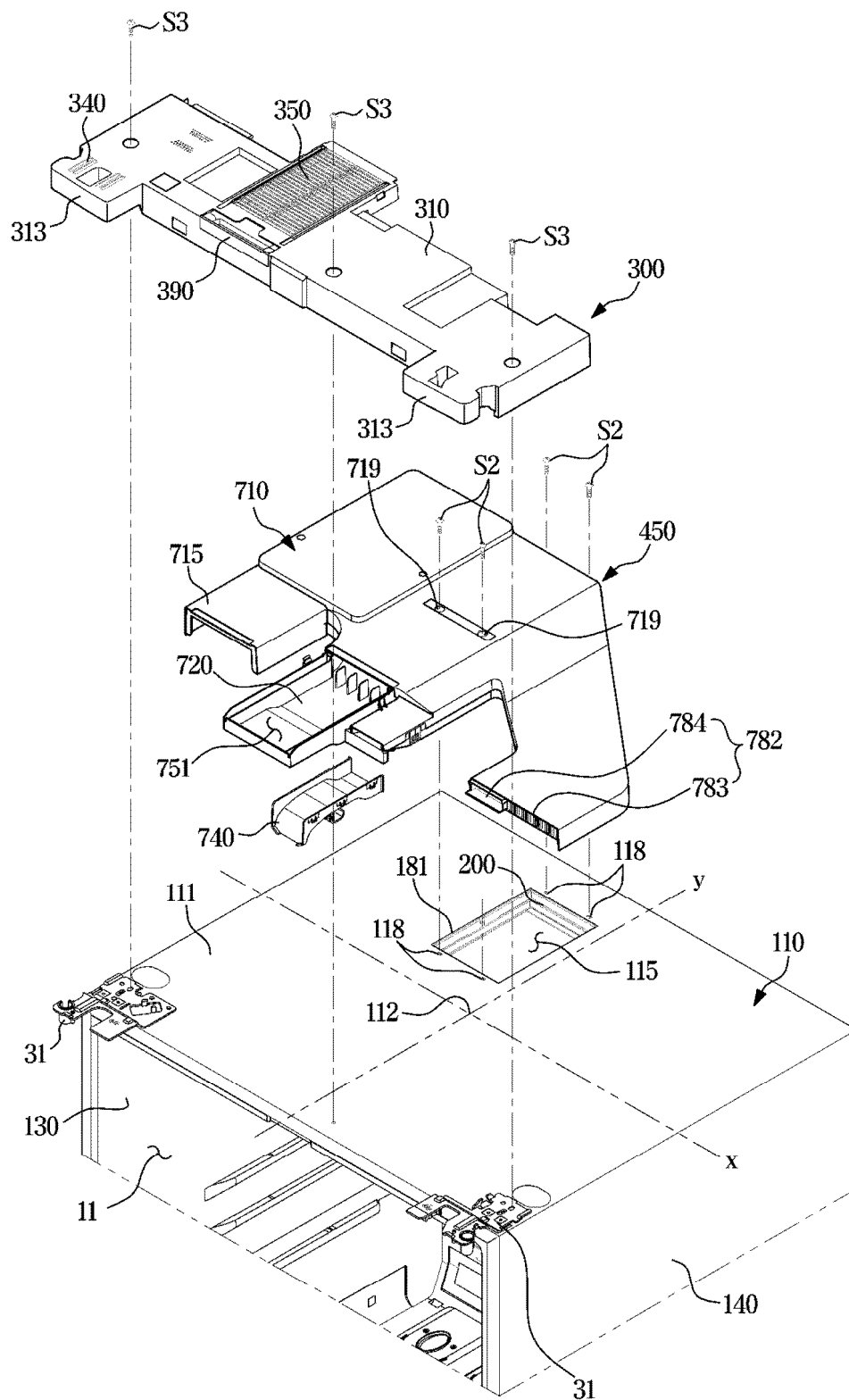
FIG. 6

FIG. 7

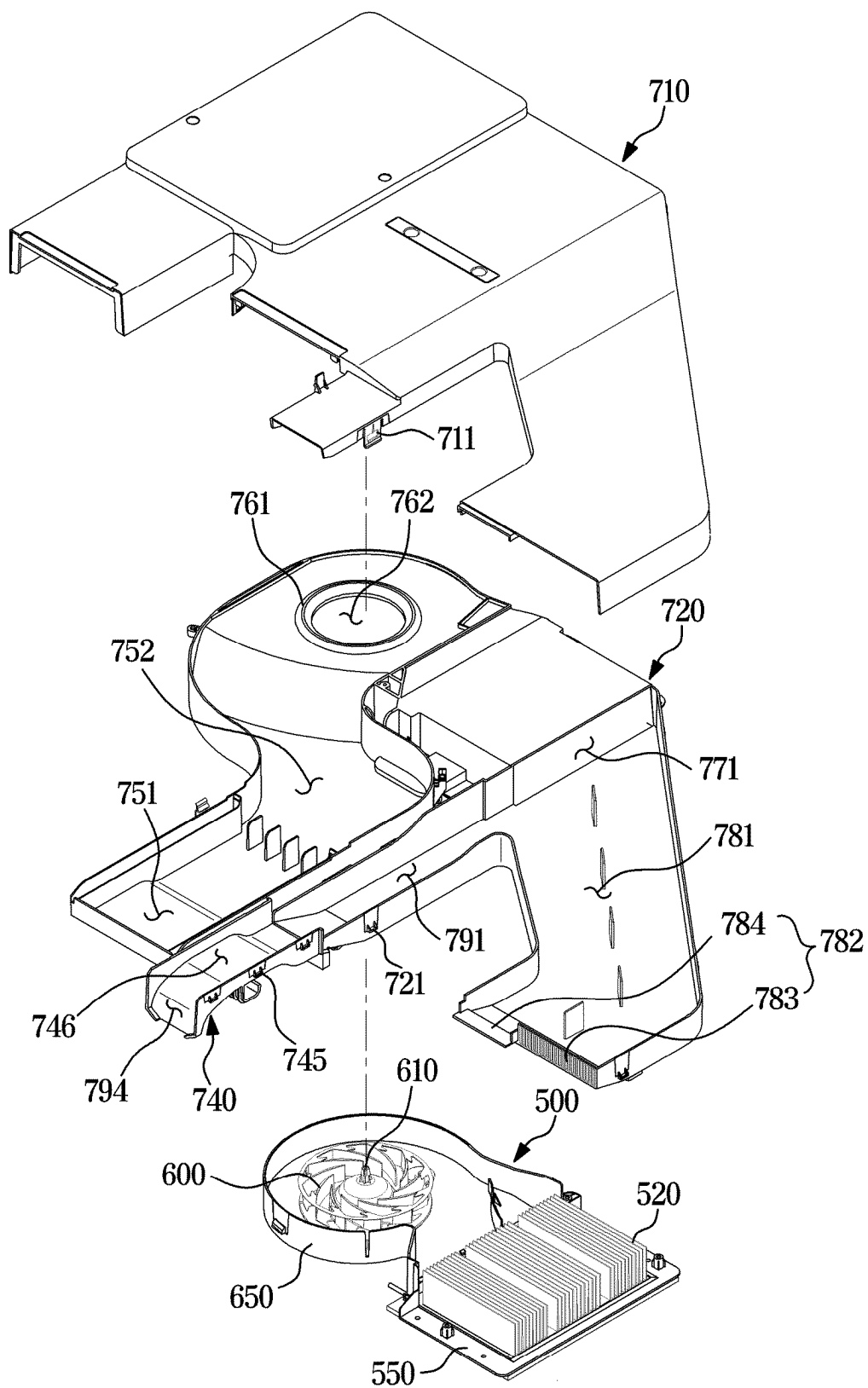


FIG. 8

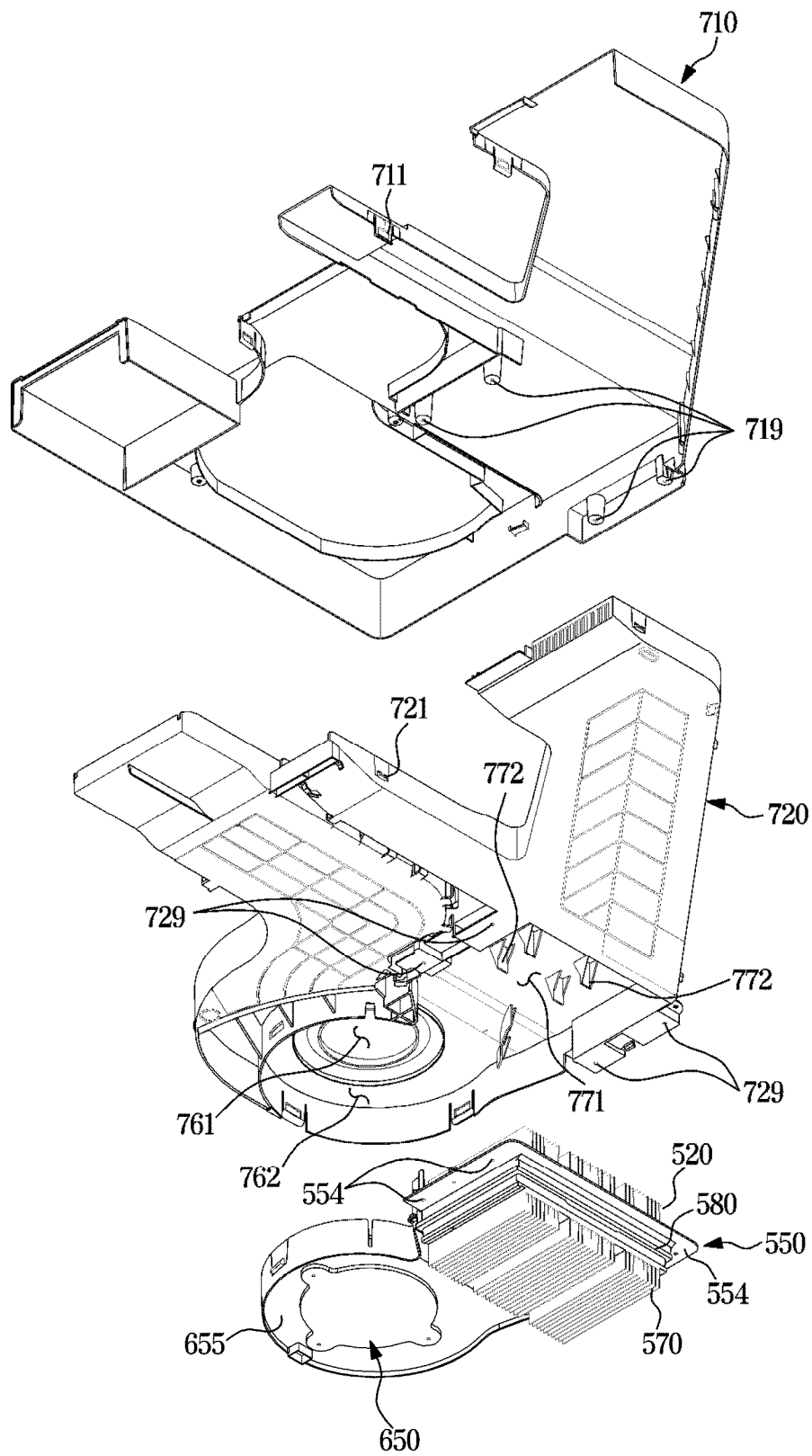


FIG. 9

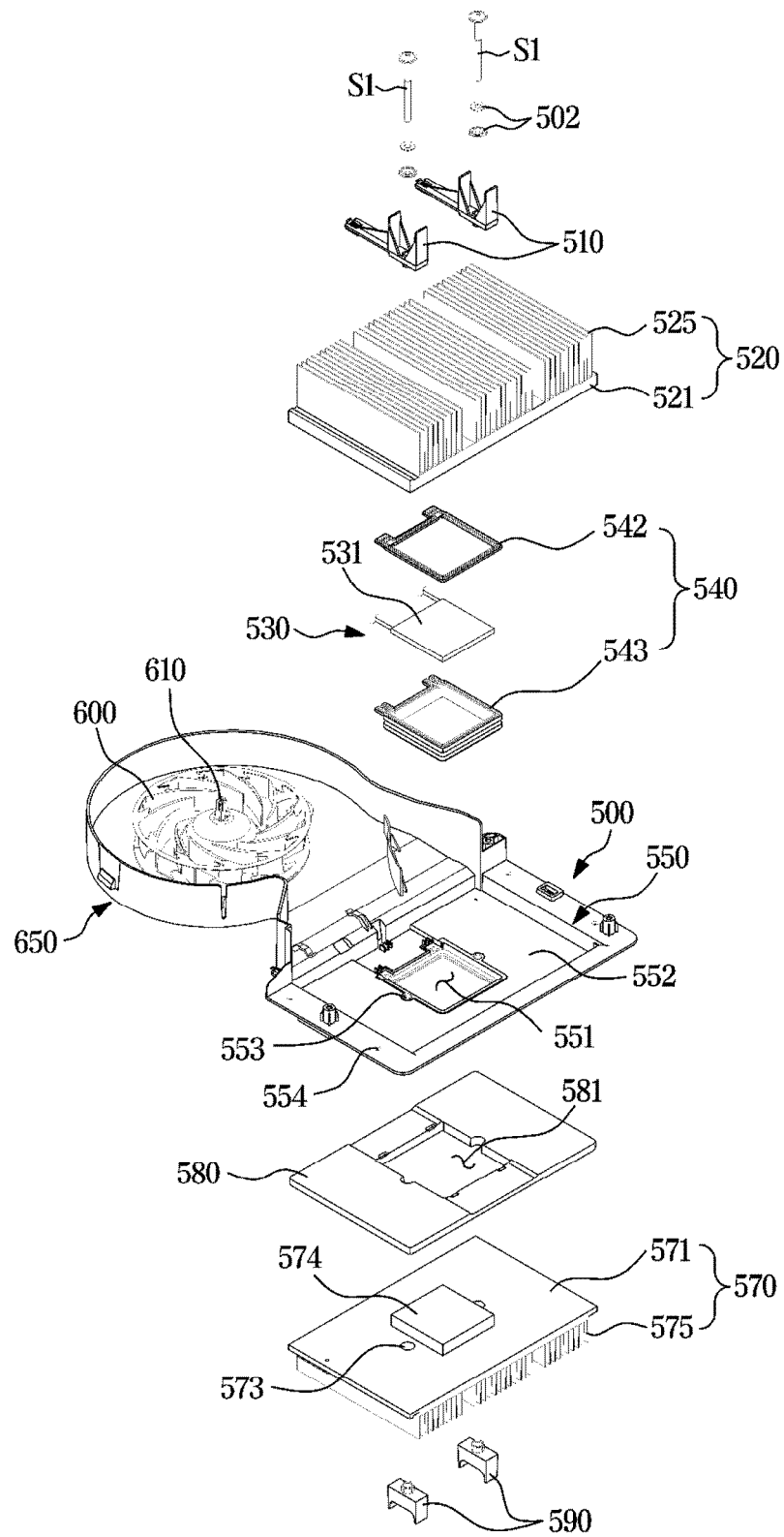


FIG. 10]

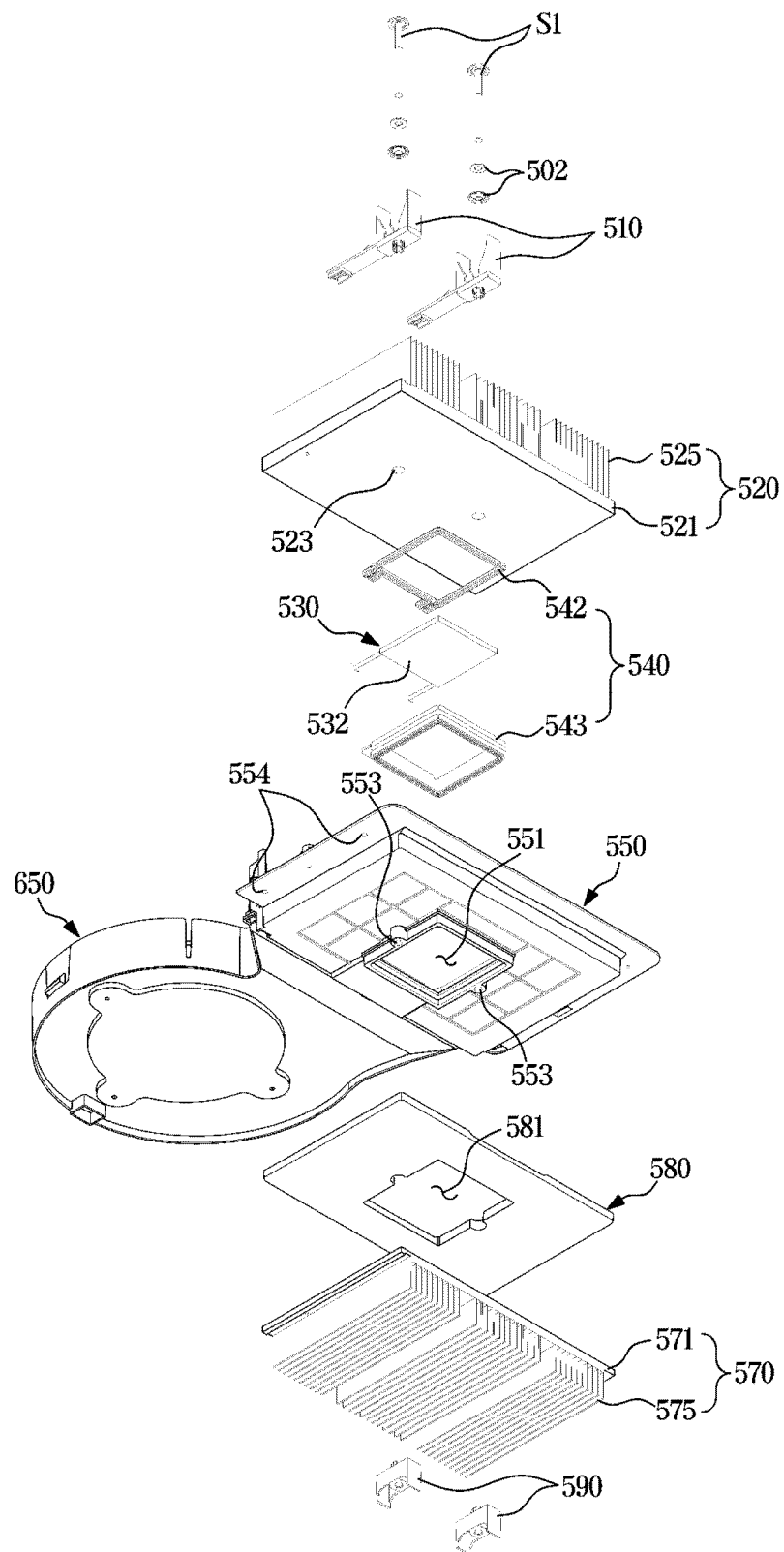


FIG. 11

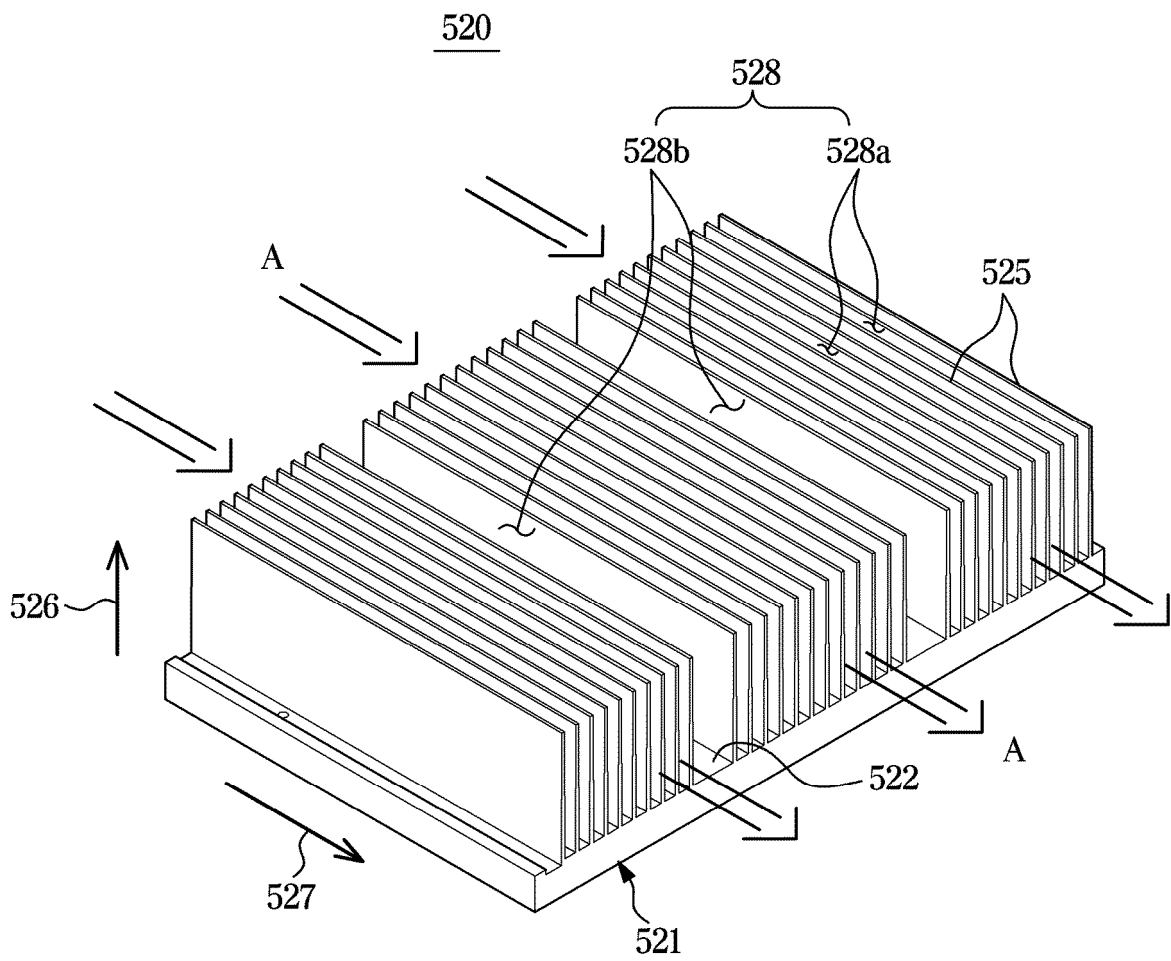


FIG. 12

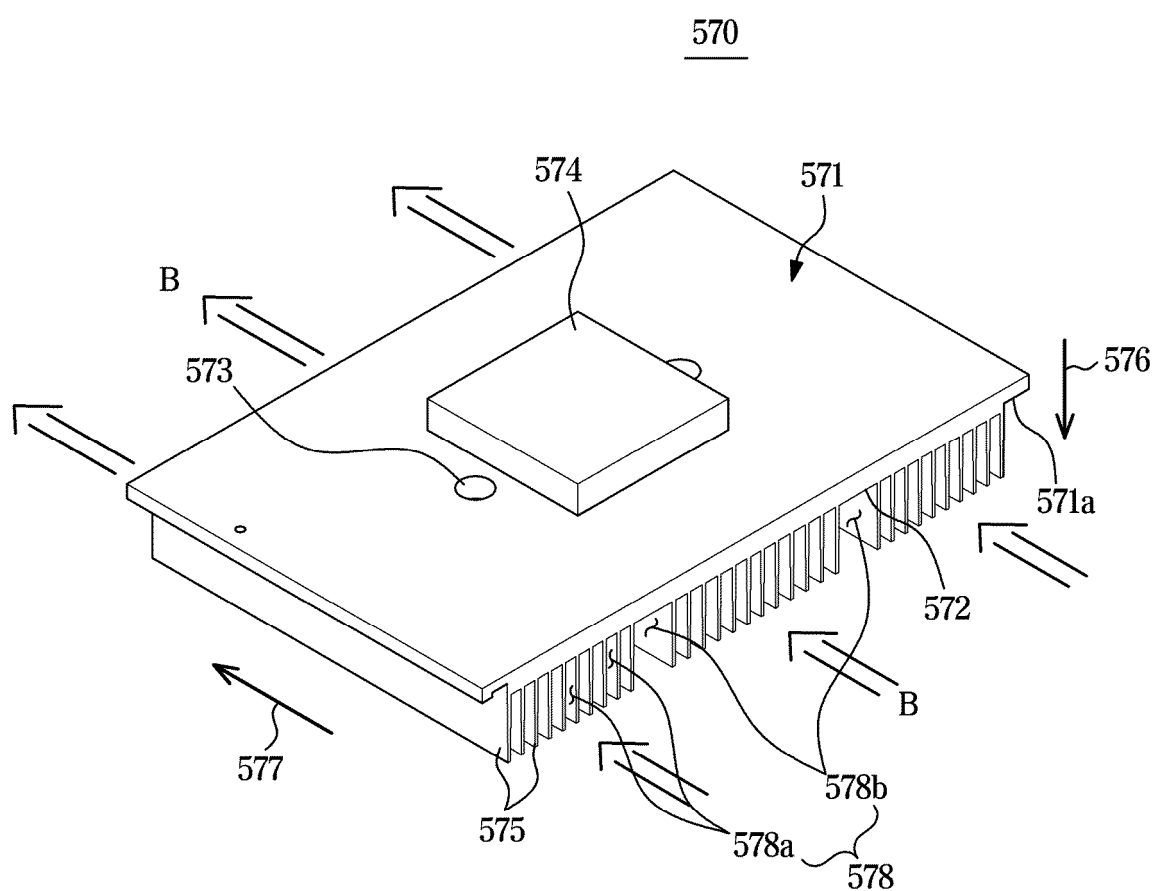


FIG. 13

510

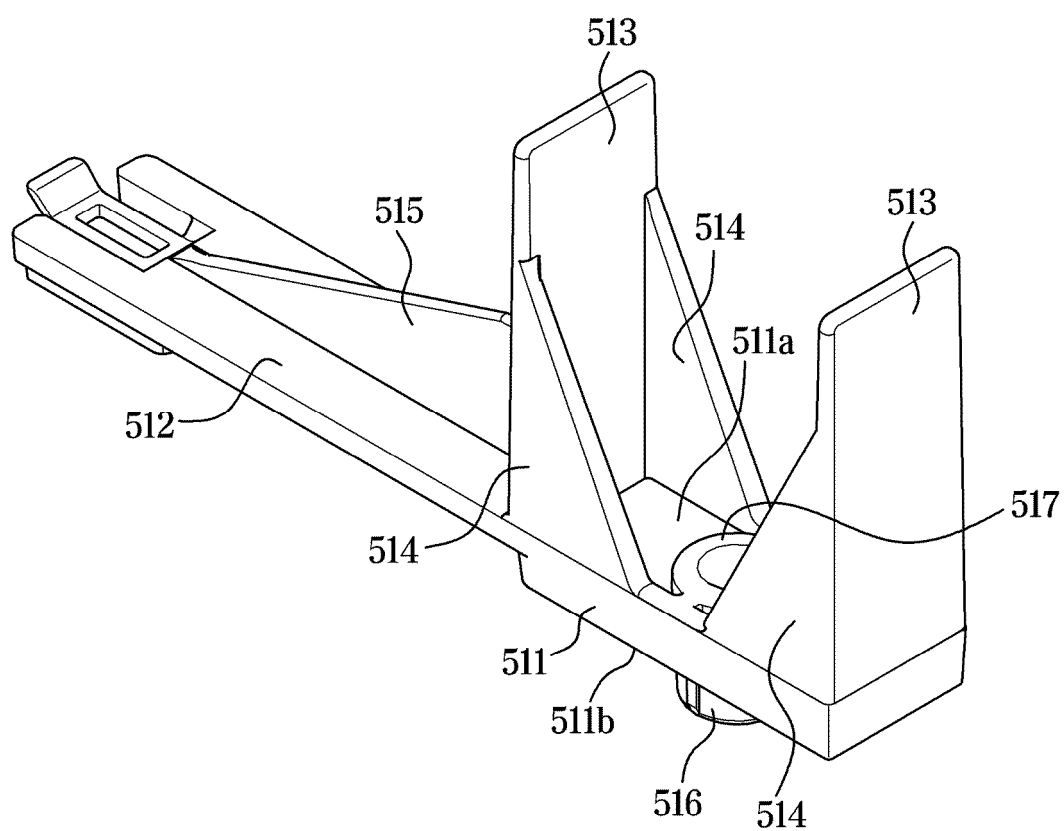


FIG. 14

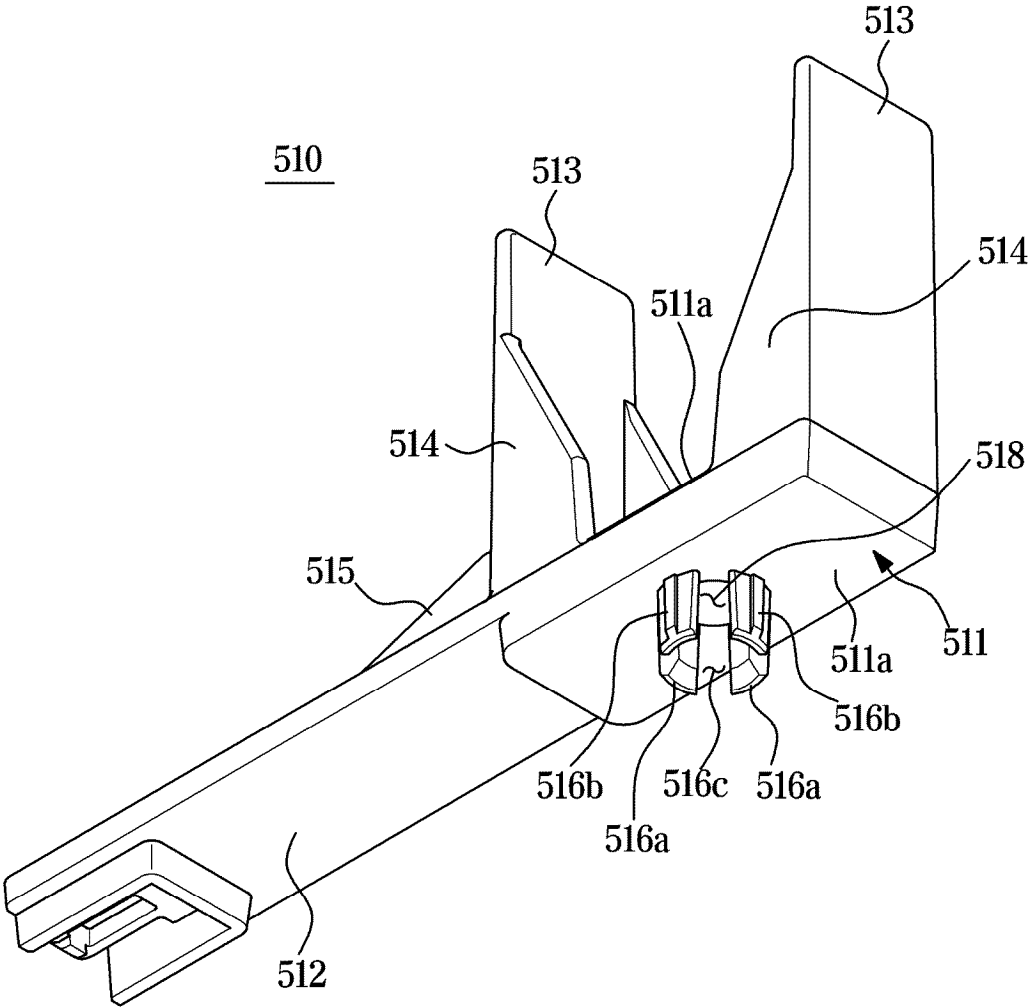


FIG. 15

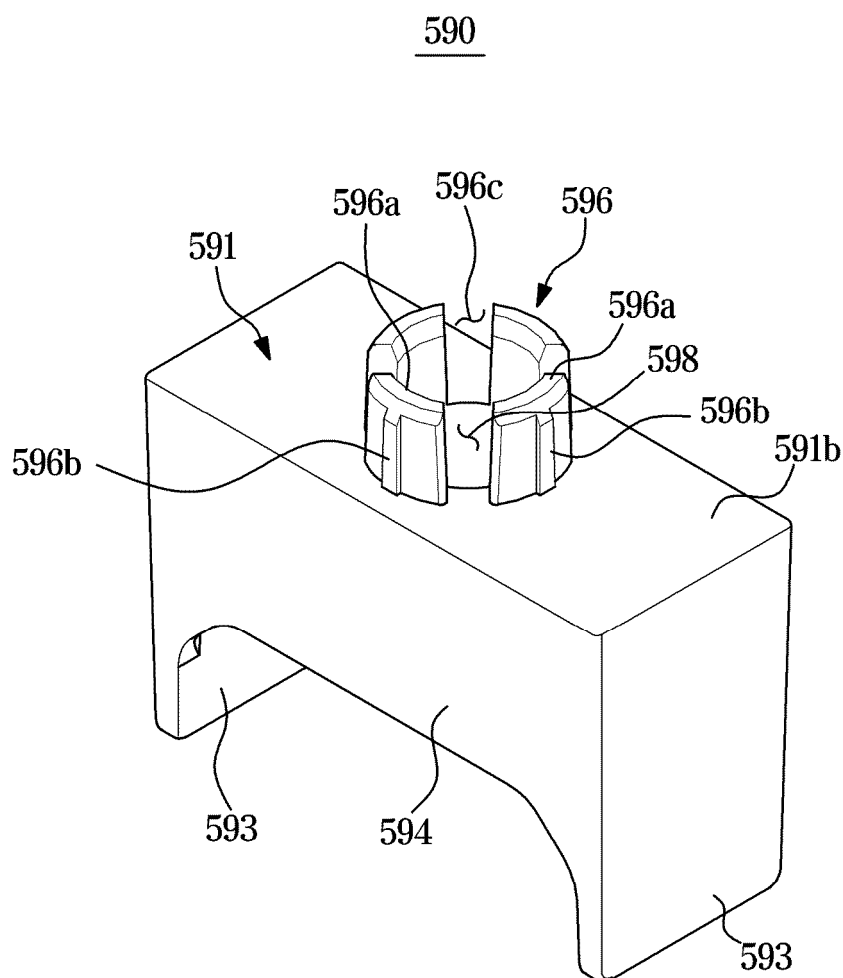


FIG. 16

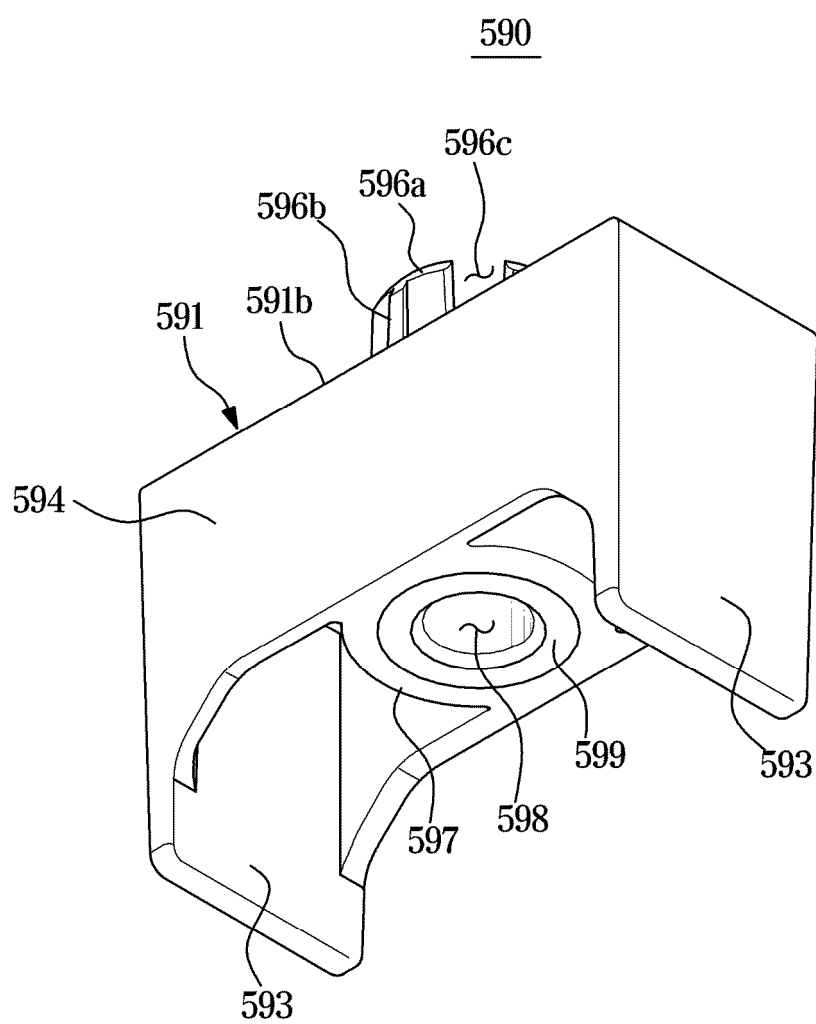


FIG. 17

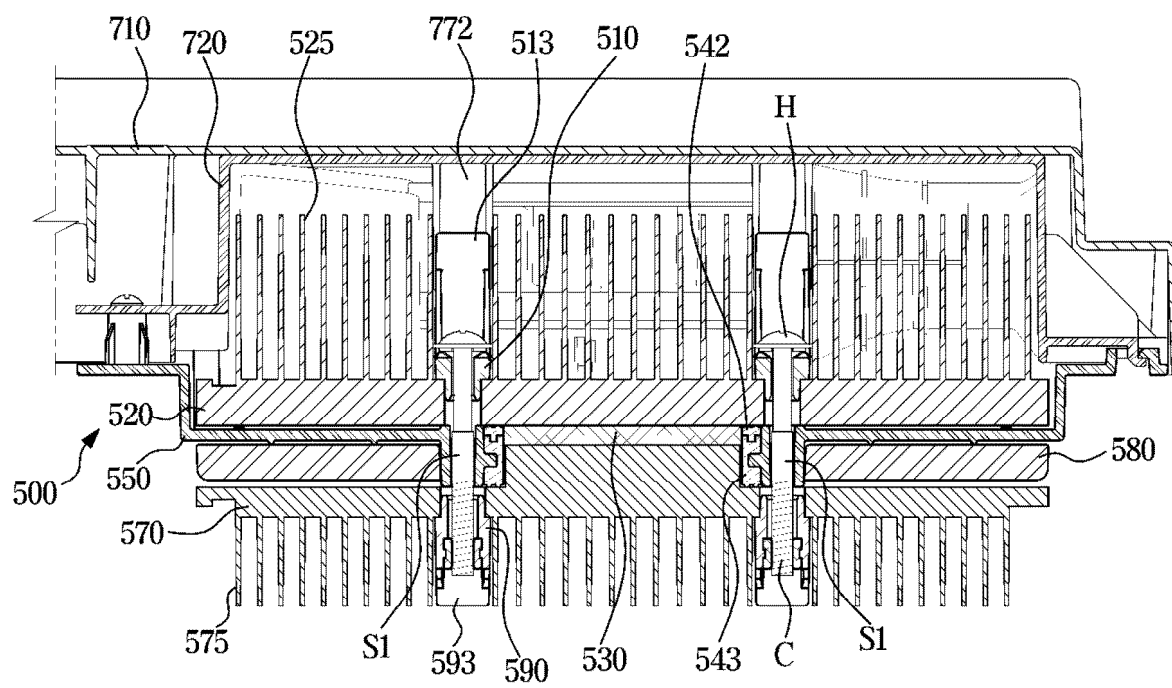


FIG. 18

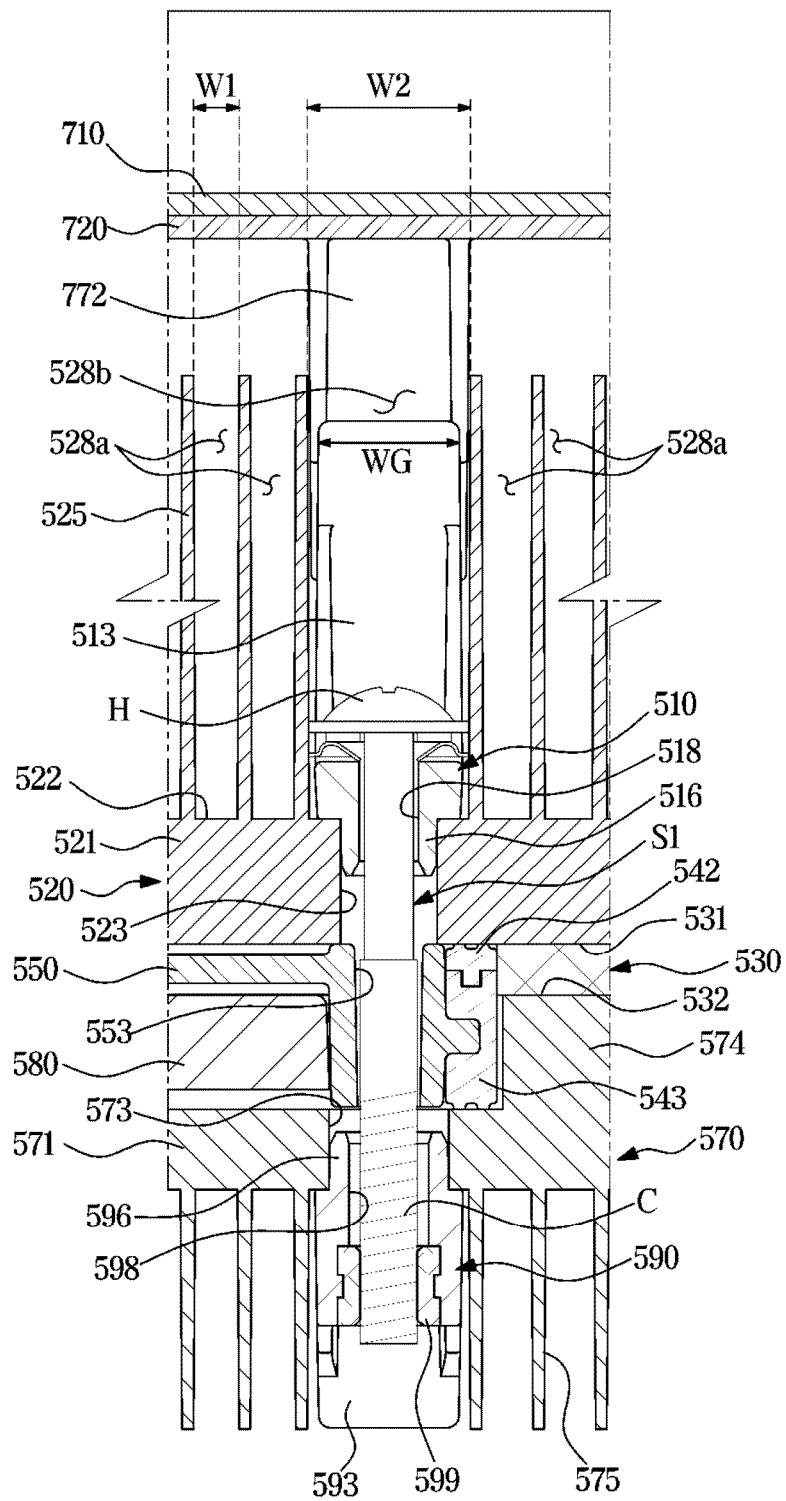


FIG. 19

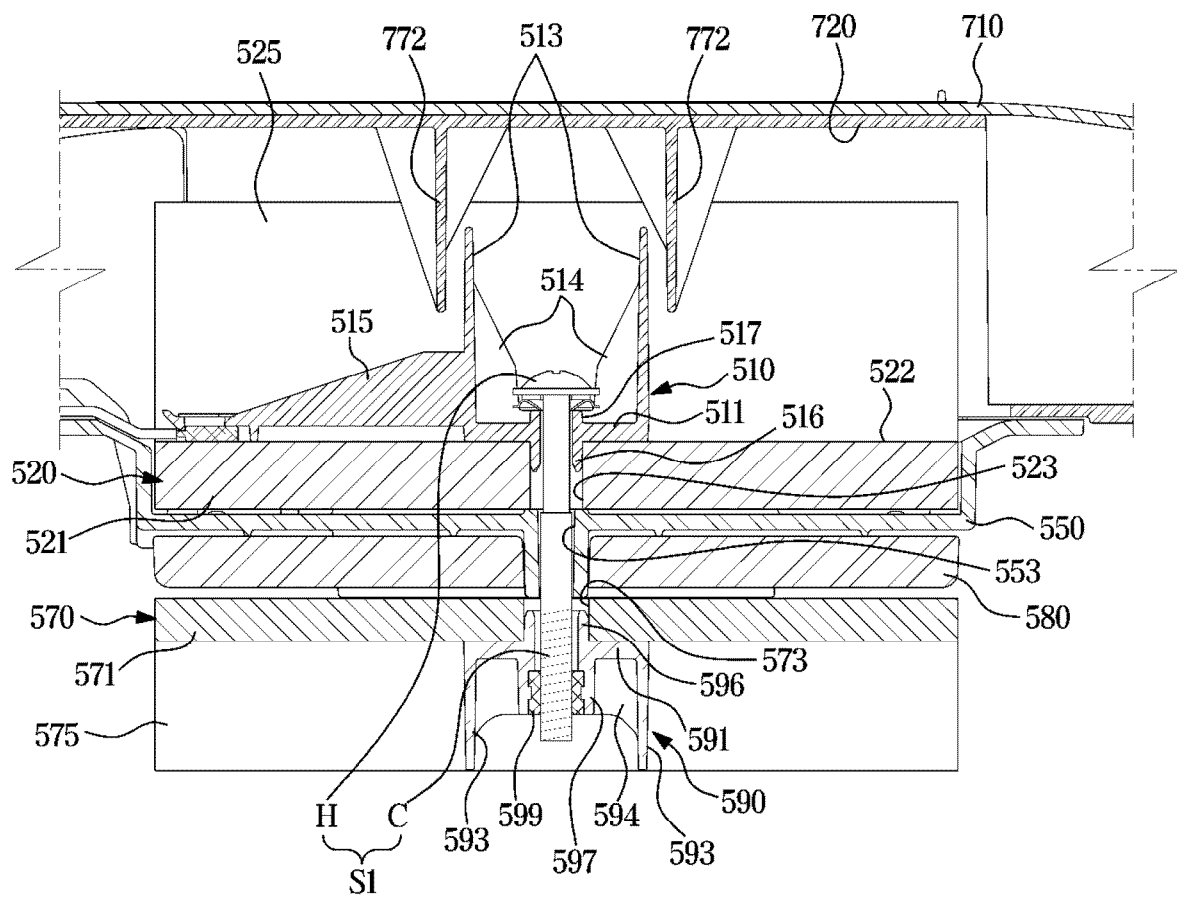


FIG. 20

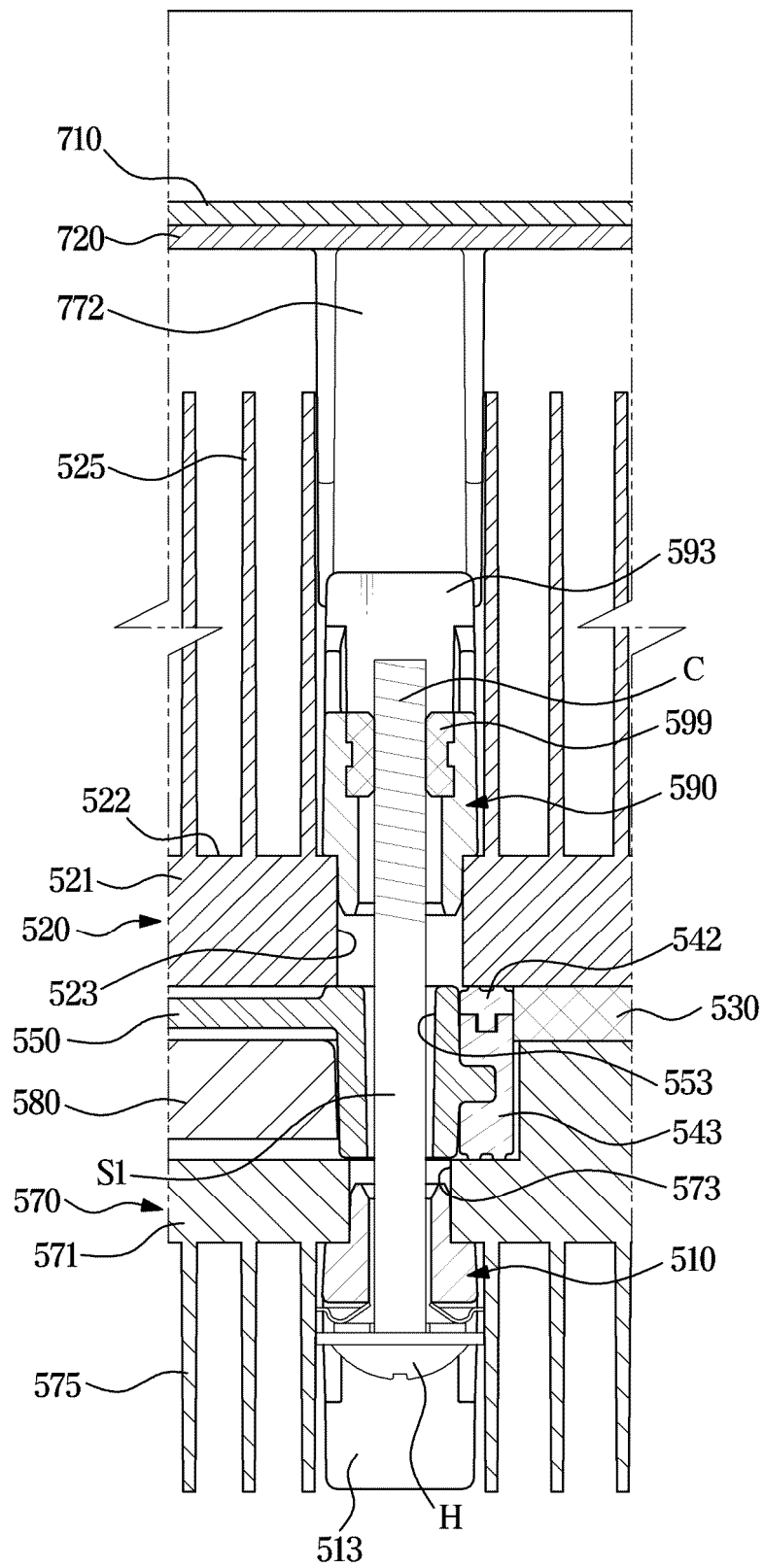


FIG. 21

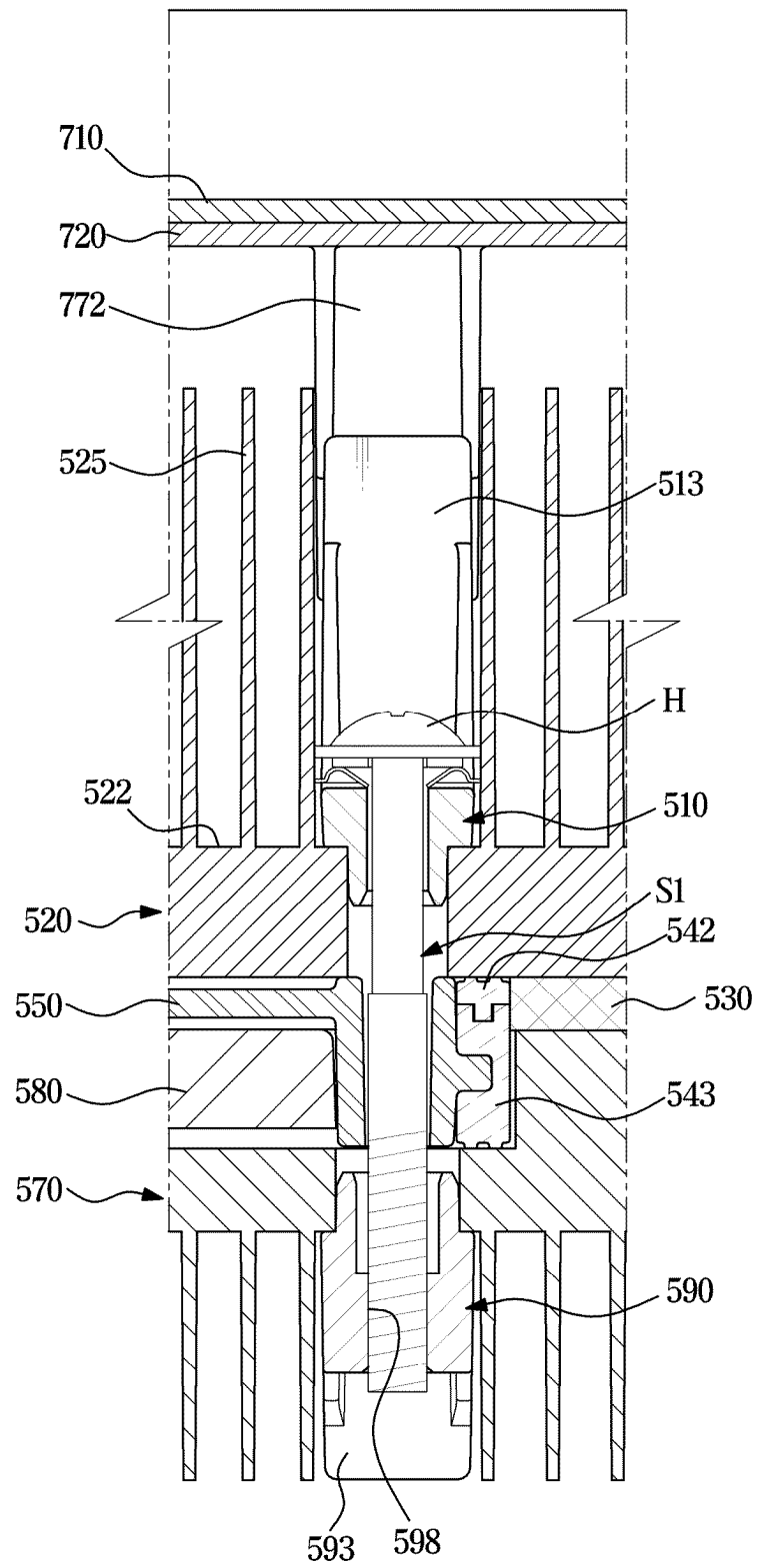


FIG. 22

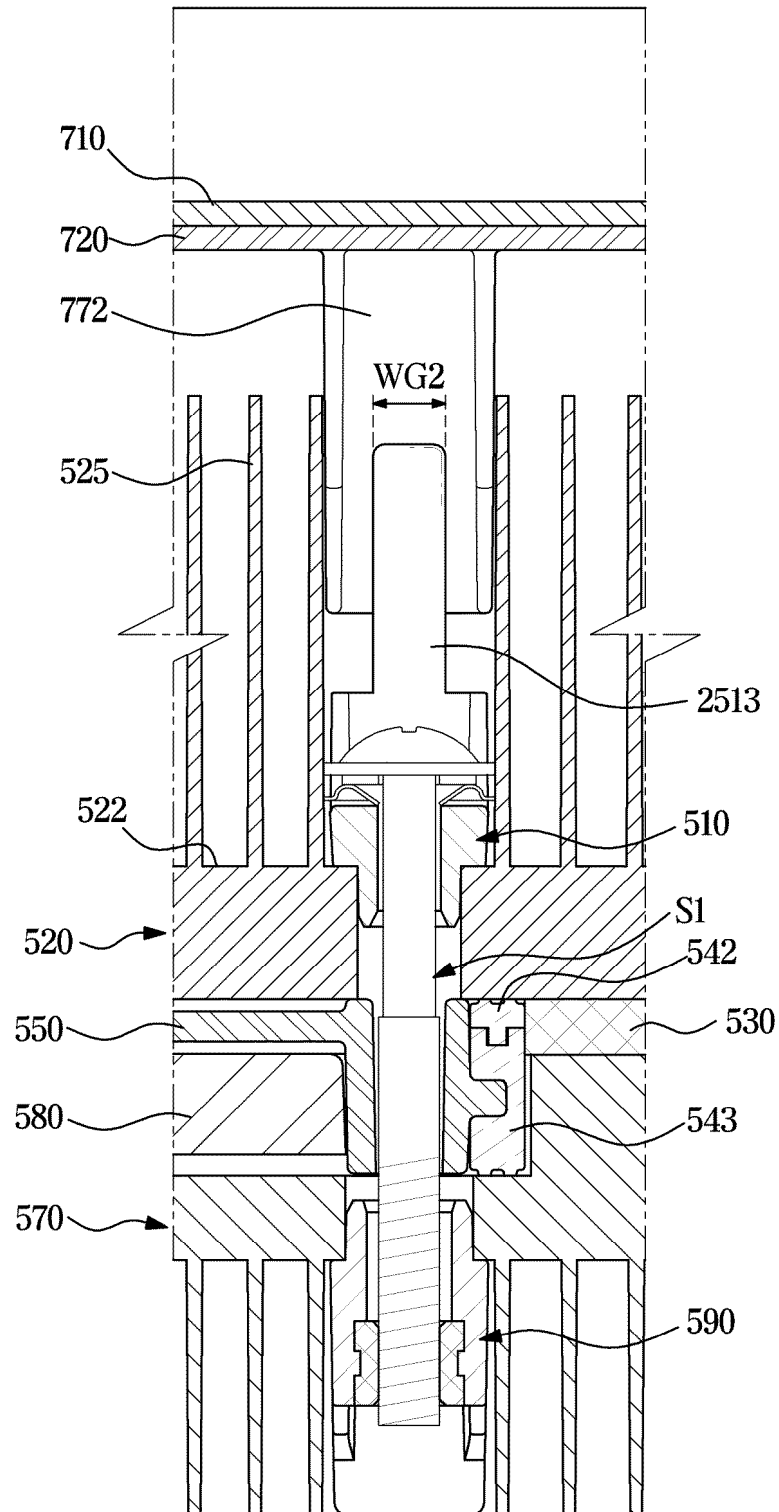


FIG. 23

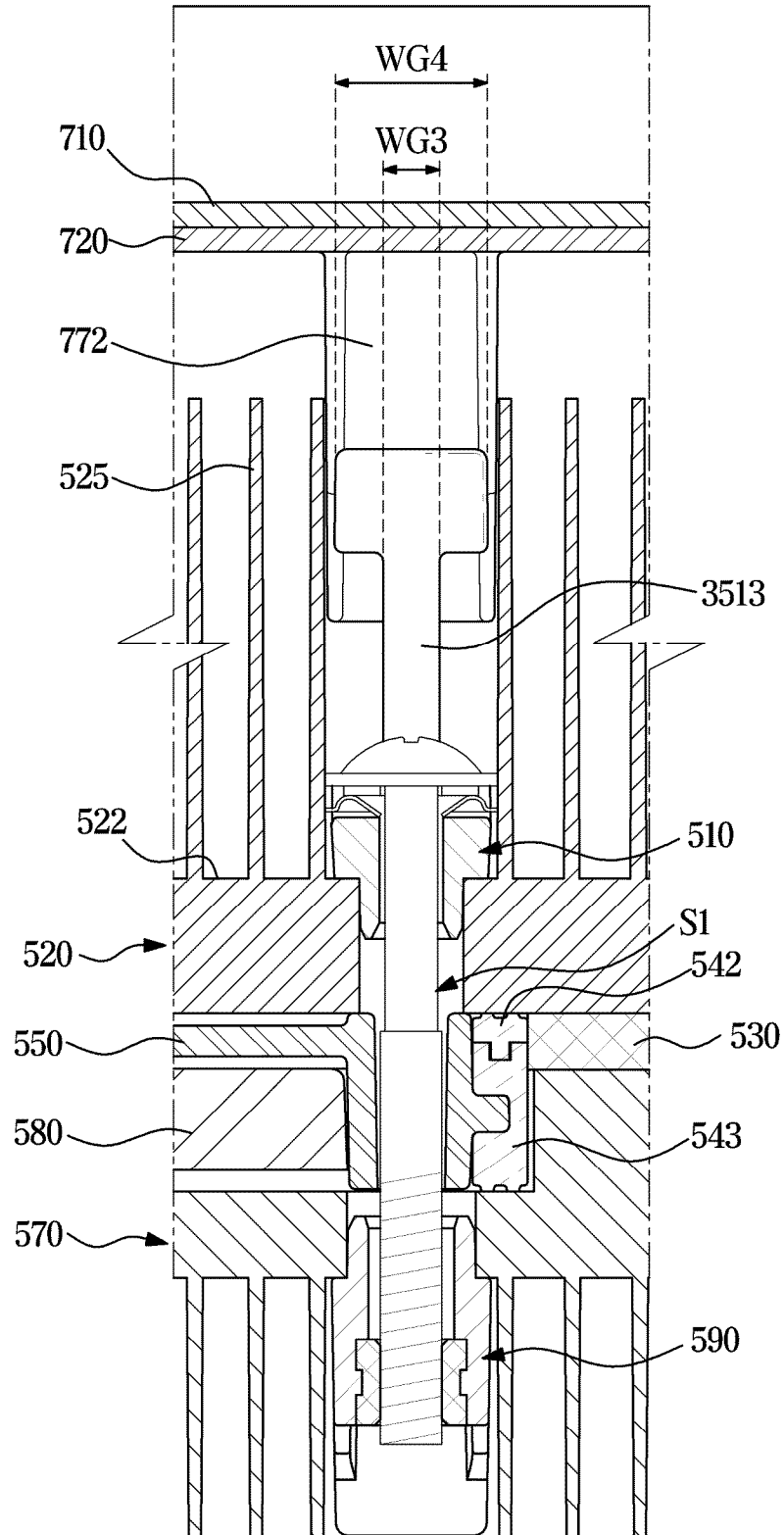
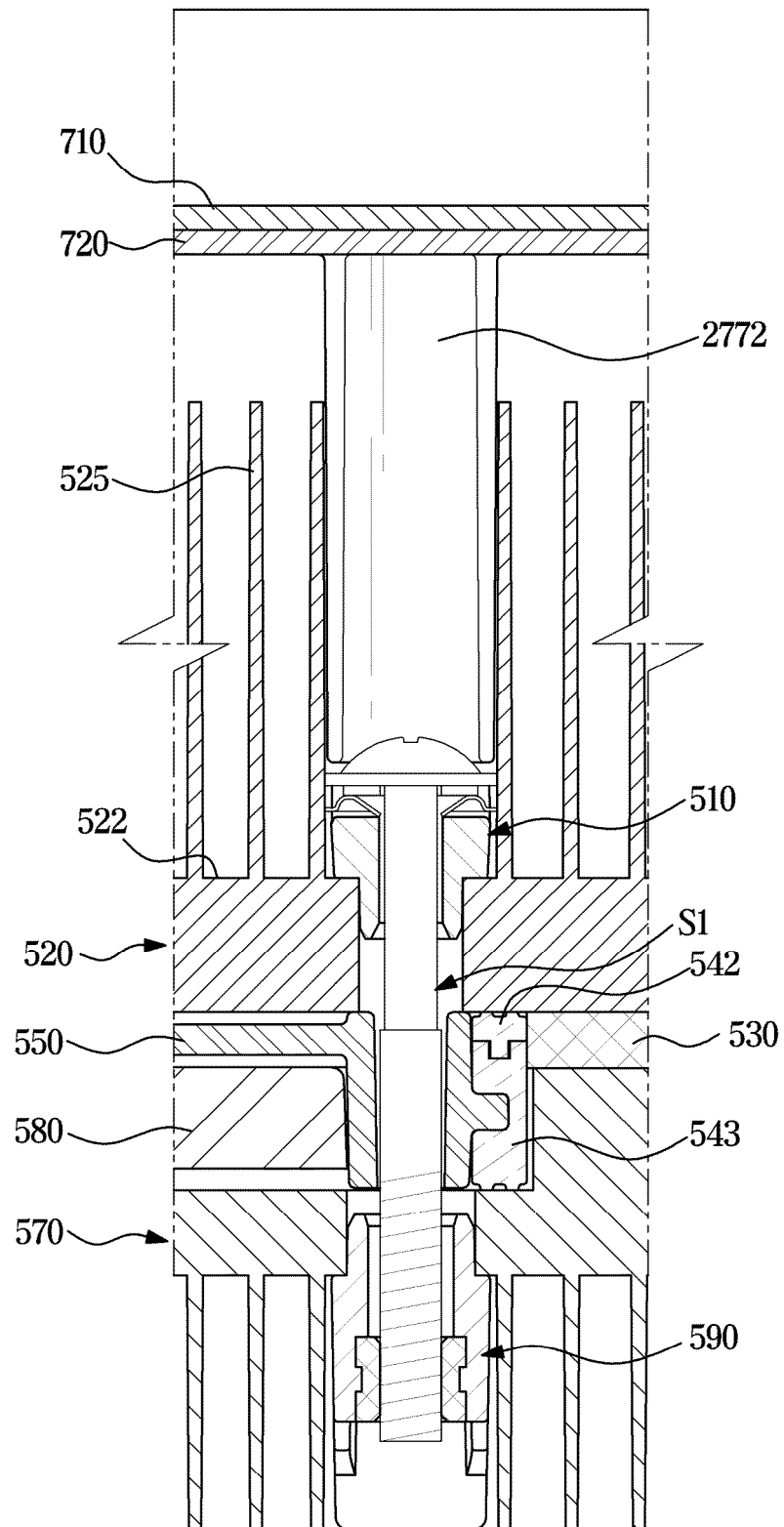


FIG. 24



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2024/020974

A. CLASSIFICATION OF SUBJECT MATTER

F25D 19/04(2006.01)i; F25D 15/00(2006.01)i; F25D 23/00(2006.01)i; F25B 21/02(2006.01)i; F25D 17/06(2006.01)i;
F25D 17/08(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F25D 19/04(2006.01); F16B 33/02(2006.01); F16B 37/12(2006.01); F25B 21/02(2006.01); F25D 11/00(2006.01);
F25D 11/04(2006.01); F25D 19/00(2006.01); H01L 23/40(2006.01); H02H 7/20(2006.01); H02J 9/06(2006.01)

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

Korean utility models and applications for utility models: IPC as above

Japanese utility models and applications for utility models: IPC as above

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

eKOMPASS (KIPO internal) & keywords: 냉장고(refrigerator), 열전모듈(thermoelectric module), 히트싱크(heat sink), 체결부재(fastener element), 와셔부재(washer element), 너트부재(nut element)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2311397 B1 (LG ELECTRONICS INC.) 13 October 2021 (2021-10-13) See paragraphs [0039] and [0184]-[0207] and figures 1 and 30-33.	1,3-5,9-12
A		2,6-8,13-15
Y	KR 10-1407447 B1 (COWAY CO., LTD. et al.) 17 June 2014 (2014-06-17) See paragraphs [0044]-[0049] and [0052] and figure 5.	1,3-5,9-12
Y	US 2015-0176625 A1 (VARIAN SEMICONDUCTOR EQUIPMENT ASSOCIATES, INC.) 25 June 2015 (2015-06-25) See paragraph [0033] and figures 3-5.	10
A	KR 10-2023619 B1 (WOONGJIN COWAY CO., LTD.) 23 September 2019 (2019-09-23) See figures 12-14.	1-15

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“D” document cited by the applicant in the international application

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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

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

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

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

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search 02 May 2025	Date of mailing of the international search report 08 May 2025
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon Building 4, 189 Cheongsaro, Seo-gu, Daejeon 35208 Facsimile No. +82-42-481-8578	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2024/020974

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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	JP 09-199647 A (TOSHIBA CORP.) 31 July 1997 (1997-07-31) See paragraphs [0007]-[0008] and figure 1.	1-15

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2024/020974

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		WO 2012-091499 A3	08 November 2012
KR 10-2007-0058249 A	08 June 2007	None	
JP 09-199647 A	31 July 1997	None	

Form PCT/ISA/210 (patent family annex) (July 2022)