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(54) **ELECTROMAGNETIC INDUCTION HEATING UNIT AND AIR CONDITIONING DEVICE**

(57) The present invention solves the problem of how to provide an electromagnetic induction heating unit and an air conditioner that, even if a magnetic field is generated by an electromagnetic induction heating unit when performing electromagnetic induction heating, the amount of the magnetic field that leaks to the portions outside of the refrigerant piping can be kept small. An electromagnetic induction heating unit **(6)** heats a refrigerant piping **(F)** through electromagnetic induction heating, and comprises: a coil **(68),** a shielding cover **(75),** and a ferrite part **(98, 99).** The coil **(68)** is disposed in the vicinity of the refrigerant piping **(F).** The shielding cover **(75)** is disposed around the refrigerant piping **(F)** and includes a magnetic body. The ferrite part **(98, 99)** is disposed on the outer side of the coil **(68),** which is the opposite side of the inner side, namely, the refrigerant piping **(F)** side, of the coil **(68),** and on the inner side of the shielding cover **(75)** and contains a magnetic material whose magnetic permeability is higher than that of the shielding cover **(75).** Both end parts of the shielding cover **(75)** in the directions in which the refrigerant piping **(F)** extends are positioned on the inner side of both end parts of the ferrite part **(98, 99).**

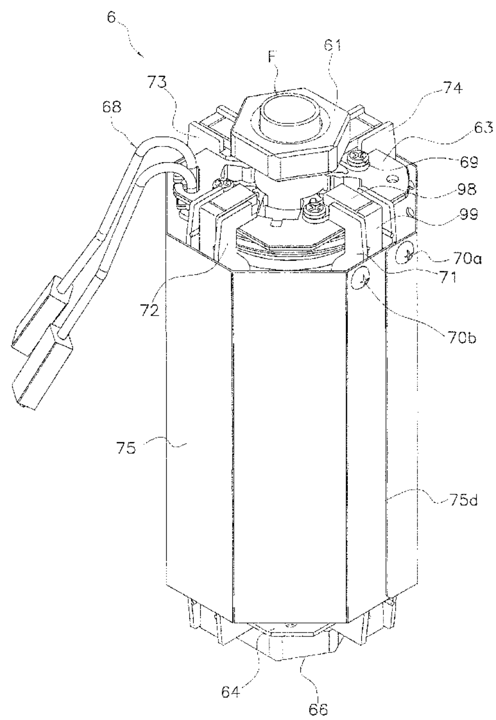

FIG. 9

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Description

TECHNICAL FIELD

[0001] The present invention relates to an electromagnetic induction heating unit and an air conditioner.

BACKGROUND WART

[0002] A refrigeration cycle is provided with a radiator, which releases the heat from a refrigerant, a heater, which imparts heat to the refrigerant, and the like. The refrigerant that circulates through the refrigeration cycle obtains heat by, for example, exchanging heat with indoor air during a cooling operation cycle, exchanging heat with outdoor air during a heating operation cycle, and the like.

[0003] According to the refrigeration cycle of an air conditioner recited in Patent Document 1 (i.e., Japanese Unexamined Patent Application Publication No. H08-210720) indicated below, a system has been proposed wherein the refrigerant obtains heat not only from indoor air and outdoor air as discussed above but also by means of a refrigerant heating apparatus separately provided. In this refrigerant heating apparatus, heat is imparted to the refrigerant, which flows through the interior of a heat exchanger, by heating the heat exchanger with a burner. Thus, because this air conditioner adopts a refrigerant heating apparatus, it is possible to heat the refrigerant when the refrigerant requires heat without being constrained by, for example, the indoor or outdoor air temperature.

SUMMARY OF THE INVENTION

<Technical Problem>

[0004] Instead of heating with a system that uses the fire of a burner and the like, it is also possible to adopt an electrical electromagnetic induction heating system as the refrigerant heating apparatus discussed above. For example, an electromagnetic induction coil can be wound around a refrigerant piping, which contains a magnetic material, and thereby, owing to the magnetic flux induced by the flow of electric current to the electromagnetic induction heating coil, the refrigerant piping can generate heat. Furthermore, the refrigerant can be heated using the heat generated in that refrigerant piping.

[0005] However, if the heating of the refrigerant piping by electromagnetic induction generates a magnetic field, then that magnetic field will arise not only inside the refrigerant piping but also in portions outside of that piping.

[0006] In response, it is conceivable to dispose, around the refrigerant piping, a member that has a material that tends to capture magnetic flux; however, even in such a case, it is sometimes difficult to sufficiently hinder the leakage of the magnetic field.

[0007] The present invention considers the points discussed above, and it is an object of the present invention to provide an electromagnetic induction heating unit and an air conditioner that, even if a magnetic field is generated by an electromagnetic induction heating unit when performing electromagnetic induction heating, the amount of the magnetic field that leaks to the portions outside of the refrigerant piping can be kept small.

<Solution to Problem>

[0008] An electromagnetic induction heating unit according to a first aspect of the invention is an electromagnetic induction heating unit that heats a refrigerant piping or a material that thermally contacts a refrigerant that flows through the refrigerant piping, or both, and comprises: a coil, an external member, and a magnetic part. The coil is disposed in the vicinity of the refrigerant piping. The external member is disposed around the refrigerant piping and includes a magnetic body. The magnetic part is disposed on the outer side of the coil, which is the opposite side of the inner side, namely, the refrigerant piping side, of the coil, and on the inner side of the external member and contains a magnetic material whose magnetic permeability is higher than that of the external member. Both end parts of the external member in the directions in which the refrigerant piping extends are positioned on the inner side of both end parts of the magnetic part. Furthermore, heating performed using the electromagnetic induction heating unit herein includes at least: the case wherein a heat generating member that thermally contacts the refrigerant piping is heated through electromagnetic induction; the case wherein a heat generating member that thermally contacts the refrigerant flowing through the refrigerant piping is heated through electromagnetic induction; and the case wherein a heat generating member that constitutes at least part of the refrigerant piping is heated through electromagnetic induction.

[0009] There are cases wherein, when electromagnetic induction heating is performed, not only does a magnetic field arise in the target magnetic body, which is meant to generate heat, but also in the periphery thereof.

[0010] In contrast, in the present electromagnetic induction heating unit, the magnetic part, which contains a magnetic material of a higher magnetic permeability than that of the external member, is disposed on the outer side of the coil; consequently, the magnetic field that arises in portions outside of the refrigerant piping tends to pass through the magnetic part more than through the external member. Furthermore, because both end parts of the external member in the directions in which the refrigerant piping extends are positioned on the inner side of both end parts of the magnetic body, the magnetic flux that would leak out to portions outside of the refrigerant piping can be much more effectively captured than the external member can. Thereby, when electromagnetic induction heating is performed, the magnetic field that arises in portions outside of the refrigerant piping can be made to efficiently pass through the magnetic body; consequently, the strength of the magnetic field in outside of the magnetic part caused by the leakage can be kept lower than the strength of the magnetic field in the magnetic part.

[0011] An electromagnetic induction heating unit according to a second aspect of the invention is the electromagnetic induction heating unit according to the first aspect of the invention, wherein the coil is wound around at least part of the refrigerant piping.

[0012] In the present electromagnetic induction heating unit, part of the magnetic flux that arises owing to the flow of electric current to the coil can be aligned with the directions in which the refrigerant piping extends. Consequently, if the longitudinal directions of the magnetic body included in the refrigerant piping and the axial directions of the refrigerant piping are substantially the same, then the heating efficiency of the electromagnetic induction can be improved.

[0013] An electromagnetic induction heating unit according to a third aspect of the invention is the electromagnetic induction heating unit according to the first or second aspects of the invention, wherein at least part of the magnetic part extends to at least one side selected from the group consisting of: one side of the coil in directions in which the refrigerant piping extends; and another side, which is the opposite side of the one side with respect to the coil.

[0014] In the present electromagnetic induction heating unit, the magnetic flux that arises owing to the supply of electric power to the coil and that would leak out to the opposite side of the refrigerant piping can be captured by the magnetic part prior to being conducted to the external member. Consequently, the magnetic part can hinder a greater amount of the magnetic field leakage than the external member can. Thereby, not only the leakage of the magnetic field to the outer side of the magnetic part but also the leakage of the magnetic field to the outer side of the external member can be much more effectively reduced by virtue of the external member capturing the magnetic field that leaks to the outer side of the magnetic part.

[0015] An electromagnetic induction heating unit according to a fourth aspect of the invention is the electromagnetic induction heating unit according to any one aspect of the first through third aspects of the invention, wherein at least part of the magnetic part extends to the inner side of the coil, which is the outer side of the refrigerant piping when viewed from the axial directions of the refrigerant piping.

[0016] In the present electromagnetic induction heating unit, the strength of the magnetic field generated by the coil can be kept lower than a strength that would leak to the portions outside of the magnetic part and thereby the magnetic field can be made to pass through the magnetic part more efficiently.

[0017] An electromagnetic induction heating unit according to a fifth aspect of the invention is the electromagnetic induction heating unit according to any one aspect of the first through fourth aspects of the invention, wherein the magnetic part comprises a plurality of magnetic components disposed such that the magnetic components contact one another.

[0018] In the present electromagnetic induction heating unit, the magnetic part is not made as an integral member that conforms to a target shape; rather, the magnetic part can be made as a combination of multiple components that conform to the target shape. Furthermore, because these magnetic components are disposed in a state wherein they contact one another, any decline in the magnetic permeability at the portions at which the magnetic components contact one another can be reduced.

[0019] An electromagnetic induction heating unit according to a sixth aspect of the invention is the electromagnetic induction heating unit according to any one aspect of the first through fifth aspects of the invention, wherein the magnetic part contains a material that is a good conductor.

[0020] In the present electromagnetic induction heating unit, even if the magnetic flux is made to pass through the magnetic part for the purpose of reducing the number of lines of magnetic force on the outer side of the magnetic part, the Joule heat generated by the electrical resistance can be reduced because the magnetic part contains a material that is a good conductor.

[0021] An electromagnetic induction heating unit according to a seventh aspect of the invention is the electromagnetic induction heating unit according to any one aspect of the first through sixth aspects of the invention, wherein the magnetic part contains ferrite.

[0022] In the present electromagnetic induction heating unit, the magnetic flux can be made to actively pass through the magnetic part, which contains ferrite, and thereby the magnetic field that leaks to the outer side of the magnetic part can be reduced.

[0023] An air conditioner according to all eighth aspect of the invention is an air conditioner that comprises: an electromagnetic induction heating unit according to any one aspect of the first through seventh aspects; and a refrigeration cycle that includes a portion wherethrough a refrigerant flows to the refrigerant piping.

[0024] In the present air conditioner, even if electromagnetic induction heating is performed, the impact on the surroundings of the electromagnetic induction heating unit can be reduced.

<Advantageous Effects of Invention>

[0025] In the electromagnetic induction heating unit according to the first aspect of the invention, the strength of the magnetic field in outside of the magnetic part caused by the leakage can be kept lower than the strength of the magnetic field in the magnetic part.

[0026] Tin the electromagnetic induction heating unit according to the second aspect of the invention, the heating efficiency of the electromagnetic induction can be improved.

[0027] In the electromagnetic induction heating unit according to the third aspect of the invention, not only the leakage of the magnetic field to the outer side of the magnetic part but also the leakage of the magnetic field to the outer side of the external member can be much more effectively reduced by virtue of the external member capturing the magnetic field that leaks to the outer side of the magnetic part.

[0028] In the electromagnetic induction heating unit according to the fourth aspect of the invention, the magnetic field can be made to pass through the magnetic part more efficiently.

[0029] In the electromagnetic induction heating unit according to the fifth aspect of the invention, any decline in the magnetic permeability at the portions at which the magnetic components contact one another can be reduced.

[0030] In the electromagnetic induction heating unit according to the sixth aspect of the invention, the Joule heat generated by the electrical resistance can be reduced.

[0031] In the electromagnetic induction heating unit according to the seventh aspect of the invention, the magnetic field that leaks to the outer side of the magnetic part can be reduced.

[0032] In the air conditioner according to the eighth aspect of the invention, even if electromagnetic induction heating is performed, the impact on the surroundings of the electromagnetic induction heating unit can be reduced.

BRIEF DESCRIPTION OF THE DRAWING

[0033]

FIG. 1 is a refrigerant circuit diagram of an air conditioner according to one embodiment of the present invention.
FIG. 2 is an external oblique view that includes a front surface side of an outdoor unit.
FIG. 3 is an oblique view of the internal layout and configuration of the outdoor unit.
FIG. 4 is an external oblique view that includes a rear surface side of the internal layout and configuration of the outdoor unit.
FIG. 5 is a general, front, oblique view that shows the internal structure of a machine chamber of the outdoor unit.
FIG. 6 is an oblique view that shows the internal structure of the machine chamber of the outdoor unit.
FIG. 7 is an oblique view of a bottom plate and an outdoor heat exchanger of the outdoor unit.
FIG. 8 is a top plan view of the layout of an electromagnetic induction heating unit.
FIG. 9 is a schematic oblique view of the electromagnetic induction heating unit mounted to an accumulator pipe.
FIG. 10 is an external oblique view of the state wherein a shielding cover has been removed from the electromagnetic induction heating unit.
FIG. 11 is a cross sectional view of the electromagnetic induction heating unit mounted to the accumulator pipe.
FIG. 12 is a view that shows the state wherein a thermistor and a fuse are mounted.
FIG. 13 is an explanatory diagram of the state wherein magnetic flux arises around the electromagnetic induction heating unit.
FIG. 14 is a schematic oblique view of a first ferrite case.
FIG. 15 is a view of the vicinity of a screw part on the upper side of the first ferrite case.
FIG. 16 is a view of the vicinity of a screw part on the lower side of the first ferrite case.
FIG. 17 is a top plan view of the shielding cover.
FIG. 18 is a front view of the shielding cover.
FIG. 19 is a view that shows an aspect wherein ferrite parts tend to conduct magnetic flux more than the shielding cover does.
FIG. 20 is an explanatory diagram of a refrigerant piping according to another embodiment (C).
FIG. 21 is an explanatory diagram of the refrigerant piping according to another embodiment (D).
FIG. 22 is a view that shows an example of the layout of a coil and the refrigerant piping according to another embodiment (E).
FIG. 23 is a view that shows an example of the layout of bobbin covers according to another embodiment (E).
FIG. 24 is a view that shows an example of the layout of ferrite cases according to another embodiment (E).

DESCRIPTION OF EMBODIMENTS

[0034] An exemplary case of an air conditioner **1,** which comprises an electromagnetic induction heating unit **6** according to one embodiment of the present invention, will now be explained, referencing the drawings.

<1-1> Air Conditioner 1

[0035] **FIG. 1.** is a refrigerant circuit diagram that shows a refrigerant circuit **10** of the air conditioner **1**.

[0036] The air conditioner **1** is an apparatus wherein an outdoor unit **2,** which serves as a heat source side apparatus, and an indoor unit **4,** which serves as a utilization side apparatus, are connected by a refrigerant piping, and the space wherein the utilization side apparatus is disposed is air conditioned; furthermore, the air conditioner **1** comprises a compressor **21,** a four-way switching valve **22,** an outdoor heat exchanger **23,** an outdoor motor operated expansion valve **24,** an accumulator **25,** outdoor fans **26,** an indoor heat exchanger **41,** an indoor fan **42,** a hot gas bypass valve **27,** a capillary tube **28,** the electromagnetic induction heating unit **6,** and the like.

[0037] The compressor **21,** the four-way switching valve **22,** the outdoor heat exchanger **23,** the outdoor motor operated expansion valve **24,** the accumulator **25,** the outdoor fans **26,** the hot gas bypass valve **27,** the capillary tube **28,** and the electromagnetic induction heating unit **6** are housed inside the outdoor unit **2.** The indoor heat exchanger **41** and the indoor fan **42** are housed inside the indoor unit **4.**

[0038] The refrigerant circuit **10** comprises a discharge pipe **A,** an indoor side gas pipe **B,** an indoor side liquid pipe **C,** an outdoor side liquid pipe **D,** an outdoor side gas pipe **E,** an accumulator pipe **F,** a suction pipe **G,** a hot gas bypass circuit **H,** branched piping **K,** and union piping **J.** The refrigerant that passes through the indoor side gas pipe **B** and the outdoor side gas pipe **E** is mostly in the gas state, but the refrigerant passing through is not limited to the gas state. The refrigerant that passes through the indoor side liquid pipe **C** and the outdoor side liquid pipe **D** is mostly in the liquid state, but the refrigerant passing through is not limited to the liquid state.

[0039] The discharge pipe **A** connects the compressor **21** and the four-way switching valve 22. A discharge temperature sensor **29d,** which detects the temperature of the refrigerant passing through, is provided to the discharge pipe **A.** Furthermore, an electric power supply part **21e** supplies electric power to the compressor **21.** The amount of electric power the electric power supply part **21e** supplies is detected by a compressor electric power detection unit **29f.**

[0040] The indoor side gas pipe **B** connects the four-way switching valve **22** and the indoor heat exchanger **41.** A pressure sensor **29a,** which detects the pressure of the refrigerant passing through, is provided along the indoor side gas pipe **B.**

[0041] The indoor side liquid pipe **C** connects the indoor heat exchanger **41** and the outdoor motor operated expansion valve **24.**

[0042] The outdoor side liquid pipe **D** connects the outdoor motor operated expansion valve **24** and the outdoor heat exchanger **23.**

[0043] The outdoor side gas pipe **E** connects the outdoor heat exchanger **23** and the four-way switching valve **22.**

[0044] The accumulator pipe **F** connects the four-way switching valve **22** and the accumulator **25** and, in the state wherein it is installed in the outdoor unit **2,** extends in the vertical directions. The electromagnetic induction heating unit **6** is mounted to part of the accumulator pipe **F.** At least a heat generating portion of the accumulator pipe **F,** which is enveloped by a coil **68** (discussed below), comprises a magnetic pipe **F2** provided such that it envelops a copper pipe **F1,** wherein the refrigerant flows (refer to **FIG. 11**). The magnetic pipe **F2** is made of steel use stainless (SUS) 430. SUS 430 is a ferromagnetic material; when placed in a magnetic field, eddy currents arise, which generate heat by the action of Joule heat induced by the material's own electrical resistance. The portion of the piping that constitutes the refrigerant circuit **10** and that is outside of the magnetic pipe **F2** comprises copper pipes. Furthermore, the material property of the pipe that envelops the copper pipe is not limited to SUS 430, and can be, for example: one type of conductor selected from the group consisting of iron, copper, aluminum, chrome, and nickel; an alloy containing at least two or more types of metal selected from the same group; and the like. In addition, examples of SUS include ferritic steel, martensitic steel, or a combination thereof. Furthermore, it is preferable to use a material that is a ferromagnetic, has a comparatively high electrical resistance, and has a higher Curie temperature than that of the working temperature range. Furthermore, the accumulator pipe **F** herein requires a larger amount of electric power; however, instead of a magnetic body and a material that contains a magnetic body, it may contain a material that can be induction heated. Furthermore, for example, the magnetic material may constitute all of the accumulator pipe **F,** only an inner side surface of the accumulator pipe **F,** or be simply included in the material that constitutes the accumulator pipe **F.** By performing electromagnetic induction heating in this manner, the accumulator pipe **F** can generate heat by electromagnetic induction, and thereby the refrigerant that is suctioned into the compressor **21** via the accumulator **25** can be heated. Thereby, the heating capacity of the air conditioner **1** can be improved. In addition, for example, even if the compressor **21** is not sufficiently heated when heating operation is started up, the electromagnetic induction heating unit **6** can perform quick heating, thereby supplementing the capacity shortfall during startup. Furthermore, if the four-way switching valve **22** switches to the cooling operation state and the defrosting operation, which eliminates frost that adheres to the outdoor heat exchanger **23** and the like, is performed, then the compressor **21** can compress the quickly heated refrigerant by virtue of the electromagnetic induction heating unit 6 quickly heating the accumulator pipe **F.** Consequently, the temperature of the hot gas discharged from the compressor **21** can be quickly raised. Thereby, the time needed for the defrosting operation to perform defrosting can be shortened. Thereby, even if it is necessary to perform the defrosting operation when appropriate during heating operation, it is possible to return to the heating operation as quickly as possible and thereby to improve user comfort.

[0045] The suction pipe **G** connects the accumulator **25** and the inlet side of the compressor 21.

[0046] The hot gas bypass circuit **H** connects a branching point **A1,** which is provided along the discharge pipe **A,** and a branching point **D1,** which is provided along the outdoor side liquid pipe **D.** The hot gas bypass valve **27,** which is capable of switching between the state in which the refrigerant is permitted to pass through and the state in which it isn't, is disposed along the hot gas bypass circuit **H.** Furthermore, the capillary tube **28,** which lowers the pressure of the refrigerant passing through, is provided along the hot gas bypass circuit **H** between the hot gas bypass valve **27** and the branching point **D1.** Because the pressure of the refrigerant can approach that of the refrigerant after the pressure has been decreased by the outdoor motor operated expansion valve **24** during heating operation, the capillary tube **28** can hinder a rise in the pressure of the refrigerant in the outdoor side liquid pipe **D** by supplying hot gas, which has passed through the hot gas bypass circuit **H,** to the outdoor side liquid pipe **D.**

[0047] The branched piping **K** constitutes part of the outdoor heat exchanger **23** and is the refrigerant piping that, to increase the effective surface area for exchanging heat, extends from a gas side inlet/outlet **23e** of the outdoor heat exchanger **23** and branches into multiple pipes at a branching and merging point **23k** (discussed below). The branched piping **K** comprises a first branch pipe **K1,** a second branch pipe **K2,** and a third branch pipe **K3,** each of which independently extend from the branching and merging point **23k** to a merging and branching point **23j**; furthermore, the branched pipes **K1, K2, K3** merge at the merging and branching point **23j**. Furthermore, viewed from the union piping **J** side, the branched piping **K** branches at the merging and branching point **23j** and extends therefrom.

[0048] The union piping **J** constitutes part of the outdoor heat exchanger **23** and is a piping that extends from the merging and branching point **23j** to a liquid side inlet/outlet **23d** of the outdoor heat exchanger **23.** The union piping **J** can, during cooling operation, make uniform the degree of supercooling of the refrigerant flowing out of the outdoor heat exchanger **23** and, during heating operation, defrost any ice that adheres to the vicinity of the lower end of the outdoor heat exchanger **23.** The union piping **J** has a cross sectional area that is substantially three times that of each of the branched pipes **K1, K2, K3,** and therefore the amount of refrigerant passing through is substantially three times that of each of the branched pipes **K1, K2, K3.**

[0049] The four-way switching valve **22** is capable of switching between a cooling operation cycle and a heating operation cycle. In **FIG. 1**, solid lines indicate the connection state wherein heating operation is performed, and dotted lines indicate the connection state wherein cooling operation is performed. During heating operation, the indoor heat exchanger **41** functions as a cooler of the refrigerant, and the outdoor heat exchanger **23** functions as a heater of the refrigerant. During cooling operation, the outdoor heat exchanger **23** functions as a cooler of the refrigerant, and the indoor heat exchanger **41** functions as a heater of the refrigerant.

[0050] The outdoor heat exchanger **23** comprises the gas side inlet/outlet **23e,** the liquid side inlet/outlet **23d,** the branching and merging point **23k,** the merging and branching point **23j,** the branched piping **K,** the union piping **J,** and heat exchanging fins **23z.** The gas side inlet/outlet **23e** is positioned at an end part on the outdoor side gas pipe **E** side of the outdoor heat exchanger **23** and connects to the outdoor side gas pipe **E.** The liquid side inlet/outlet **23d** is positioned at an end part on the outdoor side liquid pipe **D** side of the outdoor heat exchanger **23** and connects to the outdoor side liquid pipe **D.** The branching and merging point **23k** branches the piping that extends from the gas side inlet/outlet **23e** and can branch or merge the refrigerant in accordance with the direction in which the refrigerant is flowing. In the branched piping **K,** multiple pipes extend from the branched portions at the branching and merging point **23k.** The merging and branching point **23j** merges the branched piping **K** and can merge or branch the refrigerant in accordance with the direction in which the refrigerant is flowing. The union piping **J** extends from the merging and branching point **23j** to the liquid side inlet/outlet **23d.** The heat exchanging fins **23z** are plate shaped aluminum fins arrayed in the plate thickness directions and disposed at prescribed intervals. Both the branched piping **K** and the union piping **J** are to be inserted through the heat exchanging fins **23z,** which they have in common. Specifically, the branched piping **K** and the union piping **J** are disposed such that they are inserted through, at different portions of, each of the heat exchanging fins **23z,** which they have in common, in the plate thickness directions. An outdoor air temperature sensor **29b**, which detects the outdoor air temperature, is provided to the outdoor heat exchanger **23** on the leeward side in the direction of the airflow of the outdoor fans **26.** In addition, an outdoor heat exchanger temperature sensor **29c,** which detects the temperature of the refrigerant flowing through the branched piping **K,** is provided to the outdoor heat exchanger **23.**

[0051] An indoor temperature sensor **43,** which detects the indoor temperature, is provided inside the indoor unit **4.** In addition, the indoor heat exchanger **41** is provided with an indoor heat exchanger temperature sensor **44,** which detects the temperature of the refrigerant on the indoor side liquid pipe **C,** along which the outdoor motor operated expansion valve **24** is connected, side of the indoor heat exchanger **41.**

[0052] A control unit **11** is constituted by the connection of an outdoor control unit **12,** which controls equipment disposed inside the outdoor unit **2,** and an indoor control unit **13,** which controls equipment disposed inside the indoor unit **4,** via a communications wire **11a.** The control unit **11** performs various control functions with respect to the air conditioner **1.**

[0053] In addition, a timer **95,** which counts in order to measure the time elapsed when various control functions are performed, is provided to the outdoor control unit **12.**

[0054] Furthermore, a controller **90,** which accepts the input of settings from the user, is connected to the control unit **11.**

<1-2> Outdoor Unit 2

[0055] **FIG. 2** is an external oblique view of the front surface side of the outdoor unit **2. FIG. 3** is an oblique view that shows the positional relationship between the outdoor heat exchanger **23** and the outdoor fans **26. FIG. 4** is an oblique view of the rear surface side of the outdoor heat exchanger **23.**

[0056] The outer surface of the outdoor unit **2** is a substantially rectangular parallelepipedic outdoor unit casing that comprises a top plate **2a,** a bottom plate **2b,** a front panel **2c,** a left side surface panel **2d,** a right side surface panel **2f,** and a rear surface panel **2e.**

[0057] The outdoor unit **2** is partitioned by a partition plate **2h** into a fan chamber, which is on the left side surface panel **2d** side and wherein the outdoor heat exchanger **23,** the outdoor fans **26,** and the like are disposed, and a machine chamber, which is on the right side surface panel **2f** side and wherein the compressor **21**, the electromagnetic induction heating unit **6,** and the like are disposed. In addition, the outdoor unit **2** comprises outdoor unit support platform **2g,** which are fixed to the bottom plate **2b** by screwing and constitute the lowest end parts of the outdoor unit **2** on the right and left sides. Furthermore, the electromagnetic induction heating unit **6** is disposed at an upper position of the machine chamber in the vicinity of the left side surface panel **2d** and the top plate **2a.** Here, a plurality of the heat exchanging fins **23z** of the outdoor heat exchanger **23** discussed above is arrayed in the plate thickness directions, which are substantially oriented in the horizontal directions. The union piping **J** is disposed by inserting it through the heat exchanging fins **23z** of the outdoor heat exchanger **23** in the thickness directions at the lowermost portion of the heat exchanging fins **23z.** The hot gas bypass circuit **H** is disposed such that it runs along below the outdoor fans 26 and the outdoor heat exchanger **23.**

[0058] **FIG. 5** is a general, front, oblique view that shows the internal structure of the machine chamber of the outdoor unit **2. FIG. 6** is an oblique view that shows the internal structure of the machine chamber of the outdoor unit **2. FIG. 7** is an oblique view that shows the layout of the outdoor heat exchanger **23** and the bottom plate **2b** in relation to each other. **FIG. 8** is a top plan view that shows the layout of the electromagnetic induction heating unit **6.**

[0059] The partition plate **2h** of the outdoor unit **2** partitions, from the front to the back and from the upper end to the lower end, the fan chamber, wherein the outdoor heat exchanger **23,** the outdoor fans **26,** and the like are disposed, and the machine chamber, wherein the electromagnetic induction heating unit **6,** the compressor **21,** the accumulator **25,** and the like are disposed. The compressor **21** and the accumulator **25** are disposed in a lower space of the machine chamber of the outdoor unit **2.** Furthermore, the electromagnetic induction heating unit **6,** the four-way switching valve **22,** and the outdoor control unit **12** are disposed in an upper space of the machine chamber of the outdoor unit **2,** above the compressor **21,** the accumulator **25,** and the like. The compressor **21,** the four-way switching valve **22,** the outdoor heat exchanger **23,** the outdoor motor operated expansion valve **24,** the accumulator **25,** the hot gas bypass valve **27,** the capillary tube **28,** and the electromagnetic induction heating unit **6,** which are disposed in the machine chamber and are the functional elements that constitute the outdoor unit **2,** are corrected via the discharge pipe **A,** the indoor side gas pipe **B,** the outdoor side liquid pipe **D,** the outdoor side gas pipe **E,** the accumulator pipe **F,** the hot gas bypass circuit **H,** and the like such that the refrigerant circuit **10** shown in **FIG.** 1 performs a refrigeration cycle. Here, as discussed below, the hot gas bypass circuit **H** comprises nine linked portions, namely, a first bypass portion **H1** through a ninth bypass portion **H9;** furthermore, when the refrigerant flows to the hot gas bypass circuit **H,** it flows in order from the first bypass portion **H1** to the ninth bypass portion **H9.**

<1-3> Electromagnetic Induction Heating Unit 6

[0060] **FIG. 9** is a schematic oblique view of the electromagnetic induction heating unit **6** mounted to the accumulator pipe **F. FIG. 10** is an external oblique view that shows the state wherein a shielding cover **75** has been removed from the electromagnetic induction heating unit **6. FIG. 11** is a cross sectional view of the electromagnetic induction heating **unit 6** mounted to the accumulator pipe **F.**

[0061] The electromagnetic induction heating unit 6 is disposed such that it covers the magnetic pipe **F2,** which is the heat generating portion of the accumulator pipe **F,** from the outer side in the radial directions and causes the magnetic pipe **F2** to generate heat by electromagnetic induction heating. The heat generating portion of the accumulator pipe **F** has a double pipe structure that comprises the copper pipe **F1** on the inner side and the magnetic pipe **F2** on the outer side.

[0062] The electromagnetic induction heating unit **6** comprises a first hex nut **61,** a second hex nut **66,** a first bobbin cover **63,** a second bobbin cover **64,** a bobbin main body **65,** a first ferrite case **71,** a second ferrite case **72,** a third ferrite case **73,** a fourth ferrite case **74,** first ferrite parts **98,** second ferrite parts **99,** the coil **68,** the shielding cover **75,** a thermistor **14,** a fuse **15,** and the like.

[0063] The first hex nut **61** and the second hex nut **66** are made of resin, and the electromagnetic induction heating unit **6** and the accumulator pipe **F** are stably fixed using a **C** ring (not shown). The first bobbin cover **63** and the second bobbin cover **64** are made of resin and cover the accumulator pipe **F** from the outer side in the radial directions at the upper end position and the lower end position, respectively. The first bobbin cover **63** and the second bobbin cover **64** each have four screw holes for screws **69,** which are for screwing the first through fourth ferrite cases **71-74** (discussed below) to the first bobbin cover **63** and the second bobbin cover **64** using screws **69.** Furthermore, the second bobbin cover **64** has an electromagnetic induction thermistor insertion opening **64f,** which is for inserting the thermistor **14** into the second bobbin cover **64** in order to mount the thermistor **14** to the outer surface of the magnetic pipe **F2.** In addition, the second bobbin cover **64** has a fuse insertion opening **64e,** which is for inserting the fuse **15** shown in **FIG. 13** into the second bobbin cover **64** in order to mount the fuse **15** to the outer surface of the magnetic pipe **F2.** The thermistor **14** converts the temperature detected to a signal and transmits such to the control unit **11.** The fuse **15** converts the detection result to a signal and transmits such to the control unit **11.** If the control unit **11** receives a notification from the fuse **15** that the temperature detected exceeds a prescribed limit, then the control unit **11** performs control such that the supply of electric power to the coil **68** is stopped, thereby avoiding thermal damage to the equipment. The bobbin main body **65** is made of resin, and the coil **68** is wound around the bobbin main body **65.** The coil **68** is wound helically around the outer side of the bobbin main body **65**, the directions in which the accumulator pipe **F** extends being the axial directions. The coil **68** is connected to a control printed circuit board **18** (not shown), and receives the supply of a high frequency electric current. The output of the control printed circuit board **18** is controlled by the control unit **11.** As shown in **FIG. 12,** the thermistor **14** and the fuse **15** are mounted in the state wherein the bobbin main body **65** and the second bobbin cover **64** are mated. Here, in the state wherein the thermistor **14** is mounted, satisfactory pressure contact between the thermistor **14** and the outer surface of the magnetic pipe **F2** is maintained by a leaf spring **16,** which presses the thermistor **14** inward in the radial directions of the magnetic pipe **F2.** In addition, in the state wherein the fuse **15** is mounted, too, satisfactory contact pressure between the fuse **15** and the outer surface of the magnetic pipe **F2** is likewise maintained by a leaf spring **17,** which presses the fuse **15** inward in the radial directions of the magnetic pipe **F2.** Thus, because tight contact is satisfactorily maintained between the thermistor **14** and the outer surface of the accumulator pipe **F** as well as between the fuse **15** and the outer surface of the accumulator pipe **F,** responsiveness is improved and sudden changes in temperature owing to electromagnetic induction heating can be detected promptly. The first ferrite case **71** is inserted into the first bobbin cover **63** and the second bobbin cover **64** from the directions in which the accumulator pipe **F** extends and is fixed by the screws **69.** The first ferrite case **71** through the fourth ferrite case **74** each house first ferrite parts **98** and second ferrite parts **99,** which are made of ferrite-a raw material that has high magnetic permeability. As shown in the magnetic flux explanatory diagram of **FIG. 13**, by capturing the magnetic field generated by the coil **68** and thereby forming a path for the magnetic flux, the first ferrite parts **98** and the second ferrite parts **99** tend not to externally leak the magnetic field. The shielding cover **75** is disposed at the outermost circumferential portion of the electromagnetic induction heating unit **6** and collects the magnetic flux that cannot be completely gathered by the first ferrite parts **98** and the second ferrite parts **99** alone. Thereby, virtually none of the magnetic flux leaks to the outer side of the shielding cover **75:** furthermore, the location at which the magnetic flux is generated can be determined independently.

(Ferrite Cases and Ferrite Parts)

[0064] The details of the ferrite cases will now be explained.

[0065] **FIG. 14** is a schematic oblique view of the first ferrite case **71,** wherein the first ferrite parts **98** and the second ferrite parts **99** are housed and fixed. **FIG. 15** shows the structure of the vicinity of the screw part on the upper side of the first ferrite case **71. FIG. 16** shows the structure of the vicinity of the screw part on the lower side of the first ferrite case **71.** Furthermore, the first through fourth ferrite cases **71-74** all have the same shape.

[0066] The first ferrite case **71** is made of resin and has a function wherein the first bobbin cover **63** and the second bobbin cover **64** are inserted from the directions in which the accumulator pipe **F** extends and are thereby fixed and a function wherein the first ferrite parts **98** and the second ferrite parts **99** are housed and held.

[0067] The first ferrite case **71** comprises a bottom surface part **71j,** side surface parts **71h**, a first cover screw part **71a**, a first cover screw hole **71b,** a second cover screw part **71f,** a second cover screw hole **71g,** shielding cover screw parts **71c,** and shielding cover screw holes **71d.**

[0068] The bottom surface part **71j** constitutes the bottom surface of the first ferrite case **71**. As discussed below, the first ferrite parts **98** and the second ferrite parts **99** are bonded to the bottom surface part **71j.** In the state wherein it is fixed to the electromagnetic induction heating unit **6,** the bottom surface part **71j** is provided at a position at which its surface is oriented in the radial directions, its longitudinal directions being the directions in which the accumulator pipe **F** extends. The bottom surface part **71j** is mounted to one of four symmetrically provided substantially linear sides of the outer edges of the first bobbin cover **63** and the second bobbin cover **64** in the radial directions. Thereby, the rear surface side of the bottom surface part **71j** and the substantially linear sides of both the first bobbin cover **63** and the second bobbin cover **64** are fixed in the state wherein they have been brought into contact. Thereby, the first ferrite case **71** has a structure that restrains movement in the circumferential directions.

[0069] The side surface parts **71h** have surfaces that extend from both sides of the bottom surface part **71j** in directions orthogonal to the longitudinal directions thereof and in the direction leading away from the bottom surface part **71j.**

[0070] The first cover screw part **71a** is provided for screwing the first ferrite case **71** and the first bobbin cover **63** together and is provided at a position displaced from a virtual space that extends in the radial directions and is interposed by the two side surface parts **71h.** Thereby, the first ferrite parts **98** can be disposed as far as the vicinity of the magnetic pipe **F2,** which makes it possible to reduce leakage of the magnetic force.

[0071] The second cover screw part **71f** is provided for screwing the first ferrite case **71** and the second bobbin cover **64** together and is provided, on the opposite side of the first cover screw part **71a,** at a position displaced from the virtual space that extends in the radial directions and is interposed by the two side surface parts **71h.** Thereby, the first ferrite parts **98** can be disposed as far as the vicinity of the magnetic pipe **F2**, which makes it possible to reduce leakage of the magnetic force. Furthermore, because the first cover screw part **71a** and the second cover screw part **71f** are disposed on opposite sides of the virtual space that extends in the radial directions and is interposed by the two side surface parts **71h**, the first cover screw part **71a** and the second cover screw part **71f** serve not only to reduce leakage of the magnetic force but also to more rigidly fix the first ferrite case **71** to the first bobbin cover **63** and the second bobbin cover **64.**

[0072] The second cover screw hole **71g** is used for screwing the first ferrite case **71** and the second bobbin cover **64** to one another, thereby fixing them. Specifically, as in the first cover screw hole **71b** discussed above, the second cover screw hole **71g** of the first ferrite case **71** and a screw hole (not shown) for the screw **69** of the second bobbin cover **64** are screwed together by the metal screw **69** and are thereby fixed.

[0073] The shielding cover screw parts **71c** are provided at two upper locations and two lower locations and are formed such that they protrude toward the outer side, which is the opposite of the inner side wherein the side surface parts **71h** face one another.

[0074] The shielding cover screw holes **71d** are openings that are provided to each of the shielding cover screw parts **71c** and, in the state wherein the shielding cover **75** is mounted as shown in **FIG. 9**, the shielding cover **75** is screwed by screws. Thereby, the first ferrite case **71** and the shielding cover **75** are fixed. Furthermore, the shielding cover screw parts **71c** and the shielding cover screw holes **71d** are also provided for each of the second through fourth ferrite cases **72-74;** however, in actuality, the shielding cover **75** is fixed by just two opposing ferrite cases of the first through forth ferrite cases **71-74;** in the present embodiment, the two opposing ferrite cases are the first ferrite case **71** and the third ferrite case **73.**

[0075] Furthermore, the first ferrite parts **98** and the second ferrite parts **99** housed in each of the ferrite cases **71-74** are disposed such that their surface portions contact one another.

[0076] In addition, the two different shapes of the ferrite parts **98, 99,** namely, the shape of the first ferrite parts **98** and the shape of the second ferrite parts **99,** combine to conduct the magnetic field. A ferrite part that is integrally formed in a **U** shape is not used; rather, ferrite parts of the same shape are combined, which makes it possible to lower cost. Furthermore, the first ferrite parts **98** and the second ferrite parts **99** housed in each of the ferrite cases **71-74** are disposed such that their surface portions contact one another.

(Shielding Cover)

[0077] The details of the shielding cover **75** will now be explained.

[0078] As shown in the top cross sectional view of **FIG. 17,** the shielding cover **75** is a substantially octagonal piece of sheet metal that contains a magnetic material and that in a plan view follows along the shape of the outer edge of the first through fourth ferrite cases **71-74** when they are mounted to the first bobbin cover **63** and the second bobbin cover **64.**

[0079] As shown in the top plan view of **FIG. 17**, the shielding cover **75** comprises an overlapped portion **75d,** wherein one end **75a** and an other end **75b** in the circumferential directions overlap in the plate thickness directions. In the overlapped portion **75d,** a surface in the vicinity of the one end **75a** and a surface in the vicinity of the other end **75b** are welded-from above to below in the directions in which the accumulator pipe **F** extends-in the state wherein the two surfaces are in contact with one another. Thereby, even if a magnetic field is generated by the electromagnetic induction heating unit **6** and the leakage magnetic flux is drawn in by the shielding cover **75,** it is possible to prevent the local generation of eddy currents because at no place do the parts of the shielding cover **75** contact one another locally. Thereby, it is possible to reduce the heat generated by the shielding cover **75,** which constitutes the outer side of the electromagnetic induction heating unit **6,** and to maintain a low temperature as a provision against the risk of the user touching the shielding cover **75.** In addition, as can be understood by comparing **FIG. 10**, which shows the state wherein the shielding cover **75** is not mounted, and **FIG. 9**, which shows the state wherein the shielding cover **75** is mounted, the shielding cover **75** envelops the coil **68** such that a finger and the like of the user is denied access to the coil **68.** Furthermore, here, the user can be effectively prevented from accessing the coil **68** because both ends of the coil **68** in the directions in which the accumulator pipe **F** extends are disposed between both ends of the shielding cover **75.**

[0080] In addition, as shown in **FIG. 18,** the shielding cover **75** has screw holes **75x, 75y** in the vicinity of the upper end in the longitudinal directions. As shown in **FIG. 9,** when the shielding cover **75** is fixed to the first ferrite case **71**, these screw holes **75x, 75y** function as holes wherethrough screws **70a, 70b** pass.

[0081] **FIG. 19** is a cross sectional view that shows an aspect wherein the magnetic flux tends to be conducted to the ferrite parts **98**, **99** more than to the shielding cover **75.**

[0082] The magnetic permeability of the ferrite parts **98, 99** is higher than that of the shielding cover **75,** which comprises a piece of sheet metal; furthermore, the ferrite parts **98, 99** are disposed such that they extend in the radial directions at the upper end and the lower end of the coil **68** and such that they straddle the coil **68** when viewed from the directions in which the accumulator pipe **F** extends. Consequently, the magnetic flux that would leak out tends to be conducted to the ferrite parts **98, 99** more than to the shielding cover **75,** the magnetic flux generated by the coil **68** is collected by the ferrite parts **98, 99** before it is collected by the shielding cover **75,** and therefore virtually all of that magnetic flux can be conducted to the ferrite parts **98**, **99.** Furthermore, it is possible to lighten the burden of the shielding cover **75** to prevent magnetic flux leakage, and thereby the magnetic field that leaks out of the electromagnetic induction heating unit **6** can be significantly more reduced.

[0083] In addition, because the first ferrite case **71** is formed from a resin, even if the shielding cover **75** is screwed to the first ferrite case **71** using the metal screws **70a, 70b,** the first ferrite parts **98** and the second ferrite parts **99** do not directly contact the shielding cover **75.** Thus, because a structure is adopted wherein the first ferrite parts **98** and the second ferrite parts **99** do not contact the shielding cover **75,** there is naturally no local point of contact between the first ferrite parts **98** and the second ferrite parts **99** on one side and the shielding cover **75** on the other side. Consequently, even if an electric current flows to the coil **68** owing to electromagnetic induction, the concentration of magnetic flux that would result from the presence of a point of contact between the first ferrite parts **98** and the second ferrite parts **99** on one side and the shielding cover **75** on the other side tends not to occur. Thereby, it is possible to hinder the occurrence of a rise in the temperature in some portion owing to the concentration of magnetic flux.

[0084] In addition, with regard to the ferrite parts **98, 99** of the second through fourth ferrite cases **72-74** that the shielding cover **75** covers from the outer side in the radial directions at a position other than a gap portion of the shielding cover **75,** the shielding cover **75,** which contains the magnetic body, and the first ferrite parts **98** and the second ferrite parts **99,** which are housed in the second through fourth ferrite cases **72-74,** can have a double structure that hinders leakage of magnetic flux. Thereby, it is possible to more effectively hinder the leakage of magnetic flux.

[0085] Furthermore, as shown in **FIG. 8,** the portion of the shielding cover **75** positioned near the right side surface panel **2f** of the outdoor unit **2** in a plan view is disposed such that it is secured against and plane parallel with the right side surface panel **2f.** Thereby, the magnetic flux conducted to the shielding cover **75** is prevented from, for example, being further conducted to the right side surface panel **2f** or causing the local generation of heat by the generation of eddy currents at local points of contact between the right side surface panel **2f** and the shielding cover **75.**

<Features of the Air Conditioned 1 of the Present Embodiment>

[0086] There are cases wherein, when electromagnetic induction heating is performed, not only does a magnetic field arise in the target magnetic body, which is meant to generate heat, but also in the periphery thereof.

[0087] In contrast, in the electromagnetic induction heating unit **6** of the air conditioner **1,** the ferrite parts **98, 99,** which contain a magnetic material of a higher magnetic permeability than that of the shielding cover **75,** are disposed on the outer side of the coil **68** and such that they extend nearer to the coil **68** than the shielding cover **75** does. Consequently, the magnetic field that arises in portions outside of the accumulator pipe **F** tends to pass through the ferrite parts **98, 99** more than through the shielding cover **75.** Consequently, the ferrite parts **98, 99** can efficiently capture the magnetic flux that would leak out to portions outside of the accumulator pipe **F**. Thereby, when electromagnetic induction heating is performed, the magnetic field that arises in portions outside of the accumulator pipe **F** can be made to efficiently pass through the ferrite parts **98, 99;** furthermore, any magnetic flux not collected by the ferrite parts **98, 99** is collected by the shielding cover **75.** Consequently, the magnetic flux that leaks out to portions outside of the electromagnetic induction heating unit **6** can be reduced.

<Other Embodiment>

[0088] The above text explained an embodiment of the present invention based on the drawings, but the specific constitution is not limited to these embodiments, and it is understood that variations and modifications may be effected without departing from the spirit and scope of the invention.

(A)

[0089] The above embodiment explained an exemplary case wherein the ferrite parts **98, 99** conduct the magnetic flux.

[0090] However, the present invention is not limited thereto.

[0091] For example, the material used to conduct the magnetic flux may be a good conductor that is not as magnetic as ferrite. In such a case, it is possible to reduce the Joule heat generated by electrical resistance when the magnetic field has been conducted.

(B)

[0092] The embodiment explained a case wherein the electromagnetic induction heating unit **6** is mounted to the accumulator pipe **F** of the refrigerant circuit **10.**

[0093] However, the present invention is not limited thereto.

[0094] For example, a refrigerant piping other than the accumulator pipe F may be provided. In such a case, a magnetic body of, for example, the magnetic pipe **F2** is provided to a portion of the refrigerant piping whereto the electromagnetic induction heating unit **6** is provided.

(C)

[0095] The embodiment explained an exemplary case wherein the accumulator pipe **F** is configured as a double pipe, namely, as the copper pipe **F1** and the magnetic pipe **F2.**

[0096] However, the present invention is not limited thereto.

[0097] As shown in **FIG. 20,** for example, a member to be heated **F2a** and two stoppers **F1a, F1b** may be disposed inside the accumulator pipe **F,** the refrigerant piping to be heated, or the like. Here, the member to be heated **F2a** contains a magnetic material and generates heat by the electromagnetic induction heating of the abovementioned embodiment. At two locations on the inner side of the copper pipe **F1,** the stoppers **F1a, F1b** continuously permit the passage of the refrigerant but do not permit the passage of the member to be heated **F2a.** Thereby, the member to be heated **F2a** does not move even when the refrigerant flows. Consequently, the target heating position of the accumulator pipe **F** and the like can be heated. Furthermore, the heat transfer efficiency can be improved because the member to be heated **F2a** and the refrigerant directly contact one another.

(D)

[0098] Instead of using the stoppers **F1a,** the position of the member to be heated **F2a** explained in the abovementioned other embodiment (C) may be prescribed with respect to the piping.

[0099] As shown in **FIG. 21,** for example, bent portions **FW** may be provided to the copper pipe **F1** at two locations, and the member to be heated **F2a** may be disposed on the inner side of the copper pipe **F1** between the two bent portions **FW.** In so doing, too, the movement of the member to be heated **F2a** can be hindered while the refrigerant is made to pass through.

(E)

[0100] The abovementioned embodiment explained a case wherein the coil **68** is helically wound around the accumulator pipe **F.**

[0101] However, the present invention is not limited thereto.

[0102] For example, as shown in **FIG. 22,** coils **168**, which are wound around bobbin main bodies **165**, are disposed at the circumference of-without being wound around-the accumulator pipe **F.** Here, each of the bobbin main bodies **165** is disposed such that its axial directions are substantially perpendicular to the axial directions of the accumulator pipe **F.** In addition, the two pairs of the bobbin main bodies **165** and coils **168** are disposed such that they sandwich the accumulator pipe **F.**

[0103] In this case, for example, as shown in **FIG. 23,** a first bobbin cover **163** and a second bobbin cover **164**, wherethrough the accumulator pipe **F** is inserted, may be disposed in a state wherein they are mated to the bobbin main bodies **165.**

[0104] Furthermore, as shown in **FIG. 24,** the first bobbin cover **163** and the second bobbin cover **164** may be interposed by a first ferrite case **171** and a second ferrite case **172,** and thereby fixed. **FIG. 24** presents an exemplary case wherein two ferrite cases are disposed such that they sandwich the accumulator pipe **F;** however, as in the abovementioned embodiment, ferrite cases may be disposed in four directions. In addition, as in the abovementioned embodiment, the ferrite parts may be housed therein.

[0105] Furthermore, the shielding cover 175 may be provided such that it covers the outermost circumferential portion of the electromagnetic induction heating unit **6** fixed in this manner.

<Miscellaneous>

[0106] The above text explained embodiments of the present invention based on the drawings, but the specific constitution is not limited to these embodiments. For example, the present invention also includes combination embodiments obtained by, where appropriate, combining the abovementioned embodiments with portions other than those included in the embodiments discussed above within a range that a person skilled in the art could effect based on the scope of the invention described above.

INDUSTRIAL APPLICABILITY

[0107] Using the present invention is particularly effective in an electromagnetic induction heating unit and an air conditioner wherein, even if a refrigerant piping is heated by electromagnetic induction, it is possible to hinder the leakage of the magnetic field to the periphery while hindering the local generation of heat, and thereby the refrigerant can be heated using electromagnetic induction.

REFERENCE SIGNS LIST

[0108]

1	Air conditioner
6	Electromagnetic induction heating unit
10	Refrigerant circuit
14	Thermistor
15	Fuse
21	Compressor
22	Four-way switching valve
23	Outdoor heat exchanger

24 Motor operated expansion valve
25 Accumulator
41 Indoor heat exchanger
65 Bobbin main body
68 Coil
71-74 First through fourth ferrite cases
75 Shielding cover
98, 99 First ferrite part, second ferrite part
F Accumulator pipe, refrigerant piping

CITATION LIST

PATENT LITERATURE

Patent Document 1

[0109] Japanese Unexamined Patent Application Publication No. H08-210720

Claims

1. An electromagnetic induction heating unit **(6)** that heats a refrigerant piping **(F)** or a material that thermally contacts a refrigerant that flows through the refrigerant piping **(F),** or both, comprising:

    a coil **(68),** which is disposed in the vicinity of the refrigerant piping **(F);**
    an external member **(75),** which is disposed around the refrigerant piping **(F)** and
    includes a magnetic body; and
    a magnetic part **(98, 99)** that is disposed on the outer side of the coil **(68),** which is the opposite side of the inner side, namely, the refrigerant piping **(F)** side, of the coil **(68),**
    and on the inner side of the external member **(75, 175)** and that contains a magnetic
    material whose magnetic permeability is higher
    than that of the external member; wherein,
    both end parts of the external member **(75)** in the directions in which the refrigerant piping **(F)** extends are positioned on the inner side of both end parts of the magnetic part **(98, 99).**

2. An electromagnetic induction heating unit **(6)** according to claim 1, wherein
the coil **(68)** is wound around at least part of the refrigerant piping **(F).**

3. An electromagnetic induction heating unit **(6)** according to claim 1 or claim 2, wherein
at least part of the magnetic part **(98, 99)** extends to at least one side selected from the group consisting of: one side of the coil **(68)** in directions in which the refrigerant piping **(F)** extends; and another side, which is the opposite side of the one side with respect to the coil **(68).**

4. An electromagnetic induction heating unit **(6)** according to any one claim of claim 1 through claim 3, wherein
at least part of the magnetic part (**98, 99**) extends to the inner side of the coil **(68),** which is the outer side of the refrigerant piping **(F)** when viewed from the axial directions of the refrigerant piping.

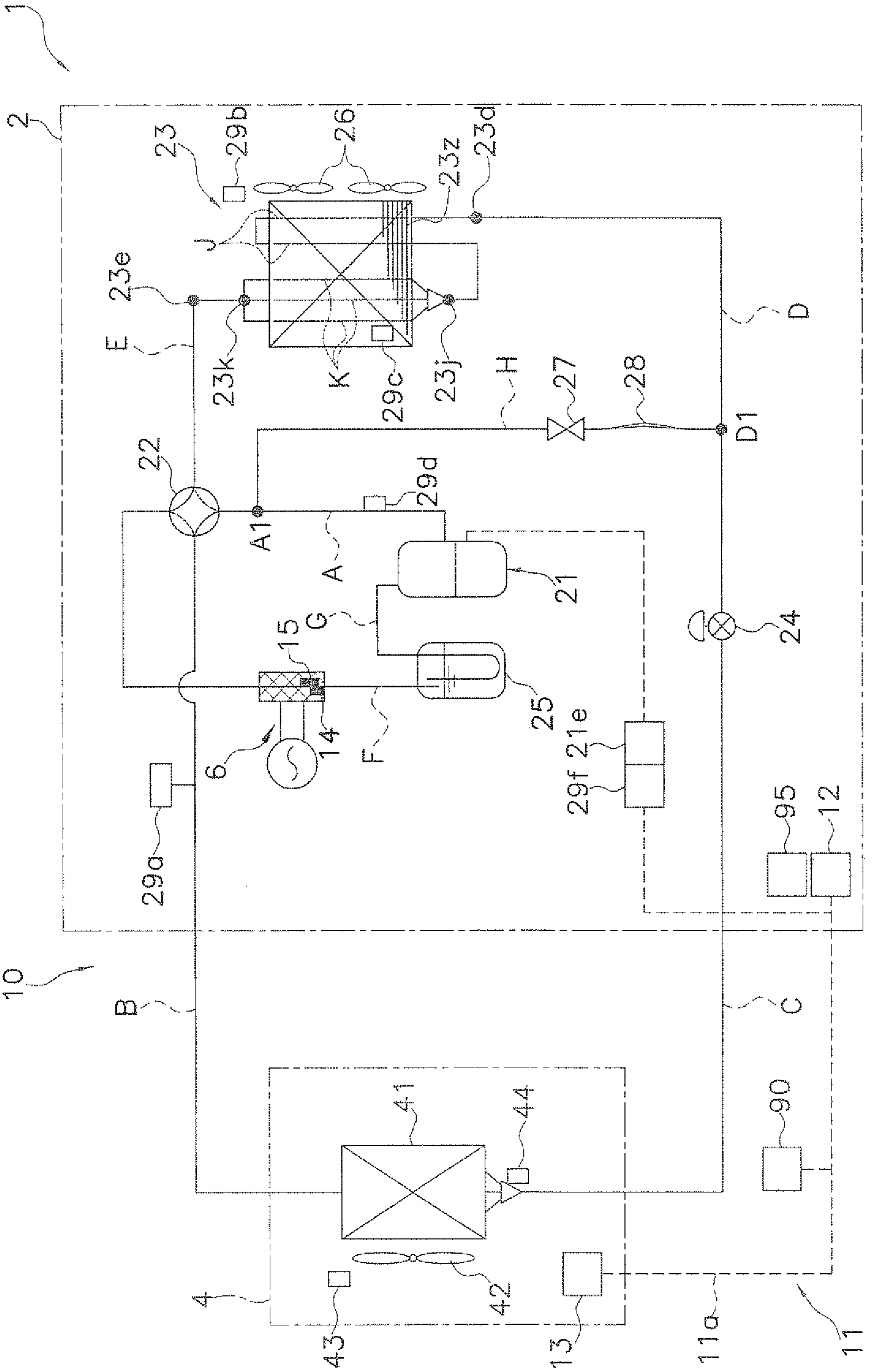
5. An electromagnetic induction heating unit **(6)** according to any one claim of claim 1 through claim 4, wherein
the magnetic part **(98, 99)** comprises a plurality of magnetic components **(98, 99)** disposed such that the magnetic components **(98, 99)** contact one another.

6. An electromagnetic induction heating unit **(6)** according to any one claim of claim 1 through claim 5, wherein
the magnetic part **(98, 99)** contains a material that is a good conductor.

7. An electromagnetic induction heating unit **(6)** according to any one claim of claim 1 through claim 6, wherein
the magnetic part **(98, 99)** contains ferrite.

8. An air conditioner **(1),** comprising:

    an electromagnetic induction heating unit **(6)** according to any one claim of claim 1 through claim 7; and
    a refrigeration cycle **(10)** that includes a portion wherethrough a refrigerant flows to the refrigerant piping **(F).**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29f
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FIG. 1

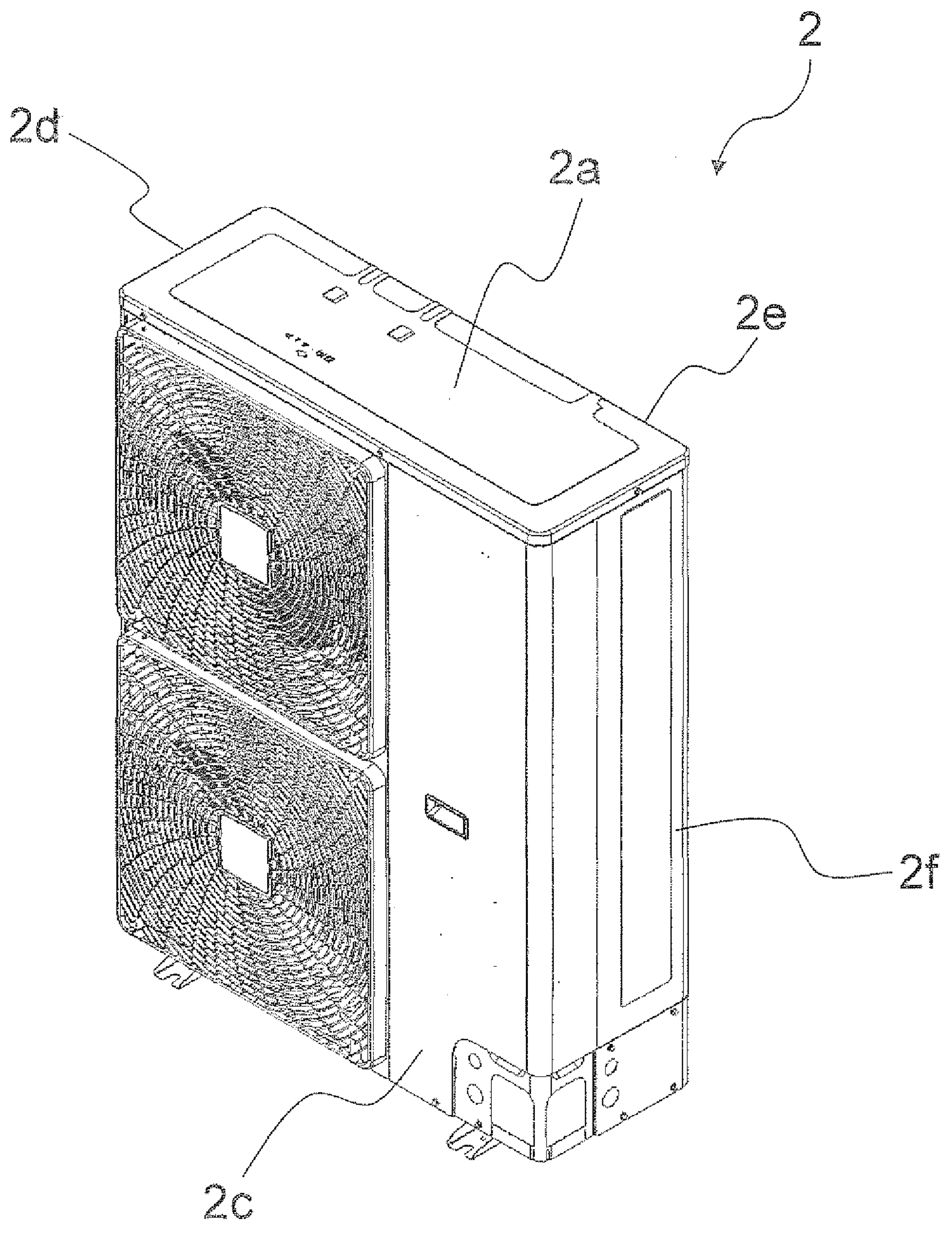

FIG. 2

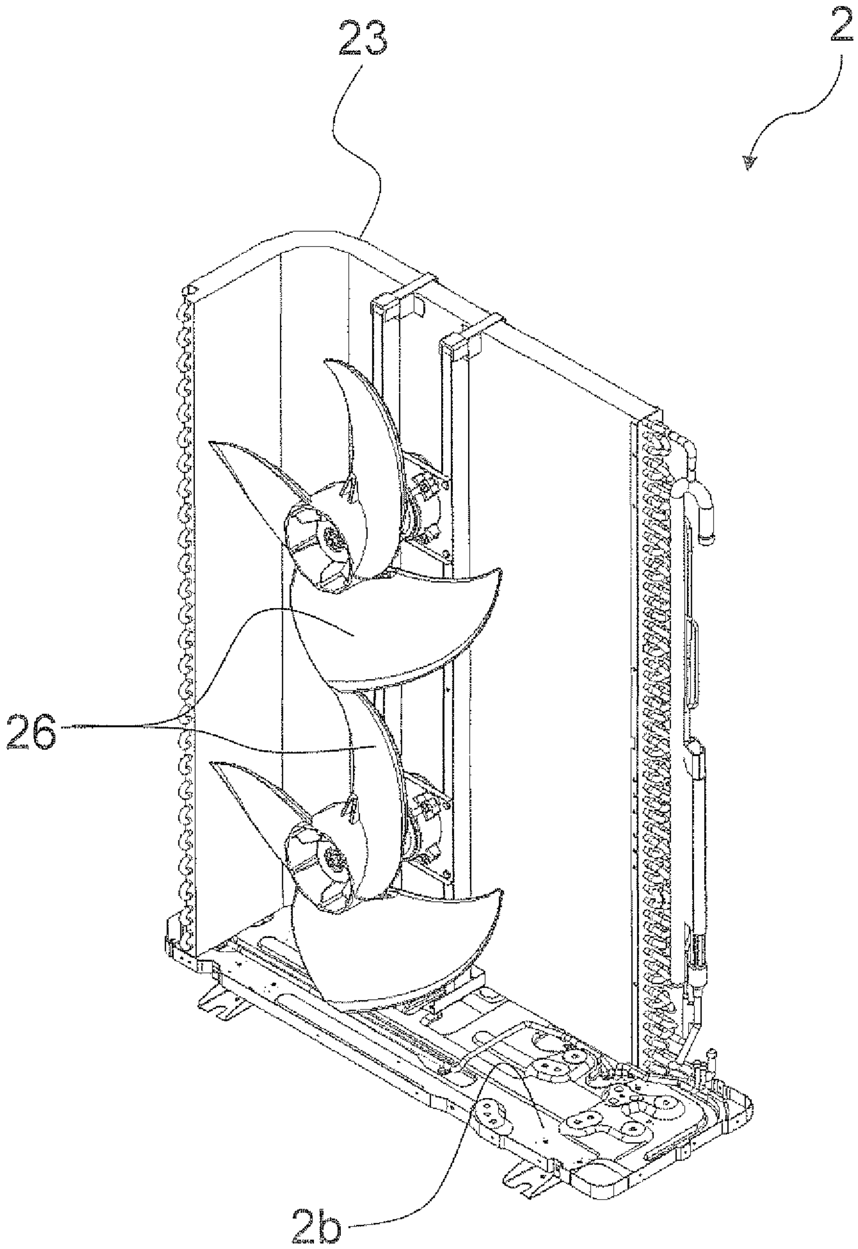

FIG. 3

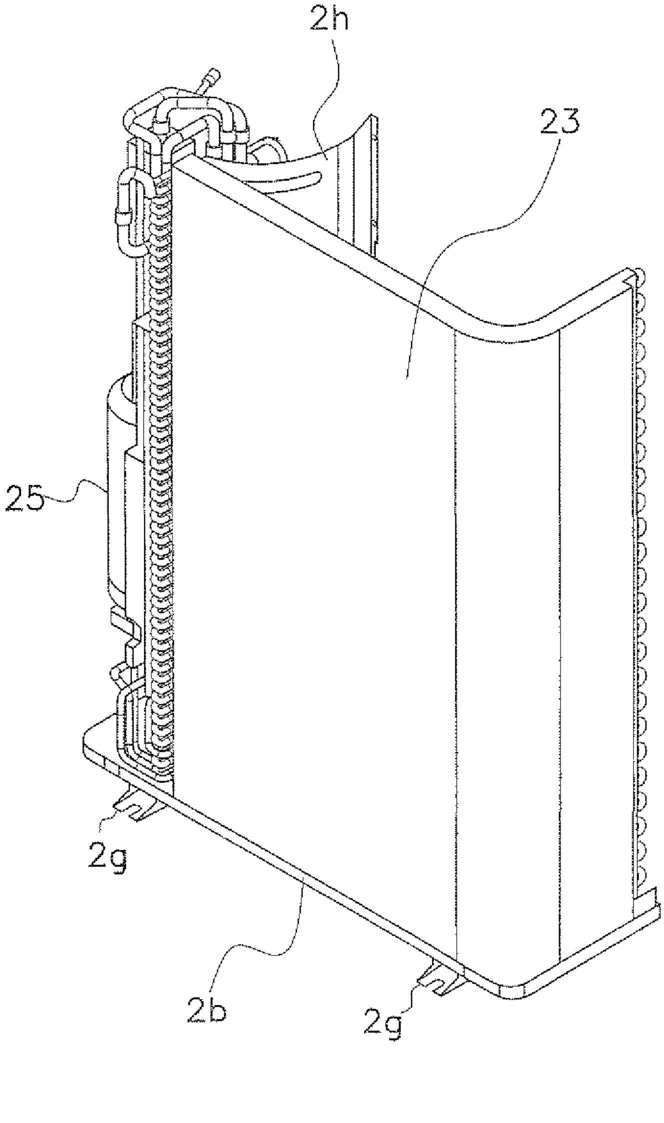

FIG. 4

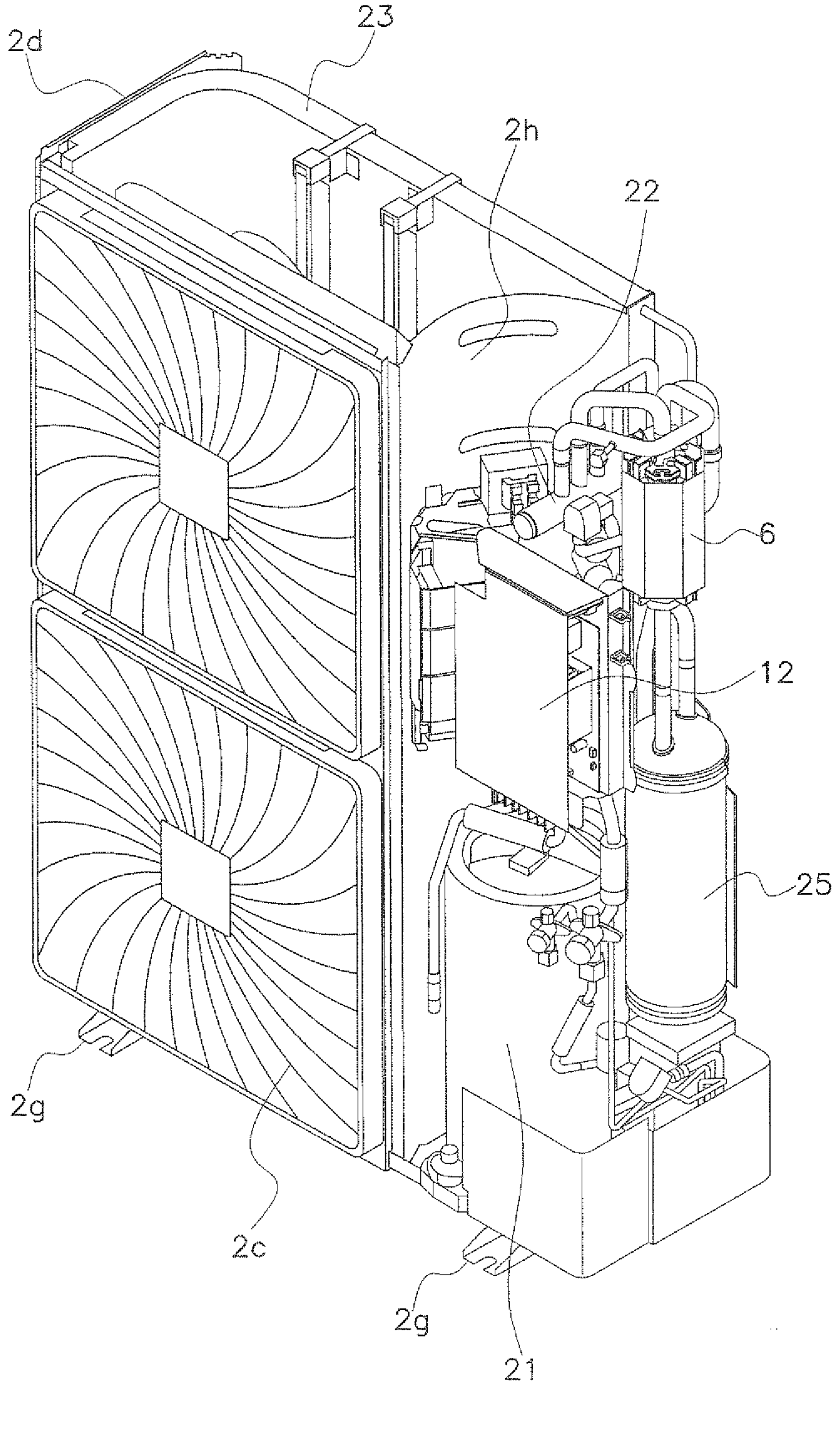

FIG. 5

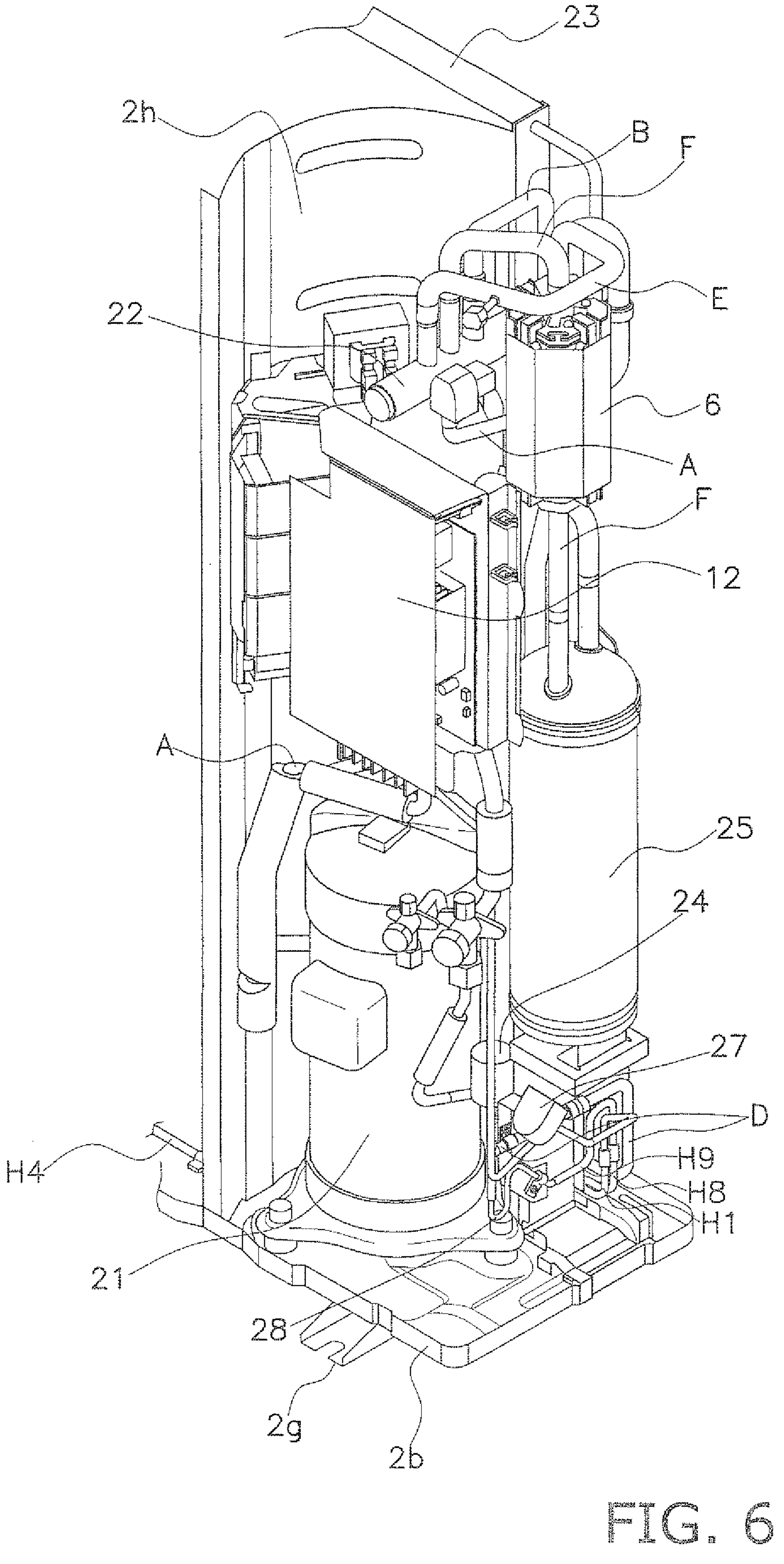

FIG. 6

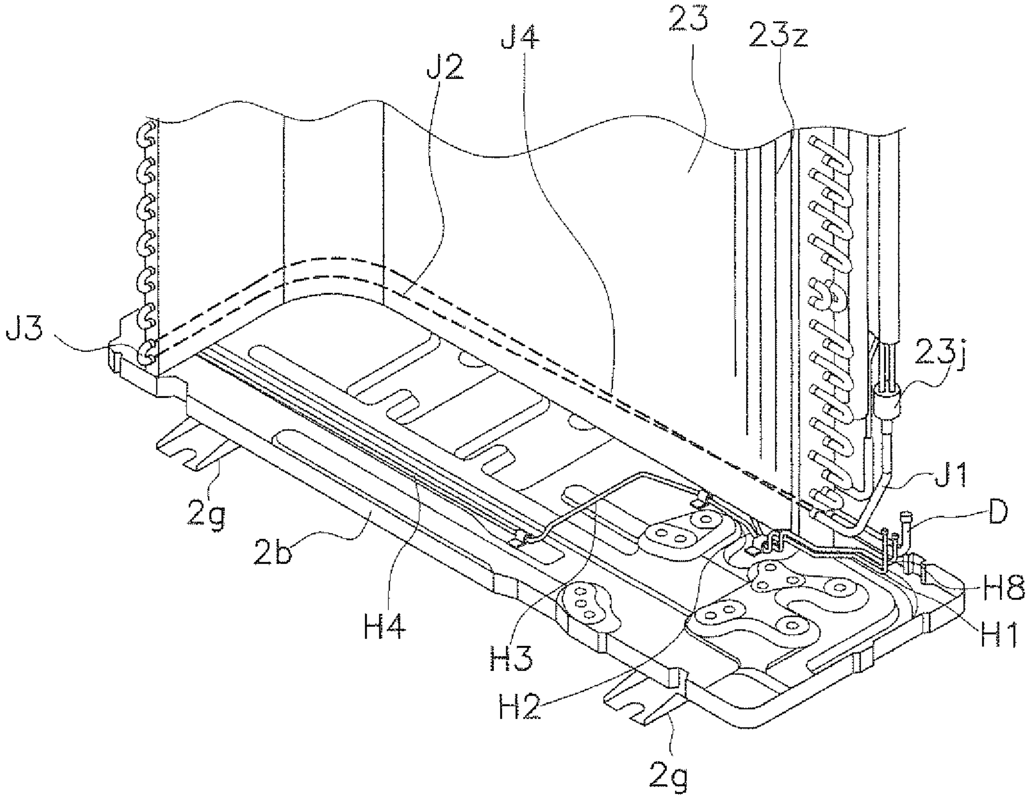

FIG. 7

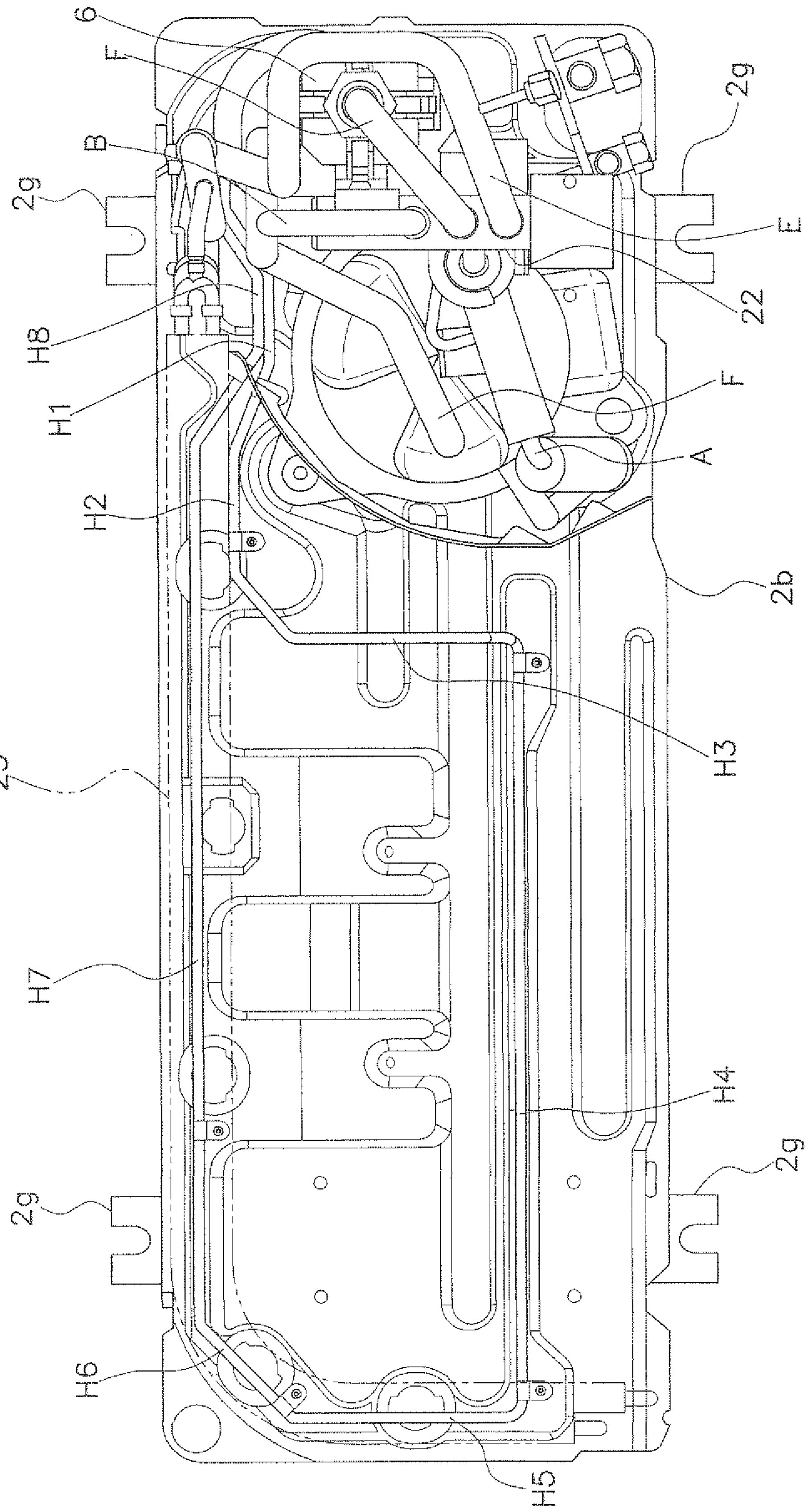

FIG. 8

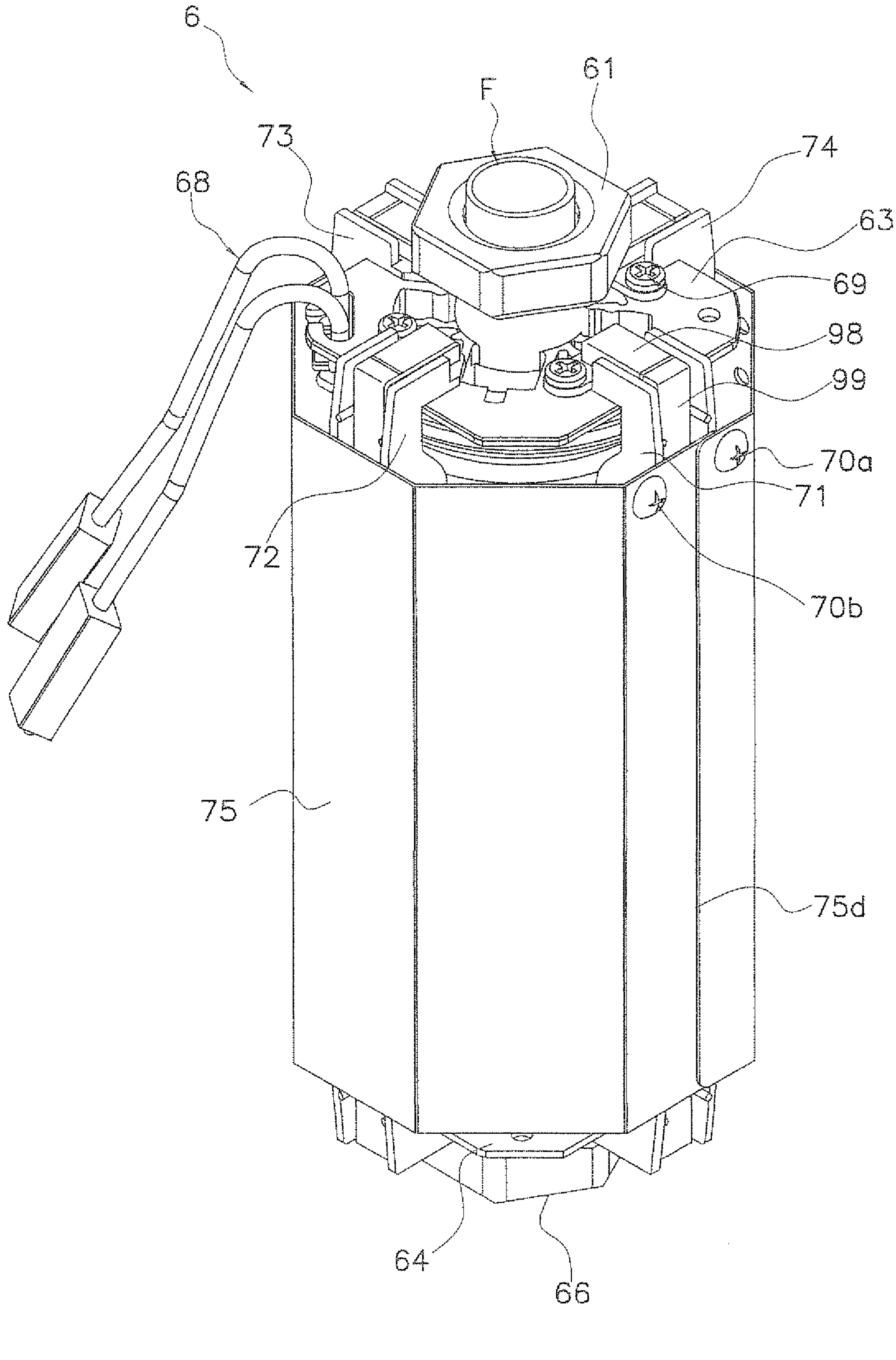

FIG. 9

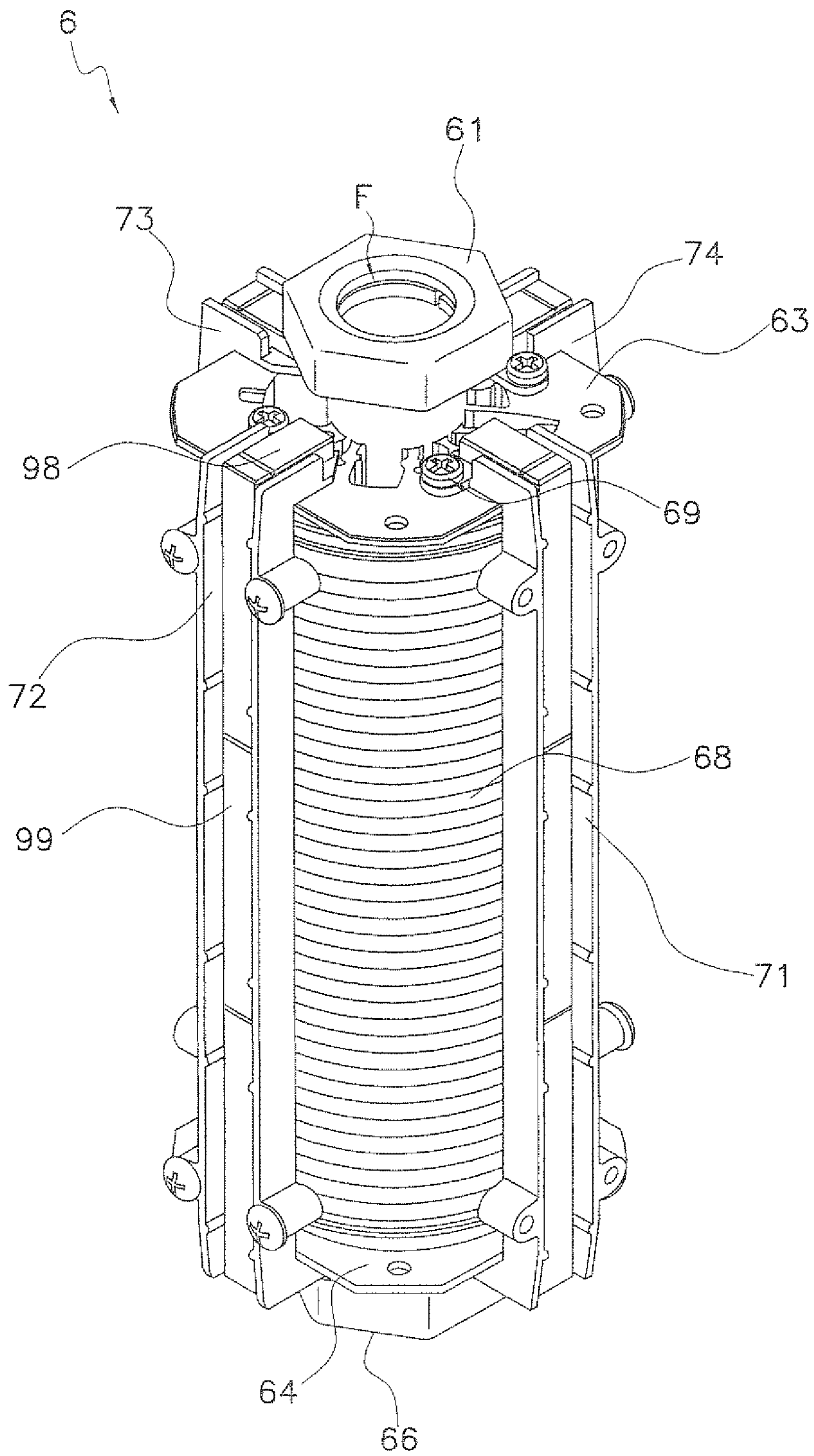

FIG. 10

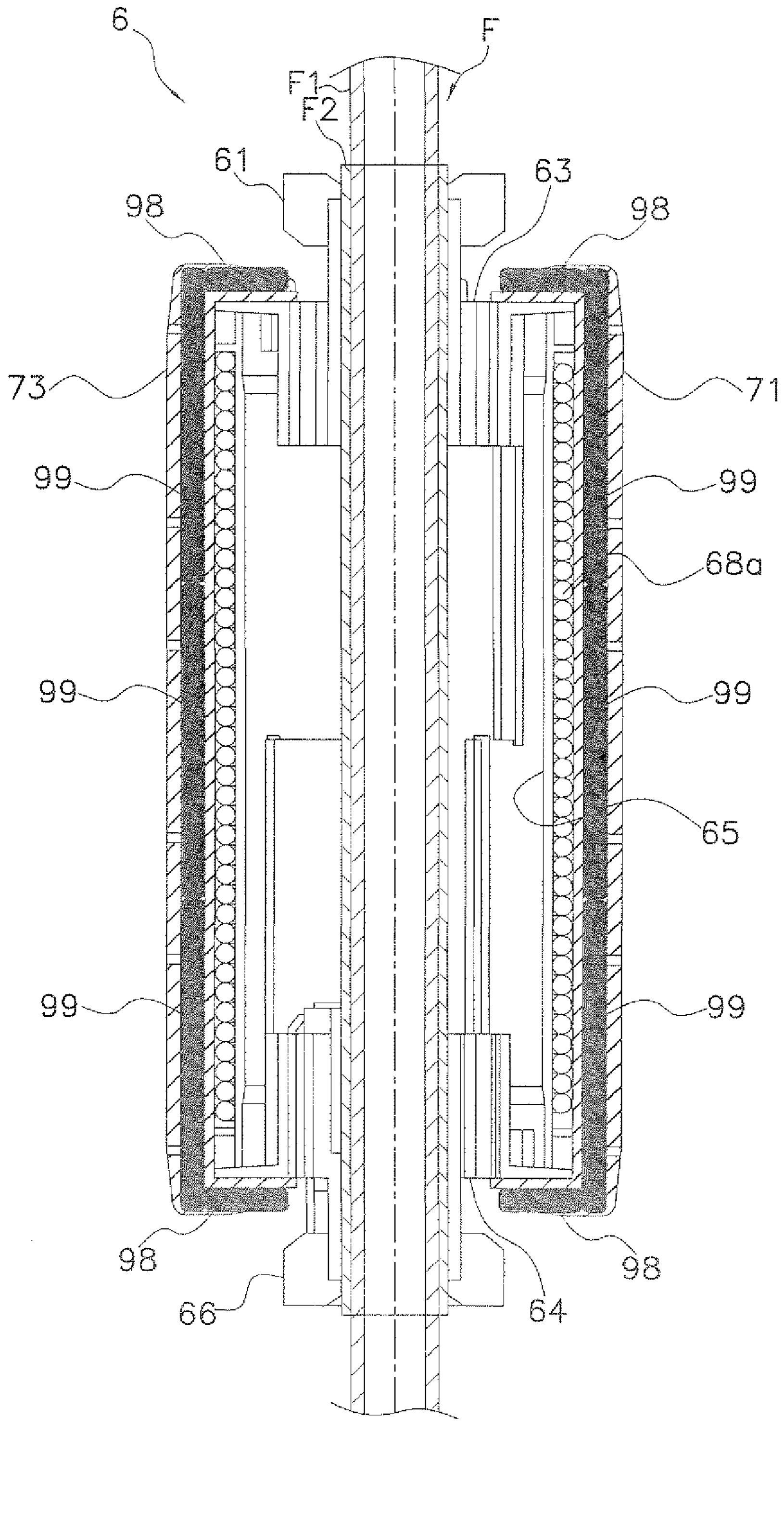

FIG. 11

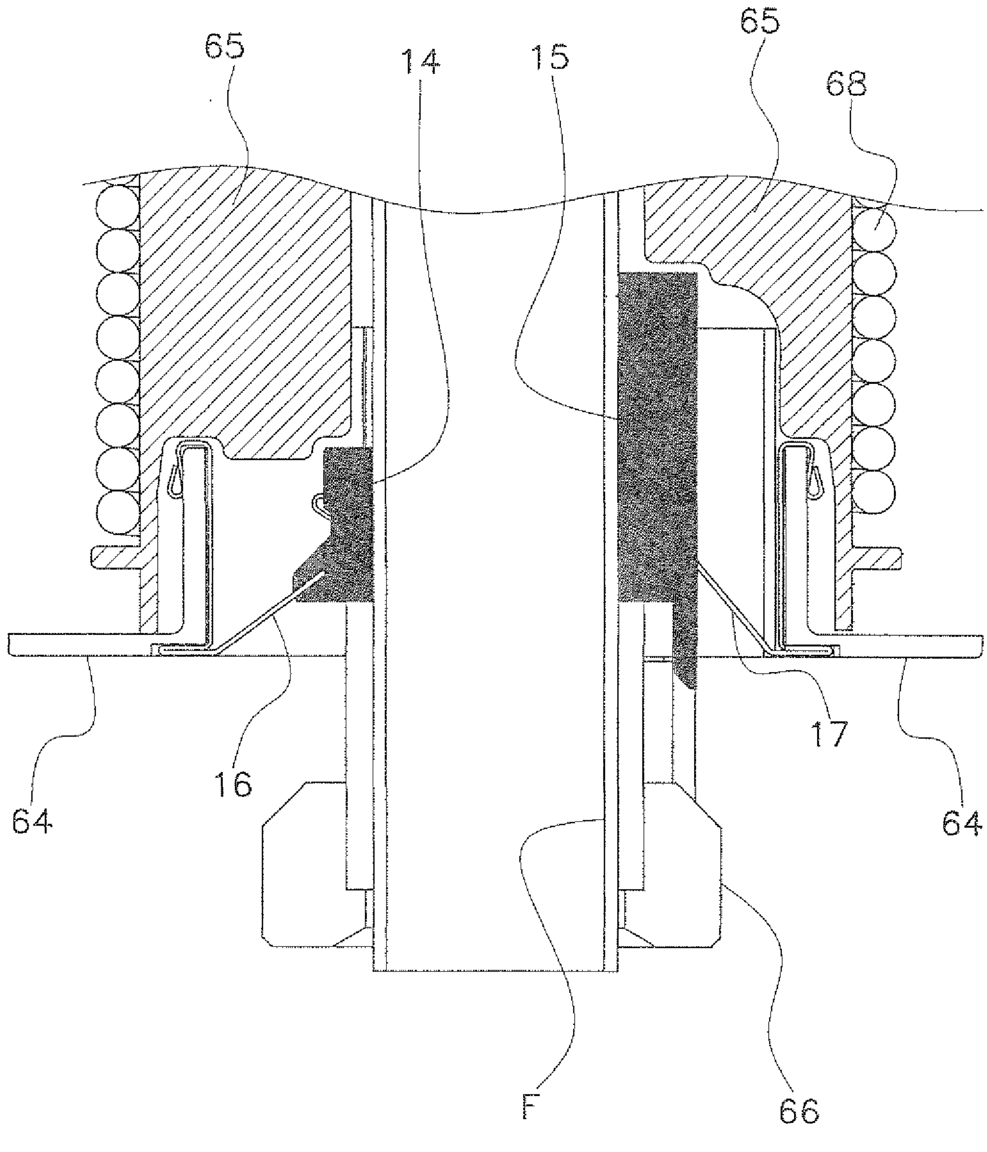

FIG. 12

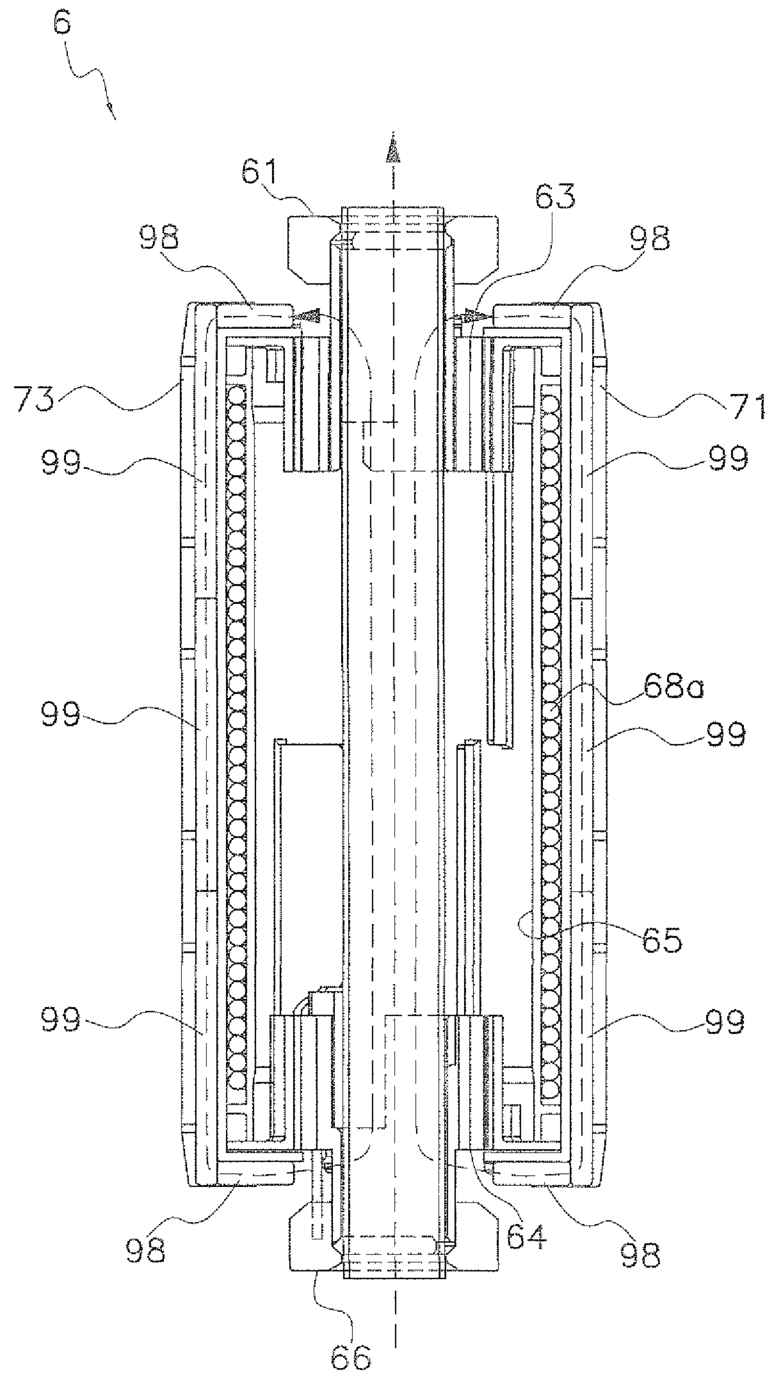

FIG. 13

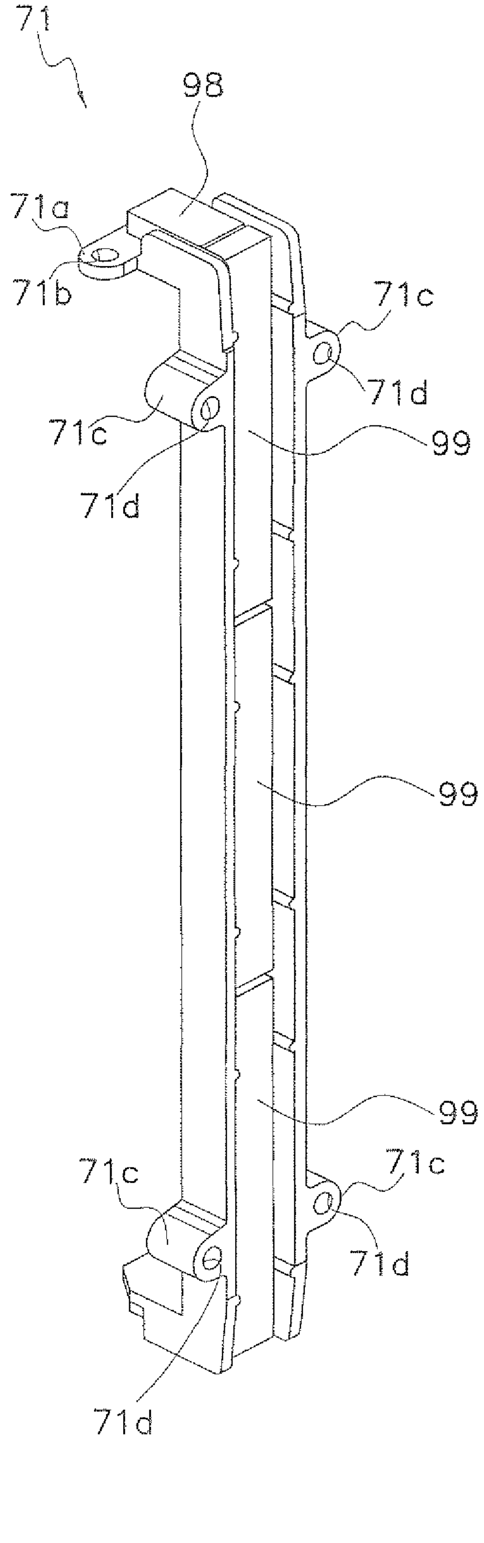

FIG. 14

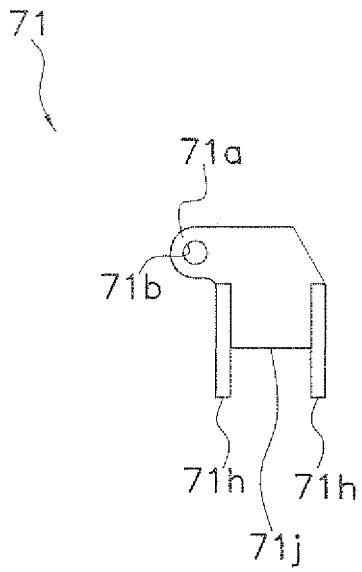

FIG. 15

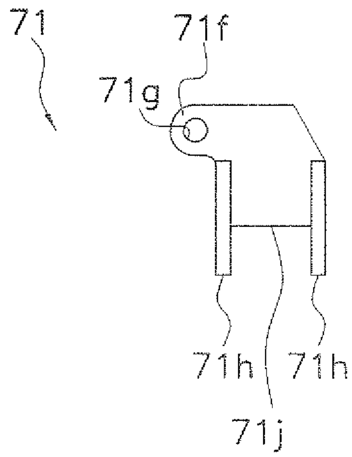

FIG. 16

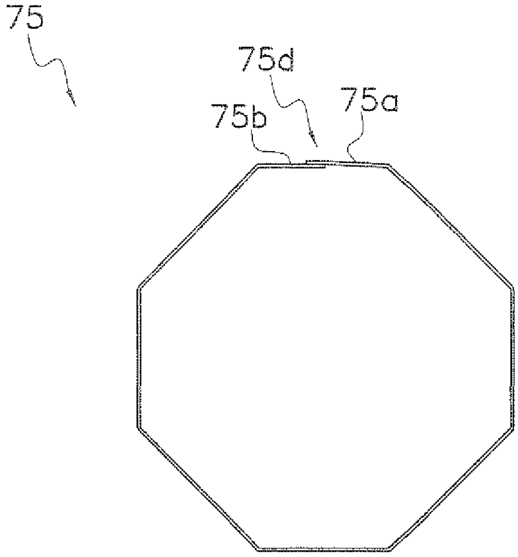

FIG. 17

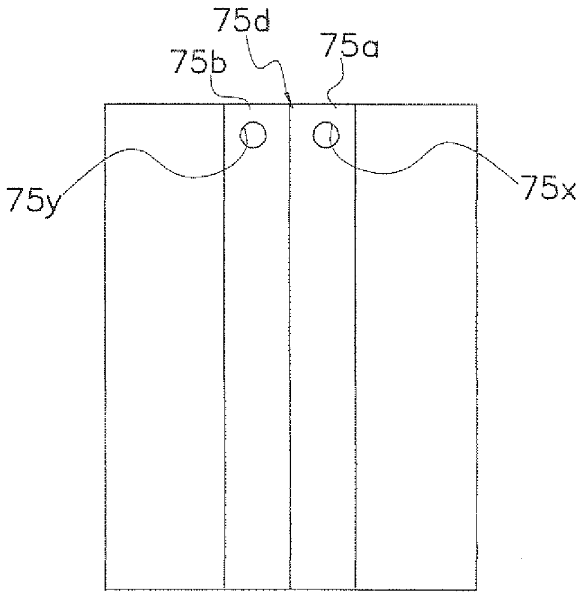

FIG. 18

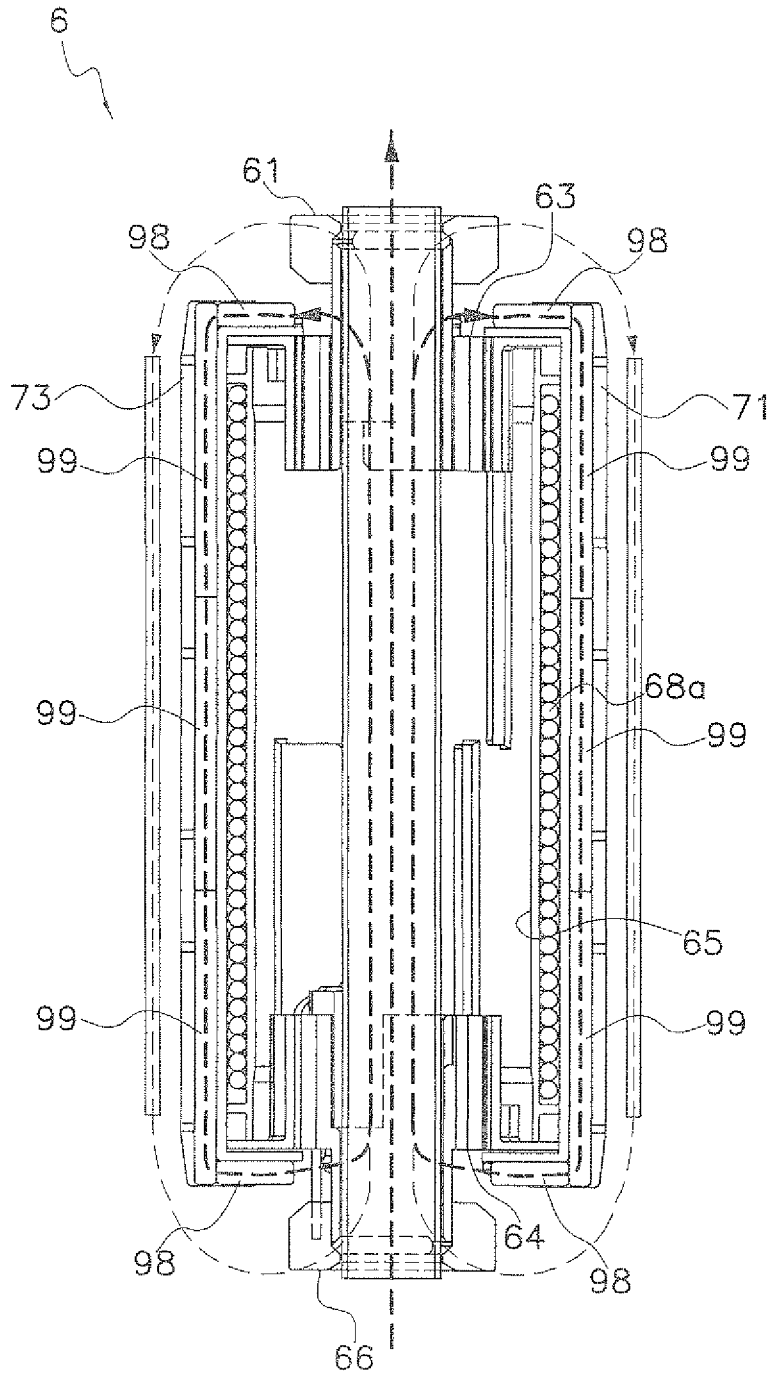

FIG. 19

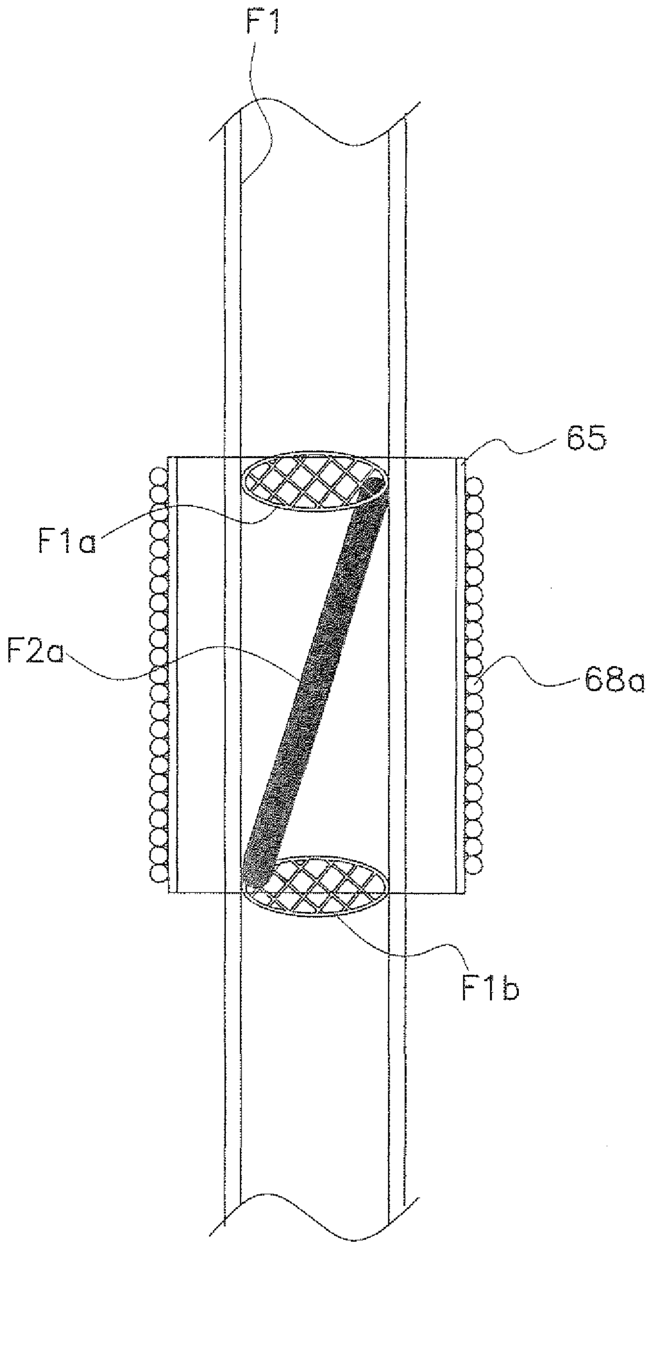

FIG. 20

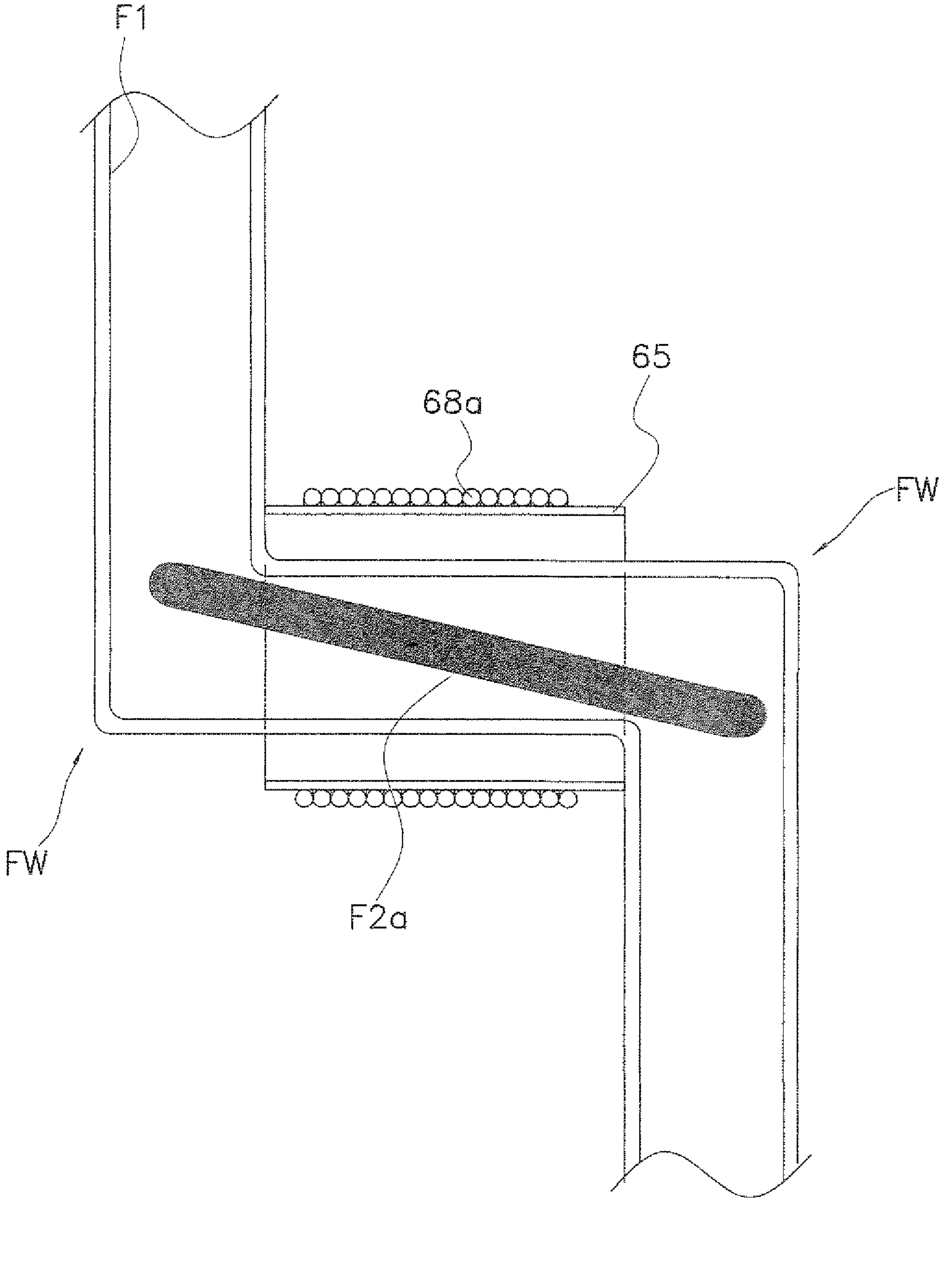

FIG. 21

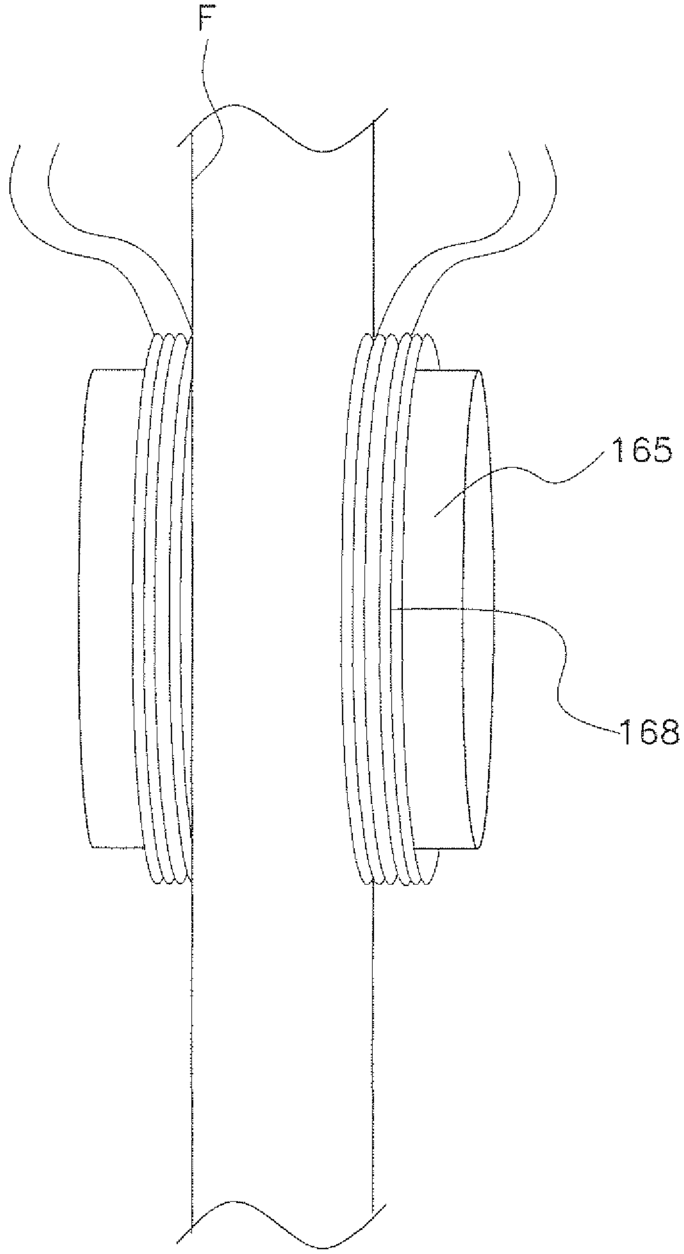

FIG. 22

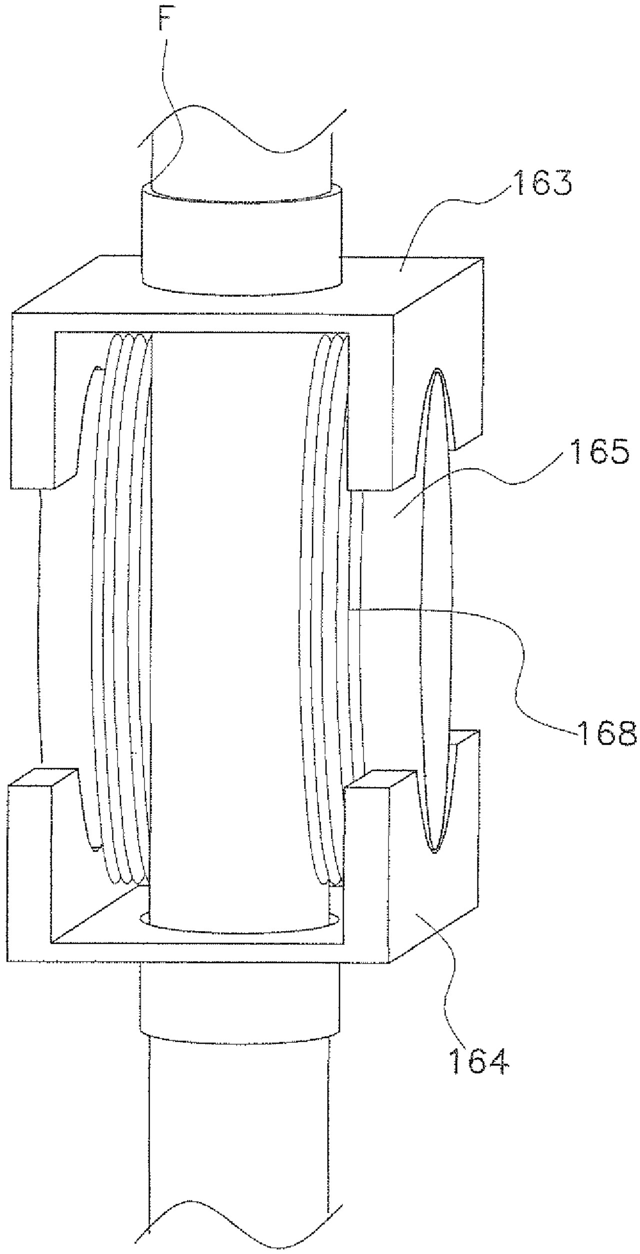

FIG. 23

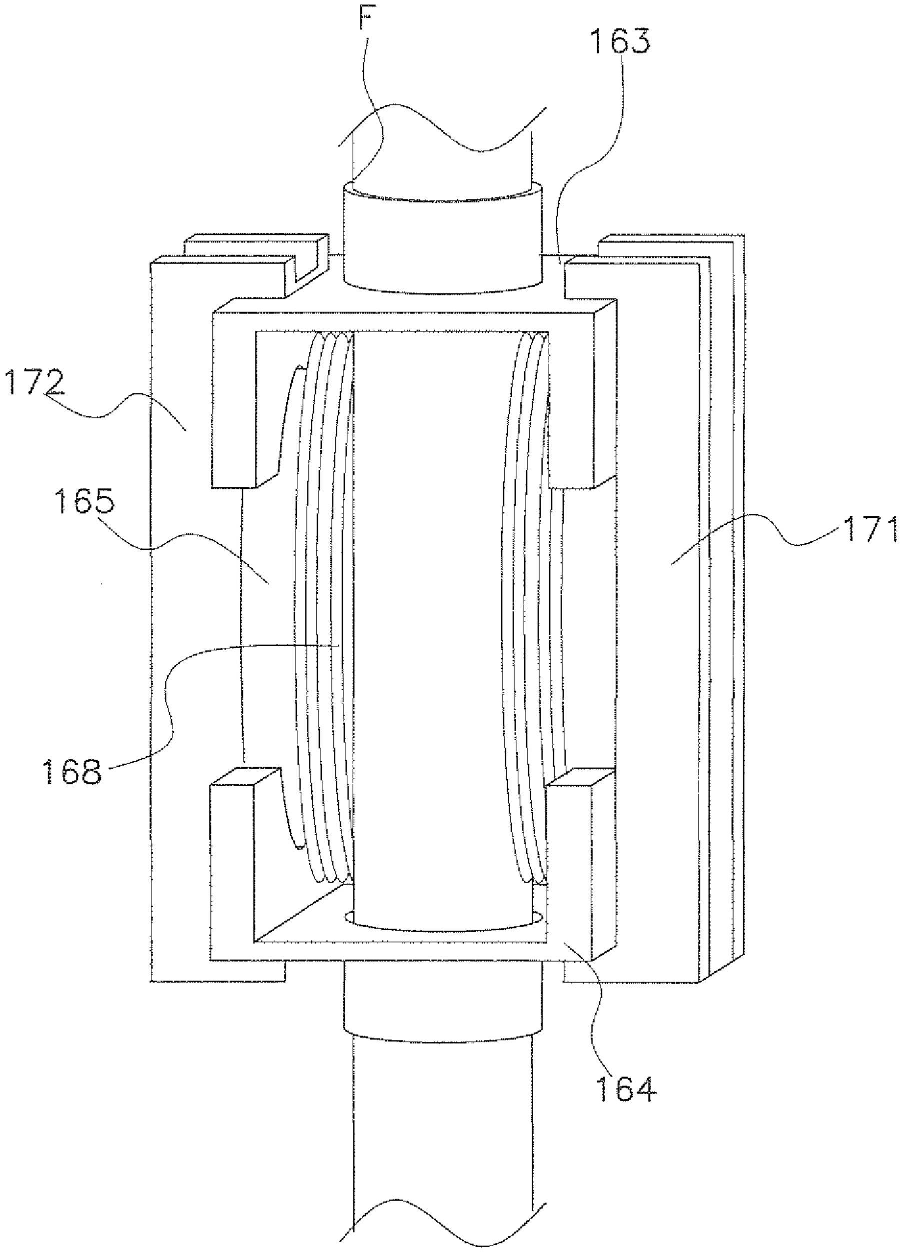

FIG. 24

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/007240

A. CLASSIFICATION OF SUBJECT MATTER
H05B6/10(2006.01)i, *F25B1/00*(2006.01)i, *F25B13/00*(2006.01)i, *F25B41/00*(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)
H05B6/10, F25B1/00, F25B13/00, F25B41/00

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2010
Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2008-202922 A (Sharp Corp.), 04 September 2008 (04.09.2008), fig. 1; paragraphs [0029] to [0037] (Family: none)	1-8
Y	JP 8-74563 A (Denki Kogyo Co., Ltd.), 19 March 1996 (19.03.1996), fig. 1; paragraphs [0016] to [0022] (Family: none)	1-8

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

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Date of the actual completion of the international search	Date of mailing of the international search report
22 February, 2010 (22.02.10)	09 March, 2010 (09.03.10)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/007240

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 140045/1982(Laid-open No. 44300/1984) (Meiji Seika Kaisha, Ltd.), 23 March 1984 (23.03.1984), claims; fig. 1, 2 (Family: none)	1-8
Y	JP 52-138737 A (Tokushu Denki Kabushiki Kaisha), 19 November 1977 (19.11.1977), fig. 1 to 3; page 2, upper left column, line 20 to lower left column, line 18 (Family: none)	4-8
Y	JP 2001-174055 A (Daikin Industries, Ltd.), 29 June 2001 (29.06.2001), fig. 5, 6; paragraphs [0043] to [0048] (Family: none)	8

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H08210720 B **[0003] [0109]**