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(54) **AIR CONDITIONER**

(57) The present invention provides an air conditioner that is capable of hindering a member, which generates heat by induction heating, from generating heat excessively. An air conditioner **(1)** that comprises a compressor **(21),** an outdoor heat exchanger **(23),** a motor operated expansion valve **(24),** and an indoor heat exchanger **(41)** further comprises a coil **(68)** and a control unit **(11).** The coil **(68)** generates a magnetic field in order to inductively heat an accumulator pipe **(F).** The control unit **(11)** ascertains a circulating refrigerant volume rate of a refrigeration cycle that comprises the compressor **(21),** the indoor heat exchanger **(41),** the motor operated expansion valve **(24),** and the outdoor heat exchanger **(23),** and, if the circulating refrigerant volume rate has increased, causes the coil **(68)** to generate the magnetic field.

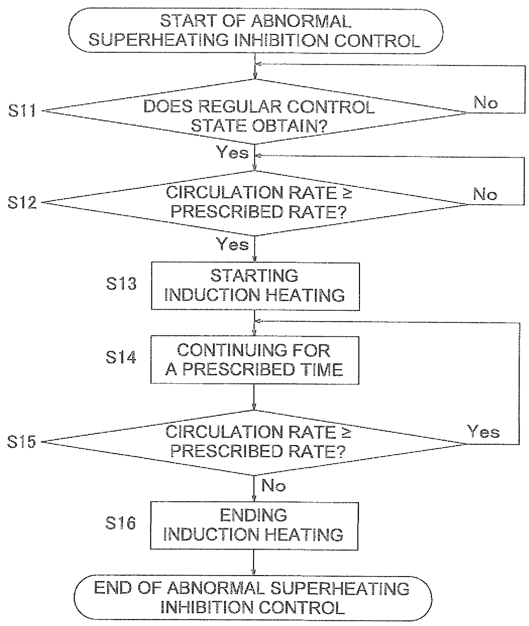

FIG. 8

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Description

TECHNICAL FIELD

[0001] The present invention relates to an air conditioner.

BACKGROUND ART

[0002] In the conventional art, an air conditioner that comprises a refrigerant heating apparatus that employs electromagnetic induction heating has been proposed.

[0003] For example, Patent Document 1 (i.e., Japanese Unexamined Patent Application Publication No. 2007-255736) below proposes an air conditioner that, in order to efficiently heat a refrigerant by induction heating, controls the start of induction heating in a state wherein the volume rate of circulation of the refrigerant has been secured to some degree.

SUMMARY OF THE INVENTION

<Technical Problem>

[0004] In the art disclosed in Patent Document 1 (i.e., Japanese Unexamined Patent Application Publication No. 2007-255736) discussed above, the volume rate of circulation secured is determined with a view toward efficient heating of the refrigerant; however, the refrigerant is not directly induction heated but rather is heated by the transmission of heat from a heat generating member, such as a magnetic body, that is itself heated by induction heating. Consequently, even if a certain volume rate of circulation can be secured to some degree, the volume rate of circulation needed to perform induction heating sometimes cannot be secured.

[0005] The present invention was conceived in consideration of the point discussed above, and an object of the present invention is to provide an air conditioner that is capable of hindering a member, which generates heat by induction heating, from generating heat excessively.

<Solution to Problem>

[0006] An air conditioner according to a first aspect of the present invention, which comprises at least a compressing mechanism, a refrigerant cooler, an expansion mechanism, and a refrigerant heater, further comprises a magnetic field generating part, a circulation volume rate ascertaining part, and a control unit, The magnetic field generating part generates a magnetic field in order to inductively heat at least one element selected from the group consisting of a refrigerant piping, which is for circulating a refrigerant to the compressing mechanism, the refrigerant cooler, the expansion mechanism, and the refrigerant heater; and a member that thermally contacts the refrigerant flowing through the refrigerant piping. The circulation volume rate ascertaining part ascertains a circulating refrigerant volume rate of a refrigeration cycle that comprises at least the compressing mechanism, the refrigerant cooler, the expansion mechanism, and the refrigerant heater. The control unit performs magnetic field output control that, when the circulating refrigerant volume rate ascertained by the circulation volume rate ascertaining part has increased, performs at least one process selected from the group consisting of causing the magnetic field generating part to generate a magnetic field, increasing the magnetic field generated by the magnetic field generating part, and raising the upper limit of the strength of the magnetic field generated by the magnetic field generating part.

[0007] In this air conditioner, when the volume rate at which the refrigerant is suctioned by the compressing mechanism is low, there is a risk that, should the magnitude of the magnetic field generated by the magnetic field generating part increase and thereby increase the degree of the induction heating, the portion to be inductively heated will generate heat excessively.

[0008] On the other hand, in this air conditioner, it is possible to inhibit the induction heated portion from being heated excessively because the magnetic field is regulated by, for example, generating the magnetic field if the volume rate at which the refrigerant is circulating has increased, increasing the strength of the generated magnetic field, and the like.

[0009] An air conditioner according to a second aspect of the present invention is the air conditioner according to the first aspect of the present invention, wherein the magnetic field generating part generates a magnetic field in order to inductively heat at least one element selected from the group consisting of the suction refrigerant piping, which is the refrigerant piping on a suction side of the compressing mechanism, and the member that thermally contacts the refrigerant flowing through the suction refrigerant piping.

[0010] In this air conditioner, the refrigerant that is about to be suctioned by the compressing mechanism is rapidly heated and the refrigerant flowing through the refrigerant piping that is significantly spaced apart from the compressing mechanism is not rapidly heated. Furthermore, refrigerant flowing on the suction side of the compressing mechanism either has a high degree of dryness or is in a superheated state and therefore tends to rise in temperature because its sensible heat tends to change more than would be the case wherein the latent heat of the refrigerant in the vapor-liquid two-phase state and the like and flowing more on the upstream side changes.

[0011] On the other hand, in this air conditioner, because magnetic field output control is performed after the volume rate at which the refrigerant is circulating has increased, it is possible to prevent excessive induction heating in the state wherein the volume rate at which the refrigerant is circulating is low Thereby, even if the refrigerant that passes on the suction side of the compressing mechanism and that tends to rise in temperature is thereby heated, it is possible to inhibit the excessive heating of the induction heated portion.

[0012] An air conditioner according to a third aspect of the present invention is the air conditioner according to the first aspect or the second aspect of the present invention, wherein the circulation volume rate ascertaining part makes its determination based on at least a prescribed piston displacement volume of the compressing mechanism, a drive frequency of the compressing mechanism, and the density of the refrigerant suctioned by the compressing mechanism.

[0013] In this air conditioner, it is possible to perform magnetic field output control in accordance with the state of the refrigerant that passes on the suction side of the compressing mechanism.

[0014] An air conditioner according to a fourth aspect of the present invention is the air conditioner according to the third aspect of the present invention, further comprising a low pressure ascertaining part and a suctioned refrigerant temperature ascertaining part. The low pressure ascertaining part ascertains the pressure of the refrigerant flowing through a low pressure portion of the refrigeration cycle. The suctioned refrigerant temperature ascertaining part ascertains the temperature of the refrigerant suctioned by the compressing mechanism. The circulation volume rate ascertaining part derives the density of the refrigerant suctioned by the compressing mechanism based on the pressure ascertained by the low pressure ascertaining part and the temperature ascertained by the suctioned refrigerant temperature ascertaining part.

[0015] In this air conditioner, the volume rate at which the refrigerant is circulating can be ascertained more accurately.

[0016] An air conditioner according to a fifth aspect of the present invention is the air conditioner according to the fourth aspect of the present invention, wherein the suctioned refrigerant temperature ascertaining part is on the suction side of the compressing mechanism in the refrigeration cycle and detects a state quantity of the refrigerant that passes on the downstream side of a portion inductively heated by the magnetic field generating part.

[0017] In this air conditioner, it is possible to ascertain a value that is not affected by induction heating by ascertaining a state quantity of the refrigerant that flows on the upstream side of the portion that generates heat by induction heating,

[0018] An air conditioner according to a sixth aspect of the present invention is the air conditioner according to the fourth aspect or the fifth aspect of the present invention, wherein the control unit performs the magnetic field output control in any one case selected from the group consisting of the case wherein the suctioned refrigerant of the compressing mechanism is in a moist state and the case wherein the suctioned refrigerant of the compressing mechanism is in a superheated state wherein the degree of superheating is less than a prescribed degree of superheating.

[0019] In this air conditioner, if the degree of superheating of the refrigerant suctioned by the compressing mechanism is high, then there is a risk that the rise in the temperature of the portion that generates heat by induction heating will become significant.

[0020] On the other hand, in this air conditioner, induction heating is performed if and only if the superheated state wherein the degree of superheating is less than the prescribed degree of superheating obtains or if the moist state obtains. Consequently, even if the drive frequency of the compressing mechanism has been high and the speed at which the refrigerant is flowing has been quick, magnetic field output control is not performed unless either the superheated state wherein the degree of superheating is less than the prescribed degree of superheating obtains or the moist state obtains, which makes it possible to better inhibit excessive superheating.

[0021] An air conditioner according to a seventh aspect of the present invention is the air conditioner according to any one aspect of the first through sixth aspects of the present invention, wherein the control unit performs the magnetic field output control if the circulating refrigerant volume rate ascertained by the circulation volume rate ascertaining part exceeds a prescribed value.

[0022] In this air conditioner, even if magnetic field output control is performed and the induction heated portion is caused to generate heat in the state wherein the volume rate at which the refrigerant is circulating exceeds the prescribed value, the large amount of the refrigerant that passes through the surrounding portion inhibits heat generation. Thereby, it is possible to reliably inhibit the excessive generation of heat of the induction heated portion.

<Advantageous Effects of Invention>

[0023] In the air conditioner of the first aspect of the invention, it is possible to inhibit the excessive heating of the induction heated portion.

[0024] In the air conditioner of the second aspect of the invention, it is possible to inhibit the excessive heating of the induction heated portion even if the refrigerant that passes on the suction side of the compressing mechanism and that tends to rise in temperature is heated.

[0025] In the air conditioner of the third aspect of the invention, it is possible to perform magnetic field output control in accordance with the state of the refrigerant that passes on the suction side of the compressing mechanism.

[0026] In the air conditioner of the fourth aspect of the invention, it is possible to more accurately ascertain the refrigerant circulation volume rate.

[0027] In the air conditioner of the fifth aspect of the invention, it is possible to ascertain a value that is not affected by induction heating.

[0028] In the air conditioner of the sixth aspect of the invention, it is possible to better inhibit excessive superheating.

[0029] In the air conditioner of the seventh aspect of the invention, it is possible to reliably inhibit the excessive generation of heat of the induction heated portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

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 of an electromagnetic induction heating unit.
FIG. 3 is an external oblique view that shows the state wherein a shielding cover has been removed from the electromagnetic induction heating unit.
FIG. 4 is an external oblique view of an electromagnetic induction thermistor.
FIG. 5 is an external oblique view of a fuse.
FIG. 6 is a schematic cross sectional view that shows the state wherein the electromagnetic induction thermistor and the fuse are mounted.
FIG. 7 is a cross sectional view of the electromagnetic induction heating unit.
FIG. 8 is a flow chart of moisture protection induction heating control.
FIG. 9 is a flow chart of abnormal superheating inhibition control.
FIG. 10 is an explanatory diagram of the refrigerant piping according to another embodiment (H).
FIG. 11 is an explanatory diagram of the refrigerant piping according to another embodiment (I).
FIG. 12 is a view that shows an example of the layout of ferrite cases according to another embodiment (J).

DESCRIPTION OF EMBODIMENTS

[0031] 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.

<First Embodiment>

<1-1> Air Conditioner 1

[0032] **FIG. 1** is a refrigerant circuit diagram that shows a refrigerant circuit **10** of the air conditioner **1.**

[0033] 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,** a 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.

[0034] The compressor **21,** the four-way switching valve **22,** the outdoor heat exchanger **23,** the 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.**

[0035] 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,** and a hot gas bypass circuit **H.** A large amount of the refrigerant in the gas state passes through the indoor side gas **pipe B** and the outdoor side gas pipe **E,** but the refrigerant passing through these pipes is not limited to the gas state. A large amount of the refrigerant in the liquid state passes through the indoor side liquid pipe **C** and the outdoor side liquid pipe **D,** but the refrigerant passing through these pipes is not limited to the liquid state.

[0036] 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 the discharge pipe **A,** is provided to the discharge pipe **A.** Furthermore, an electric current supply part **21e** supplies an electric current to the compressor **21.** The amount of electric power supplied by the electric current supply part **21e** is detected by a compressor electric power detection unit **29f.** Furthermore, a rotational speed ascertaining part **29r** detects the drive rotational speed of a piston of the compressor **21.** The indoor side gas **pipe B** connects the four-way switching valve **22** and the indoor heat exchanger **41.** A first pressure sensor **29a,** which detects the pressure of the refrigerant passing through the indoor side gas pipe **B,** is provided along the indoor side gas pipe **B.** The indoor side liquid pipe **C** connects the indoor heat exchanger **41** and the motor operated expansion valve **24.** The outdoor side liquid pipe **D** connects the motor operated expansion valve **24** and the outdoor heat exchanger **23.** The outdoor side gas pipe **E** connects the outdoor heat exchanger **23** and the four-way switching valve **22.** A second pressure sensor **29g,** which detects the pressure of the refrigerant passing through the outdoor side gas pipe **E,** is provided along the outdoor side gas pipe **E.**

[0037] The accumulator pipe **F** connects the four-way switching valve **22** and the accumulator **25** and, in the state wherein the accumulator 25 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. 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 are induced, 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. 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 rapid 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 rapidly heated refrigerant by virtue of the electromagnetic induction heating unit **6** rapidly heating the accumulator pipe **F.** Consequently, the temperature of the hot gas discharged from the compressor **21** can be rapidly raised. Thereby, the time needed by the defrosting operation to thaw the frost 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.

[0038] Furthermore, a suction temperature sensor **19** that detects the temperature of the refrigerant that flows between the electromagnetic induction heating **unit 6** and the four-way switching valve **22** is provided to the accumulator pipe **F.** In the state wherein a refrigeration cycle performs heating operation, the suction temperature sensor **19** detects the temperature of the refrigerant flowing on the downstream side of the electromagnetic induction heating unit **6** before the refrigerant is heated by induction heating by the electromagnetic induction heating unit **6.**

[0039] The suction **pipe G** connects the accumulator **25** and the suction side of the compressor **21.**

[0040] 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 the hot gas bypass circuit **H** 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 the hot gas bypass circuit **H,** 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 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.**

[0041] 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.

[0042] One end of the outdoor heat exchanger **23** is connected to the end part of the outdoor side gas pipe **E** on the outdoor heat exchanger **23** side, and the other end of the outdoor heat exchanger **23** is connected to the end part of the outdoor side liquid pipe **D** on the outdoor heat exchanger **23** side. In addition, an outdoor heat exchanger temperature sensor **29c,** which detects the temperature of the refrigerant flowing through the air conditioner **1,** is provided to the outdoor heat exchanger **23.** Furthermore, an outdoor temperature sensor **29b,** which detects the outdoor air temperature, is provided to the outdoor heat exchanger **23** on the downstream side in the direction of the airflow.

[0043] An indoor temperature sensor **43,** which detects the indoor temperature, is provided inside the indoor unit **4.** In addition, an indoor heat exchanger temperature sensor **44,** which detects the temperature of the refrigerant on the indoor side liquid pipe **C,** along which the motor operated expansion valve **24** is connected, is provided in the indoor heat exchanger **41.**

[0044] 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.**

[0045] 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.**

[0046] Furthermore, a controller **90,** which accepts the input of settings from the user, is connected to the control unit **11.**

<1-2> Electromagnetic Induction Heating Unit 6

[0047] **FIG. 2** is a schematic oblique view of the electromagnetic induction heating unit **6** mounted to the accumulator pipe **F. FIG. 3** 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. 4** is an external oblique view of an electromagnetic induction thermistor **14. FIG. 5** is an external oblique view of a fuse **15. FIG. 6** is a cross sectional view for the state wherein the electromagnetic induction thermistor **14** and the fuse **15** are mounted to the accumulator pipe **F. FIG. 7** is a cross sectional view of the electromagnetic induction heating unit **6** mounted to the accumulator pipe **F.**

[0048] 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.

[0049] 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,** the electromagnetic induction thermistor **14,** the fuse **15,** and the like.

[0050] 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, 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 electromagnetic induction thermistor **14** into the second bobbin cover **64** in order to mount the electromagnetic induction 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** into the second bobbin cover **64** in order to mount the fuse **15** to the outer surface of the magnetic pipe **F2.** As shown in **FIG. 4,** the electromagnetic induction thermistor **14** comprises an electromagnetic induction thermistor detecting part **14a,** an outer side projection **14b,** a side surface projection **14c,** and an electromagnetic induction thermistor wiring **14d,** which converts the detection result of the electromagnetic induction thermistor detecting part **14a** to a signal and transmits such to the control unit **11.** The electromagnetic induction thermistor detecting part **14a** has a shape that conforms to the curved shape of the outer surface of the accumulator pipe **F** and has a substantial contact surface area. As shown in **FIG. 5,** the fuse **15** comprises a fuse detection part **15a,** an asymmetrically shaped member **15b,** and a fuse wiring **15d,** which converts the detection result of the fuse detection part **15a** 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 (not shown), and receives the supply of a high frequency electric current. The output of the control printed circuit board is controlled by the control unit **11.** As shown in **FIG. 6,** the electromagnetic induction 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 electromagnetic induction thermistor **14** is mounted, satisfactory pressure contact between the electromagnetic induction thermistor **14** and the outer surface of the magnetic pipe **F2** is maintained by a leaf spring **16,** which presses the electromagnetic induction 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 electromagnetic induction 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 rapidly. 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 the first ferrite parts **98** and the second ferrite parts **99,** which are made of ferrite-a raw material that has high magnetic permeability. As shown in the cross sectional view of the accumulator pipe **F** and the electromagnetic induction heating unit **6 of FIG. 7,** 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.

<1-3> Electromagnetic Induction Heating Control

[0051] Control is performed wherein the electromagnetic induction heating unit **6** discussed above causes the magnetic pipe **F2** of the accumulator pipe **F** to generate heat at startup, namely, to start heating operation when the refrigeration cycle is caused to perform heating operation, when heating performance is supplemented, and when defrosting operation is performed.

[0052] Here, as an example of the various types of control performed by the electromagnetic induction heating unit **6** when supplementing heating performance, control for inhibiting an abnormal rise in the temperature of the magnetic pipe **F2** of the accumulator pipe F will be explained.

(Abnormal Superheating Inhibition Control)

[0053] Abnormal superheating inhibition control is control performed after control at startup of the compressor **21** and the like has ended in order to verify-in the regular control state wherein the state of the distribution of the refrigerant in the refrigerant circuit **10** of the air conditioner **1** has stabilized-that the volume rate at which the refrigerant is circulating through the accumulator pipe **F** is sufficiently secured when the electromagnetic induction heating unit **6** starts induction heating for the purpose of, for example, supplementing heating operation capacity.

[0054] Here, the control unit **11** calculates the volume rate at which the refrigerant is circulating in the refrigeration cycle (i.e., the volume rate at which the refrigerant passes through the magnetic pipe **F2** portion of the accumulator pipe **F)** by multiplying the piston displacement volume of the compressor **21,** which is stored in memory (not shown) as a predetermined quantity, the drive rotational speed of the compressor **21,** which is ascertained by the rotational speed ascertaining part **29r,** and the density of the refrigerant suctioned into the compressor **21.** The suctioned refrigerant density is calculated by the control unit **11** based on the refrigerant pressure detected by the second pressure sensor **29g** and the refrigerant temperature detected by the suction temperature sensor **19.**

[0055] In the regular control state, which is the state that obtains after the various types of control performed at the startup of the air conditioner **1** have ended, the control unit **11-in** the state wherein the drive frequency of the compressor **21** is maintained at the rated maximum frequency-performs control that responds to changes such as a change in the outdoor air temperature and a change in the user setting temperature by a variation in the circulating refrigerant volume rate owing to regulation of the degree of opening of the motor operated expansion valve **24.** Here, the control unit **11** controls the degree of opening of the motor operated expansion valve **24** such that the degree of supercooling of the refrigerant that passes between the indoor heat exchanger **41** and the motor operated expansion valve **24** in the heating operation state, is maintained at 5°C. This degree of supercooling is obtained by virtue of the control unit **11** calculating the difference between the saturation temperature corresponding to the pressure detected by the second pressure sensor **29g** and the temperature detected by the indoor heat exchanger temperature sensor **44.**

[0056] The explanation below references the flow chart of moisture abnormal superheating inhibition control shown in **FIG. 8.**

[0057] In a step **S11,** the control unit **11** determines whether the regular control state obtains. Here, if it is determined that the regular control state does obtain, then the method transitions to a step **S12.** Furthermore, in the regular control state, the output of the electromagnetic induction heating unit **6** is zero.

[0058] In the step **S12,** the control unit **11** determines whether the volume rate at which the refrigerant is circulating in the refrigeration cycle is greater than or equal to a prescribed abnormal superheating inhibition volume rate. If it is less than the abnormal superheating inhibition volume rate, then the method repeats the step **S12.** If it is greater than or equal to the abnormal superheating inhibition volume rate, then the method transitions to a step **S13.**

[0059] In the step **S13,** the control unit **11** causes the electromagnetic induction heating unit **6** to start induction heating the accumulator pipe **F.**

[0060] In a step **S14,** the control unit **11** waits for the elapse of a prescribed time while maintaining the control state as is.

[0061] In a step **S15,** the control unit **11** once again determines whether the volume rate at which the refrigerant is circulating in the refrigeration cycle is greater than or equal to the prescribed abnormal superheating inhibition volume rate. If it is greater than or equal to the abnormal superheating inhibition volume rate, then the method returns to the step **S14.** If it is less than the abnormal superheating inhibition volume rate, then the method transitions to a step **S16.**

[0062] In the step **S16,** the control unit **11** causes the electromagnetic induction heating unit **6** to stop induction heating the accumulator pipe **F.**

[0063] In so doing, it is possible to prevent an abnormal rise in the temperature of the accumulator pipe **F** by ensuring the fluidity of the refrigerant in the accumulator pipe F when the electromagnetic induction heating unit **6** performs induction heating.

<Characteristics of the Air Conditioner 1 of the First Embodiment>

[0064] In the air conditioner **1,** abnormal superheating inhibition control is performed, before the accumulator pipe **F** is induction heated by the electromagnetic induction heating unit **6,** in order to first verify whether the state that obtains is the state wherein the volume rate at which refrigerant is circulating in the refrigeration cycle is greater than or equal to the abnormal superheating inhibition volume rate. Consequently, the electromagnetic induction heating unit **6** induction heats only in the state wherein the refrigerant is flowing in the refrigeration cycle at a volume rate that is greater than or equal to the abnormal superheating inhibition volume rate and not in the state wherein that volume rate is less than the abnormal superheating inhibition volume rate.

[0065] Consequently, the heat supplied to the accumulator pipe **F** by virtue of the induction heating by the electromagnetic induction heating unit **6** is robbed by the circulating refrigerant, and therefore an abnormal rise in the temperature of the accumulator pipe **F** can be prevented because a sufficient refrigerant circulation volume rate has been secured.

<Second Embodiment>

[0066] The configuration of an air conditioner of a second embodiment is the same as that of the air conditioner **1** of the first embodiment discussed above, and consequently an explanation thereof is omitted,

[0067] In the air conditioner of the second embodiment, abnormal superheating inhibition moisture protection control is performed instead of the abnormal superheating inhibition control of the first embodiment.

[0068] Abnormal superheating inhibition moisture protection control is control that is performed after control at the startup of the compressor **21** and the like has ended in order to verify-when the electromagnetic induction heating unit **6** induction heats to supplement heating capacity-that a sufficient volume rate of refrigerant circulating through the accumulator pipe **F** is secured when the electromagnetic induction heating unit **6** starts induction heating such that liquid compression does not occur in the compressor 21. Here, when the electromagnetic induction heating unit **6** induction heats to supplement heating capacity, the electric power supplied to the coil **68** is set to 50% of the maximum output.

[0069] In the state wherein the electromagnetic induction heating unit **6** induction heats to supplement heating capacity, which is the state that obtains after the various types of control performed at the startup of the air conditioner **1** have ended, the control unit **11-in** the state wherein the drive frequency of the compressor **21** is maintained at the rated maximum frequency-responds to state changes such as a change in the outdoor air temperature, a change in the set temperature made by the user, and the like by a variation in the circulating refrigerant volume rate owing to regulation of the degree of opening of the motor operated expansion valve **24.** Here, the control unit **11** controls the degree of opening of the motor operated expansion valve **24** such that the degree of supercooling of the refrigerant that passes between the indoor heat exchanger **41** and motor operated expansion valve **24** in the heating operation state, is maintained at 5°C. This degree of supercooling is obtained by virtue of the control unit **11** calculating the difference between the saturation temperature that corresponds to the pressure detected by the second pressure sensor **29g** and the temperature detected by the indoor heat exchanger temperature sensor **44.**

[0070] The control unit **11** calculates the degree of dryness or the degree of superheating of the refrigerant suctioned by the compressor **21** based on the difference between the saturation temperature that corresponds to the pressure detected by the second pressure sensor **29g** and the temperature detected by the electromagnetic induction thermistor **14.**

[0071] The control unit **11** calculates the degree of dryness or the degree of superheating of the refrigerant discharged by the compressor **21** based on the difference between the saturation temperature that corresponds to the pressure detected by the first pressure sensor **29a** and the temperature detected by the discharge temperature sensor **29d.**

[0072] The explanation below references the flow chart of abnormal superheating inhibition moisture protection control shown in **FIG. 9.**

[0073] In a step **S21,** the control unit **11** determines whether the electromagnetic induction heating unit **6** is induction heating. Here, if it is determined that induction heating is in progress, then the method transitions to a step **S22.** If induction heating is not in progress, then the method repeats the step **S21.**

[0074] In the step **S22,** the control unit **11** determines whether an induction heating start condition, wherein the degree of superheating of the suctioned refrigerant is less than 4°C and the degree of superheating of the discharged refrigerant is less than 10°C, is satisfied. If the induction heating start condition is not satisfied, then the method repeats the step **S22.** If the induction heating start condition is satisfied, then the method transitions to a step **S23.**

[0075] In the step **S23,** the control unit **11** determines whether the volume rate at which the refrigerant is circulating in the refrigeration cycle is greater than or equal to a prescribed abnormal superheating inhibition volume rate at maximum output. If less than the abnormal superheating inhibition volume rate at maximum output, then the method repeats the step **S23.** If greater than or equal to the abnormal superheating inhibition volume rate at maximum output, then the method transitions to a step **S24.**

[0076] In the step **S24,** the control unit **11** increases the degree to which the electromagnetic induction heating unit **6** induction heats the accumulator pipe **F.** Namely, the amount of electric power supplied to the coil **68** of the electromagnetic induction heating unit 6 is increased. Here, the electric power supplied to the coil **68** is increased from the state wherein it is at 50% of the maximum output to the state wherein it is at the maximum output.

[0077] In the step **S25,** the control unit **11** waits for the prescribed time to elapse while maintaining the control state as is.

[0078] In a step **S26,** the control unit **11** once again determines whether the volume rate at which the refrigerant is circulating in the refrigeration cycle is greater than or equal to the prescribed abnormal superheating inhibition volume rate at maximum output. If greater than or equal to the abnormal superheating inhibition volume rate at maximum output, then the method transitions to a step **S27.** If less than the abnormal superheating inhibition volume rate at maximum output, then the method transitions to a step **S28.**

[0079] In the step **S27,** the control unit **11** determines whether an induction heating end condition, wherein the degree of superheating of the suctioned refrigerant is greater than or equal to 5°C or the degree of superheating of the discharged refrigerant is greater than or equal to 12°C, is satisfied. If the induction heating end condition is not satisfied, then the method returns to the step **S25.** If the induction heating end condition is satisfied, then the method transitions to the step **S28.**

[0080] In the step **S28,** the control unit **11** decreases the output of the electromagnetic induction heating unit 6 in its induction heating of the accumulator pipe **F** to 50% of the maximum output, which is the state wherein heating performance is supplemented.

[0081] In so doing, even if the output of induction heating by the electromagnetic induction heating unit 6 increases, then it is possible to prevent an abnormal rise in the temperature of the accumulator pipe F while preventing liquid compression in the compressor **21** by ensuring the fluidity of the refrigerant of the accumulator pipe **F.**

<Characteristics of the Air Conditioner 1 of the Second Embodiment>

[0082] In the abnormal superheating inhibition moisture protection control of the second embodiment, it is possible to achieve not only the characteristics of the abovementioned first embodiment but also to prevent both liquid compression in the compressor **21** and an abnormal rise in the temperature of the accumulator pipe **F.**

[0083] Furthermore, if, in the second embodiment, the output of the electromagnetic induction heating unit **6** is further increased while the electromagnetic induction heating unit **6** is induction heating at an output of 50% in order to supplement heating performance, then it is difficult to determine whether the volume rate at which the refrigerant is circulating through the portion to be induction heated by the electromagnetic induction heating unit 6 has been secured because the temperature detected by the electromagnetic induction thermistor **14** has already risen. In contrast, in the air conditioner **1** of the second embodiment, the suction temperature sensor **19** is installed at a position on the downstream side of the portion to be induction heated by the electromagnetic induction heating unit **6.** Consequently, with regard to the volume rate at which the refrigerant is circulating in the refrigeration cycle, it is possible to ascertain the volume rate at which the refrigerant is flowing on the downstream side of the portion to be induction heated by the electromagnetic induction heating unit 6 by deriving the density of that refrigerant, not the volume rate at which the refrigerant is flowing between the induction heating target portion and the compressor **21** in the state after the refrigerant has been heated. Furthermore, if this circulation volume rate is the abnormal superheating inhibition volume rate at maximum output, then the control unit **11** permits the output of the electromagnetic induction heating unit **6** to be set at the maximum. Thereby, even if the electromagnetic induction heating unit **6** performs induction heating at maximum output, it is possible to inhibit an abnormal rise in the temperature of the portion to be induction heated.

<Other Embodiments>

[0084] 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)

The abovementioned embodiment explained an exemplary case wherein SUS 430 is used as the material of the magnetic pipe **F2.**
However, the present invention is not limited thereto. For example, it can be a conductor such as iron, copper, aluminum, chrome, nickel, and the like, or an alloy containing at least two metals selected from that group.
In addition, the magnetic material may be, for example, one of two types, namely, ferritic or martensitic, or a combination thereof, but is preferably a material that is ferromagnetic and that has a comparatively high electrical resistance and a Curie temperature higher 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 piping of the accumulator pipe **F.**

(B)

The abovementioned second embodiment explained an exemplary case wherein the degree of dryness or the degree of superheating of the refrigerant suctioned by the compressor **21** is ascertained based on the temperature detected by the electromagnetic induction thermistor **14.**
However, the present invention is not limited thereto.

For example, in the electromagnetic induction thermistor **14,** it is difficult to detect the temperature of the refrigerant flowing through the portion to be induction heated while the electromagnetic induction heating unit **6** is induction heating, and therefore a higher temperature is sometimes inadvertently detected owing to the heat generated at the magnetic pipe **F2.**

In such a case, instead of the electromagnetic induction thermistor **14,** a sensor that detects the temperature of the accumulator pipe F at a location spaced apart from the portion to be induction heated to the extent that any error in the transmission of heat by induction heating can be ignored may be further provided between the suction side of the compressor **21** and the portion to be induction heated. Thereby, even while induction heating is in progress, the degree of dryness or the degree of superheating of the refrigerant suctioned by the compressor 21 can be ascertained more accurately.

(C)

The induction heating start condition and the induction heating end condition of the first embodiment and the induction heating start condition and the induction heating end condition of the second embodiment were explained according to exemplary cases wherein the same conditions were set.

However, the present invention is not limited thereto. For example, abnormal superheating inhibition moisture protection control in the second embodiment is control wherein the output of the electromagnetic induction heating unit 6 in performing induction heating is already at 50% and is then further increased to the maximum output. Consequently, the induction heating start condition for increasing the output to the maximum output (i.e., the induction heating start condition in the second embodiment) may be set to a condition wherein the refrigerant suctioned by the compressor **21** is in a moister state than it is in the induction heating start condition of the first embodiment.

(D)

The second embodiment explained an exemplary case wherein, when the circulating refrigerant volume rate is greater than or equal to the abnormal superheating inhibition volume rate at maximum output, the output of the electromagnetic induction heating **unit 6** is increased from 50% to the maximum output.

However, the present invention is not limited thereto. For example, the output of the electromagnetic induction heating **unit 6** may be adjusted in accordance with the derived circulating refrigerant volume rate.

(E)

The first and second embodiments explained exemplary cases that determine whether the abnormal superheating inhibition volume rate has been reached or whether the abnormal superheating inhibition volume rate at maximum output has been reached.

However, the present invention is not limited thereto. For example, if the output of the electromagnetic induction heating unit **6** cannot be increased because the abnormal superheating inhibition volume rate, the abnormal superheating inhibition volume rate at maximum output, or the like could not be achieved, then control that raises the rotational frequency of the compressor **21** may be performed and a state may be created wherein the capacity of induction heating by the electromagnetic induction heating unit 6 can be actively increased without an attendant abnormal rise in the temperature of the portion to be induction heated.

(F)

In the abovementioned first embodiment, an exemplary case was explained wherein the state of the refrigerant in the refrigeration cycle is stabilized by supercooling degree constant control.

However, the present invention is not limited thereto. For example, control may be performed wherein the degree of change in the distribution state of the refrigerant in the refrigeration cycle is maintained in a prescribed distribution state or within a prescribed distribution range during a prescribed time. With regard to detecting the distribution state of the refrigerant, for example, a sight glass and the like may be provided in advance to a condenser of the refrigeration cycle and the distribution state of the refrigerant may be ascertained by using the sight glass to ascertain the liquid level of the refrigerant; furthermore, control may be performed to stabilize the distribution state such that it is in the prescribed distribution state or within the prescribed distribution range.

(G)

The abovementioned embodiments explained a case wherein the electromagnetic induction heating unit **6** is mounted to the accumulator pipe **F** of the refrigerant circuit **10.**

However, the present invention is not limited thereto. For example, the electromagnetic induction heating may be mounted to a refrigerant piping other than the accumulator pipe **F.** In such a case, a magnetic body, for example, the magnetic pipe **F2** is provided to a portion of the refrigerant piping whereto the electromagnetic induction heating unit **6** is provided.

(H)

The abovementioned embodiments 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.**

However, the present invention is not limited thereto. As shown in **FIG. 10,** for example, a magnetic body member **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 magnetic body member **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 magnetic body member **F2a.** Thereby, the magnetic body member **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 magnetic body member **F2a,** which generates heat, and the refrigerant directly contact one another.

(I)

Instead of using the stoppers **F1a, F1b** the position of the magnetic body member **F2a** explained in the abovementioned other embodiment (H) may be prescribed with respect to the piping.

As shown in **FIG. 11,** for example, bent portions **FW** may be provided to the copper pipe **F1** at two locations, and the magnetic body member **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 magnetic body member **F2a** can be hindered while the refrigerant is made to pass through.

(J)

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

However, the present invention is not limited thereto. For example, as shown in **FIG. 12,** 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, each pair comprising one of the bobbin main bodies **165** and one of the coils **168,** are disposed such that they sandwich the accumulator pipe **F.** In this case, as shown in **FIG 12,** a first bobbin cover **163** and a second bobbin cover **164,** wherethrough the accumulator pipe **F** is inserted, are preferably disposed in a state wherein they are mated to the bobbin main bodies **165.** In addition, as shown in **FIG. 12,** the first bobbin cover **163** and the second bobbin cover **164** are preferably interposed by a first ferrite case **171** and a second ferrite case **172,** and thereby fixed.

FIG. 12 shows an exemplary case wherein the two ferrite cases **171,172** are provided such that they sandwich the accumulator pipe **F;** however, as in the abovementioned embodiments, ferrite cases may be disposed in four directions around the accumulator pipe **F.** In addition, as in the abovementioned embodiments, the ferrite parts may be housed therein.

<Miscellaneous>

[0085] The above text explained embodiments of the present invention with some examples, but the present invention is not limited to these embodiments. For example, the present invention also includes other combination embodiments obtained by appropriately combining parts of the abovementioned embodiments within a range that a person skilled in the art could effect based on the scope of the invention described above.

INDUSTRIAL APPLICABILITY

[0086] The present invention is capable of hindering a member, which generates heat by induction heating, from generating heat excessively, and consequently is particularly useful in an air conditioner that is capable of heating a refrigerant by electromagnetic induction heating.

REFERENCE SIGNS LIST

[0087]

- **1** Air conditioner
- **11** Control unit
- **19** Suction temperature sensor (suctioned refrigerant temperature ascertaining part)
- **21** Compressor (compressing mechanism)
- **23** Outdoor heat exchanger (refrigerant heater)
- **24** Motor operated expansion valve (expansion mechanism)
- **29a** First pressure sensor
- **29g** Second pressure sensor (low pressure ascertaining part)
- **29r** Rotational speed ascertaining part (circulation volume rate ascertaining part)
- **41** Indoor heat exchanger (refrigerant cooler)
- **44** Indoor heat exchanger temperature sensor (supercooling degree ascertaining part)
- **68** Coil (magnetic field generating part)
- **F** Accumulator pipe (suction refrigerant piping)

CITATION LIST

PATENT LITERATURE

Patent Document 1

[0088]

Japanese Unexamined Patent Application Publication No. 2007-255736

Claims

1. An air conditioner **(1)** that comprises at least a com-

pressing mechanism **(21),** a refrigerant cooler **(41),** an expansion mechanism **(24),** and a refrigerant heater **(23),** comprising:

a magnetic field generating part **(68)** that generates a magnetic field in order to inductively heat at least one element selected from the group consisting of a refrigerant piping **(F),** which is for circulating a refrigerant to the compressing mechanism **(21),** the refrigerant cooler **(41),** the expansion mechanism **(24),** and the refrigerant heater **(23);** and a member that thermally contacts the refrigerant flowing through the refrigerant piping **(F);**
a circulation volume rate ascertaining part **(29r),** which ascertains a circulating refrigerant volume rate of a refrigeration cycle that comprises at least the compressing mechanism **(21),** the refrigerant cooler **(41),** the expansion mechanism **(24),** and the refrigerant heater **(23);** and
a control unit **(11),** which performs magnetic field output control that, when the circulating refrigerant volume rate ascertained by the circulation volume rate ascertaining part **(29r)** has increased, performs at least one process selected from the group consisting of causing the magnetic field generating part **(68)** to generate a magnetic field, increasing the magnetic field generated by the magnetic field generating part **(68),** and raising the upper limit of the strength of the magnetic field generated by the magnetic field generating part **(68).**

2. An air conditioner **(1)** according to claim **1,** wherein the magnetic field generating part **(68)** generates a magnetic field in order to inductively heat at least one element selected from the group consisting of the suction refrigerant piping **(F),** which is the refrigerant piping on a suction side of the compressing mechanism **(21),** and the member that thermally contacts the refrigerant flowing through the suction refrigerant piping **(F).**

3. An air conditioner **(1)** according to claim 1 or claim 2, wherein
the circulation volume rate ascertaining part **(29r)** makes its determination based on at least a prescribed piston displacement volume of the compressing mechanism **(21),** a drive frequency of the compressing mechanism **(21),** and the density of the refrigerant suctioned by the compressing mechanism **(21).**

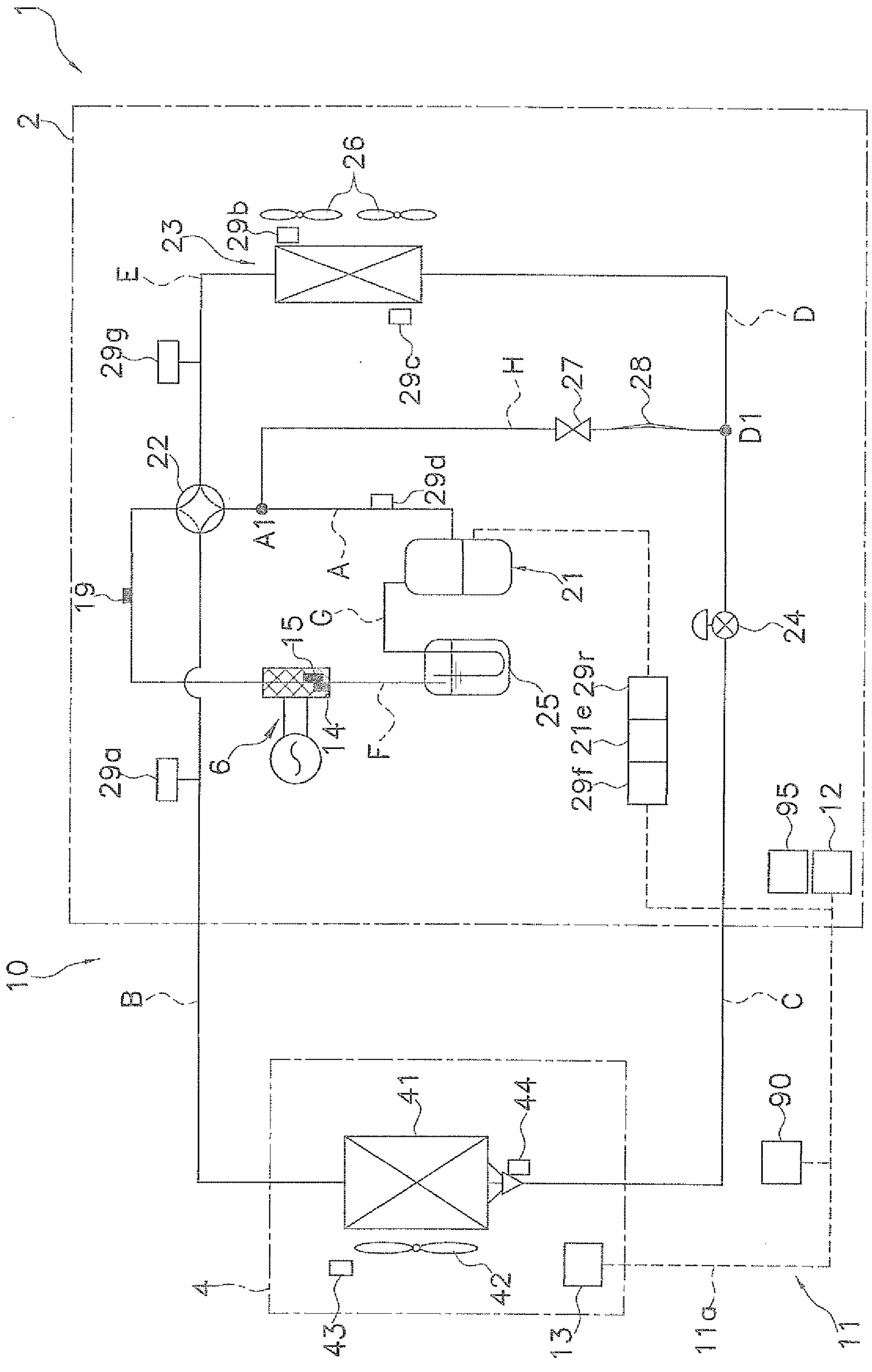
4. An air conditioner **(1)** according to claim 3, further comprising:

a low pressure ascertaining part **(29g),** which ascertains the pressure of the refrigerant flowing through a low pressure portion of the refrigeration cycle; and
a suctioned refrigerant temperature ascertaining part **(19),** which ascertains the
temperature of the refrigerant suctioned by the compressing mechanism **(21);** wherein,
the circulation volume rate ascertaining part **(29r)** derives the density of the refrigerant suctioned by the compressing mechanism **(21)** based on the pressure ascertained by the low pressure ascertaining part **(29g)** and the temperature ascertained by the suctioned refrigerant temperature ascertaining part **(19).**

5. An air conditioner **(1)** according to claim 4, wherein the suctioned refrigerant temperature ascertaining part **(19)** is on the suction side of the compressing mechanism **(21)** in the refrigeration cycle and detects a state quantity of the refrigerant that passes on the downstream side of a portion inductively heated by the magnetic field generating part **(68).**

6. An air conditioner **(1)** according to claim 4 or claim 5, wherein
the control unit **(11)** performs the magnetic field output control in any one case selected from the group consisting of the case wherein the suctioned refrigerant of the compressing mechanism **(21)** is in a moist state and the case wherein the suctioned refrigerant of the compressing mechanism **(21)** is in a superheated state wherein the degree of superheating is less than a prescribed degree of superheating.

7. An air conditioner **(1)** according to any one claim of claim 1 through claim 6, wherein
the control unit **(11)** performs the magnetic field output control if the circulating refrigerant volume rate ascertained by the circulation volume rate ascertaining part **(29r)** exceeds a prescribed value.


1
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11a
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12
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28
29a
29b
29c
29d
29f
29g
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B
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D
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E
F
G
H

FIG. 1

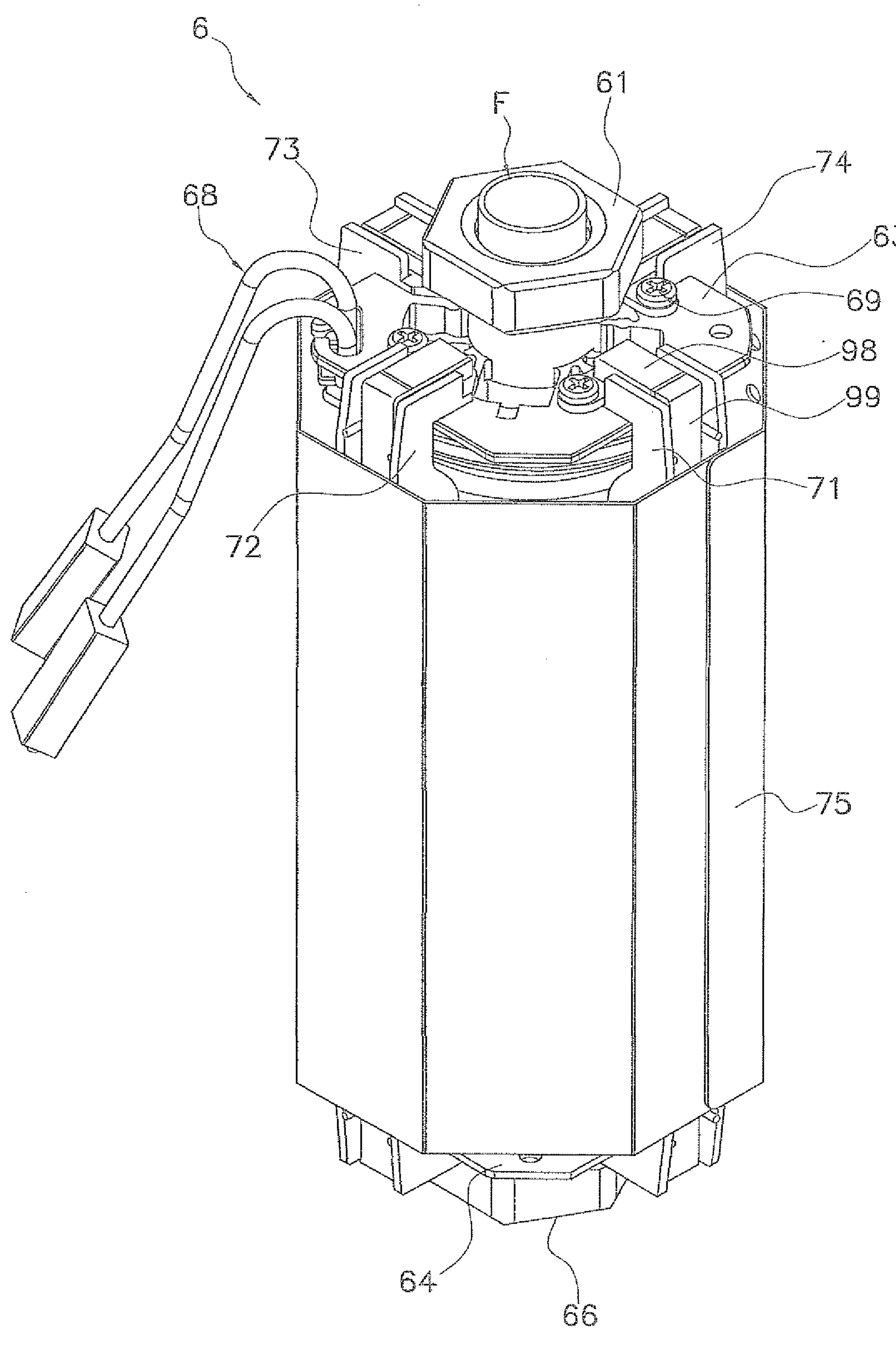


FIG. 2

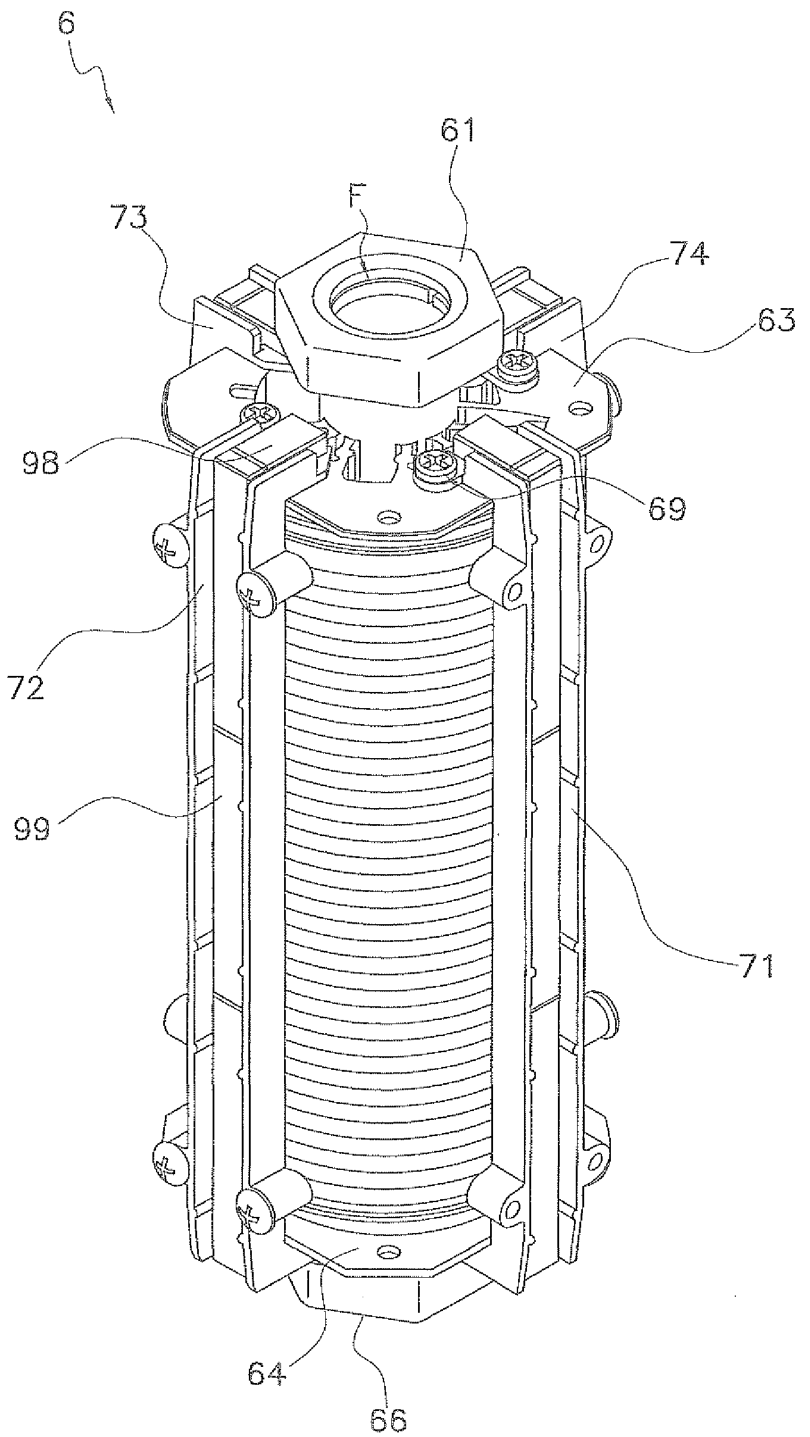


FIG. 3

FIG. 4

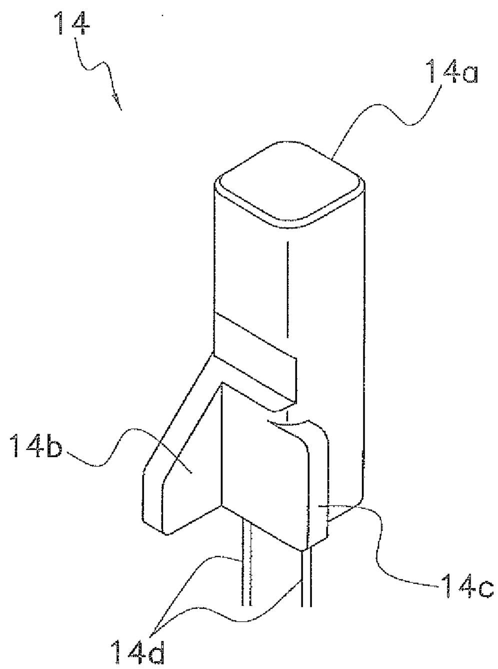
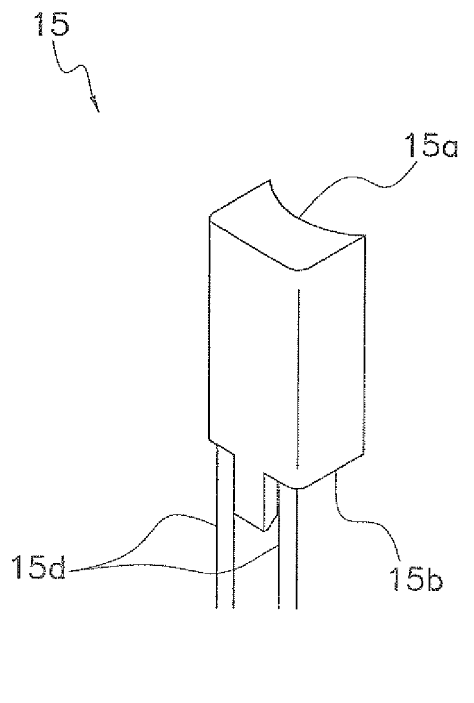


FIG. 5



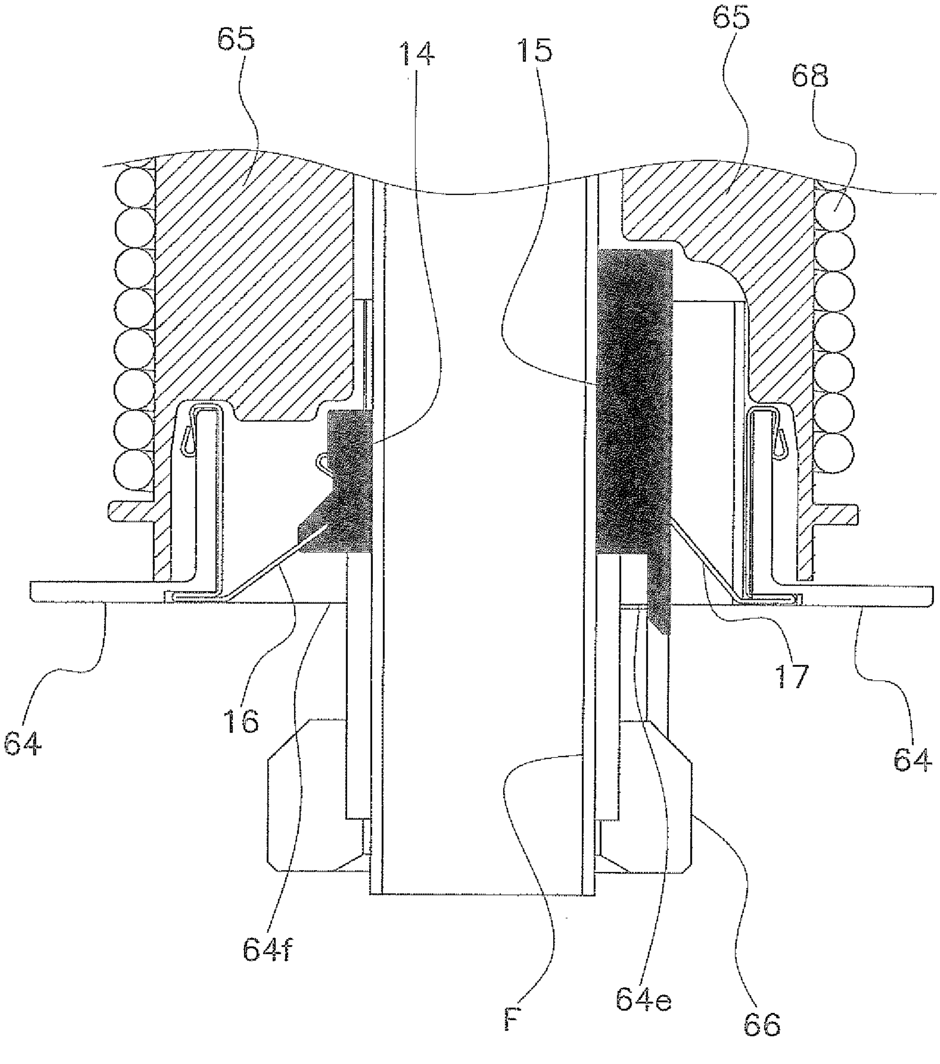


FIG. 6

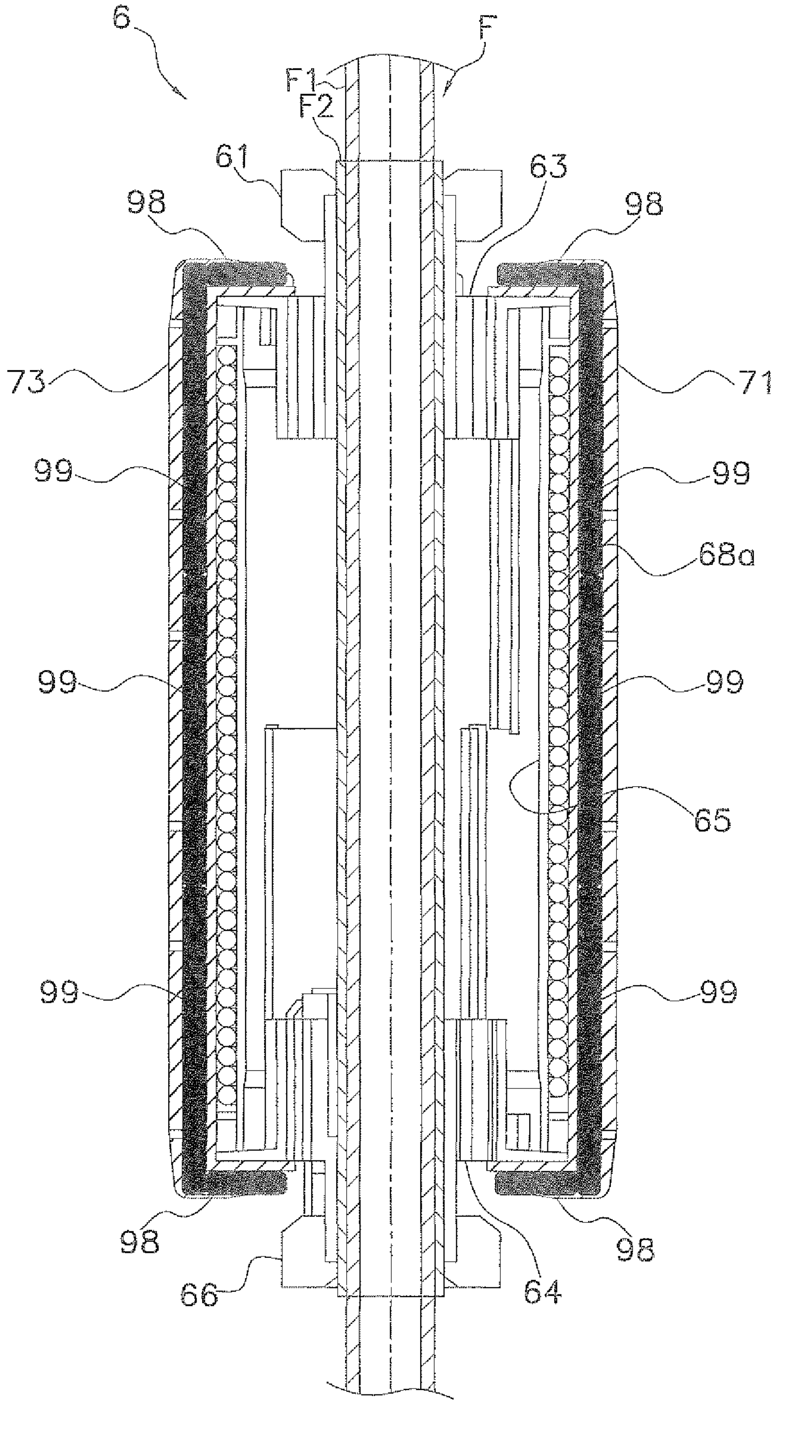


FIG. 7

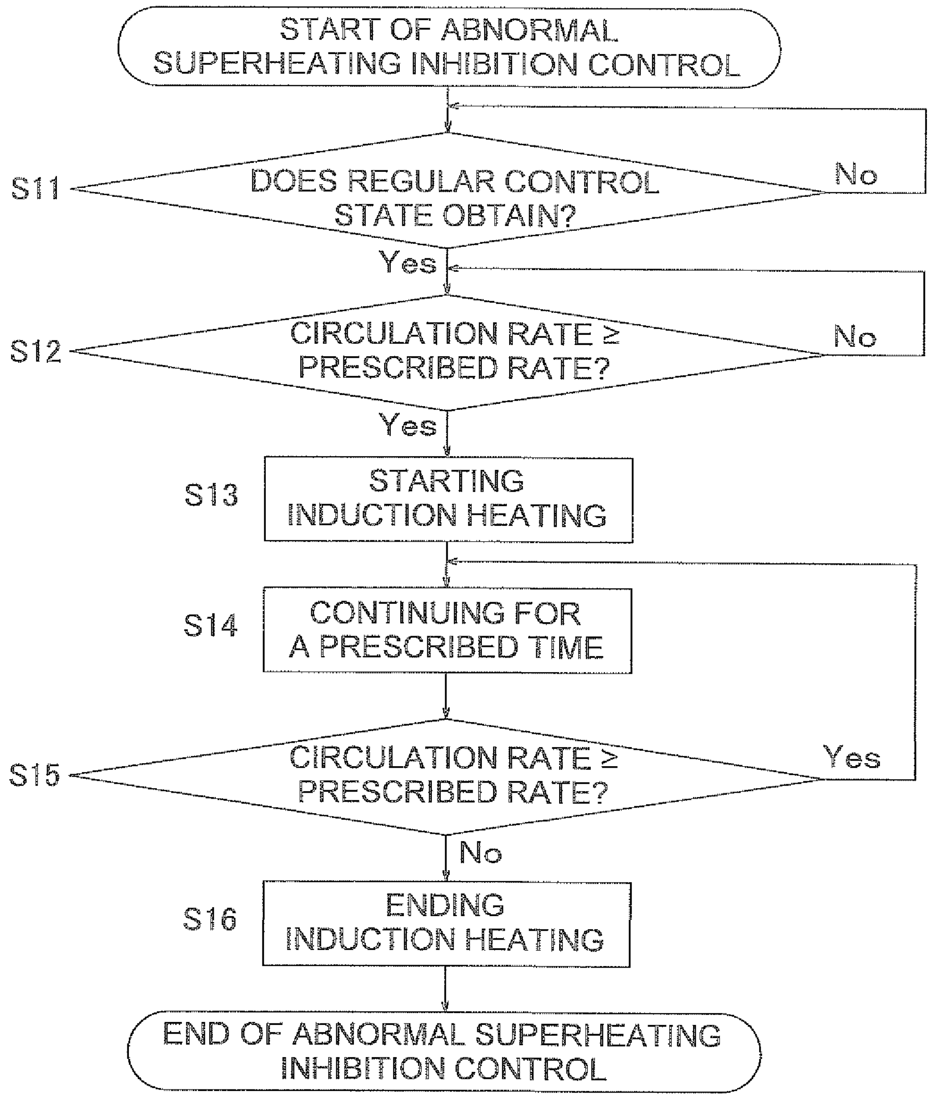

START OF ABNORMAL SUPERHEATING INHIBITION CONTROL
S11
DOES REGULAR CONTROL STATE OBTAIN?
No
Yes
S12
CIRCULATION RATE ≥ PRESCRIBED RATE?
No
Yes
S13
STARTING INDUCTION HEATING
S14
CONTINUING FOR A PRESCRIBED TIME
S15
CIRCULATION RATE ≥ PRESCRIBED RATE?
Yes
No
S16
ENDING INDUCTION HEATING
END OF ABNORMAL SUPERHEATING INHIBITION CONTROL

FIG. 8

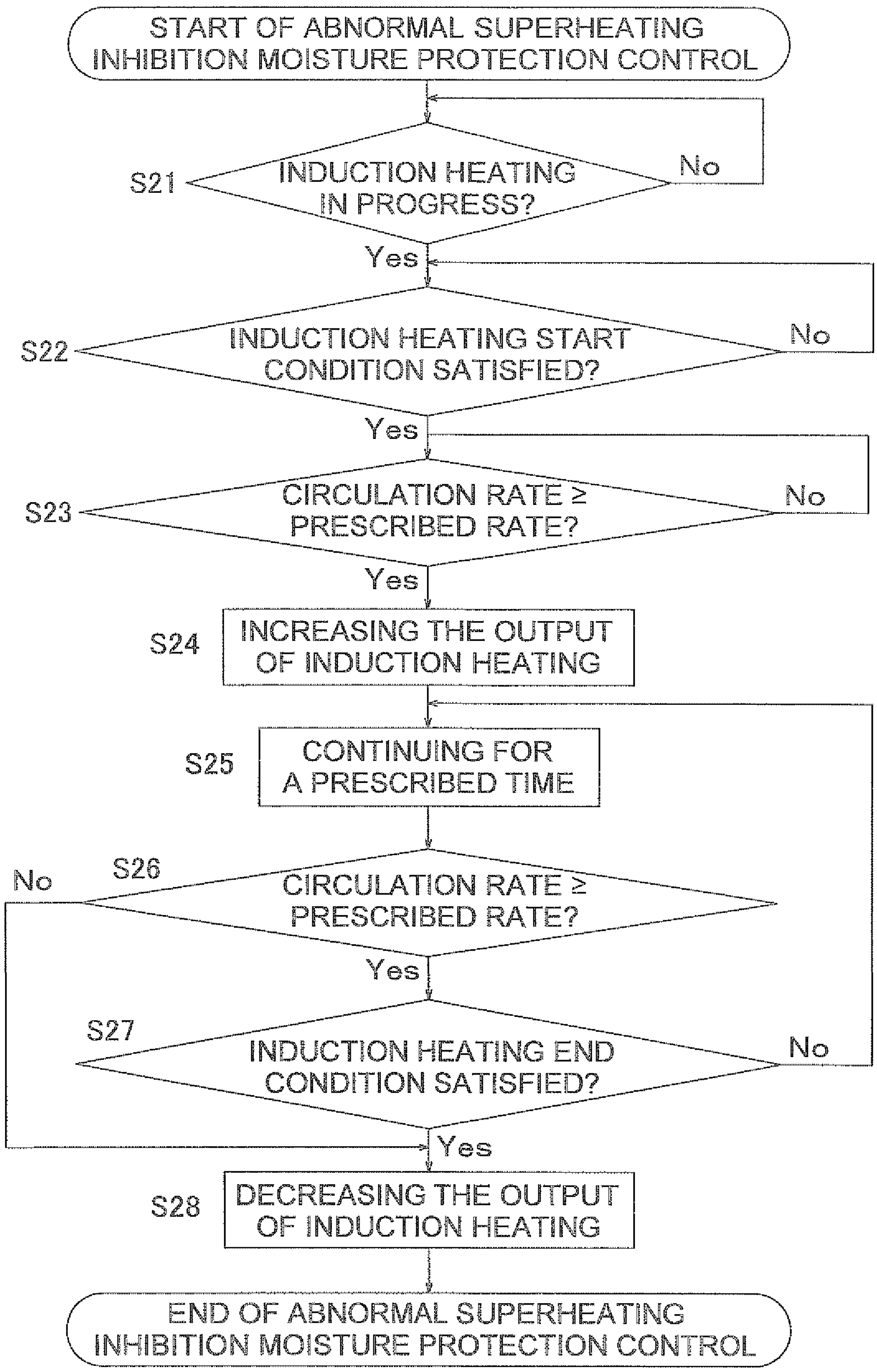

START OF ABNORMAL SUPERHEATING INHIBITION MOISTURE PROTECTION CONTROL
S21
INDUCTION HEATING IN PROGRESS?
No
Yes
S22
INDUCTION HEATING START CONDITION SATISFIED?
No
Yes
S23
CIRCULATION RATE ≥ PRESCRIBED RATE?
No
Yes
S24
INCREASING THE OUTPUT OF INDUCTION HEATING
S25
CONTINUING FOR A PRESCRIBED TIME
No
S26
CIRCULATION RATE ≥ PRESCRIBED RATE?
Yes
S27
INDUCTION HEATING END CONDITION SATISFIED?
No
Yes
S28
DECREASING THE OUTPUT OF INDUCTION HEATING
END OF ABNORMAL SUPERHEATING INHIBITION MOISTURE PROTECTION CONTROL

FIG. 9

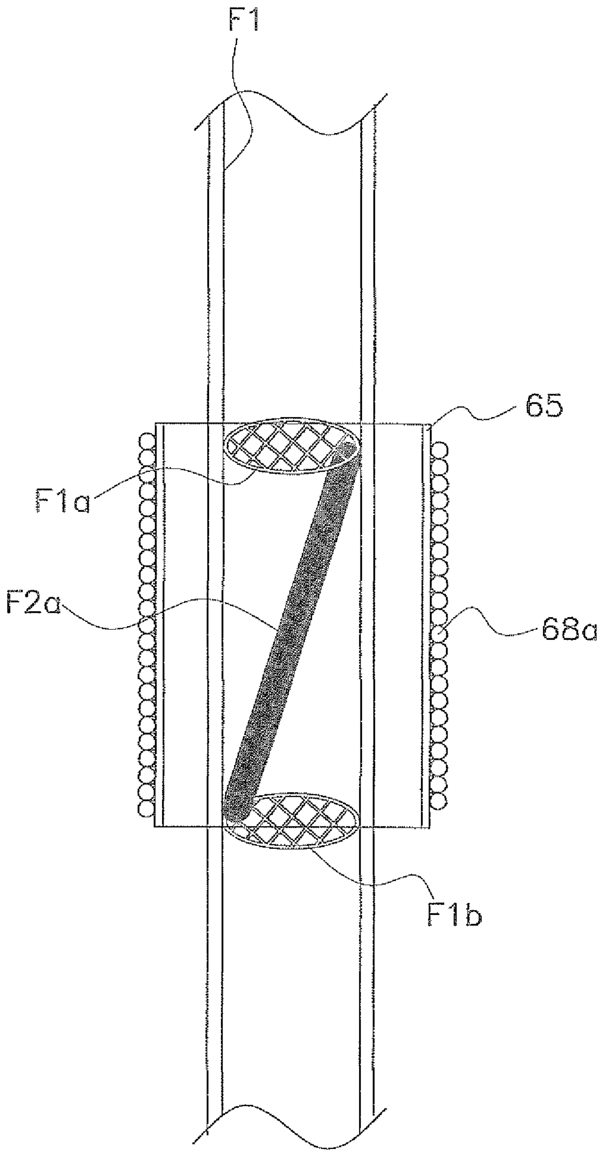


FIG. 10

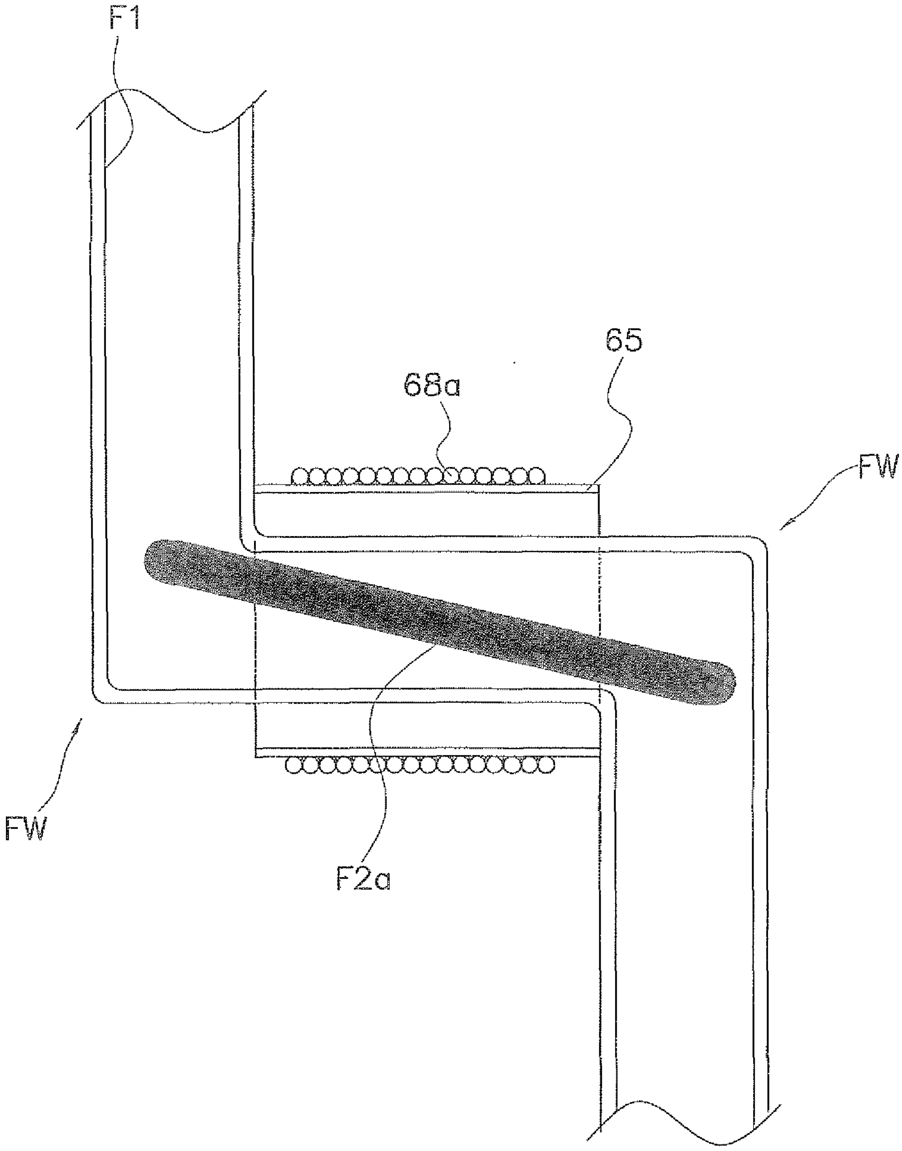


FIG. 11

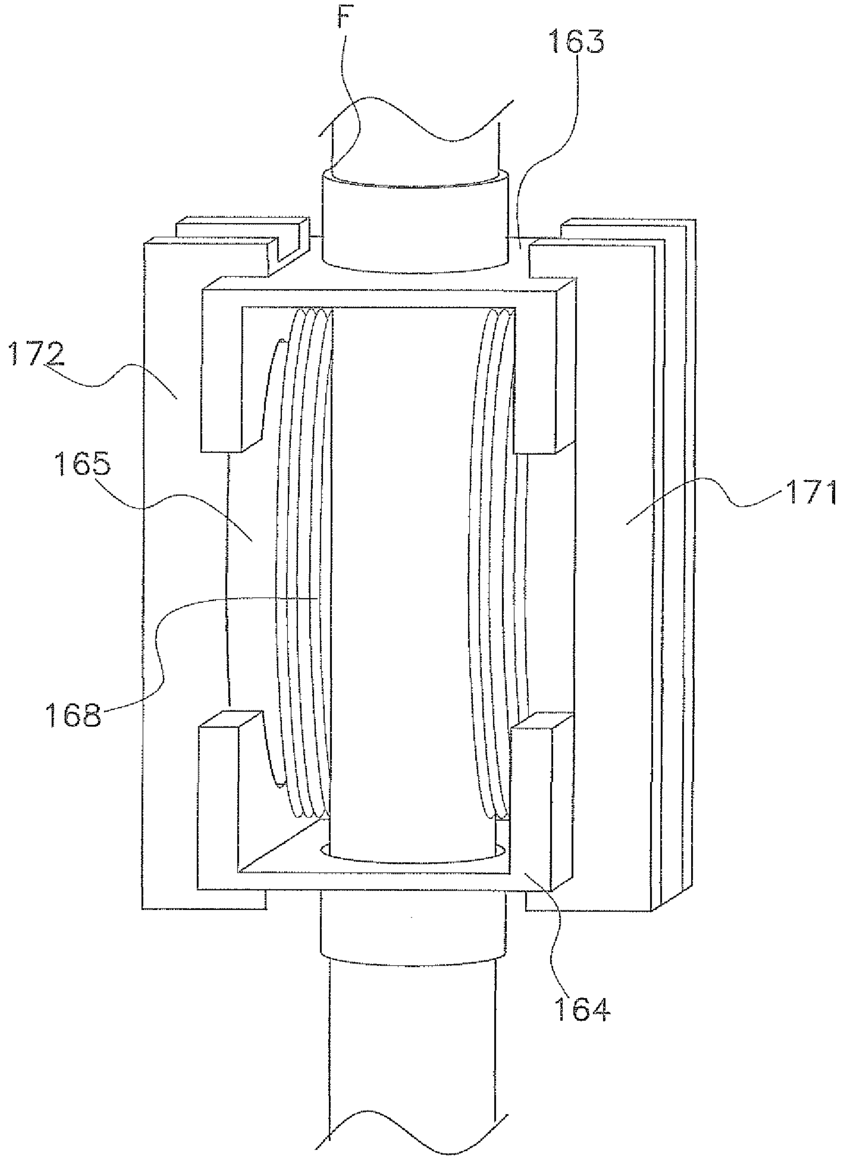


FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/001941

A. CLASSIFICATION OF SUBJECT MATTER
F25B1/00(2006.01)i, *F24F11/02*(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)
F25B1/00, F24F11/02

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 62-77574 A (Toshiba Corp.), 09 April 1987 (09.04.1987), page 2, upper right column, line 2 to page 4, lower right column, line 2; fig. 1 to 7 (Family: none)	1-8
Y	JP 2001-255025 A (Daikin Industries, Ltd.), 21 September 2001 (21.09.2001), claims; paragraphs [0001] to [0100]; fig. 1 to 22 (Family: none)	1-8

[X] 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
"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

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"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
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Date of the actual completion of the international search	Date of mailing of the international search report
16 June, 2010 (16.06.10)	29 June, 2010 (29.06.10)

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/001941

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	JP 4-15446 A (Matsushita Electric Industrial Co., Ltd.), 20 January 1992 (20.01.1992), claims; page 3, lower right column, line 18 to page 5, lower left column, line 6 (Family: none)	1-8
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REFERENCES CITED IN THE DESCRIPTION

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- JP 2007255736 A **[0003] [0004] [0088]**