(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 517 218 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.03.2025 Bulletin 2025/10

(21) Application number: **24193510.5**

(22) Date of filing: **08.08.2024**

(51) International Patent Classification (IPC):
F25B 5/02 *(2006.01)* ***F25B 6/04*** *(2006.01)*
F25B 47/02 *(2006.01)* ***F25B 49/02*** *(2006.01)*
F25C 1/00 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F25B 49/022; F25B 5/02; F25B 6/04; F25B 47/022; F25C 5/10; F25B 2400/0403; F25B 2400/0409; F25B 2400/0411; F25B 2700/2106

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

(30) Priority: **01.09.2023 KR 20230116262**

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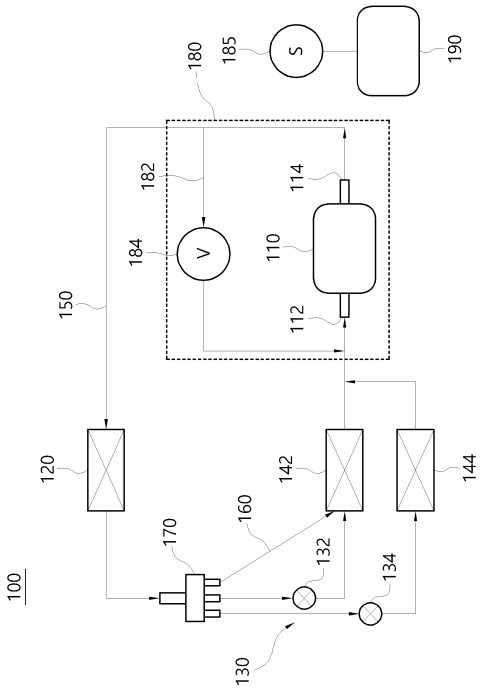
(54) ICE MAKER HAVING A REFRIGERANT PREHEATING UNIT AND CONTROLLING METHOD OF THE SAME

(57) An ice maker (100) having a refrigerant preheating unit and a control method thereof are disclosed. The ice maker (100) having a refrigerant preheating unit according to one aspect of the present invention and a control method thereof may include: a compressor (110) for compressing a refrigerant; a condenser (120) for condensing a refrigerant discharged from a discharge end of the compressor; an expansion unit (130) for expanding a refrigerant condensed in the condenser; an ice-making evaporator (142) for evaporating a refrigerant expanded in the expansion unit to make ice; a refrigerant flow path unit (150) for guiding a refrigerant discharged from the compressor to a suction end of the compressor through the condenser, the expansion unit (130) and the ice-making evaporator (142); an ice-removing refrigerant flow path unit (160) for guiding a refrigerant discharged from the compressor (120) to the ice-making evaporator (142); a refrigerant preheating unit (180) for causing a refrigerant discharged from the compressor (120) to be re-suctioned into the compressor (110) before passing through the condenser; and a control unit (190) for controlling the refrigerant preheating unit.

[FIG. 1]



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Description

[Technical Field]

[0001] The present invention relates to an ice maker having a refrigerant preheating unit, and more specifically to an ice maker having a refrigerant preheating unit which is capable of ensuring ice removal performance even in a low-temperature environment, and a control method thereof.

[Background Art]

[0002] Generally, ice makers are devices that cool water to below 0°C, which is the freezing point, to make ice and supply the same to the user. Such ice makers are installed in refrigerators and ice water purifiers that require ice.

[0003] The types of ice makers include an immersion-type ice maker that makes an immersion member in which a refrigerant flows submerge in water such that ice is created in the immersion member, a spray-type ice maker that sprays water on an ice mold equipped with a cooling unit such as an evaporator in which a refrigerant flows such that ice is created in the ice mold, and a flowing-type ice maker that makes water flow through an ice mold equipped with a cooling unit such as an evaporator in which a refrigerant flows such that ice is created in the ice mold.

[0004] Ice created in an ice mold can be removed from the ice mold and then taken out to the user, or can be stored in an ice storage tank and then taken out according to the user's request.

[0005] Meanwhile, when removing the frozen ice from the ice mold, the ice mold and the ice are separated by using a hot gas discharged from a compressor that compresses a refrigerant or a separate heater.

[0006] Such ice makers are installed and used indoors or outdoors, but if the environment where the ice maker is placed is a low-temperature environment in winter, it takes time for the temperature of a hot gas compressed and discharged from the compressor to rise, and thus, it takes a long time to remove the ice frozen in the ice mold, which can cause user dissatisfaction.

[0007] Alternatively, if the environment where the ice maker is placed is extremely low-temperature, the temperature of a hot gas does not rise to the temperature required to remove the ice, and thus, not only can the ice not be removed, but also the ice is not completely removed from the ice mold, thereby causing the ice mold to malfunction.

[0008] Korean Patent Application Laid-Open No. 10-2014-0006488 discloses an ice-making evaporator in which an evaporation unit and a heating unit are formed integrally. According to the structure, since the heat of a heating unit consisting of an electric heater and the like is quickly conducted to the surface of the ice-making evaporator, the ice is quickly removed even in a low-temperature environment. However, according to this configuration, since the ice-making evaporator experiences rapid thermal changes, there is a problem in that the durability of the ice-making evaporator is reduced.

[0009] Korean Patent Application Laid-Open No. 10-2003-0024361 discloses a hot and cold-water purifier with an ice-making device. According to the structure, the high-temperature, high-pressure liquid refrigerant that has passed through the compressor is supplied as a hot gas to the ice-making evaporator. According to this structure, since the ice-making evaporator does not experience rapid thermal changes, there is an advantage of improved durability.

[0010] However, since a separate hot gas refrigerant flow path for removing ice that bypasses a condenser must be formed separately from the cold-water refrigerant flow path and the ice-making refrigerant flow path passing through the condenser, the system complexity increases, and there is a problem in that the miniaturization of the ice-making device is difficult.

[0011] Korean Patent Application Laid-Open Nos. 10-2019-0065033, 10-2019-0102808 and 10-2020-0078891 disclose an ice-making system that supplies a high-temperature liquid refrigerant that has passed through a condenser as a hot gas to an ice-making evaporator. According to this structure, in addition to the advantage of improving the durability of the ice-making evaporator, the system complexity is reduced because the cold-water refrigerant flow path, the ice-making refrigerant flow path and the ice-removing hot gas refrigerant flow path all pass through the condenser, and there is an advantage of contributing to the miniaturization of the ice-making device.

[0012] However, since the temperature of a refrigerant decreases as it passes through the condenser, the ice-removing efficiency decreases, thereby making it difficult to use in a low-temperature environment. In addition, since the eco-friendly new refrigerant R-600a has the characteristic of a lower temperature at the compressor discharge compared to the existing R-134a, this structure has a problem of further decreasing the ice-removing efficiency when applying eco-friendly new refrigerants such as R-600a.

[Related Art Documents]

[Patent Documents]

[0013]

Korean Patent Application Laid-Open No. 10-2014-0006488
Korean Patent Application Laid-Open No. 10-2019-0065033
Korean Patent Application Laid-Open No. 10-2019-0102808
Korean Patent Application Laid-Open No. 10-2020-0078891

[Disclosure]

[Technical Problem]

[0014] The present invention has been devised to solve the above problems, and an object of the present invention is to provide an ice maker having a refrigerant preheating unit which is capable of securing a necessary ice-removing temperature while minimizing an increase in the system complexity of the ice-removing system, and a control method thereof.

[0015] Another object of the present invention is to provide an ice maker having a refrigerant preheating unit which is capable of preventing ice-removing failure of the ice maker due to an ice-removing error while minimizing user complaints by guaranteeing ice-removing performance even in a low-temperature environment when using an eco-friendly new refrigerant, and a control method thereof.

[0016] The problems of the present invention are not limited to the problems mentioned above, and other tasks that are not mentioned will be clearly understood by those skilled in the art from the description below.

[Technical Solution]

[0017] According to an aspect of the present invention, provided is an ice maker having a refrigerant preheating unit, including a compressor for compressing a refrigerant; a condenser for condensing a refrigerant discharged from a discharge end of the compressor; an expansion unit for expanding a refrigerant condensed in the condenser; an ice-making evaporator for evaporating a refrigerant expanded in the expansion unit to make ice; a refrigerant flow path unit for guiding a refrigerant discharged from the compressor to a suction end of the compressor through the condenser, the expansion unit and the ice-making evaporator; an ice-removing refrigerant flow path unit for guiding a refrigerant discharged from the compressor to the ice-making evaporator; a refrigerant preheating unit for causing a refrigerant discharged from the compressor to be re-suctioned into the compressor before passing through the condenser; and a control unit for controlling the refrigerant preheating unit.

[0018] The refrigerant preheating unit may include a bypass flow path which is branched from a discharge end of the compressor and is connected to a suction end of the compressor; a bypass opening/closing valve for opening/closing the bypass flow path; and a sensor for measuring the temperature of the external environment.

[0019] The sensor may measure the temperature of the outside air or the temperature of purified water.

[0020] The ice maker may further include a cold-water evaporator for cooling purified water with a refrigerant expanded in the expansion unit.

[0021] The refrigerant flow path unit may include an ice-making refrigerant flow path for guiding a refrigerant that has passed through the condenser to the ice-making evaporator; a cold-water refrigerant flow path for guiding a refrigerant that has passed through the condenser to the cold-water evaporator; and a multi-directional valve for guiding a refrigerant that has passed through the condenser to at least any one of the ice-making refrigerant flow path and the cold-water refrigerant flow path.

[0022] The expansion unit may include an ice-making expansion valve which is provided on the ice-making refrigerant flow path and expands a refrigerant directed to the ice-making evaporator; and a cold-water expansion valve which is provided on the cold-water refrigerant flow path and expands a refrigerant directed to the cold-water evaporator.

[0023] The ice-removing refrigerant flow path unit may be provided to branch from the multi-directional valve and guides a refrigerant to the ice-making evaporator.

[0024] Before ice is made in the ice-making evaporator, if the idle time of the compressor is greater than a preset time, and the temperature of the external environment measured by the sensor is below a preset temperature, the control unit may open the bypass opening/closing valve for a set period of time to control a refrigerant discharged from the compressor to circulate to a suction end of the compressor through the bypass flow path.

[0025] When ice is being made or ice making is completed in the ice-making evaporator, if the temperature of the

external environment measured by the sensor is below a preset temperature, the control unit may open the bypass opening/closing valve for a set period of time to control a refrigerant discharged from the compressor to circulate to a suction end of the compressor through the bypass flow path.

[0026] The preset temperature may be 13 to 18°C.

[0027] Meanwhile, according to another aspect of the present invention, provided is a method for controlling the above-described ice maker having a refrigerant preheating unit, including an environmental temperature measuring step for measuring the temperature of an outside air environment; a low-temperature environment determining step for determining whether the temperature measured in the environmental temperature measuring step is lower than a preset temperature; a preheating time calculating step for calculating a refrigerant preheating time at a corresponding temperature when the environmental temperature determined in the low-temperature environment determining step is a low-temperature environment that is lower than a preset temperature; and a refrigerant preheating step for circulating a refrigerant through the bypass flow path of a refrigerant preheating unit through the compressor during the time calculated in the preheating time calculating step.

[0028] The method may further include a compressor idle time measuring step which is performed before the preheating time calculating step, and counts an elapsed time after the compressor has stopped operating; and an idle time determining step for determining whether the idle time of the compressor counted in the compressor idle time measuring step exceeds a set reference time, wherein the preheating time calculating step is performed when the idle time of the compressor determined in the idle time determining step exceeds a set reference time.

[0029] After the refrigerant preheating step, an ice-making step for making ice by using an ice-making evaporator after the preheating of a refrigerant is completed through a refrigerant preheating step; and an ice-removing step for removing ice that has been made in the ice-making step are performed.

[0030] Before the preheating time calculating step, an ice-making step for making ice by using an ice making evaporator may be performed, and the refrigerant preheating step may be performed after the ice-making step.

[0031] The preset temperature may be 13 to 18°C.

[Advantageous Effects]

[0032] The ice maker having a refrigerant preheating unit according to the present invention and the control method thereof enable rapid ice removal because the refrigerant continues to circulate through the compressor until the refrigerant temperature reaches an appropriate temperature to reach an appropriate ice removal temperature, and can also prevent over-icing in which ice is refrozen without being removed.

[0033] The ice maker having a refrigerant preheating unit according to an embodiment of the present invention and the control method thereof can ensure stable ice removal even when used in a low-temperature environment or when an eco-friendly new refrigerant with relatively low efficiency is used since the refrigerant is preheated through the circulation path of the compressor.

[0034] In addition, the ice maker having a refrigerant preheating unit according to an embodiment of the present invention and the control method thereof implement the configuration of a refrigerant preheating unit that preheats the refrigerant by a bypass flow path for connecting the outlet and inlet of the compressor without additional configuration such as a separate heater such that the structure is simple, the manufacturing cost is reduced, and the miniaturization of the ice maker can be achieved.

[0035] It should be understood that the effects of the present invention are not limited to the effects described above, and include all effects that can be inferred from the composition of the invention described in the detailed description or claims of the present invention.

[Description of Drawings]

[0036]

FIG. 1 is a diagram briefly illustrating the refrigerant piping diagram of an ice maker having a refrigerant preheating unit according to an exemplary embodiment of the present invention.

FIG. 2 is a chart illustrating changes in the refrigerant temperatures on the compressor discharge side over time when the ice maker having a refrigerant preheating unit according to an exemplary embodiment of the present invention and a conventional general ice maker are operated at outside air temperatures of 15°C and 3°C.

FIG. 3 is a graph illustrating changes in the refrigerant temperatures on the compressor discharge side over time when the ice maker having a refrigerant preheating unit according to an exemplary embodiment of the present invention and a conventional general ice maker are operated at an outside air temperature of 15°C.

FIG. 4 is a graph illustrating changes in the refrigerant temperatures on the compressor discharge side over time when the ice maker having a refrigerant preheating unit according to an exemplary embodiment of the present invention and

a conventional general ice maker are operated at an outside air temperature of 3°C.

(a) of FIG. 5 is a graph illustrating changes in the refrigerant temperatures on the compressor suction side over time when the ice maker having a refrigerant preheating unit according to an exemplary embodiment of the present invention and a conventional general ice maker are operated at an outside air temperature of 15°C.
(b) of FIG. 5 is a graph illustrating changes in the refrigerant temperatures on the compressor discharge side over time when the ice maker having a refrigerant preheating unit according to an exemplary embodiment of the present invention and a conventional general ice maker are operated at an outside air temperature of 15°C.

FIG. 6 is a flowchart illustrating the method for controlling an ice maker having a refrigerant preheating unit according to an exemplary embodiment of the present invention.
FIG. 7 is a flowchart illustrating the method for controlling an ice maker having a refrigerant preheating unit according to another exemplary embodiment of the present invention.

[Modes of the Invention]

[0037] Hereinafter, with reference to the attached drawings, the exemplary embodiments of the present invention will be described in detail so that those skilled in the art can easily practice the present invention. The present invention may be implemented in many different forms and is not limited to the exemplary embodiments described herein. In order to clearly explain the present invention, parts that are not related to the description have been omitted in the drawings, and the same or similar components are assigned the same reference numerals throughout the specification.

[0038] The words and terms used in the present specification and claims are not to be construed as limited in their usual or dictionary meanings, but according to the principle that the inventor can define terms and concepts in order to explain his or her invention in the best way, they must be interpreted with meaning and concepts consistent with technical ideas.

[0039] Therefore, the exemplary embodiments described in the present specification and the configuration illustrated in the drawings correspond to a preferred exemplary embodiment of the present invention, and do not represent the entire technical idea of the present invention, and thus, the corresponding configuration may have various equivalents and variations that may replace the same at the time of filing of the present invention.

[0040] It should be understood that the terms "include" or "have", when used in the present specification, are intended to describe the presence of stated features, integers, steps, operations, elements, components and/or a combination thereof, but not preclude the possibility of the presence or addition of one or more other features, integers, steps, operations, elements, components or a combination thereof.

[0041] The presence of an element in/on "front", "rear", "upper or above or top" or "lower or below or bottom" of another element includes not only being disposed in/on "front", "rear", "upper or above or top" or "lower or below or bottom" directly in contact with other elements, but also cases in which another element being disposed in the middle, unless otherwise specified. In addition, unless otherwise specified, that an element is "connected" to another element includes not only direct connection to each other but also indirect connection to each other.

[0042] Hereinafter, the ice maker 100 having a refrigerant preheating unit according to an exemplary embodiment of the present invention will be described with reference to the drawings.

[0043] The ice maker 100 having a refrigerant preheating unit according to an exemplary embodiment of the present invention may include a compressor 110, a condenser 120, an expansion unit 130, an ice-making evaporator 142, a cold-water evaporator 144, a refrigerant flow path unit 150, an ice-removing refrigerant flow path unit 160, a multi-directional branch valve 170, a refrigerant preheating unit 180 and a control unit 190, as illustrated in FIG. 1.

[0044] The ice maker 100 according to the present invention relates to an ice maker 100 that freezes ice, but may also be applied to a case where the ice maker 100 is integrated into a water purifier.

[0045] The compressor 110 is a component that compresses a refrigerant. The compressor 110 sucks a refrigerant from a suction end 112 and compresses the same, and the compressed refrigerant may be discharged through a discharge end 114 of the compressor 110. The refrigerant compressed in the compressor 110 may have its pressure and temperature increased compared to before compression.

[0046] The condenser 120 is a component that condenses the refrigerant discharged from the discharge end 114 of the compressor 110 by exchanging heat with the outside air. The refrigerant whose pressure and temperature have increased in the compressor 110 may be heat-exchanged with the outside air in the condenser 120 to release the internal heat to the outside.

[0047] The expansion unit 130 is a component that expands the refrigerant that has exchanged heat in the condenser 120 to lower the pressure. The expansion unit 130 is generally composed of a capillary tube or an expansion valve, and the refrigerant expanded in the expansion unit 130 has its temperature lowered while its pressure is lowered.

[0048] Meanwhile, the ice-making evaporator 142 may absorb the surrounding heat while evaporating the refrigerant expanded in the expansion unit 130 into a gaseous state to make ice. The ice-making evaporator 142 is equipped with an

ice-making mold that freezes ice, and may make purified water into ice in the ice-making mold.

[0049] The refrigerant flow path unit 150 may be arranged to guide a refrigerant discharged from the compressor 110 through the condenser 120, the expansion unit 130 and the ice-making evaporator 142 and then back to the suction end 112 of the compressor 110.

[0050] Meanwhile, the cold-water evaporator 144 is an evaporator for cooling purified water, not ice, to make cold water.

[0051] Apart of the refrigerant flow path unit 150 that has passed through the condenser 120 may be branched off and connected to the cold-water evaporator 144. The refrigerant that has absorbed the heat of purified water in the cold-water evaporator 144 may be guided back to the refrigerant flow path unit 150 and then back to the suction end 112 of the compressor 110.

[0052] Meanwhile, an ice-removing refrigerant flow path unit 160 may be provided that directly guides a refrigerant discharged from the compressor 110 to the ice-making evaporator 142.

[0053] The ice-removing refrigerant flow path unit 160 may directly guide a refrigerant discharged from the compressor 110 to the ice-making evaporator 142 without passing through the expansion unit 130.

[0054] The refrigerant that has not passed through the expansion unit 130 is in a non-expanded high-temperature and high-pressure state, and it may heat an ice-making mold of the ice-making evaporator 142 to melt the boundary surface of the ice frozen in the ice-making mold, thereby separating the ice from the ice-making mold.

[0055] The ice-removing refrigerant flow path unit 160 may be branched between the discharge end 114 of the compressor 110 and the condenser 120, or may be branched between the condenser 120 and the expansion unit 130.

[0056] A multi-directional branch valve 170, such as a flow diverter valve and the like, may be installed between the condenser 120 and the expansion unit 130 in a part of the refrigerant flow path unit 150. The multi-directional branch valve 170 may be combined with an ice-making refrigerant flow path that guides the refrigerant that has passed through the condenser 120 to the ice-making evaporator 142, or a cold-water refrigerant flow path that guides the refrigerant that has passed through the condenser 120 to the cold-water evaporator 144.

[0057] The expansion unit 130 may include an ice-making expansion valve 132 and a cold-water expansion valve 134 as components that expand the refrigerant.

[0058] The ice-making expansion valve 132 may be provided to expand a refrigerant directed to the ice-making evaporator 142 on the ice-making refrigerant path, and the cold-water expansion valve 134 may be provided to expand a refrigerant directed to the cold-water evaporator 144 on the cold-water refrigerant flow path.

[0059] Meanwhile, the refrigerant preheating unit 180 may be provided such that the refrigerant discharged from the compressor 110 is re-inhaled into the compressor 110 before passing through the condenser 120.

[0060] In addition, the control unit 190 may be provided to control the refrigerant preheating unit 180.

[0061] The refrigerant preheating unit 180 may include a bypass flow path 182, a bypass opening/closing valve 184 and a sensor 185.

[0062] The bypass flow path 182 may be branched from a discharge end 114 of the compressor 110 of the refrigerant flow path unit 150 and joined to a suction end 112 of the compressor 110 of the refrigerant flow path unit 150.

[0063] In addition, the bypass opening/closing valve 184 may be provided to open/close the bypass flow path 182.

[0064] That is, when the bypass opening/closing valve 184 is opened, the refrigerant discharged from the discharge end 114 of the compressor 110 may be re-inhaled into the suction end 112 of the compressor 110 and repeatedly compressed. As the refrigerant is repeatedly compressed, the pressure and temperature of the refrigerant may further increase.

[0065] In addition, the sensor 185 may measure the temperature of the external environment of the location where the ice maker 100 is located. In this case, the sensor 185 may be provided to measure the temperature of the atmosphere or the temperature of purified water.

[0066] The control unit 190 may open or close the bypass opening/closing valve 184 according to the temperature of the external environment measured by the sensor 185.

[0067] For example, before ice is made in the ice-making evaporator 142, if the idle time of the compressor 110 during which the operation is stopped is greater than a preset time, and the temperature of the external environment measured by the sensor 185 is below a preset temperature, the control unit 190 may open the bypass opening/closing valve 184 for a set period of time to control a refrigerant discharged from the compressor 110 to circulate to a suction end 112 of the compressor 110 through the bypass flow path 182.

[0068] That is, in a situation where the ice-making process has not been performed for a sufficiently long time and there is a concern that the ice-making efficiency by the refrigerant may be reduced due to the low temperature of the external environment, the control unit 190 may control the bypass opening/closing valve 184 such that the refrigerant is repeatedly compressed to further increase its pressure and temperature.

[0069] Alternatively, when ice is being made or ice making is completed in the ice-making evaporator 142, if the temperature of the external environment measured by the sensor 185 is below a preset temperature, the control unit 190 may open the bypass opening/closing valve 184 for a set period of time to control a refrigerant discharged from the compressor 110 to circulate to a suction end 112 of the compressor 110 through the bypass flow path 182.

[0070] That is, even when the ice-making process is being performed, if there is a concern that the ice-making efficiency

by the refrigerant may be reduced due to the low temperature of the external environment, the control unit 190 may control the bypass opening/closing valve 1894 such that the refrigerant is repeatedly compressed and the pressure and temperature thereof are further increased.

[0071] In this case, the time at which the bypass opening/closing valve 184 is opened may vary depending on the temperature of the external environment measured by the sensor 185.

[0072] That is, before ice is made in the ice-making evaporator 142, the control unit 190 controls the bypass opening/closing valve 184 according to at least one condition among the idle time of the compressor 110, whether ice-making is in progress, and the temperature of the external environment.

[0073] In this case, the temperature at which the control unit 190 determines the opening of the bypass valve, that is, the temperature of the external environment, may be between 13°C and 18°C. Preferably, the temperature may be 15°C.

[0074] That is, when the temperature of the external environment measured by the sensor 185 is between 13 and 18°C, the control unit 190 operates the refrigerant preheating unit 180.

[0075] When the bypass opening/closing valve 184 is opened by the control unit 190, the refrigerant discharged from the compressor 110 is sucked back into a suction end 112 of the compressor 110 and compressed repeatedly to increase the temperature of the refrigerant.

[0076] Therefore, by supplying the high-temperature refrigerant to the ice-making evaporator 142 through the ice-removing refrigerant flow path unit 160 in a state where the temperature of the refrigerant is sufficiently increased, the ice-removing performance may be guaranteed even in a low-temperature environment.

[0077] FIG. 2 is a chart illustrating changes in the temperature when the refrigerants of a conventional general ice maker 100 and the ice maker 100 having a refrigerant preheating unit according to an exemplary embodiment of the present invention are discharged from the compressor 110, when the environmental temperature of the outside air is 15°C and 3°C.

[0078] In addition, FIG. 3 is a graph illustrating changes in the temperature of the refrigerant discharged from a compressor provided in a conventional ice maker and the refrigerant discharged from the compressor 110 of the ice maker 100 having a refrigerant preheating unit according to an exemplary embodiment of the present invention, when the environmental temperature of the outside air is 15°C, and FIG. 4 is a graph illustrating changes in the temperature of the refrigerant discharged from a compressor provided in a conventional ice maker and the refrigerant discharged from the compressor 110 of the ice maker 100 having a refrigerant preheating unit according to an exemplary embodiment of the present invention, when the environmental temperature of the outside air is 3°C.

[0079] In the above graphs, the horizontal axis is time (unit: seconds) and the vertical axis is temperature (unit: Celsius).

[0080] As illustrated in FIGS. 2 to 4, when the environmental temperature of the outside air is 15°C, the temperature of the refrigerant discharged from the conventional ice maker is 23.2°C 1 minute after the compressor starts operating, 32.8°C 5 minutes later, and 32.8°C 10 minutes later, indicating that the temperature of the refrigerant does not increase any further after 5 minutes of operation.

[0081] On the other hand, in the case of the ice maker 100 having a refrigerant preheating unit of the exemplary embodiment of the present invention, the temperature is 29.5°C 1 minute after the compressor 110 starts operating, which is 6.3°C higher than the conventional one, 44.4°C 5 minutes later, and 55.9°C 10 minutes later.

[0082] Therefore, in the case of the ice maker 100 having a refrigerant preheating unit of the exemplary embodiment of the present invention, it can be seen that the refrigerant temperature is higher than that of the conventional ice maker immediately after the operation of the compressor 110, and the temperature of the refrigerant continuously increases to a higher temperature while the compressor 110 is operated.

[0083] The above-described difference shows the same tendency even when the environmental temperature of the outside air is 3°C, and it can be seen that the refrigerant temperature of the ice maker 100 having a refrigerant preheating unit according to the exemplary embodiment of the present invention is significantly higher than the refrigerant temperature of the conventional ice maker throughout all sections after the compressor 110 is operated.

[0084] FIG. 5 is a graph illustrating differences between the temperature of the refrigerant sucked and discharged by the compressor of the conventional ice maker and the temperature of the refrigerant sucked and discharged by the compressor 110 of the ice maker 100 having a refrigerant preheating unit according to the exemplary embodiment of the present invention, when the environmental temperature of the outside air is 15°C. In the above graph, the horizontal axis is time (unit: seconds), and the vertical axis is temperature (unit: Celsius).

[0085] As can be seen in (a) of FIG. 5, in the case of the conventional ice maker, the temperature of the refrigerant when sucked from the compressor 110 can be seen to rise and fall repeatedly from a maximum temperature of around 20°C.

[0086] On the other hand, in the ice maker 100 having a refrigerant preheating unit according to the exemplary embodiment of the present invention, the temperature rapidly rises to around 80°C until about 3,000 seconds have passed, and the maximum temperature rises little by little thereafter. Moreover, the degree of rise and fall of the temperature of the refrigerant can also be seen to be small compared to the conventional ice maker.

[0087] In addition, as can be seen in (b) of FIG. 5, the temperature of the refrigerant discharged from the compressor 110 reaches a maximum temperature of 40°C after about 1,400 seconds and converges around this temperature.

[0088] On the other hand, it can be seen that the temperature of the refrigerant discharged from the ice maker 100 having

a refrigerant preheating unit according to the exemplary embodiment of the present invention rapidly increases to a maximum temperature of about 90°C after about 3,000 seconds, and the maximum temperature gradually increases thereafter.

[0089] Therefore, even in a low-temperature environment where the external environmental temperature is low, the high-temperature refrigerant can be quickly supplied to the ice-making evaporator 142 through the ice-removing refrigerant flow path unit 160, thereby ensuring the ice-removing performance.

[0090] Hereinafter, an exemplary embodiment of the method for controlling the ice maker having a refrigerant preheating unit according to the present invention described above will be described.

[0091] The method for controlling the ice maker having a refrigerant preheating unit according to the present exemplary embodiment may be a control method when the compressor 110 has stopped operating and is about to start operating (e.g., when the power of the ice maker 100 is turned off for a long time and then turned on). In this case, the ice maker 100 may be in a state before making ice.

[0092] The method for controlling the ice maker having a refrigerant preheating unit according to the present exemplary embodiment may include an environmental temperature measuring step (S130), a compressor idle time measuring step (S140), a preheating time calculating step (S150), a refrigerant preheating step (S160), an ice-making step (S170) and an ice-removing step (S180), as illustrated in FIG. 6.

[0093] First of all, after the power of the ice maker 100 is turned on (S 110), it may be determined whether the ice making conditions for making ice are satisfied (S120). For example, it is to determine whether the purified water for making ice is supplied sufficiently and whether the compressor 110 is operating normally.

[0094] Meanwhile, if the ice-making conditions are satisfied, the environmental temperature measuring step (S130) may be performed. The environmental temperature measuring step (S130) measures the temperature of the environment in which the ice maker 100 is placed, by having the sensor 185 measure the temperature of the external environment or the temperature of the purified water.

[0095] In addition, after the environmental temperature is measured in the environmental temperature measuring step (S130), a low-temperature environment determining step (S132) may be performed to determine whether the measured environmental temperature is lower than a preset reference temperature.

[0096] That is, the control unit 190 determines whether the environmental temperature measured in the environmental temperature measuring step (S130) is lower than a preset reference temperature (e.g., 15°C) (S132). If the measured environmental temperature is lower than the preset reference temperature and is a low-temperature environment, the compressor idle time measuring step (S140) for measuring the idle time of the compressor 110 may be performed.

[0097] Alternatively, if the environmental temperature measured in the environmental temperature measuring step (S130) is higher than the reference temperature and is not a low-temperature environment, the ice-making step (S170) may be performed immediately.

[0098] In the compressor idle time measuring step (S140), the amount of time that has elapsed since the compressor 110 stopped operating may be counted. That is, in the compressor idle time measuring step (S140), the time during which the compressor 110 was not in operation may be measured.

[0099] After the compressor idle time measuring step (S140), a compressor idle time determining step (S142) may be performed. The compressor idle time determining step (S142) is a step for determining whether the compressor idle time counted in the compressor idle time measuring step (S140) exceeds a preset reference time. The preset reference time may be determined differently depending on the environmental temperature measured in the environmental temperature measuring step (S130).

[0100] For example, in an environment of 15°C, the preset reference time of the compressor idle time may be between 15 and 40 minutes.

[0101] If the compressor idle time elapsed time counted in the compressor idle time measuring step (S140) exceeds the preset reference time, a preheating time calculating step (S150) may be performed. Alternatively, if the compressor idle time counted in the compressor idle time measuring step (S140) does not exceed the preset reference time, the ice-making step (S170) may be performed immediately.

[0102] Meanwhile, the preheating time calculating step (S150) is a step for calculating a refrigerant preheating time at a corresponding temperature (i.e., the measured environmental temperature), when the compressor idle time exceeds the preset reference time and the environmental temperature measured in the environmental temperature measuring step (S130) is a low-temperature environment lower than the preset reference temperature.

[0103] For example, the refrigerant preheating time calculated in the preheating time calculating step (S150) may be longer when the measured environmental temperature is 10°C compared to when the measured environmental temperature is 15°C in the environmental temperature measuring step (S130).

[0104] After the preheating time calculating step (S150), the refrigerant preheating step (S160) may be performed. The refrigerant preheating step (S160) is a step in which the refrigerant is heated by circulating through the compressor 110 through the bypass flow path 182 of the refrigerant preheating unit 180 during the refrigerant preheating time calculated in the preheating time calculating step (S150).

[0105] In the refrigerant preheating step (S160), the control unit 190 may control the bypass opening/closing valve 184 to open the bypass flow path 182 to start refrigerant preheating (S162).

[0106] When the bypass opening/closing valve 184 is opened, the refrigerant discharged from the compressor 110 may be continuously compressed and heated while being sucked back into the compressor 110 through the bypass flow path 182. In other words, the refrigerant is repeatedly compressed and heated while circulating through the compressor 110 and the bypass flow path 182.

[0107] After the bypass opening/closing valve 184 is opened for a preset time, the control unit 190 controls the bypass opening/closing valve 184 to close the bypass flow path 182, thereby completing the preheating of the refrigerant (S164).

[0108] After the refrigerant preheating step (S160) is completed, an ice-making step (S170) of making ice in the ice-making evaporator 142 may be performed.

[0109] In addition, after the ice-making step (S170) is performed, the ice-removing step (S180) for removing ice that has been made may be performed.

[0110] In the ice-removing step (S180), the refrigerant preheated in the above-described refrigerant preheating step (S160) may be supplied to the ice-making evaporator 142 through the ice-removing refrigerant flow path unit 160 to heat the ice mold of the ice-making evaporator 142 to remove ice (S180).

[0111] Hereinafter, another exemplary embodiment of the method for controlling the ice maker having a refrigerant preheating unit according to the present invention as described above will be described.

[0112] The method for controlling the ice maker having a refrigerant preheating unit according to the present exemplary embodiment may be a control method in a state where the ice maker 100 is operating (e.g., in a state where ice is being made or has been made in the ice-making evaporator 142 of the ice maker 100).

[0113] The method for controlling the ice maker having a refrigerant preheating unit according to the present exemplary embodiment may include an environmental temperature measuring step (S230), a preheating time calculating step (S250), a refrigerant preheating step (S260) and an ice-removing step (S290), as illustrated in FIG. 7.

[0114] First of all, after the power of the ice maker 100 is turned on (S210), it may be determined whether the ice-making conditions for making ice are satisfied (S220). For example, it may be determined whether the purified water for making ice is sufficiently supplied and whether the operation of the compressor 110 is normal.

[0115] Meanwhile, if the ice-making conditions are satisfied, the environmental temperature measuring step (S230) and the ice-making step (S240) may be performed. In the present exemplary embodiment, the environmental temperature measuring step (S230) is performed before the ice-making step (S240) as an example. Alternatively, the environmental temperature measuring step (S230) and the ice-making step (S240) may be performed simultaneously or at different times.

[0116] The environmental temperature measuring step (S230) measures the temperature of the environment in which the ice maker 100 is placed by measuring the outside air temperature or the temperature of the purified water in the environment in which the ice maker 100 is placed by a sensor 185.

[0117] The control unit 190 determines (S232) whether the environmental temperature measured in the environmental temperature measuring step (S230) is higher than a preset reference temperature (e.g., 15°C). If the measured environmental temperature is a low-temperature environment lower than the preset reference temperature, the preheating time calculating step (S250) may be performed.

[0118] Certainly, if the measured environmental temperature is higher than the preset reference temperature (i.e., not a low-temperature environment), the ice-removing step (S270) for removing the ice may be performed immediately.

[0119] The preheating time calculating step (S250) is a step for calculating the refrigerant preheating time according to the environmental temperature measured in the environmental temperature measuring step (S230).

[0120] For example, the refrigerant preheating time calculated in the preheating time calculating step (S250) may be calculated to be longer when the environmental temperature measured in the environmental temperature measuring step (S230) is 10°C than when it is 15°C.

[0121] After the preheating time calculating step (S250), a refrigerant preheating step (S260) may be performed. The refrigerant preheating step (S260) is a step for heating the refrigerant by circulating through the compressor 110 through the bypass flow path 182 of the refrigerant preheating unit 180 during the refrigerant preheating time calculated in the preheating time calculating step (S250).

[0122] In the refrigerant preheating step (S260), the control unit 190 may control the bypass opening/closing valve 184 to open the bypass flow path 182 to start refrigerant preheating (S262).

[0123] When the bypass opening/closing valve 184 is opened, the refrigerant discharged from the compressor 110 may be continuously compressed and heated while being sucked back into the compressor 110 through the bypass flow path 182. That is, the refrigerant is repeatedly compressed and heated while circulating through the compressor 110 and the bypass flow path 182.

[0124] After the bypass opening/closing valve 184 is opened for a preset time, the control unit 190 may control the bypass opening/closing valve 184 to close the bypass flow path 182 to end refrigerant preheating (S264). After the refrigerant preheating step (S260) is completed, an ice-removing step (S270) for removing ice from the ice-making

evaporator 142 may be performed.

[0125] In the ice-removing step (S270), the refrigerant preheated in the above-described refrigerant preheating step (S260) may be supplied to the ice-making evaporator 142 through the ice-removing refrigerant flow path 160 to heat the ice mold of the ice-making evaporator 142 to remove ice (S270).

[0126] Although the exemplary embodiments of the present invention have been described above, the spirit of the present invention is not limited to the exemplary embodiments presented in the present specification, and those skilled in the art who understand the spirit of the present invention may easily suggest other exemplary embodiments by changing, modifying, deleting or adding components within the scope of the same spirit, but this will also fall within the scope of the present invention.

[Explanation of Reference Numerals]

100:	Ice maker	110:	Compressor
112:	Suction end	114:	Discharge end
120:	Condenser	130:	Expansion unit
142:	Ice-making evaporator	144:	Cold-water evaporator
150:	Refrigerant flow path unit	160:	Ice-removing refrigerant flow path unit
170:	Multi-directional branch valve	180:	Refrigerant preheating unit
182:	Bypass flow path	184:	Bypass opening/closing valve
185:	Sensor	190:	Control unit
S110, S210:	Ice maker power ON	S120, S220:	Ice making conditions satisfied
S130, S230:	Environmental temperature measuring step		
S140, S240:	Compressor idle time measuring step		
S142:	Compressor idle time determining step		
S150, S250:	Preheating time calculating step		
S160, S260:	Refrigerant preheating step		
S162, S262:	Refrigerant preheating ON		
S164, S264:	Refrigerant preheating OFF		
S170, S240:	Ice-making step	S180, S270:	Ice-removing step

Claims

1. An ice maker (100) having a refrigerant preheating unit, comprising:

a compressor (110) for compressing a refrigerant;
a condenser (120) for condensing a refrigerant discharged from a discharge end of the compressor;
an expansion unit (130) for expanding a refrigerant condensed in the condenser;
an ice-making evaporator (142) for evaporating a refrigerant expanded in the expansion unit to make ice;
a refrigerant flow path unit (150) for guiding a refrigerant discharged from the compressor to a suction end of the compressor through the condenser, the expansion unit and the ice-making evaporator;
an ice-removing refrigerant flow path unit (160) for guiding a refrigerant discharged from the compressor to the ice-making evaporator;
a refrigerant preheating unit (180) for causing a refrigerant discharged from the compressor to be re-suctioned into the compressor before passing through the condenser; and
a control unit (190) for controlling the refrigerant preheating unit.

2. The ice maker of claim 1, wherein the refrigerant preheating unit comprises:

a bypass flow path (182) which is branched from a discharge end of the compressor and is connected to a suction end of the compressor;
a bypass opening/closing valve (184) for opening/closing the bypass flow path; and
a sensor (185) for measuring the temperature of the external environment.

3. The ice maker of claim 2, wherein the sensor (185) is configured to measure the temperature of the outside air or the temperature of purified water.

4. The ice maker of claim 1, further comprising:
a cold-water evaporator (144) for cooling purified water with a refrigerant expanded in the expansion unit.

5. The ice maker of claim 4, wherein the refrigerant flow path unit (150) comprises:

an ice-making refrigerant flow path for guiding a refrigerant that has passed through the condenser to the ice-making evaporator;
a cold-water refrigerant flow path for guiding a refrigerant that has passed through the condenser to the cold-water evaporator; and
a multi-directional valve (170) for guiding a refrigerant that has passed through the condenser (120) to at least any one of the ice-making refrigerant flow path and the cold-water refrigerant flow path.

6. The ice maker of claim 5, wherein the expansion unit (130) comprises:

an ice-making expansion valve (132) which is provided on the ice-making refrigerant flow path and is configured to expand a refrigerant directed to the ice-making evaporator; and
a cold-water expansion valve (134) which is provided on the cold-water refrigerant flow path and is configured to expand a refrigerant directed to the cold-water evaporator.

7. The ice maker of claim 5, wherein the ice-removing refrigerant flow path unit (160) is provided to branch from the multi-directional valve (170) and is configured to guide a refrigerant to the ice-making evaporator (142).

8. The ice maker of claim 2, wherein before ice is made in the ice-making evaporator (142), if the idle time of the compressor is greater than a preset time, and the temperature of the external environment measured by the sensor is below a preset temperature, the control unit (190) opens the bypass opening/closing valve (184) for a set period of time to control a refrigerant discharged from the compressor (110) to circulate to a suction end of the compressor through the bypass flow path.

9. The ice maker of claim 2, wherein when ice is being made or ice making is completed in the ice-making evaporator (142), if the temperature of the external environment measured by the sensor is below a preset temperature, the control unit (190) opens the bypass opening/closing valve for a set period of time to control a refrigerant discharged from the compressor (110) to circulate to a suction end of the compressor through the bypass flow path.

10. The ice maker according to any one of claim 8 or 9, wherein the preset temperature is between 13 and 18°C.

11. A method for controlling the ice maker having a refrigerant preheating unit according to any one of claims 1 to 9, comprising:

an environmental temperature measuring step (S130, S230) for measuring the temperature of an outside air environment;
a low-temperature environment determining step (S132) for determining whether the temperature measured in the environmental temperature measuring step is lower than a preset temperature;
a preheating time calculating step (S150, S250) for calculating a refrigerant preheating time at a corresponding temperature when the environmental temperature determined in the low-temperature environment determining step is a low-temperature environment that is lower than a preset temperature; and
a refrigerant preheating step (S160, S260) for circulating a refrigerant through the bypass flow path of a refrigerant preheating unit through the compressor during the time calculated in the preheating time calculating step.

12. The method of claim 11, further comprising:

a compressor idle time measuring step (S140) which is performed before the preheating time calculating step, and counts an elapsed time after the compressor has stopped operating; and
an idle time determining step (S142) for determining whether the idle time of the compressor counted in the compressor idle time measuring step exceeds a set reference time,
wherein the preheating time calculating step (S150, S250) is performed when the idle time of the compressor determined in the idle time determining step exceeds a set reference time.

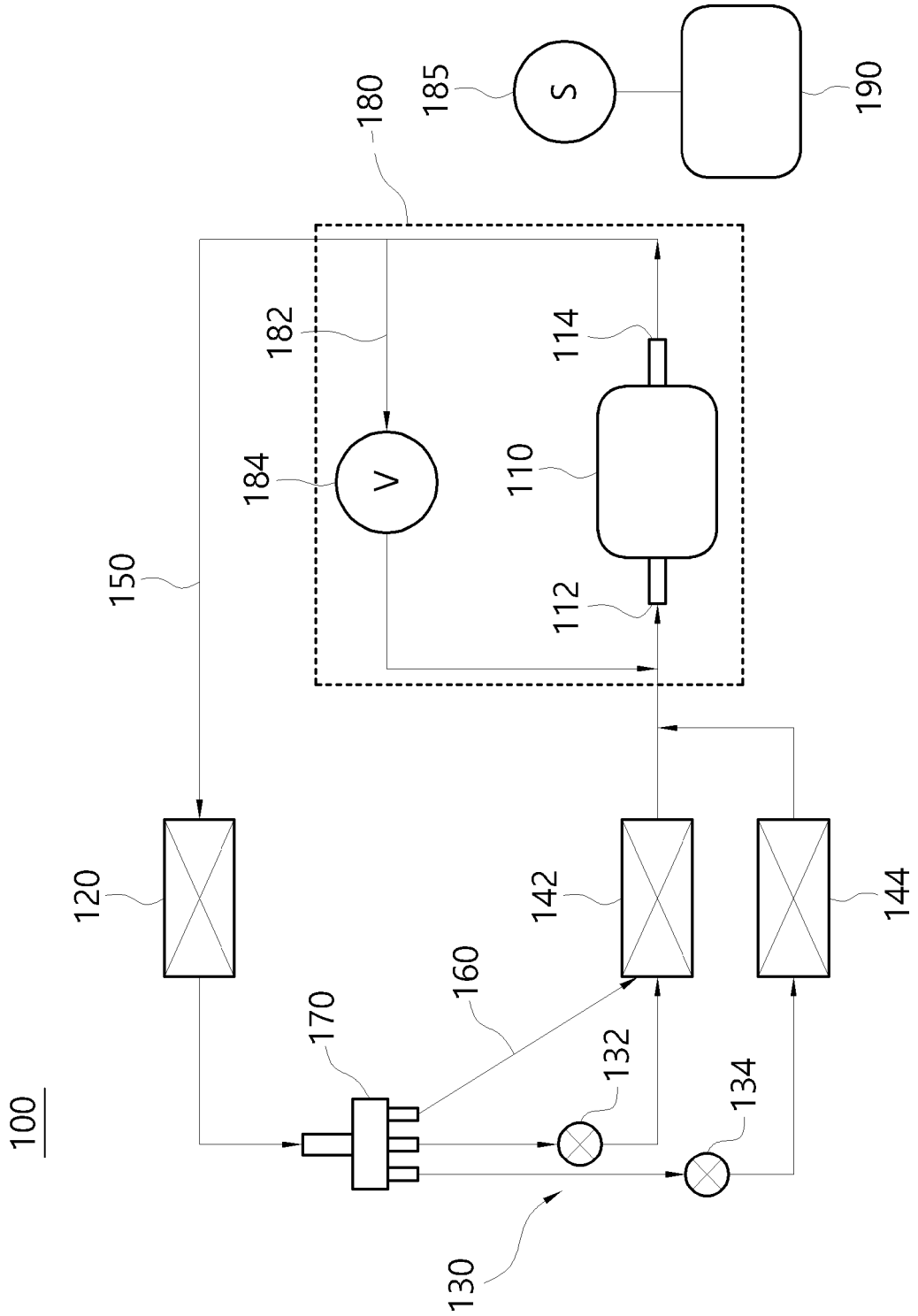
13. The method of claim 12, wherein after the refrigerant preheating step,

an ice-making step (S170) for making ice by using an ice-making evaporator after the preheating of a refrigerant is completed through a refrigerant preheating step; and
an ice-removing step (S180) for removing ice that has been made in the ice-making step are performed.

14. The method of claim 11, wherein before the preheating time calculating step (S150, S250), an ice-making step (S170, S240) for making ice by using an ice making evaporator is performed, and
wherein the refrigerant preheating step (S160, S260) is performed after the ice-making step (S170, S240).

15. The method of claim 11, wherein the preset temperature is between 13 and 18°C.

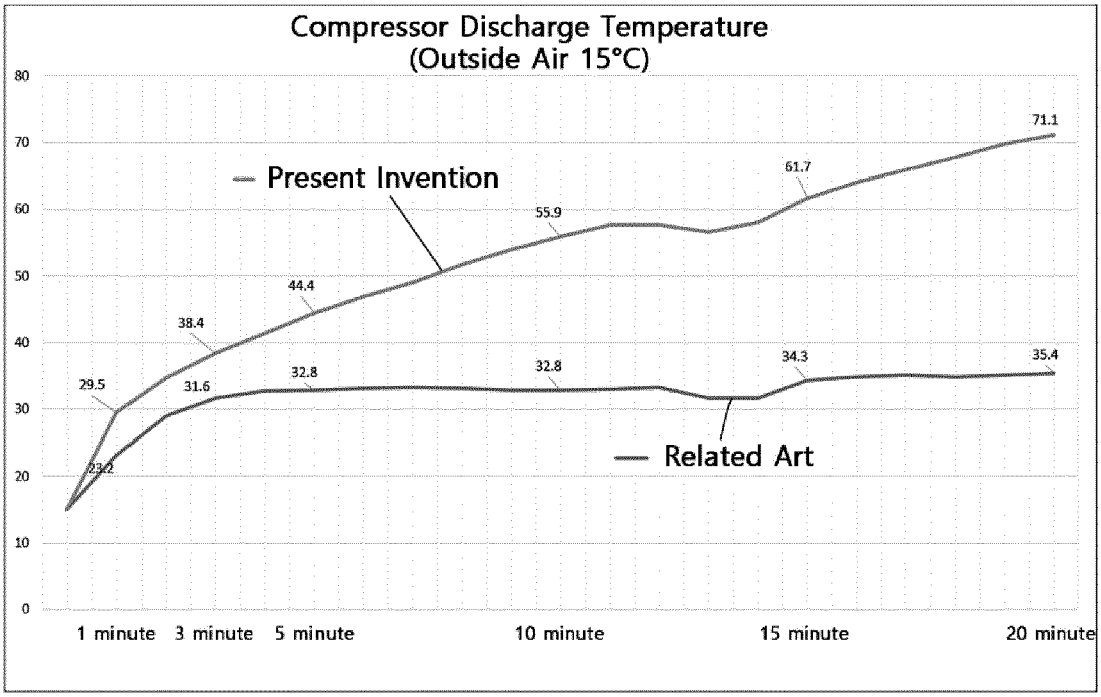
【FIG. 1】


100
120
130
132
134
142
144
150
160
170
180
182
184
185
190
110
112
114
V
S

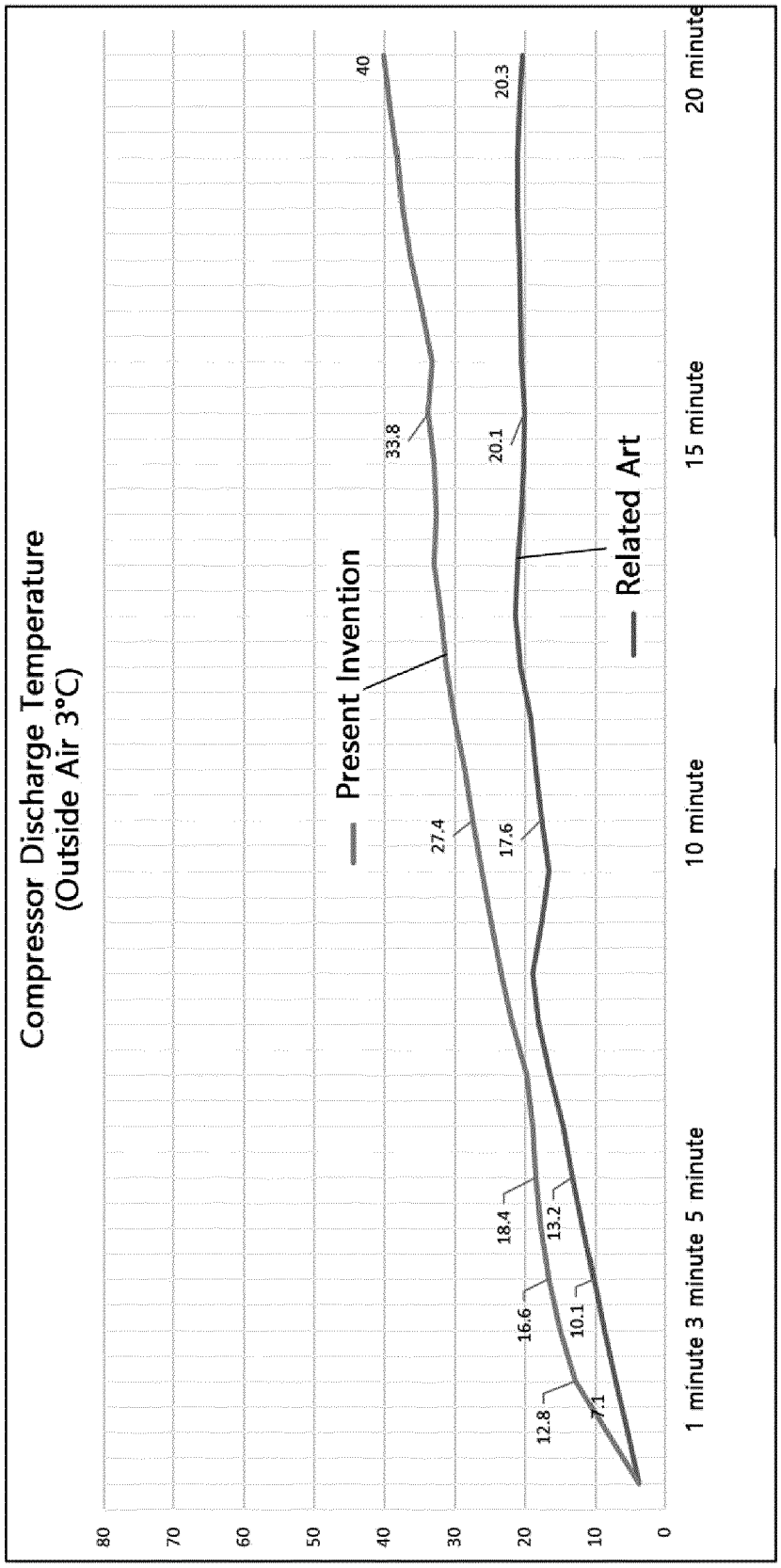
【FIG. 2】

Compressor Discharge Temperature (℃)	Outside Air 15℃				Outside Air 3℃			
	After 1 minute	After 3 minutes	After 5 minutes	After 10 minutes	After 1 minute	After 3 minutes	After 5 minutes	After 10 minutes
Related Art	23.2	31.6	32.8	32.8	7.1	10.1	13.2	17.6
Present Invention	29.5 (6.3↑)	38.4 (6.8↑)	44.4 (11.6↑)	55.9 (23.1↑)	12.8 (5.7↑)	16.6 (6.5↑)	18.4 (5.2↑)	27.4 (9.8↑)

【FIG. 3】

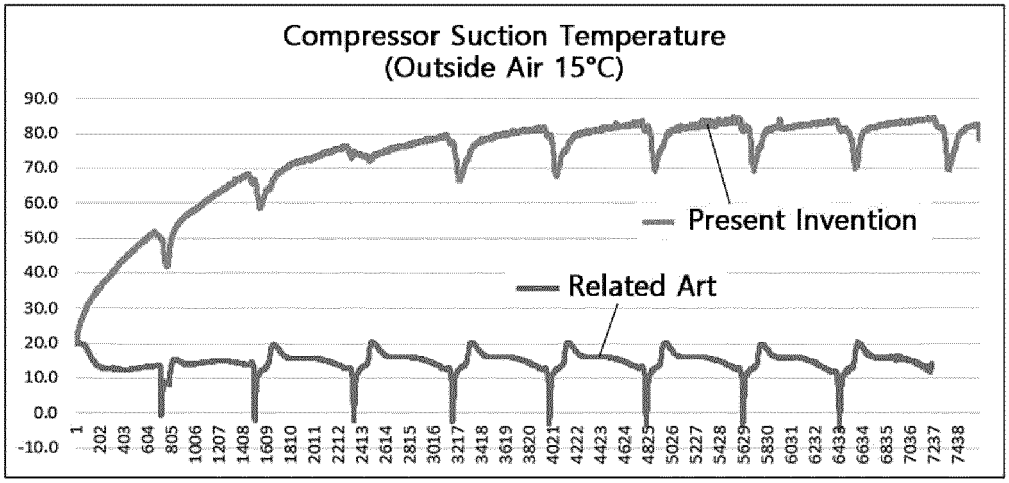

Compressor Discharge Temperature
(Outside Air 15°C)
80
70
60
50
40
30
20
10
0
Present Invention
Related Art
29.5
38.4
44.4
55.9
61.7
71.1
23.2
31.6
32.8
32.8
34.3
35.4
1 minute
3 minute
5 minute
10 minute
15 minute
20 minute

【FIG. 4】

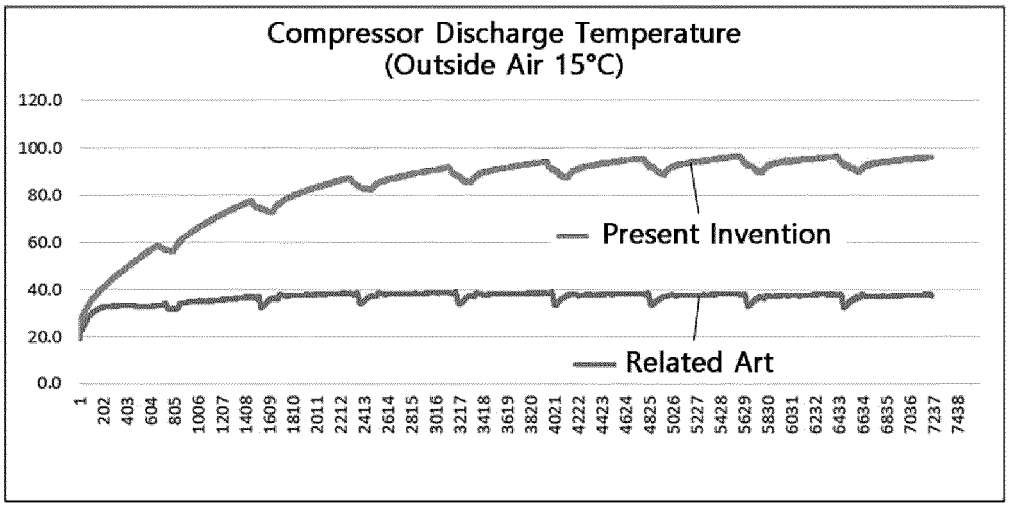

Compressor Discharge Temperature
(Outside Air 3°C)
Present Invention
Related Art
80
70
60
50
40
30
20
10
0
1 minute
3 minute
5 minute
10 minute
15 minute
20 minute
40
33.8
27.4
18.4
13.2
20.3
20.1
17.6
16.6
10.1
12.8
7.1

【FIG. 5】

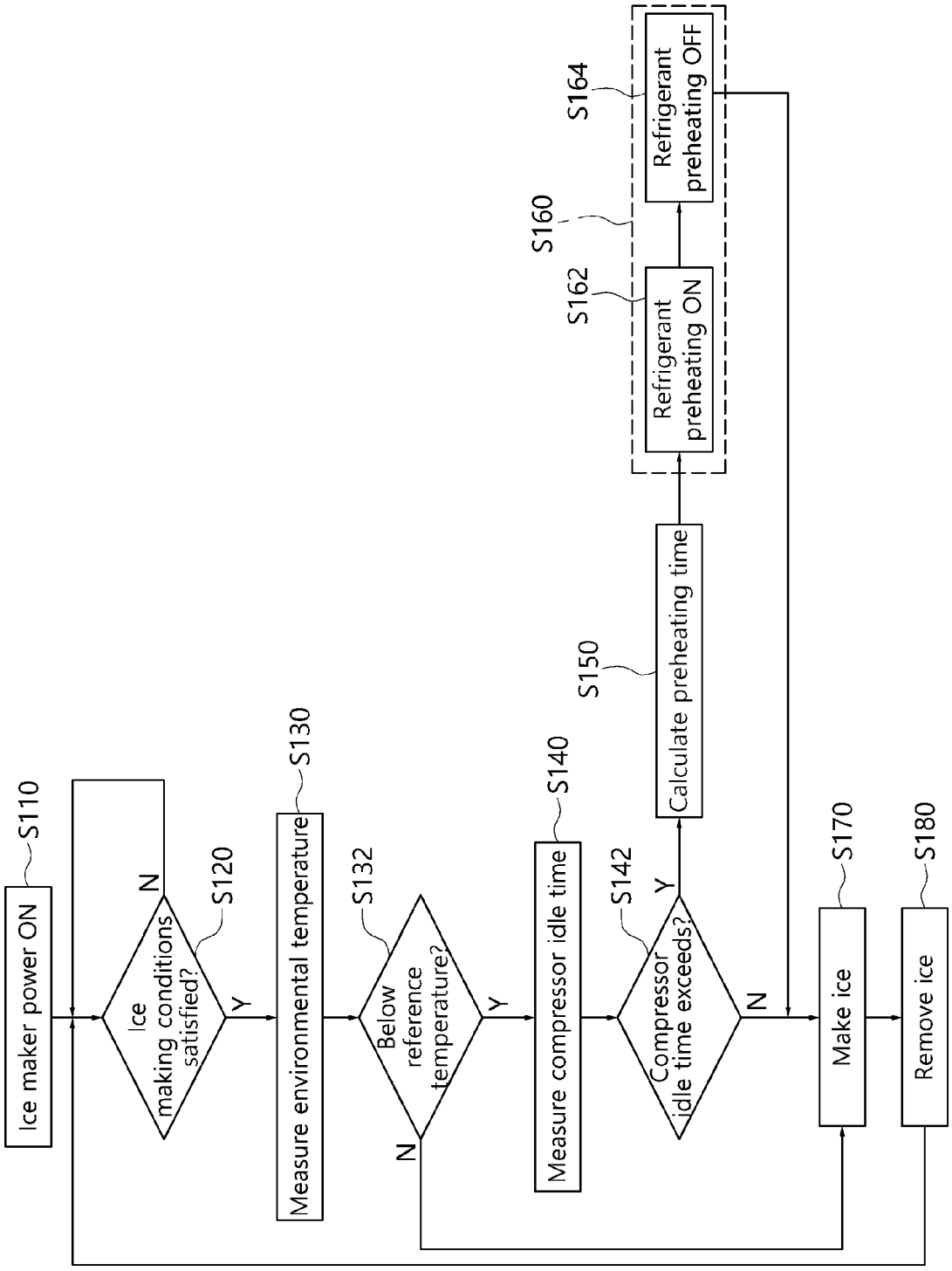
(a)


Compressor Suction Temperature
(Outside Air 15°C)
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
Present Invention
Related Art
1
202
403
604
805
1006
1207
1408
1609
1810
2011
2212
2413
2614
2815
3016
3217
3418
3619
3820
4021
4222
4423
4624
4825
5026
5227
5428
5629
5830
6031
6232
6433
6634
6835
7036
7237
7438

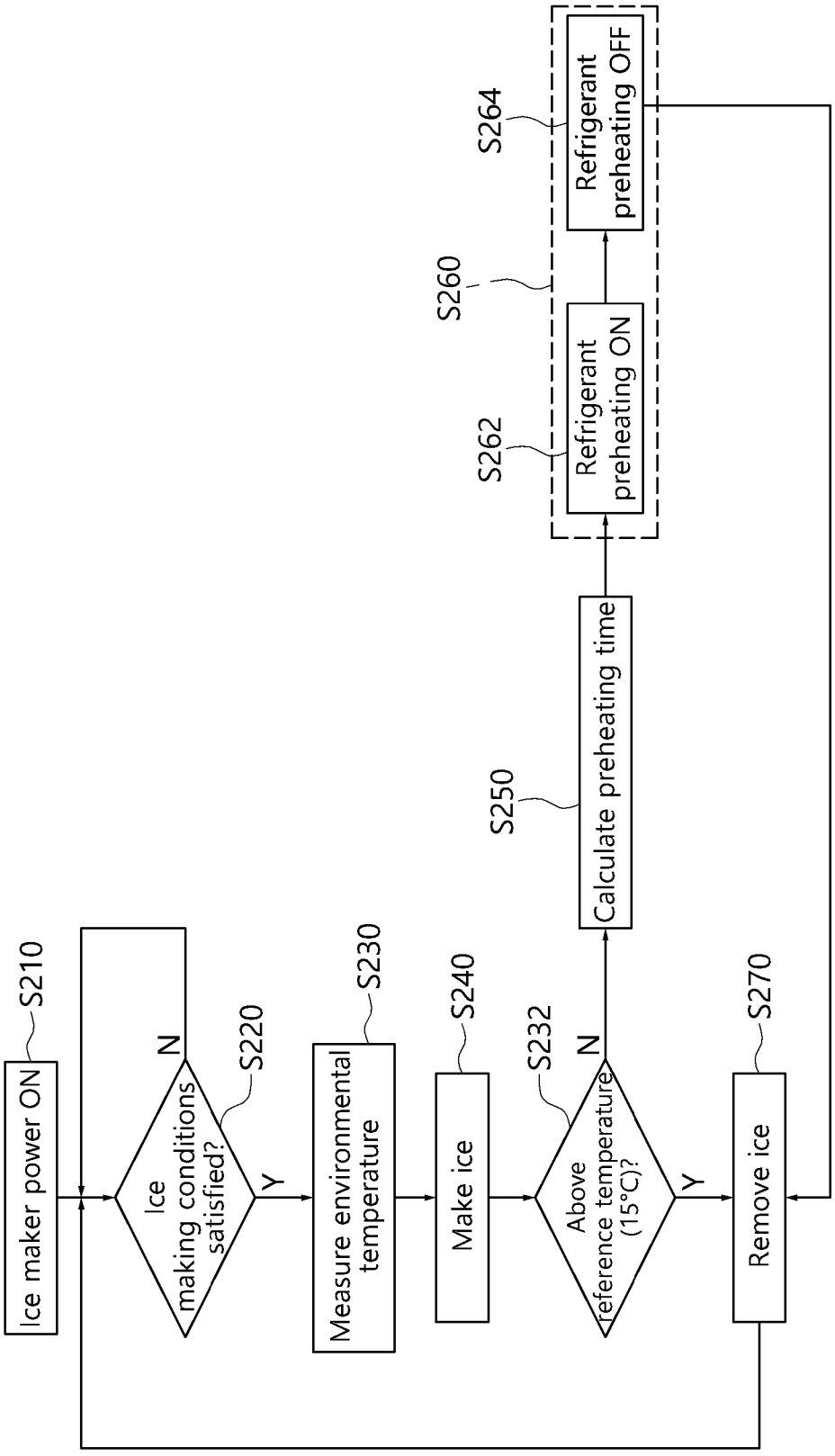
(b)


Compressor Discharge Temperature
(Outside Air 15°C)
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Present Invention
Related Art
1
202
403
604
805
1006
1207
1408
1609
1810
2011
2212
2413
2614
2815
3016
3217
3418
3619
3820
4021
4222
4423
4624
4825
5026
5227
5428
5629
5830
6031
6232
6433
6634
6835
7036
7237
7438

【FIG. 6】


Ice maker power ON
S110
Ice making conditions satisfied?
S120
N
Y
Measure environmental temperature
S130
Below reference temperature?
S132
N
Y
Measure compressor idle time
S140
Compressor idle time exceeds?
S142
Y
N
Calculate preheating time
S150
S160
Refrigerant preheating ON
S162
Refrigerant preheating OFF
S164
Make ice
S170
Remove ice
S180

【FIG. 7】


Ice maker power ON
S210
Ice making conditions satisfied?
S220
N
Y
Measure environmental temperature
S230
Make ice
S240
Above reference temperature (15°C)?
S232
N
Y
Calculate preheating time
S250
Refrigerant preheating ON
S262
Refrigerant preheating OFF
S264
S260
Remove ice
S270

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EUROPEAN SEARCH REPORT

Application Number
EP 24 19 3510

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	KR 100 407 867 B1 (CHUNG HO NAIS CO LTD [KR]) 1 December 2003 (2003-12-01) * paragraphs [0002] - [0079]; figure 2 *	1-15	INV. F25B5/02 F25B6/04 F25B47/02 F25B49/02 F25C1/00
A	FR 3 026 478 A1 (VALEO SYSTEMES THERMIQUES [FR]) 1 April 2016 (2016-04-01) * pages 2-20; figures 1-9 *	1-15	
A	US 11 149 971 B2 (EMERSON CLIMATE TECHNOLOGIES [US]) 19 October 2021 (2021-10-19) * columns 4-17; figure 4 *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

F25B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 October 2024	Amous, Moez

CATEGORY OF CITED DOCUMENTS

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28-10-2024

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FR 3026478 A1	01-04-2016	NONE	
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		EP 3755956 A1	30-12-2020
		US 2019264933 A1	29-08-2019
		WO 2019165254 A1	29-08-2019

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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- KR 1020030024361 **[0009]**
- KR 1020190065033 **[0011] [0013]**
- KR 1020190102808 **[0011] [0013]**
- KR 1020200078891 **[0011] [0013]**