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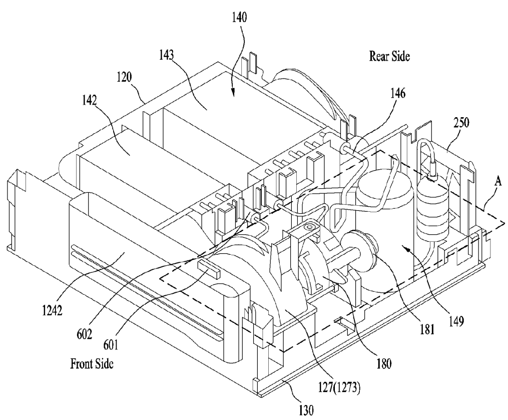
(54) **METHOD FOR CONTROLLING LAUNDRY TREATING APPATUS**

(57) A method for controlling a laundry treatment apparatus (100), the laundry treatment apparatus (100) including: a cabinet (101) defining an appearance of the apparatus (100); a cabinet discharge hole defined in one face of the cabinet (101) to exchange air inside the cabinet (101) and air outside the cabinet (101) with each other; a laundry accommodation space disposed inside the cabinet (101) and configured to accommodate laundry therein; a duct (120); a heat pump (140) including: a blowing fan (1273) located inside the duct to circulate air inside the duct; an evaporator (142); a condenser (143); and a compressor (149) located outside the duct to compress combustible refrigerant; and a fan (250) configured for introducing air outside the cabinet (101) through the cabinet discharge hole into the cabinet (101) or for discharging air inside the cabinet (101) through the cabinet discharge hole out of the cabinet (101), wherein the method comprises: operating the fan (250); operating the compressor (149) when a preset heat pump operation time duration has lapsed after the fan (250) is set into operation; and stopping the operation of the fan (250) when a preset fan operation time duration has elapsed.

【FIG. 2】



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a method for controlling a laundry treatment apparatus.

BACKGROUND ART

[0002] In general, a laundry treatment apparatus uses a heater or a heat pump to dry laundry. In particular, the laundry treatment apparatus using the heat pump uses an evaporator and a condenser to dehumidify and cool wet air, then heats the air again, and then supplies the dried hot air to the laundry. Compared to a scheme using the heater, the scheme using the heat pump may generate high-temperature heat with a small amount of work and thus is excellent in energy efficiency and has been recently used.

[0003] Refrigerant is essential to realize a refrigeration cycle of the heat pump. Refrigerant is a working fluid that is easily evaporated in the refrigeration cycle and takes heat from a low temperature part and transfers the heat to a high temperature part.

[0004] The refrigerant may be classified into natural refrigerant, 1st generation CFC (chlorofluorocarbon), 2nd generation HCFC (hydro chlorofluorocarbon), 3rd generation HFC (hydrofluorocarbon), 4th generation HFO (hydrofluoroolefin), etc. CFC and HCFC-based refrigerants known as freon gas are known as main substances for ozone depletion, and thus use thereof is limited pursuant to the Montreal Protocol on Substances that Deplete the Ozone Layer.

[0005] The HFC-based refrigerant does not destroy the ozone layer, but acts as a global warming material. A representative refrigerant thereof is R-134a, which is used in automobile and household electronic products. This refrigerant was classified as one of six major global warming substances pursuant to the Kyoto Protocol to the United Nations Framework Convention on Climate Change, but was used because the Kyoto Protocol was not compulsory. However, as the HFC-based refrigerant was defined as a substance for ozone depletion pursuant to the Montreal Protocol in 1987 and thus use thereof will be banned before 2020 in developed countries and 2030 in developing countries. Further, as the HFC-based refrigerants were defined as fluorinated gas (F-gas) by EP in 2006. Thus, the HFO-based refrigerants with low GWP are emerging as next-generation refrigerants.

[0006] The global warming potential (GWP) refers to an extent to which other greenhouse gases contribute to global warming, based on an extent to which carbon dioxide contributes to global warming. That is, the GWP refers to a value obtained by dividing an amount of solar energy absorbed by 1 kg of individual greenhouse gas by an amount of solar energy absorbed by 1 kg of carbon dioxide. The GWP refers to an index of a warming effect per unit mass. For example, when considering GWP of carbon dioxide as 1, GWP of methane is 21, GWP of nitrous oxide is 310, GWP of hydrogen fluoride is 1,300, and GWP of sulfur hexafluoride is 23,900.

[0007] In particular, in the European EU, when the GWP of a specific refrigerant exceeds 150, a commercial sealed refrigeration apparatus using the same will be prevented from being sold in Europe since 2020. A commercial centralized refrigeration apparatus using refrigerant of GWP exceeding 150 and using power exceeding 40kW will be prohibited from market sale since 2022.

[0008] To cope with this EP regelation, a heat pump using R-290 and a laundry treatment apparatus using the same have been developed. However, R-290 is a high-purity propane gas, which has flammability, and has a risk of explosion. In particular, when a concentration thereof in air becomes higher than 1.8% due to leakage of R-290, there is a risk of ignition or explosion during use.

[0009] Therefore, there is a need for a device or a control method capable of detecting a leak thereof during operation and preventing an explosion thereof. A related prior document for detecting the refrigerant leakage includes Korean Patent No. 10-1229364. This patent document discloses determining a temperature of air passing through a condenser or intake means using a temperature sensor, and determining that the refrigerant leaks out when a decrease in the measured temperature is equal to or higher than a preset level. In this connection, when the refrigerant is not a combustible refrigerant, and thus there is no risk of explosion, there is no need to disclose a treatment method or a countermeasure to prevent the explosion of leaked refrigerant. That is, the above patent document does not deal with the combustible refrigerant. Further, in the above patent document, determining whether the refrigerant leaks out using only the temperature decrease based on a simple temperature difference may result in incorrect determination.

DISCLOSURE

TECHNICAL PURPOSES

[0010] One purpose of the present disclosure is to provide a control method of a laundry treatment apparatus including a heat pump using combustible refrigerant, in which during operation of the laundry treatment apparatus or detection of leakage of the refrigerant, a concentration of the leaked refrigerant is diluted to prevent explosion thereof.

[0011] Purposes of the present disclosure are not limited to the above-mentioned purpose. Other purposes and advantages of the present disclosure as not mentioned above may be understood from following descriptions and more clearly understood from embodiments of the present disclosure. Further, it will be readily appreciated that the purposes and advantages of the present disclosure may be realized by features and combinations thereof as disclosed in the claims.

TECHNICAL SOLUTIONS

[0012] The present disclosure provides a control method of a laundry treatment apparatus including a heat pump using a combustible refrigerant, in which a fan operates based on a preset time regardless of detection of leakage in order to prevent the leaked refrigerant from exploding.

[0013] Further, the present disclosure provides a control method of a laundry treatment apparatus including a heat pump using a combustible refrigerant, in which when a combustible refrigerant leaks during a drying cycle of the laundry treatment apparatus, a fan operates for a certain period of time to prevent explosion thereof.

[0014] Further, the present disclosure provides a control method of a laundry treatment apparatus including a heat pump using a combustible refrigerant, in which a fan operates such that the leaked refrigerant is diluted with surrounding air and thus a concentration of the leaked refrigerant does not exceed an explosion limit.

[0015] Therefore, the fan has a function of cooling a compressor and a function of diluting air or refrigerant.

[0016] For the dilution function of the fan, the drum motor and the compressor are not activated immediately when the drying cycle starts but the fan located near the compressor may be activated immediately when the drying cycle starts. Then, the drum motor and the compressor may be sequentially activated at a preset time interval. In addition, the fan may be activated for a preset reference time duration and then may be deactivated. This is to prevent the explosion in advance using the fan to dilute the leaked refrigerant. Otherwise, when the user starts the drying cycle by pressing a button, the explosion may occur.

[0017] Further, periodically operating the fan for a certain period of time, for example, 10 seconds may prevent the leaked refrigerant from being collected into one place.

[0018] Further, in order to detect leakage of the combustible refrigerant, a temperature of an evaporator inlet and a temperature of the air discharged from the drum are measured. Whether a temperature difference therebetween is below an allowable temperature difference is determined. Further, whether a state in which a temperature difference therebetween is below an allowable temperature difference lasts for a period of time is determined. In addition, a controller reads the current load actually input to the compressor and checks whether a state in which the load is below a threshold current value lasts for a certain time duration.

[0019] When the above two conditions are satisfied, it may be determined that the leakage occurs. Then, the control method operates the fan for a certain time to prevent the explosion.

[0020] In one aspect of the present disclosure, a method for controlling a laundry treatment apparatus is provided. The laundry treatment apparatus includes a cabinet defining an appearance of the apparatus; a cabinet discharge hole defined in one face of the cabinet to exchange air inside the cabinet and air outside the cabinet with each other; a cylindrical drum disposed inside the cabinet; a drum motor for driving the drum; a duct defining a fluid channel for circulating air in the drum; a heat pump including: a blowing fan located inside the duct to circulate air inside the duct; an evaporator located inside the duct to cool air entering the duct; a condenser located inside the duct to heat air passing through the evaporator; and a compressor located outside the duct to compress combustible refrigerant passing through the evaporator and to supply the compressed refrigerant to the condenser; and a fan for introducing air outside the cabinet through the cabinet discharge hole into the cabinet or for discharging air inside the cabinet through the cabinet discharge hole out of the cabinet. The method is characterized by comprising: operating the fan; operating the drum motor in a first rotational direction when a preset drum motor operation time duration has lapsed after the fan operates; operating the compressor when a preset heat pump operation time duration has lapsed after the fan operates; and stopping the operation of the fan when a preset fan operation time duration has elapsed.

[0021] In one implementation, the method further comprises: setting a first operation period and a first operation time duration of the fan based on whether a preset first reference time duration has elapsed; and repeating activation and deactivation of the fan based on the first operation period and the first operation time duration until a preset drying cycle time duration has elapsed.

[0022] In one implementation, the method further comprises terminating an operation of the compressor after the drying cycle time duration has elapsed.

[0023] The method of claim 3, wherein the method further comprises: a cooling cycle initiation operation to start the fan after terminating the operation of the compressor; and repeating activation and deactivation of the fan based on a preset second operation period and a second operation time duration until a preset cooling cycle time duration has elapsed; and terminating an operation of each of the compressor and the drum motor when the cooling cycle time duration has elapsed.

[0024] In one aspect of the present disclosure, a method for controlling a laundry treatment apparatus is provided. The laundry treatment apparatus includes a cabinet defining an appearance of the apparatus; a cabinet discharge hole defined in one face of the cabinet to exchange air inside the cabinet and air outside the cabinet with each other; a cylindrical drum disposed inside the cabinet; a drum motor for driving the drum; a duct defining a fluid channel for circulating air in the drum; a heat pump including: a blowing fan located inside the duct to circulate air inside the duct; an evaporator located inside the duct to cool air entering the duct; a condenser located inside the duct to heat air passing through the evaporator; and a compressor located outside the duct to compress combustible refrigerant passing through the evaporator and to supply the compressed refrigerant to the condenser; and a fan for introducing air outside the cabinet through the cabinet discharge hole into the cabinet or for discharging air inside the cabinet through the cabinet discharge hole out of the cabinet. The apparatus is characterized by further comprising: a first temperature sensor located below the drum to measure a first temperature of air discharged from the drum; a second temperature sensor to measure a second temperature of the combustible refrigerant flowing into the evaporator; and a controller for measuring a current load of the compressor, and receiving a control signal of each of the first temperature sensor and the second temperature sensor, and transmitting a control signal to each of the drum motor, the compressor, the blowing fan, and the fan. The method is characterized by comprising: operating the fan; operating the drum motor in a first rotation direction when a preset drum motor operation time duration has lapsed after the fan operates; operating the compressor when a preset heat pump operation time duration has lapsed after the fan operates; stopping the operation of the fan when a preset fan operation time duration has elapsed; determining whether an operation time duration of the compressor meets a preset second reference time duration; upon determination that the operation time duration of the compressor meets the preset second reference time duration, performing a measurement operation in which the controller reads a current load of the compressor in real time, and receives the first temperature and the second temperature in real time from the first and second temperature sensors respectively; performing a refrigerant leakage determination operation including: determining whether a state in which the current load is below a preset threshold current value lasts for a preset first continuous time duration; and determining whether a state in which an absolute value of a difference between the first temperature and the second temperature is smaller than or equal to a preset allowable temperature difference lasts for a preset second continuous time duration; and when the state in which the current load is below the preset threshold current value lasts for the preset first continuous time duration, and when the state in which the absolute value of the difference between the first temperature and the second temperature is smaller than or equal to the preset allowable temperature difference lasts for the preset second continuous time duration, performing a first emergency action operation in which the fan is activated during a preset first emergency action time duration.

[0025] In one implementation, when both of a first condition that the state in which the current load is below the preset threshold current value lasts for the preset first continuous time duration, and a second condition that the state in which the absolute value of the difference between the first temperature and the second temperature is smaller than or equal to the preset allowable temperature difference lasts for the preset second continuous time duration are not satisfied, the measurement operation is repeated.

[0026] In one implementation, the method further comprises: determining whether a number of repetitions of the first emergency actions exceeds 3; and upon determination that the number of repetitions of the first emergency actions is below 3, repeating the measurement operation, the leakage determination operation, and the first emergency action operation.

[0027] In one implementation, the method further comprises: when the number of repetitions of the first emergency actions exceeds 3, terminating the operation of each of the drum motor and the compressor, and activating the fan during a preset second emergency action time duration.

[0028] In one implementation, the method further comprises displaying an error after the second emergency action operation is completed.

[0029] In one implementation, the controller displays the error on a display located at a top of a front face of the cabinet.

[0030] In one implementation, the method further comprises terminating, by the controller, an operation of the compressor for a preset reverse rotation time duration; rotating, by the controller, the drum motor in a second rotation direction opposite to the first rotation direction for the preset reverse rotation time duration; after the reverse rotation time duration has elapsed, rotating, by the controller, the drum motor in the first rotation direction and operating, by the controller, the compressor; resetting, by the controller, the compressor operation time duration; and determining, by the controller, whether the second reference time duration has elapsed.

[0031] In one implementation, in the measurement operation, when the current load is greater than the threshold current value, the controller resets a first measurement time duration which refers to a time duration for which a current measurement of the compressor continues to be a value below the preset threshold current value during the drying cycle. And when the current load is smaller than or equal to the threshold current value, and the first measurement time duration is smaller than the first continuous time duration, the controller accumulates the first measurement time duration.

[0032] In one implementation, in the measurement operation, when the absolute value of the difference between the first temperature and the second temperature exceeds the allowable temperature difference, the controller resets a second measurement time duration which refers to a time duration during which a state in which the absolute value of the difference between the first temperature measured by the first temperature sensor and the second temperature measured by the second temperature sensor is below the preset allowable temperature difference continuously lasts for a predefined time duration during the drying cycle, And, when the absolute value of the difference between the first temperature and the second temperature is smaller than or equal to the allowable temperature difference, and the second measurement time duration is smaller than the second continuous time duration, the controller accumulates the second measurement time duration.

TECHNICAL EFFECTS

[0033] In accordance to the above features of the present disclosure, first, the explosion of combustible refrigerant is prevented in advance, and then safe use thereof is realized. Second, an accuracy of the refrigerant leak detection may be improved using a plurality of measurement schemes. Third, user reliability may be secured.

[0034] In addition to the effects as described above, specific effects of the present disclosure are described together with specific details for carrying out the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035]

FIG. 1 shows one embodiment of a laundry treatment apparatus.
FIG. 2 shows an evaporator, a condenser, a compressor and a fan placed on a base of the laundry treatment apparatus.
FIG. 3 shows a control method of the laundry treatment apparatus for preventing explosion during a drying cycle of the laundry treatment apparatus.
FIG. 4 shows a control method of the laundry treatment apparatus for preventing explosion during a drying cycle of the laundry treatment apparatus.
FIG. 5 shows a control method of the laundry treatment apparatus for leak detection and explosion prevention during a drying cycle of the laundry treatment apparatus.

DETAILED DESCRIPTIONS

[0036] For simplicity and clarity of illustration, elements in the figures are not necessarily drawn to scale. The same reference numbers in different figures denote the same or similar elements, and as such perform similar functionality. Furthermore, in the following detailed description of the present disclosure, numerous specific details are set forth in order to provide a thorough understanding of the present disclosure. However, it will be understood that the present disclosure may be practiced without these specific details. In other instances, well-known methods, procedures, components, and circuits have not been described in detail so as not to unnecessarily obscure aspects of the present disclosure.

[0037] Examples of various embodiments are illustrated and described further below. It will be understood that the description herein is not intended to limit the claims to the specific embodiments described. On the contrary, it is intended to cover alternatives, modifications, and equivalents as may be included within the spirit and scope of the present disclosure as defined by the appended claims.

[0038] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the present disclosure. As used herein, the singular forms "a" and "an" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises", "comprising", "includes", and "including" when used in this specification, specify the presence of the stated features, integers, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, operations, elements, components, and/or portions thereof. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items. Expression such as "at least one of" when preceding a list of elements may modify the entire list of elements and may not modify the individual elements of the list.

[0039] It will be understood that, although the terms "first", "second", "third", and so on may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are used to distinguish one element, component, region, layer or section from another element, component, region, layer or section. Thus, a first element, component, region, layer or section described below could be termed a second element, component, region, layer or section, without departing from the spirit and scope of the present disclosure.

[0040] In addition, it will also be understood that when a first element or layer is referred to as being present "on" or "beneath" a second element or layer, the first element may be disposed directly on or beneath the second element or may be disposed indirectly on or beneath the second element with a third element or layer being disposed between the first and second elements or layers. It will be understood that when an element or layer is referred to as being "connected to", or "coupled to" another element or layer, it may be directly on, connected to, or coupled to the other element or layer, or one or more intervening elements or layers may be present. In addition, it will also be understood that when an element or layer is referred to as being "between" two elements or layers, it may be the only element or layer between the two elements or layers, or one or more intervening elements or layers may also be present.

[0041] Unless otherwise defined, all terms including technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this inventive concept belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0042] As used herein, expressions that indicate relative or absolute placement, such as "in a direction", "along a direction", "parallel", "orthogonal", "center", "concentric" or "coaxial" may imply that a tolerance in terms of an angle or a distance is allowed as long as a function related to the expressions is realized.

[0043] As used herein, expressions indicating relationships between states of objects, such as "same", and "homogeneous" may imply that a tolerance in terms of a value related to the state of the object is allowed as long as a function related to the expressions is realized.

[0044] As used herein, an expression representing a shape such as a square shape or a cylindrical shape may imply that the shape includes irregularities, chamfers, and the like as long as a function related to the expression is realized.

[0045] A configuration applied to one embodiment may be applied to another embodiment as long as such application does not cause structural or functional inconsistency.

[0046] The present disclosure relates to a control method of a laundry treatment apparatus using a combustible refrigerant, such as R-290. As described above, the 4th generation HFO refrigerant is (i) non-toxic and stable; (ii) has proper solubility in mineral oil as refrigerant oil; and (iii) is free of risk of destruction of the ozone layer and has very low global warming potential (GWP).

[0047] The global warming potential (GWP) refers to an extent to which other greenhouse gases contribute to global warming, based on an extent to which carbon dioxide contributes to global warming. That is, the GWP refers to a value obtained by dividing an amount of solar energy absorbed by 1 kg of individual greenhouse gas by an amount of solar energy absorbed by 1 kg of carbon dioxide. The GWP refers to an index of a warming effect per unit mass. For example, when considering GWP of carbon dioxide as 1, GWP of methane is 21, GWP of nitrous oxide is 310, GWP of hydrogen fluoride is 1,300, and GWP of sulfur hexafluoride is 23,900.

[0048] On the other hand, 4th generation HFO refrigerant such as R-290 is combustible. In particular, when the combustible refrigerant leaks, and thus a concentration of R-290 exceeds 1.8%, there is a risk of ignition or explosion during operation. Thus, a control method to prevent this ignition or explosion is needed.

[0049] FIG. 1 shows an appearance of one embodiment of a laundry treatment apparatus 100 that uses a heat pump using combustible refrigerant, such as R-290 to performs a drying function. Referring to FIG. 1, the laundry treatment apparatus 100 includes a cabinet 101 which is a main body of the laundry treatment apparatus in a substantially rectangular parallelepiped shape. A circular laundry inlet 106 is defined in a front face 103 of the cabinet. On a front face 103 of the cabinet, a control panel 104 for controlling various functions of a dryer and displaying an operation state may be disposed.

[0050] The front face 103 of the cabinet may have a door 108 that is pivotally coupled to the cabinet 101 to open and close the laundry inlet 106. An open or closed state of the door may be detected using a non-contact detection sensor using a magnet instead of an existing electric contact detection scheme. This is intended to prevent risk of explosion when a combustible refrigerant such as R-290 leaks. That is, in the existing electrical contact detection scheme, when the electrical contact is pressed, spark may occur, and the spark may explode the combustible refrigerant. To prevent this explosion in advance, the apparatus may include a magnet 1082 disposed on one side of the door that operates in a non-contact manner without using the electrical contact, and a sensor 1083 positioned on the front face 103 of the cabinet and then disposed at a position corresponding to a position of the magnet 1082. The sensor 1083 may include a reed switch that senses a magnetic force of the magnet 1082. Therefore, as the door 108 approaches the laundry inlet 106, and even when the magnet 1082 does not contact the sensor 1083, the reed switch is turned on due to the magnetic force of the magnet 1082 to detect the door.

[0051] The cabinet 101 receives therein a cylindrical drum 110 that communicates with the laundry inlet 106 and accommodates laundry therein. Below the drum 110, a base 130 may be disposed. Mechanical parts including a duct 120 circulating air of the drum 110 and a heat pump 140 capable of dehumidifying and cooling the air and then reheating the air may be disposed on the base 130. The base 130 may define a bottom of the cabinet 101. The base 130 may define a space in which mechanical parts to perform various functions of the laundry treatment apparatus 100 may be installed. This will be described later using FIG. 2.

[0052] Further, the door 108 may include a light-transmitting portion. Therefore, even when the door 108 is closed, an interior of the drum 110 may be visually exposed to an outside through the light transmitting portion.

[0053] The drum 110 has a cylindrical shape, and may have both an open front face and an open rear face. However, this is only one embodiment. Alternatively, the front face may be open and the rear face may be closed. This may be determined based on a drum operation scheme.

[0054] For example, a drum driving shaft (not shown) for rotating the drum may be disposed in rear of the drum, and the drum driving shaft (not shown) may be directly coupled to a drum motor 180 (see FIG. 2) to rotate the drum 110 via the drum motor. Alternatively, the drum driving shaft (not shown) driving the drum as located in rear of the drum may be coupled to the drum, and the drum motor 180 (see FIG. 2), a pulley 181 (see FIG. 2) and a belt for connecting the pulley 181, (see FIG. 2) and the drum driving shaft to each other may be used to rotate not the drum but the drum driving shaft.

[0055] FIG. 2 shows an arrangement of a duct 120, the heat pump 140 including an evaporator 142 and a condenser 143, the drum motor 180 and a fan 250 located below the drum 110.

[0056] On the base 130, the duct 120 which serves to circulate air is located. The duct may include various fluid channels as follows. The duct may include a second fluid channel around the evaporator 142 and the condenser 143, a first fluid channel for transferring air discharged from the drum 110 to the second fluid channel, and a third fluid channel air passing through the second fluid channel back to the drum.

[0057] The second flow channel of the duct may be defined using a bottom surface of the base 130 as a bottom surface of the second flow channel and using a cover plate (not shown) defining a top surface of the second fluid channel and covering the evaporator 142 and the condenser 143, and using side plates. Alternatively, the second fluid channel may be formed of a single member. That is, the second fluid channel may have any shape and configuration as long as the second fluid channel may transfer air.

[0058] FIG. 2 shows that the evaporator 142 and the condenser 143 are exposed by removing the cover plate (not shown) defining the top surface of the duct 120.

[0059] The heat pump 140 refers to a device that heat and cool air circulating through a circulating fluid channel via heat exchange with refrigerant. In the heat pump 140, the evaporator 142, the compressor 149, and the condenser 143 are sequentially connected to each other via a refrigerant pipe 146 along which the refrigerant flows. Among the components of heat pump 140, components that directly exchange heat with the circulated air are the evaporator 142 and the condenser 143.

[0060] The refrigerant circulating the heat pump 140 absorbs heat from hot and humid air exiting the drum from the evaporator 142 and thus is evaporated. Thus, the circulated air is cooled. Moisture contained in the air condenses and then falls to a bottom surface of the duct-shaped circulating fluid channel due to gravity.

[0061] Then, the refrigerant circulating the refrigerant pipe 146 of the heat pump 140 is evaporated in the evaporator 142 and then compressed to have high temperature and high pressure by the compressor 149. Thereafter, in the condenser 143, the refrigerant transfers heat the air passing through the evaporator 142 and then the refrigerant condenses. Accordingly, the air that meets through the evaporator 142 is heated and becomes hot and dry air, and is again introduced into the drum 110 via the third fluid channel.

[0062] The drum motor 180 is configured for generating a driving force for rotation of the drum 110. To this end, a belt (not shown) for transmitting the driving force of the drum motor 180 to the drum 100 may be connected to the drum motor 180. The belt may be disposed to surround an outer periphery of the drum 110.

[0063] Further, in order to adjust a tension of the belt, the pulley 181 and a spring (not shown) may be used. The pulley 181 may be configured to apply a constant tension to the belt. The pulley 181 may be rotatably mounted on a drum motor mount located on the base 130 where the drum motor is mounted or on a bracket mounted on the drum motor mount (not shown).

[0064] In order to adjust the tension of the belt, the drum motor 180 may be configured to be rotated about one axis within a certain angular range and then returned to an initial position due to an elastic force of the spring. To this end, the drum motor 180 may be mounted on the drum motor mount located below the drum motor 180 and may be rotatable around a single axis. The spring may be connected to each of the drum motor mount and the drum motor 180.

[0065] In the example, a blowing fan 1273 may be mounted on a shaft of the drum motor 180. In one embodiment of the present disclosure, the belt may be connected to a shaft disposed at one side of the drum motor 180, and the blowing fan 1273 may be mounted on a shaft disposed at the other side of the drum motor 180. The blowing fan 1273 may be installed inside a blowing fan receiving portion 127 to transfer air discharged to a space below the drum through the blowing fan 1273 to the duct 120 where the evaporator 142 and the condenser 143 are located.

[0066] Therefore, the shafts respectively disposed at both opposing sides of the drum motor 180 are rotated in the same direction and at the same speed. When the two shafts are disposed in one drum motor 180, this may create many advantages from the viewpoint of improving power consumption of the laundry treating apparatus 100. Basically, power consumption may be reduced by half compared to a scheme where the drum motor 180 for rotating the drum 110 and a drum motor for rotating the blowing fan 1273 are respectively disposed.

[0067] A time when the blowing fan 1273 needs to rotate is the same as a time when the drum 110 rotates. This is because while the drum 110 rotates, hot dry air may be supplied to the drum 110 and hot and humid air may be discharged from the drum 110. Further, even when a drying cycle is over and the air is only circulated via a cooling cycle, the blowing fan 1273 operates for the circulation of the air and thus the drum 110 rotates. Therefore, a state in which rotation of one of the drum 110 and the blowing fan 1273 is unnecessary does not occur.

[0068] That is, the laundry treatment apparatus may perform a drying cycle in which the compressor 149 of the heat pump 140 is used to compresses the refrigerant and the laundry of the drum 110 is dried using hot dry air created by the evaporator 142 and the condenser 143, and a cooling cycle in which the laundry is dried by circulating hot air to cool down the air slowly without the heat pump 140. Both the drying and cooling cycles require drum rotation and air circulation. Therefore, a state in which rotation of one of the drum motor 180 and the blowing fan 1273 is unnecessary does not occur.

[0069] The fan 250 may be installed adjacent to the compressor 149. The fan 250 may be configured to blow air towards the compressor 149 or to inhale the air around the compressor 149 and subsequently blow the air. A temperature of the compressor 149 may be lowered due to an operation of the fan 250. As a result, compression efficiency may be improved. In one embodiment of the present disclosure, the fan 250 is located in front of the compressor 149 and then close to a rear face of the cabinet. The cabinet 101 where the fan 250 is located may have a cabinet discharge hole (not shown) defined therein for exchanging air outside the cabinet and air inside the cabinet with each other. Preferably, the cabinet discharge hole (not shown) may be formed in a rear side of the cabinet where the fan 250 is located. However, since the cabinet 101 is not a closed structure, a gap created during a joining process may define the cabinet discharge hole and thus air inside and air outside the cabinet may be exchanged with each other via the gap.

[0070] In the control method according to the present disclosure, the fan 250 may be used for other purposes. That is, in the control method according to the present disclosure, when using a combustible refrigerant such as R-290, the fan 250 may be used to dilute the leaked refrigerant to prevent explosion thereof. The combustible refrigerant R-290 has a density larger than that of air. Thus, when the R-290 leaks, it gathers at a specific location inside the cabinet. Then, it may explode due to an electrical spark. In order to prevent such explosion, the concentration of the combustible refrigerant is lowered to a value below an explosion limit (limit of inflammability) by moving air to the location where the combustible refrigerant is expected to gather. Alternatively, in order to prevent such explosion, the combustible refrigerant may be discharged to the outside of the cabinet. The explosion limit refers to a range of a concentration or a pressure required for a mixture of the combustible gas and the oxygen to ignite and explode.

[0071] When the R-290 as a high-purity propane gas leaks and the concentration thereof in air exceeds 1.8%, there is a risk of ignition or explosion during use. Thus, the R-290 must be quickly diluted with the surrounding air or vented out of the cabinet, using the fan 250.

[0072] A location where the leakage is expected to occur may be a location near the compressor 149 where much vibration and many joints are present. Therefore, the leaked refrigerant may be mainly collected in an area (indicated by "A" in FIG. 2) of the base 130 except for the duct 120. In this connection, the fan 250 may circulate the air inside the cabinet 101 and eventually dilute or lower the concentration of the leaked refrigerant. Further, the refrigerant may be discharged to the outside through the cabinet discharge hole. Alternatively, the concentration of leaked refrigerant may be reduced by introducing outside air into the interior of the cabinet. Therefore, the fan 250 may simultaneously perform not only cooling the compressor, but also inducing air circulation or air exchange when the combustible refrigerant leaks, thereby achieving dilution of the leaked refrigerant and thus preventing explosion thereof. Therefore, the fan 250 must be able to operate during the drying cycle or the cooling cycle regardless of detection of the leakage, thereby to prevent the explosion of the combustible refrigerant. Further, the fan 250 should be able to operate to prevent explosion even when detecting the leakage of refrigerant during the drying cycle. Further, the user stops using the laundry treatment apparatus 100 and then, leakage of the refrigerant may occur and then the user starts using the apparatus 100 again. Thus, the explosion may occur during the re-start thereof. For this reason. when the laundry treatment apparatus starts operating, that is, when the drying cycle is started, it is necessary to dilute the leaked refrigerant by operating the fan 250 for a certain period of time to circulate the air inside the cabinet 101 or to exchange the interior air with the outside air.

[0073] A component required to detect the leaked refrigerant and then accurately determine that the refrigerant has leaked will be described. The leaked combustible refrigerant, such as R290, is colorless and odorless. Thus, it is impossible to distinguish the combustible refrigerant with the naked eye or odor. Therefore, a component for determining the leakage is required.

[0074] To this end, the apparatus 100 may include a first temperature sensor 601 to measure a temperature (first temperature) of the air discharged from the drum 110 and a second temperature sensor 602 to measure a temperature (second temperature) of the combustible refrigerant flowing into the evaporator. The apparatus 100 may include a controller (not shown) for controlling a function of the laundry treatment apparatus. The controller may be disposed on a rear surface of the control panel 104, that is, a surface thereof facing the interior of the cabinet. The controller may receive a user input through the control panel and control a function of the laundry treatment apparatus based on the input. The controller (not shown) may be located in an empty space inside the cabinet. That is, the controller may be located anywhere as long as the controller may control the function of the laundry treatment apparatus. The controller (not shown) may read a current load of the compressor 149. Thus, a separate current meter is not required. However, when necessary, a measuring device or a sensor for measuring the current of the compressor 149 may be separately provided. The first temperature sensor and the second temperature sensor may be limited particularly as long as they may measure the first temperature and the second temperature respectively.

[0075] The controller (not shown) may receive a control signal of the first temperature sensor 601 and the second temperature sensor 602. The controller may transmit a control signal that may control rotation of the drum motor 180, rotation of a motor inside the compressor, rotation of the blowing fan, and rotation of the fan. The control signal may variably control the rotation of each of the drum motor 180, the compressor 149, the blowing fan 1273, and the fan 250 in an inverter scheme.

[0076] When the laundry treatment apparatus 100 is driven via a user input, the laundry treatment apparatus 100 may perform the drying cycle in which the compressor 149 of the heat pump 140 is used to compress the refrigerant and hot dry air is created via the evaporator 142 and the condenser 143 thereof to dry the laundry of the drum 110, and the cooling cycle in which the laundry is dried by circulating only the air as already heated to cool down the air slowly without using the heat pump 140.

[0077] In the drying cycle and the cooling cycle, the controller (not shown) execute the fan at preset timing to prevent explosion of the refrigerant regardless of leakage detection thereof. This is intended to circulate the air inside the cabinet normally. Therefore, even when the combustible refrigerant leaks, the concentration of the refrigerant may be diluted by circulating the air.

[0078] Further, in the drying cycle in which the compressor operates, the refrigerant circulates due to the operation of the compressor, such that the refrigerant leakage may occur quickly and in a larger amount. Therefore, it is not enough to dilute the concentration of the leaked refrigerant by simply operating the fan at the preset time. Thus, in the drying cycle in which the compressor operates, it is necessary to detect the leakage thereof. For this purpose, the first temperature sensor 601 and the second temperature sensor 602 may measure the first and second temperature respectively in real time. The current load of the compressor 149 may be read in real time. Thus, it may be determined whether the refrigerant leaks, based on the measurements. Both of a temperature difference and the current value may be used to determine whether the refrigerant leaks. That is, only when both conditions related to the temperature difference and the current value respectively are satisfied, it may be determined that the refrigerant leaks. Thus, the determination accuracy may be improved rather than in a scheme of determining the leakage only based on a single condition.

[0079] Hereinafter, a determination method for determining the leakage will be described in detail. The first temperature sensor 601 measures a hot air temperature (first temperature) discharged from the interior of the drum. The second temperature sensor 602 measures a refrigerant temperature (second temperature) at an inlet of the evaporator which corresponds to the lowest temperature in a refrigerant circulation path. In a normal situation, that is, a situation when the refrigerant is circulated without leakage thereof and heat exchange between air and refrigerant occurs, a difference between the first temperature and the second temperature is large. However, in the leakage situation, as a larger amount of the refrigerant leaks, a smaller amount of the refrigerant is compressed and condensed. Therefore, a smaller amount of heat exchange between refrigerant and air is made. Eventually, the difference between the first temperature and the second temperature may be smaller. Based on this principle, the leakage thereof may be determined. In the control method according to the present disclosure, it may be determined that the leakage occurs when an absolute value of the difference between the first temperature and the second temperature is smaller than or equal to a preset allowable temperature difference, which may preferably be set to 2°C.

[0080] When the refrigerant leaks, the air temperature and the refrigerant temperature are the same. Thus, it is not necessary to measure the air temperature at a bottom of the drum, or to measure the refrigerant temperature at the inlet of the evaporator. Depending on an environment in use, a temperature sensor may be installed elsewhere. In this case, when the air temperature and the refrigerant temperature are measured, the leakage may be determined. However, it takes a certain transient time for the evaporator 142 and the condenser 143 need to operate in a steady state. Thus, when a preset second reference time duration has lapsed, the first temperature and the second temperature may be measured and then compared to each other and then the refrigerant leak may be determined based on the comparison result. That is, before the second reference time duration has lapsed, the compressor does not operate in the steady state, such that the difference between the first temperature and the second temperature may not be large. Thus, it may be unreasonable to determine whether the leakage occurs based on the difference.

[0081] The leakage may be detected using the current load of the compressor 149. When the refrigerant leaks, power consumed by the compressor will gradually decrease, so that the current or the current load of the compressor during the leakage is reduced. Therefore, in the control method according to the present disclosure, it may be determined that the refrigerant has leaked when the current or the current load of the compressor decreases to a value below a preset threshold current value or a preset threshold current load value. Preferably, the preset threshold current value or the preset threshold current load value may be set to 0.8 A (ampere).

[0082] However, it take a certain time for the compressor 149 to operate in the steady state. When the current or current load of the compressor measured after the preset second reference time duration has lapsed is determined to be below the threshold current value or threshold current load, it is determined that the refrigerant has leaked. That is, before the preset second reference time duration has lapsed, the compressor may not operate in the steady state, so that the current load of the compressor may not be large. Thus, it may be unreasonable to determine whether the leakage occurs based on the current load.

[0083] Therefore, the second reference time duration may mean an elapsed time after the compressor 149 operates in the drying cycle, or an elapsed time after the compressor 149 is stopped and restarted. Preferably, the second reference time duration may be set to 15 minutes.

[0084] FIG. 3 shows a control method in which the fan always works to prevent explosion regardless of leakage detection of the combustible refrigerant in the drying cycle.

[0085] When the user starts to operate the laundry treatment apparatus 100, the control method according to the present disclosure starts a drying cycle initiation operation S100. Specifically, in the control method according to the present disclosure, in the drying cycle initiation operation S100, the fan 250 may be operated (S110) with the start of the drying cycle. The control method according to the present disclosure then operates the drum motor 180 and the compressor 149 sequentially. In other words, the fan 250 may operate at the start of the drying cycle. When a preset drum motor operation time duration has lapsed after the drying cycle starts, the control method according to the present disclosure may cause the drum motor 180 to operate S130. Then, when a preset compressor operation time duration has lapsed after the drying cycle starts, the control method according to the present disclosure may cause the compressor 149 to operate S150. The drum motor operation time duration and the compressor operation time duration may preferably be set to 10 seconds and 15 seconds after the drying cycle starts, respectively. However, this is only one embodiment. A duration of each of the drum motor operation time duration and the compressor operation time duration may vary. Alternatively, a duration of the drum motor operation time duration may be different from that of the compressor operation time duration.

[0086] Then, the control method according to the present disclosure determines whether a preset fan operation time duration has elapsed. In this connection, the fan 250 operates at the initiation of the drying cycle. When it is determined that the fan operation time duration has elapsed, the operation of the fan 250 may be terminated S172. It is assumed that there is the leaked refrigerant before a current operation time duration of the fan. That is, when the refrigerant has leaked for a period of time from an end of previous use to a current use, the refrigerant may be gathered near the compressor 149 inside the cabinet 101. Thus, the controller (not shown) may activate the fan 250 to circulate air during the fan operation time duration to dilute the leaked refrigerant or discharge the same to the outside. The fan operation time duration may be preferably set to 2 minutes 30 seconds.

[0087] Thereafter, the method may perform operation S200 for setting a first operation period PT1 of the fan and a first operation time duration OT1 of the fan, according to whether a preset first reference time duration has elapsed. The first reference time duration refers to an elapsed time from when the drying cycle starts (that is, when the fan is started) and may be set to preferably 20 minutes.

[0088] The fan 250 works to cool the compressor. This is because, in general, the fan 250 operates for more than 10 minutes after 9 to 10 minutes has elapsed since the drying cycle starts. Therefore, the fan 250 should be operated more often before 9 to 10 minutes has lapsed since the fan is started (that is, the drying cycle starts). However, after 9 to 10 minutes has elapsed since the drying cycle starts (the fan is started), the fan 250 operates to cool the compressor. Thus, it is not necessary to operate the fan frequently to prevent the explosion.

[0089] Thus, in order to ensure that the fan 250 operates for cooling of the compressor, the first reference time duration may preferably be set to 20 minutes.

[0090] When it is determined S210 that the first reference time duration has not elapsed, the control method according to the present disclosure may set the first fan operation period PT1 to be smaller S221 and thus operate the fan frequently. However, when it is determined that the first reference time duration has elapsed, the control method according to the present disclosure may set the first fan operation period PT1 to be relatively larger S222. Preferably, when the first reference time duration has not elapsed, the control method according to the present disclosure may set the first fan operation period PT1 and the first fan operation time duration OT1 to 5 minutes and 10 seconds, respectively. When the first reference time duration has elapsed, the first fan operation period PT1 and the first fan operation time duration OT1 may be set to 20 minutes and 10 seconds, respectively.

[0091] Thereafter, the control method according to the present disclosure may repeat periodically activation and deactivation of the fan 250 S300 until a drying cycle time duration t1 preset based on the set first fan operation period PT1 and the set first fan operation time duration OT1 has lapsed.

[0092] That is, the control method according to the present disclosure determines whether the first fan operation period PT1 has lapsed S301. When the first fan operation period PT1 has lapsed, the fan 250 is operated S303. The control method according to the present disclosure determines whether the first fan operation time duration OT1 has elapsed S305. When the first fan operation time duration OT1 has elapsed, the fan 250 may be stopped. Further, the control method according to the present disclosure determines whether a preset drying cycle time duration t1 has elapsed S309, and then terminates an operation of the compressor 149 when the drying cycle time duration t1 has elapsed. Thus, the drying cycle may be terminated S310. Then, a next step, that is, the cooling cycle may be started S330.

[0093] Upon determining that the first fan operation period PT1 has not lapsed S301, the control method according to the present disclosure does not operate the fan 250. The method determines whether the drying cycle time duration t1 has elapsed. Thus, when the drying cycle time duration t1 has not elapsed, the first fan operation period PT1 and the first fan operation time duration OT1 may be set again based on the first reference time duration.

[0094] For example, it may be assumed that the drying cycle time duration is 72 minutes and the first reference time duration is 20 minutes. In this case, to prevent the explosion, the fan 250 runs for 2 minutes and 30 seconds since the beginning of the drying cycle. Subsequently, when the elapsed time duration of the drying cycle (a time duration elapsing from a start of the drying cycle) is 5 minutes, the fan operates for 10 seconds. When the elapsed time duration is 10 minutes, the fan operates for 10 seconds. When the elapsed time duration is 15 minutes, the fan operates for 10 seconds. When the elapsed time duration is 20 minutes, the fan operates for 10 seconds. When the elapsed time duration is 40 minutes, the fan operates for 10 seconds. When the elapsed time duration is 60 minutes, the fan operates for 10 seconds. Then, when the elapsed time duration is 72 minutes, the fan operates for 10 seconds, the drying cycle ends. That is, when the elapsed time duration is within the first reference time duration of 20 minutes, the fan 250 operates for 10 seconds every 5 minutes except for the drying cycle initiation operation S100. When the elapsed time duration exceeds 20 minutes, the fan 250 runs for 10 seconds every 20 minutes.

[0095] When the drying cycle time duration t1 is a multiple of the first fan operation period PT1, and when the drying cycle time duration t1 has lapsed, the operation of the laundry treatment apparatus 100 is terminated. Thus, in this case, the method may further include determining whether the drying cycle time duration t1 has been terminated, prior to the determination S301 of whether the first fan operation period PT1 has lapsed.

[0096] FIG. 4 shows a control method in which when the cooling cycle is initiated after the drying cycle is terminated, the fan always works to prevent explosion regardless of leakage detection of combustible refrigerant.

[0097] When the cooling cycle starts S400, the control method according to the present disclosure operates the fan 250. At this time, the control method according to the present disclosure may repeat the activation and deactivation of the fan 250 periodically until a cooling cycle time duration t2 preset based on a preset second fan operation period PT2 and a second fan operation time duration OT2 has lapsed. The second fan operation period PT2 and the second fan operation time duration OT2 may preferably be set to 20 minutes and 10 seconds, respectively.

[0098] The second fan operation period PT2 and the second fan operation time duration OT2 may be set to be equal to or larger than the first fan operation period PT1 and the first fan operation time duration OT1, respectively. This is because the compressor 149 does not operate in the cooling cycle, and the air that has already been heated is circulated and cooled slowly using the blowing fan 1273, such that the fan 250 may run infrequently.

[0099] That is, the control method according to the present disclosure determines whether the second fan operation period PT2 has lapsed S501. Then, when the second fan operation period PT2 has lapsed, the fan 250 is operated S503. The control method according to the present disclosure determines S505 whether the second fan operation time duration OT2 has elapsed. Then, when the second fan operation time duration OT2 has elapsed, the method may stop the operation of the fan 250. Further, the control method according to the present disclosure determines whether the preset cooling cycle time duration t2 has elapsed S509. When the cooling cycle time duration t2 has elapsed, the operations of the compressor 149 and the drum motor 180 may be terminated and thus the cooling cycle may be terminated S510.

[0100] When the control method according to the present disclosure determines S301 that the second fan operation period PT2 has not lapsed, the fan 250 is deactivated. Then, the method determines whether the cooling cycle time duration t2 has elapsed. When the cooling cycle time duration t2 has not elapsed, the method returns to the determining operation S501 of whether the second fan operation period PT2 has lapsed.

[0101] For example, when the cooling cycle time duration t2 is 43 minutes, the fan 250 may run for 10 seconds from the beginning of the cooling cycle. When the cooling cycle time duration t2 is 40 minutes, the fan may operate for 10 seconds from the beginning of the cooling cycle.

[0102] When the cooling cycle time duration t2 is a multiple of the second fan operation period PT2, and when the cooling cycle time duration t2 has lapsed, an operation of the laundry treatment apparatus 100 is terminated. Thus, the fan 250 may not be operated. Thus, in this case, the method may further include determining whether the cooling cycle time duration t2 has been terminated, prior to the determination S501 of whether the second fan operation period PT2 has lapsed.

[0103] FIG. 5 shows a determination method for detecting the leakage of the combustible refrigerant in the drying cycle for which the compressor operates, and a control method for coping with the leakage. In the drying cycle, the compressor 149 is driven, so that the refrigerant leakage may occur more rapidly. Therefore, the control method of the apparatus 100 for the explosion prevention as shown in FIG. 3 and FIG. 4 alone may not be sufficient to guarantee the explosion prevention due to the leakage of the combustible refrigerant. Therefore, a control method to actively determine whether there is leakage due to the operation of the compressor for the drying cycle and to cope with the leakage when the leakage occurs is required.

[0104] Further, the control method of the apparatus 100 for the leak detection in FIG. 5 may be executed simultaneously with the control method for the explosion prevention in FIG. 3. Hereinafter, FIG. 5 will be described.

[0105] When the user starts to operate the laundry treatment apparatus 100, the control method according to the present disclosure starts a drying cycle initiation operation S100. This operation S100 is the same as the drying cycle initiation operation in FIG. 3. In the drying cycle initiation operation S100, the fan 250 may be first operated at the start of the drying cycle. Thereafter, the drum motor 180 and the compressor 149 may be sequentially operated. In other words, the fan 250 may operate at the start of the drying cycle, and then when the preset drum motor operation time duration has lapsed, the drum motor 180 may operate. The compressor 149 may then operate when the preset compressor operation time duration has lapsed. The drum motor operation time duration and the compressor operation time duration may preferably be set to 10 seconds and 15 seconds after the drying cycle starts, respectively. However, this is only one embodiment. A duration of each of the drum motor operation time duration and the compressor operation time duration may vary. Alternatively, a duration of the drum motor operation time duration may be different from that of the compressor operation time duration.

[0106] Then, the method may determine whether a preset fan operation time duration has elapsed S171. In this connection, the fan 250 starts to operate at the start of the drying cycle. When the preset fan operation time duration has elapsed, the fan 230 may be deactivated. Thus, it is assumed that there is the leaked refrigerant before a current operation time. That is, when the refrigerant has leaked for a period of time from a previous use to a current use, the refrigerant may be gathered near the compressor 149 inside the cabinet 101. Thus, the controller (not shown) may activate the fan 250 to circulate air during the fan operation time duration to dilute the leaked refrigerant or discharge the same to the outside. The fan operation time duration may be preferably set to 2 minutes 30 seconds. Thus, the drying cycle initiation operation shown in S100 in FIG. 5 is the same as the drying cycle initiation operation S100 in FIG. 3.

[0107] Thereafter, the control method according to the present disclosure determines whether a preset second time duration as an operation time duration of the compressor has lapsed. This is because, as described above, before the second reference time duration has lapsed, the compressor may not operate in the steady state. Thus, the difference between the first temperature and the second temperature may not be large and the measured current may be smaller than the threshold current value. Thus, it is unreasonable to determine the leakage based on the measurements.

[0108] Therefore, the second reference time duration means an operating time duration of the compressor 149 after the compressor 149 is operated for the drying cycle, or mean an operating time duration of the compressor 149 after the compressor 149 is stopped and restarted. The second reference time duration may be preferably set to 15 minutes.

[0109] The method may determine S700 whether the operating time duration of the compressor 149 meets the second reference time duration. When the operation time duration of the compressor 149 meets the second reference time duration, the controller (not shown) in a leakage measurement operation S800 measures a current (Icomp) load, that is, a current as actually used by the compressor 149, in real time. This may be achieved by a microcomputer as one of components making up the controller reading a current value flowing from a printed circuit board (PCB) of the controller toward the compressor. The first temperature sensor 601 measures the first temperature T1, that is, the temperature of the air discharged from drum 110. The second temperature sensor 602 measures the refrigerant temperature at the inlet of the evaporator, that is, the second temperature T2 in real time. In this connection, the real time measurement means sampling at a measurement interval smaller than 1 second.

[0110] The first temperature sensor 601 may be located in a region in which the air from drum 110 flows toward a bottom of the drum. Preferably, the sensor 601 may be installed in a filter receiving portion 1242 (see FIG. 2) where a filter is installed to filter foreign matter mixed in the air discharged from the drum. In FIG. 2, the sensor 610 is installed on a wall. However, this is only one embodiment. The sensor 610 may be installed on a floor or an entrance to the blowing fan 1273.

[0111] The second temperature sensor 602 may be located at an inlet of the evaporator into which the refrigerant passing through the condenser 143 expands and moves.

[0112] The control method according to the present disclosure determines whether the leakage occurs based on the measured first temperature and second temperature and the measured compressor current value (Icomp).

[0113] The control method according to the present disclosure compares a threshold current value with the measured value Icomp of the current of the compressor 149 S911. When the measured value Icomp of the current of the compressor 149 is smaller than or equal to the threshold current value, the controller (not shown) compares a first measurement time duration with a preset first continuous time duration S912. When the measured value Icomp of the current of the compressor 149 exceeds the threshold current value, there is no leakage. Thus, instead of accumulating the first measurement time duration and a second measurement time duration, the method may reset the first measurement time duration and the second measurement time duration S801. Then, the method may measure the compressor current at S810 and measure the first and second temperatures at S821 and S822.

[0114] When the current based condition and the temperature difference based condition are satisfied at the same time, it may be determined that the leakage occurs. Thus, when the both conditions are not satisfied, the control method according to the present disclosure may reset the first measurement time duration and the second measurement time duration again.

[0115] In this connection, the first measurement time duration refers to a time duration for which a current measurement of the compressor continues to be a value below a preset threshold current value during the drying cycle. Therefore, when a measured current value Icomp of the compressor being below the threshold current value lasts for 2 seconds, and then a measured current value Icomp of the compressor exceeds the threshold current value, and then a measured current value Icomp of the compressor being below the threshold current value lasts for 4 seconds, the first measurement time duration is not 6 seconds as a sum of 4 and 2 seconds, but is 4 seconds.

[0116] The second measurement time duration refers to a time duration during which a state in which an absolute value of the difference between the first temperature measured by the first temperature sensor and the second temperature measured by the second temperature sensor is below a preset allowable temperature difference continuously lasts for a predefined time duration during the drying cycle. Therefore, when the difference is below and then exceeds the allowable temperature difference during the measurement thereof, the second measurement time duration may be reset and the measurement thereof may be restarted.

[0117] When the current Icomp of the compressor 149 is below the threshold current value, and the state in which the first measurement time duration is greater than or equal to the preset first continuous time duration S912, the control method according to the present disclosure may determine that the leakage occurs, based on the current measurement. In this connection, the first continuous time duration may be preferably set to 5 seconds.

[0118] When the current Icomp of the compressor 149 is smaller than or equal to the threshold current value, but the first measurement time duration is smaller than the first continuous time duration, the control method according to the present disclosure may accumulate the first measurement time duration S913 and then measure the current of the compressor again S810.

[0119] Similarly, the controller (not shown) determines whether the absolute value of the difference between the first temperature T1 and the second temperature T2 is equal to or smaller than the allowable temperature difference S921. When the absolute value of the difference between first temperature T1 and second temperature T2 is smaller than or equal to the allowable temperature difference, the controller (not shown) compares the second measurement time duration with a preset second continuous time duration S922. When the absolute value of the difference between the first temperature T1 and the second temperature T2 exceeds the allowable temperature difference, there is no leakage. Thus, instead of accumulating the first measurement time duration and the second measurement time duration, the method may reset the same S801, and then measure the compressor current again S810 and measure the first and second temperatures S821 and S822.

[0120] When the current based condition and the temperature difference based condition are satisfied at the same time, it may be determined that the leakage occurs. Thus, when the both conditions are not satisfied, the control method according to the present disclosure may reset the first measurement time duration and the second measurement time duration again S801.

[0121] When the absolute value of the difference between the first temperature T1 and the second temperature T2 is smaller than or equal to the allowable temperature difference, and when the first measurement time duration is greater than or equal to the preset first continuous time duration S912, the control method according to the present disclosure may determine that the leakage occurs, based on the temperature measurement. In this connection, the second continuous time duration may be preferably set to 5 seconds.

[0122] When the absolute value of the difference between the first temperature T1 and the second temperature T2 is smaller than or equal to the allowable temperature difference, but the second measurement time duration is smaller than the second continuous time duration, the control method according to the present disclosure may accumulate the second measurement time duration S923 and measure the first temperature T1 and second temperature T2 again S821 and S822.

[0123] The control method according to the present disclosure determines whether the leakage condition based on the current measurement and the leakage condition based on the temperature measurement are simultaneously satisfied S930. When the leakage condition based on the current measurement and the leakage condition based on the temperature measurement are simultaneously satisfied, the method may determine that the leakage occurs. However, when at least one of the leakage condition based on the current measurement and the leakage condition based on the temperature measurement is not satisfied, the method may measure the current Icomp of the compressor 149 again S810, and measure the first and second temperatures again S821 and S822.

[0124] Therefore, the control method according to the present disclosure determines that the leakage occurs, only when the leakage condition based on the current measurement and the leakage condition based on the temperature measurement are simultaneously satisfied. Specifically, only when the measured value of the current Icomp of the compressor 149 is smaller than or equal to the threshold current value, and the first measurement time duration is equal to or greater than the first continuous time duration, and when the absolute value of the difference between the first temperature T1 and the second temperature T2 is equal to or smaller than the allowable temperature difference and the second measurement time duration is equal to or greater than the second continuous time duration, the control method according to the present disclosure determines that the leakage occurs. When the method determines that the leakage occurs, the control method according to the present disclosure may execute a next step, that is, an emergency action operation S1000.

[0125] The emergency action operation S1000 may include an first emergency action operation S940 in which an operation of the fan is repeated three times during a preset first emergency action time duration and a second emergency action operation S960 which is performed when the first emergency action operation S940 is executed at least four times.

[0126] In the first emergency action operation S940, the control method according to the present disclosure operates the fan without deactivating the compressor 149 and drum motor 180. The first emergency action time duration may be preferably set to 5 minutes.

[0127] Further, the control method according to the present disclosure checks whether the number of first emergency actions of the fan 250 due to the leak detection exceeds 3 times. When the number is smaller than 3 times, the first measurement time duration and the second measurement time duration may be reset S801. The compressor current value (Icomp) measurement S810, and the first temperature and second temperature measurements S821 and S822 may be executed again. When the number of times of the first emergency actions exceeds 3 times, the second emergency action operation may be triggered S960.

[0128] In the second emergency action operation S960, the control method according to the present disclosure deactivates the compressor 149 and the drum motor 180. However, during a preset second emergency action time duration, the fan 250 may execute a second emergency action. The second emergency action time duration may be preferably set to 5 minutes.

[0129] Thereafter, the controller (not shown) may display an error on the display 109 of the control panel 104 (FIG. 1) located on the front face of the cabinet. Alternatively, an error may be notified to the user through a speaker, or an alarm message may be sent to the user's mobile phone via wireless communication.

[0130] Further, the laundry treatment apparatus 100 may include an anti-entanglement process to eliminate entanglement of laundry during the drying cycle. In the anti-entanglement process, the drum 110 may be rotated in an opposite direction to a rotating direction thereof during the drying cycle, and then the laundry entanglement may be reduced. When the drum 110 rotates in a first rotation as one of clockwise and counterclockwise directions during the drying cycle, the drum may rotate in a second rotation direction opposite to the first rotation, during a preset reverse rotation time duration in the anti-entanglement process. Further, in the anti-entanglement process, the operation of the compressor 149 may be stopped.

[0131] In this connection, the reverse rotation time duration is set to a time duration for which the compressor 149 is deactivated and only the drum motor rotates in the second rotation direction opposite to the first rotation direction in the anti-entanglement process during the drying cycle. The reverse rotation time duration may be preferably set to 2 minutes. The compressor 149 may not run during the reverse rotation time duration. Therefore, after the anti-entanglement process is terminated, the compressor 149 may start to operate while the drum rotates again in the first rotation direction. In this case, the compressor restarts after the termination of the anti-entanglement process. Thus, during a certain time duration from the restart, the compressor may not work in the steady state. Thus, in this case, the leakage detection and determination may be restarted when it is determined S700 that the operation time duration of the compressor 149 after the compressor 149 is restarted meets the second reference time duration.

[0132] Accordingly, the second reference time duration may mean an elapsed time after the compressor 149 starts to operate for the drying cycle, or an elapsed time after the compressor 149 is stopped and restarted. Preferably, the second reference time duration may be set to 15 minutes.

[0133] Before the second reference time duration has lapsed, the compressor may not operate normally. Thus, the difference between the first temperature and the second temperature may not be large and the current load may also be small. Thus, it may be unreasonable to determine whether the leakage occurs based on the difference and the current load.

[0134] The specific embodiments are illustrated herein. The specific embodiments as shown may be replaced with modifications designed to achieve the same purpose. It will be obvious to the skilled person that the present disclosure may be applied differently in different environments. That is, the present application should be understood to cover variations or changes to the present disclosure. The claims that follow are not limited to the specific embodiments herein. Therefore, when modified embodiments include components of the claims of the present disclosure, the modifications should be regarded as belonging to the scope of the present disclosure.

The application is further illustrated by the following items:

[0135]

1. A method for controlling a laundry treatment apparatus (100), the laundry treatment apparatus including:

   a cabinet (101) defining an appearance of the apparatus;
   a cabinet discharge hole defined in one face of the cabinet to exchange air inside the cabinet and air outside the cabinet with each other;
   a cylindrical drum (110) disposed inside the cabinet;
   a drum motor (180) configured for driving the drum;
   a duct (120) defining a fluid channel for circulating air in the drum;
   a heat pump (140) including:

      a blowing fan (1273) located inside the duct to circulate air inside the duct;
      an evaporator (142) located inside the duct to cool air entering the duct;
      a condenser (143) located inside the duct to heat air having passed through the evaporator; and
      a compressor (149) located outside the duct to compress combustible refrigerant passing through the evaporator and to supply the compressed refrigerant to the condenser; and

a fan (250) configured for introducing air outside the cabinet through the cabinet discharge hole into the cabinet or for discharging air inside the cabinet through the cabinet discharge hole out of the cabinet,
wherein the method comprises:
operating the fan;
operating the drum motor in a first rotational direction when a preset drum motor operation time duration has lapsed after the fan operates;
operating the compressor when a preset heat pump operation time duration has lapsed after the fan operates; and
stopping the operation of the fan when a preset fan operation time duration has elapsed.

2. The method of item 1, wherein the method further comprises:

setting a first operation period and a first operation time duration of the fan based on whether a preset first reference time duration has elapsed; and
repeating activation and deactivation of the fan based on the first operation period and the first operation time duration until a preset drying cycle time duration has elapsed.

3. The method of item 2, wherein the method further comprises terminating operation of the compressor after the drying cycle time duration has elapsed.

4. The method of item 3, wherein the method further comprises:

a cooling cycle initiation operation to start the fan after terminating the operation of the compressor; and
repeating activation and deactivation of the fan based on a preset second operation period and a second operation time duration until a preset cooling cycle time duration has elapsed; and
terminating operation of each of the compressor and the drum motor when the preset cooling cycle time duration has elapsed.

5. The method of any one of the preceding items, wherein the laundry treatment apparatus further includes:

a first temperature sensor (601) located below the drum to measure a first temperature of air discharged from the drum;
a second temperature sensor (602) to measure a second temperature of the combustible refrigerant flowing into the evaporator; and
a controller configured for measuring a current load of the compressor, and receiving a signal of each of the first temperature sensor and the second temperature sensor, and transmitting a control signal to each of the drum motor, the compressor, the blowing fan, and the fan;
wherein the method further comprises:

determining whether an operation time duration of the compressor meets a preset second reference time duration;
upon determination that the operation time duration of the compressor meets the preset second reference time duration, performing a measurement operation in which the controller reads a current load of the compressor in real time, and receives the first temperature and the second temperature in real time from the first and second temperature sensors respectively;
performing a refrigerant leakage determination operation including:

determining whether a state in which the current load is below a preset threshold current value lasts for a preset first continuous time duration; and
determining whether a state in which an absolute value of a difference between the first temperature and the second temperature is smaller than or equal to a preset allowable temperature difference lasts for a preset second continuous time duration,

when the state in which the current load is below the preset threshold current value lasts for the preset first continuous time duration, and when the state in which the absolute value of the difference between the first temperature and the second temperature is smaller than or equal to the preset allowable temperature difference lasts for the preset second continuous time duration, performing a first emergency action operation in which the fan is activated during a preset first emergency action time duration.

6. The method of item 5, wherein when both of a first condition that the state in which the current load is below the preset threshold current value lasts for the preset first continuous time duration, and a second condition that the state in which the absolute value of the difference between the first temperature and the second temperature is smaller than or equal to the preset allowable temperature difference lasts for the preset second continuous time duration are not satisfied, the measurement operation is repeated.

7. The method of item 5 or 6, wherein the method

further comprises:

determining whether a number of repetitions of the first emergency actions exceeds 3;
upon determination that the number of repetitions of the first emergency actions is below 3, repeating the measurement operation, the leakage determination operation, and the first emergency action operation.

8. The method of item 7, wherein the method further comprises:
when the number of repetitions of the first emergency actions exceeds 3, terminating the operation of each of the drum motor and the compressor, and activating the fan during a preset second emergency action time duration.

9. The method of any one of items 5 to 8, further comprising displaying an error after the second emergency action operation is completed.

10. The method of item 9, wherein the controller displays the error on a display located at a top of a front face of the cabinet.

11. The method of any one of items 5 to 10, wherein the method further comprises:

terminating, by the controller, operation of the compressor for a preset reverse rotation time duration;
rotating, by the controller, the drum motor in a second rotation direction opposite to the first rotation direction for the preset reverse rotation time duration;
after the reverse rotation time duration has elapsed, rotating, by the controller, the drum motor in the first rotation direction and operating, by the controller, the compressor;
resetting, by the controller, the compressor operation time duration; and
determining, by the controller, whether the second reference time duration has elapsed.

12. The method of any one of items 5 to 11, wherein, in the measurement operation, when the current load is greater than the threshold current value, the controller resets a first measurement time duration which refers to a time duration for which a current measurement of the compressor continues to be a value below the preset threshold current value during the drying cycle, and
wherein when the current load is smaller than or equal to the threshold current value, and the first measurement time duration is smaller than the first continuous time duration, the controller accumulates the first measurement time duration.

13. The method of item 12, wherein, in the measurement operation, when the absolute value of the difference between the first temperature and the second temperature exceeds the allowable temperature difference, the controller resets a second measurement time duration which refers to a time duration during which a state in which the absolute value of the difference between the first temperature measured by the first temperature sensor and the second temperature measured by the second temperature sensor is below the preset allowable temperature difference continuously lasts for a predefined time duration during the drying cycle, and
wherein, when the absolute value of the difference between the first temperature and the second temperature is smaller than or equal to the allowable temperature difference, and the second measurement time duration is smaller than the second continuous time duration, the controller accumulates the second measurement time duration.

Claims

1. A method for controlling a laundry treatment apparatus (100), the laundry treatment apparatus including:

a cabinet (101) defining an appearance of the apparatus;
a cabinet discharge hole defined in one face of the cabinet (101) to exchange air inside the cabinet (101) and air outside the cabinet (101) with each other;
a laundry accommodation space disposed inside the cabinet and configured to accommodate laundry therein;
a duct (120) defining a fluid channel for circulating air in the laundry accommodation space;
a heat pump (140) including:

a blowing fan (1273) located inside the duct (120) to circulate air inside the duct (120);
an evaporator (142) located inside the duct (120) to cool air entering the duct (120);
a condenser (143) located inside the duct (120) to heat air having passed through the evaporator (142); and
a compressor (149) located outside the duct (120) to compress combustible refrigerant passing through the evaporator (142) and to supply the compressed refrigerant to the condenser (143); and

a fan (250) configured for introducing air outside the cabinet (101) through the cabinet discharge hole into the cabinet (101) or for discharging air inside the cabinet (101) through the cabinet discharge hole out of the cabinet (101), wherein the method comprises:

operating the fan (250) (S110);
operating the compressor (149) when a preset heat pump operation time duration has lapsed after the fan (250) is set into operation (S150); and
stopping the operation of the fan (250) when a preset fan (250) operation time duration has elapsed.

2. The method of claim 1, wherein the fan (250) is located below the laundry accommodation space.

3. The method of claim 1, wherein the fan (250) is located outside the duct (120) and configured to cool the compressor (149).

4. The method of any one of claims 1 to 3, wherein the method further comprises:

setting a first operation period and a first operation time duration of the fan (250) based on whether a preset first reference time duration has elapsed (S221, S222); and
repeating activation (S303) and deactivation (S307) of the fan (250) based on the first operation period (S301) and the first operation time duration (S305) until a preset drying cycle time duration has elapsed (S309).

5. The method of claim 4, wherein the method further comprises terminating operation of the compressor (149) (S310) after the drying cycle time duration has elapsed (S309).

6. The method of claim 5, wherein the method further comprises:

a cooling cycle initiation operation to start the fan (250) after terminating the operation of the compressor (149) (S330); and
repeating activation (S503) and deactivation (S507) of the fan (250) based on a preset second operation period and a second operation time duration until a preset cooling cycle time duration has elapsed; and
terminating operation of the compressor (149) when the preset cooling cycle time duration has elapsed (S510).

7. The method of any one of the preceding claims, wherein the laundry treatment apparatus (100) further includes:

a first temperature sensor (601) located below the laundry accommodation space to measure a first temperature of air discharged from the laundry accommodation space;
a second temperature sensor (602) to measure a second temperature of the combustible refrigerant flowing into the evaporator (142); and
a controller configured for measuring a current load of the compressor (149), and receiving a signal of each of the first temperature sensor (601) and the second temperature sensor (602), and transmitting a control signal to each of the compressor (149), the blowing fan (1273), and the fan (250);
wherein the method further comprises:

determining whether an operation time duration of the compressor (149) meets a preset second reference time duration (S700);
upon determination that the operation time duration of the compressor (149) meets the preset second reference time duration, performing a measurement operation in which the controller reads a current load of the compressor (149) in real time (S810), and receives the first temperature and the second temperature in real time from the first and second temperature sensors (601, 602) respectively (S820, S821);

performing a refrigerant leakage determination operation including:

determining whether a state in which the current load is below a preset threshold current value lasts for a preset first continuous time duration (S911, S912); and
determining whether a state in which an absolute value of a difference between the first temperature and the second temperature is smaller than or equal to a preset allowable temperature difference lasts for a preset second continuous time duration (S921, S922), and
when the state in which the current load is below the preset threshold current value lasts for the preset first continuous time duration, and
when the state in which the absolute value of the difference between the first temperature and the second temperature is smaller than or equal to the preset allowable temperature difference lasts for the preset second continuous time duration (S930),
performing a first emergency action operation in which the fan (250) is activated during a preset first emergency action time duration (S940).

8. The method of claim 7, wherein when both of a first condition that the state in which the current load is below the preset threshold current value lasts for the preset first continuous time duration, and a second condition that the state in which the absolute value of the difference between the first temperature and the second temperature is smaller than or equal to the preset allowable temperature difference lasts for the preset second continuous time duration are not satisfied, the measurement operation is repeated (S800).

9. The method of claim 7 or 8, wherein the method further comprises:

determining whether a number of repetitions of the first emergency actions exceeds 3 (S950); upon determination that the number of repetitions of the first emergency actions is below 3, repeating the measurement operation (S800), the leakage determination operation (S900), and the first emergency action operation (S940).

10. The method of claim 9, wherein the method further comprises:
when the number of repetitions of the first emergency actions exceeds 3, terminating the operation of the compressor (149), and activating the fan (250) during a preset second emergency action time duration (S960).

11. The method of any one of claims 7 to 10, further comprising displaying an error after the second emergency action operation is completed (S970).

12. The method of claim 11, wherein the controller displays the error on a display located at a front face of the cabinet (101).

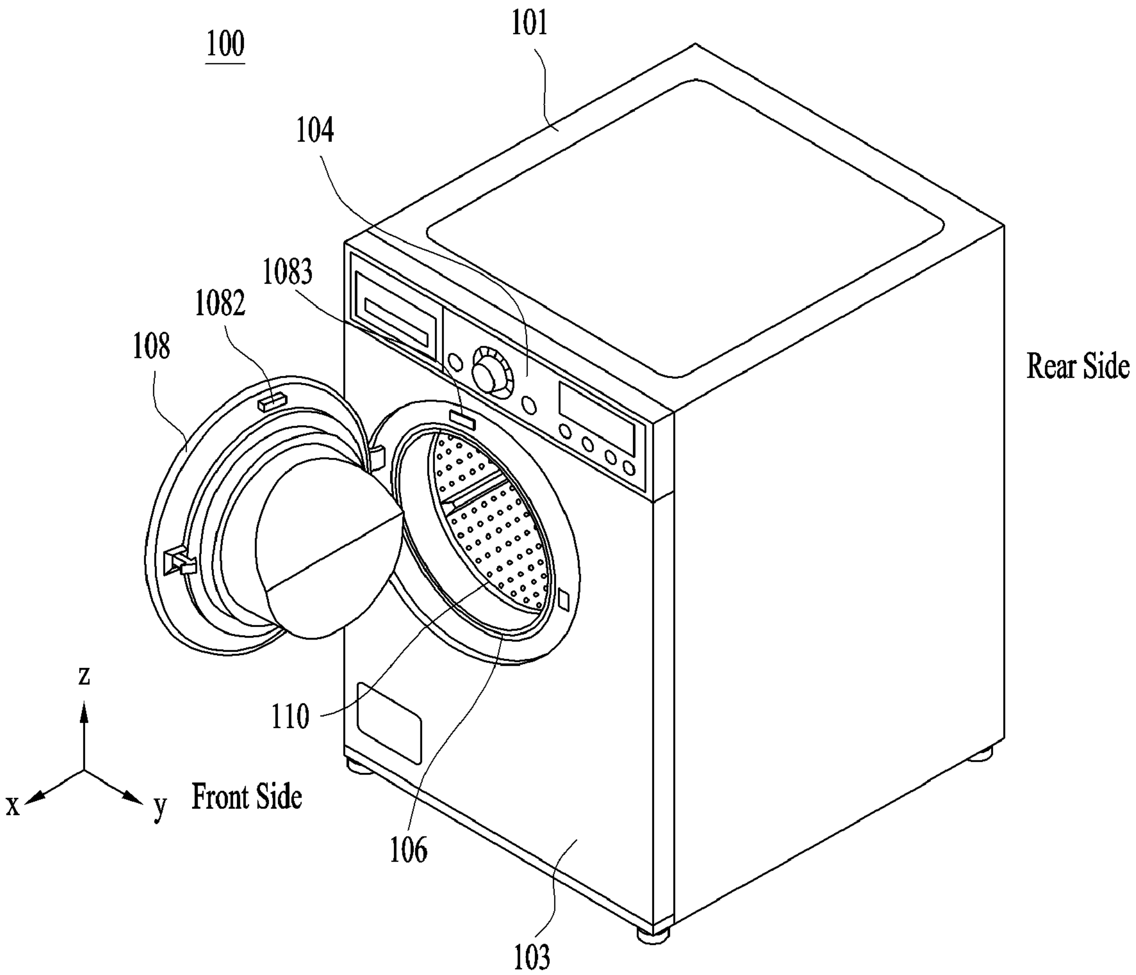
13. The method of any one of claims 7 to 12, wherein, in the measurement operation,

when the current load is greater than the threshold current value, the controller resets a first measurement time duration which refers to a time duration for which a current measurement of the compressor (149) continues to be a value below the preset threshold current value during the drying cycle (S801), and
wherein, when the current load is smaller than or equal to the threshold current value, and the first measurement time duration is smaller than the first continuous time duration, the controller accumulates the first measurement time duration (S913).

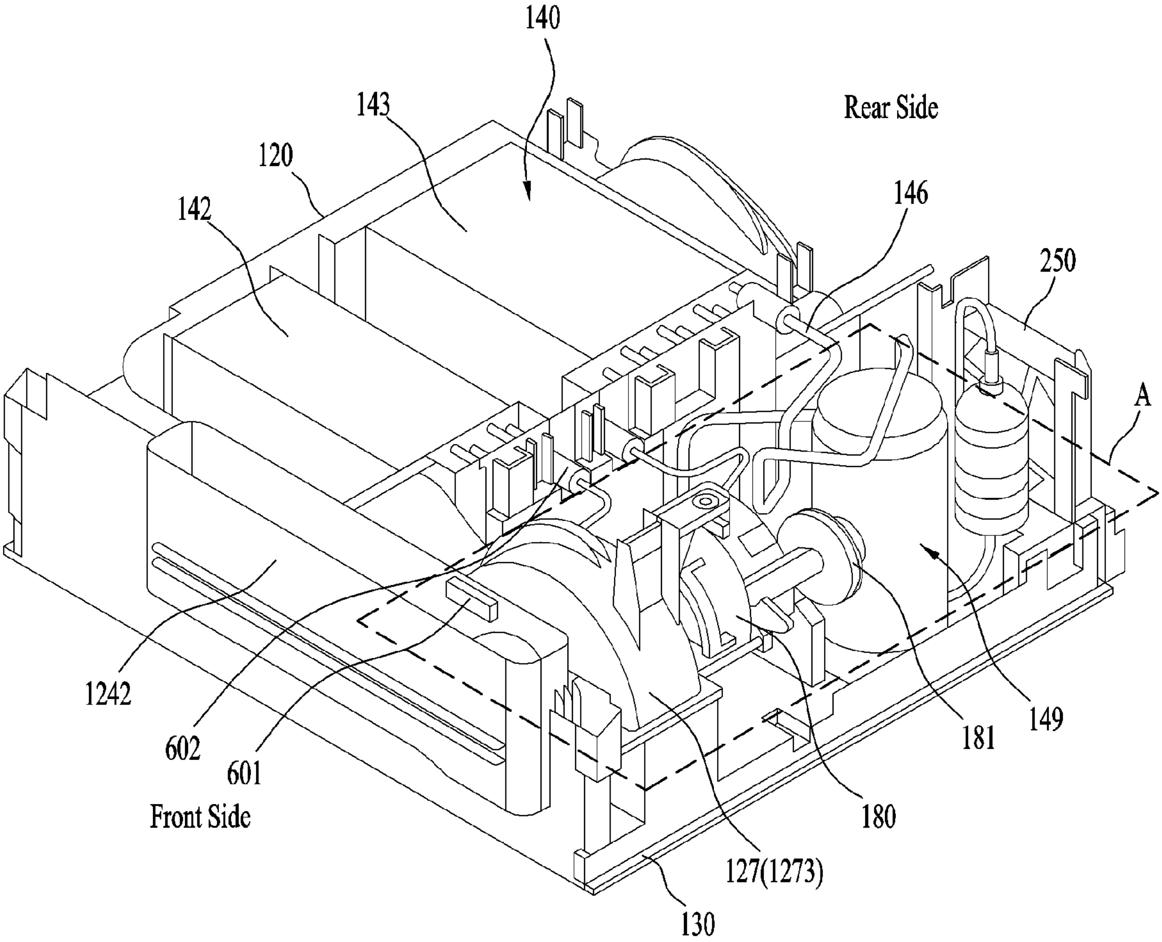
14. The method of claim 13, wherein, in the measurement operation,

when the absolute value of the difference between the first temperature and the second temperature exceeds the allowable temperature difference, the controller resets a second measurement time duration which refers to a time duration during which a state in which the absolute value of the difference between the first temperature measured by the first temperature sensor (601) and the second temperature measured by the second temperature sensor (602) is below the preset allowable temperature difference continuously lasts for a predefined time duration during the drying cycle (S801), and
wherein, when the absolute value of the difference between the first temperature and the second temperature is smaller than or equal to the allowable temperature difference, and the second measurement time duration is smaller than the second continuous time duration, the controller accumulates the second measurement time duration (S923).

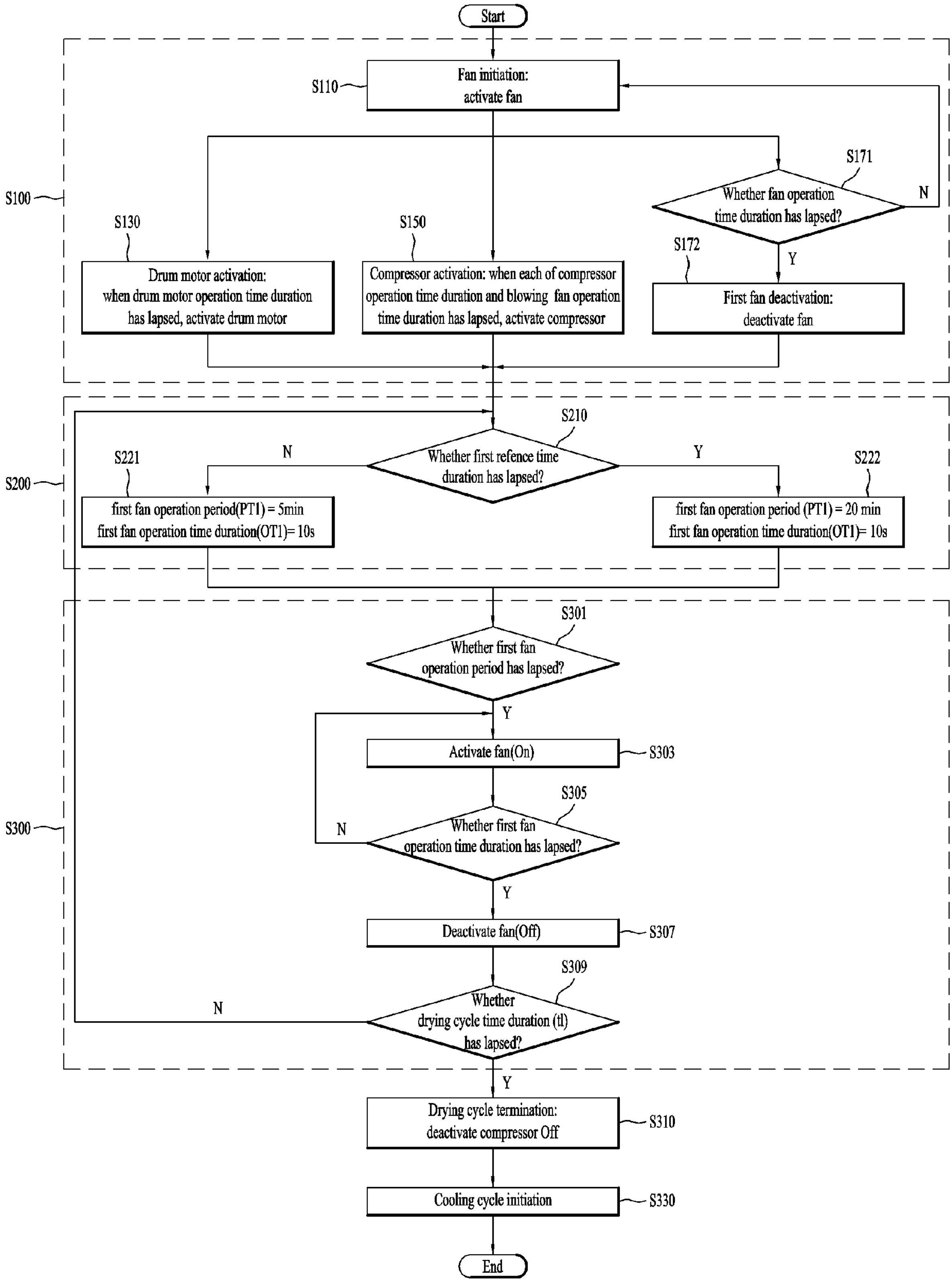
【FIG. 1】



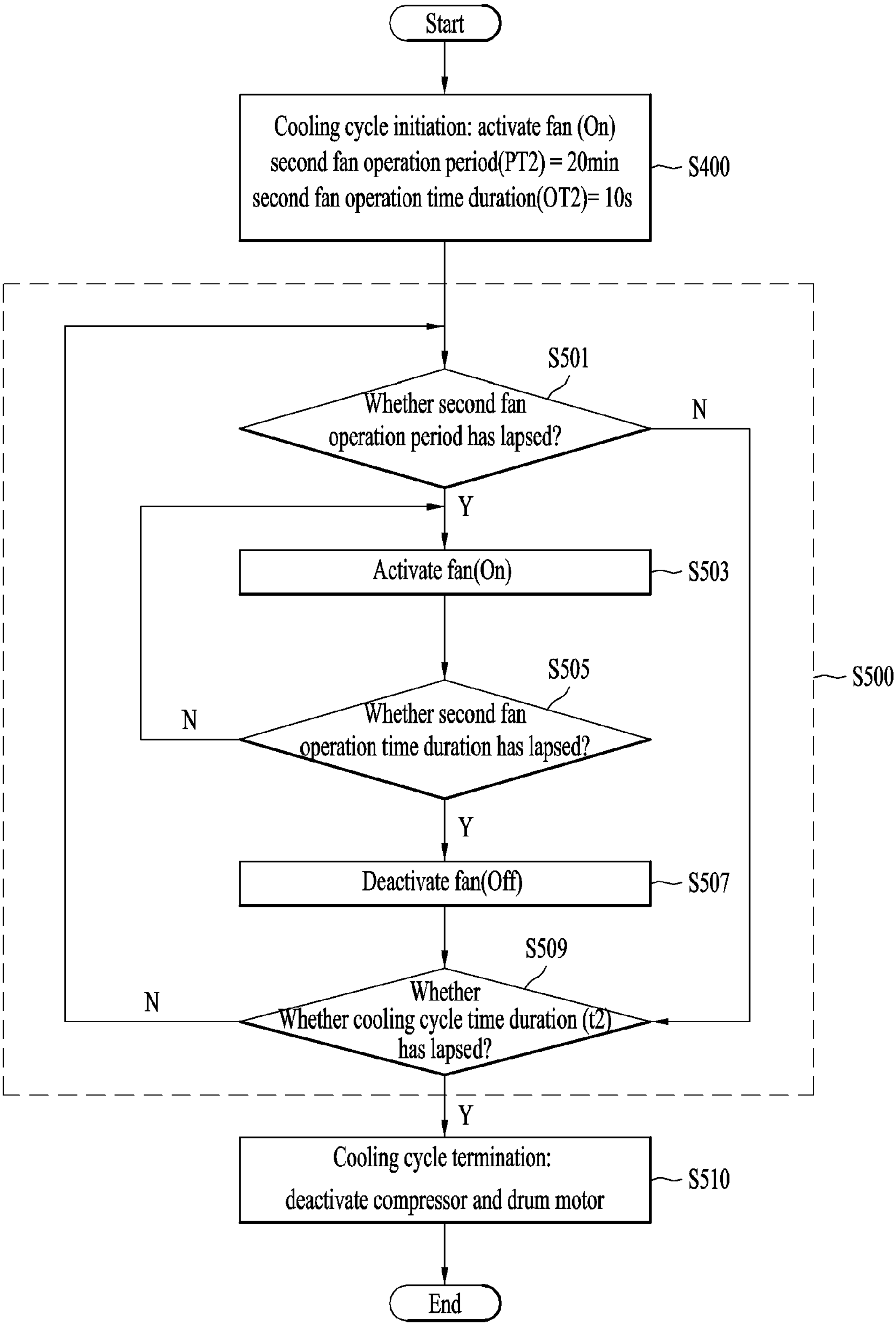
【FIG. 2】


140
143
Rear Side
120
146
142
250
A
1242
602
601
Front Side
181
149
180
127(1273)
130

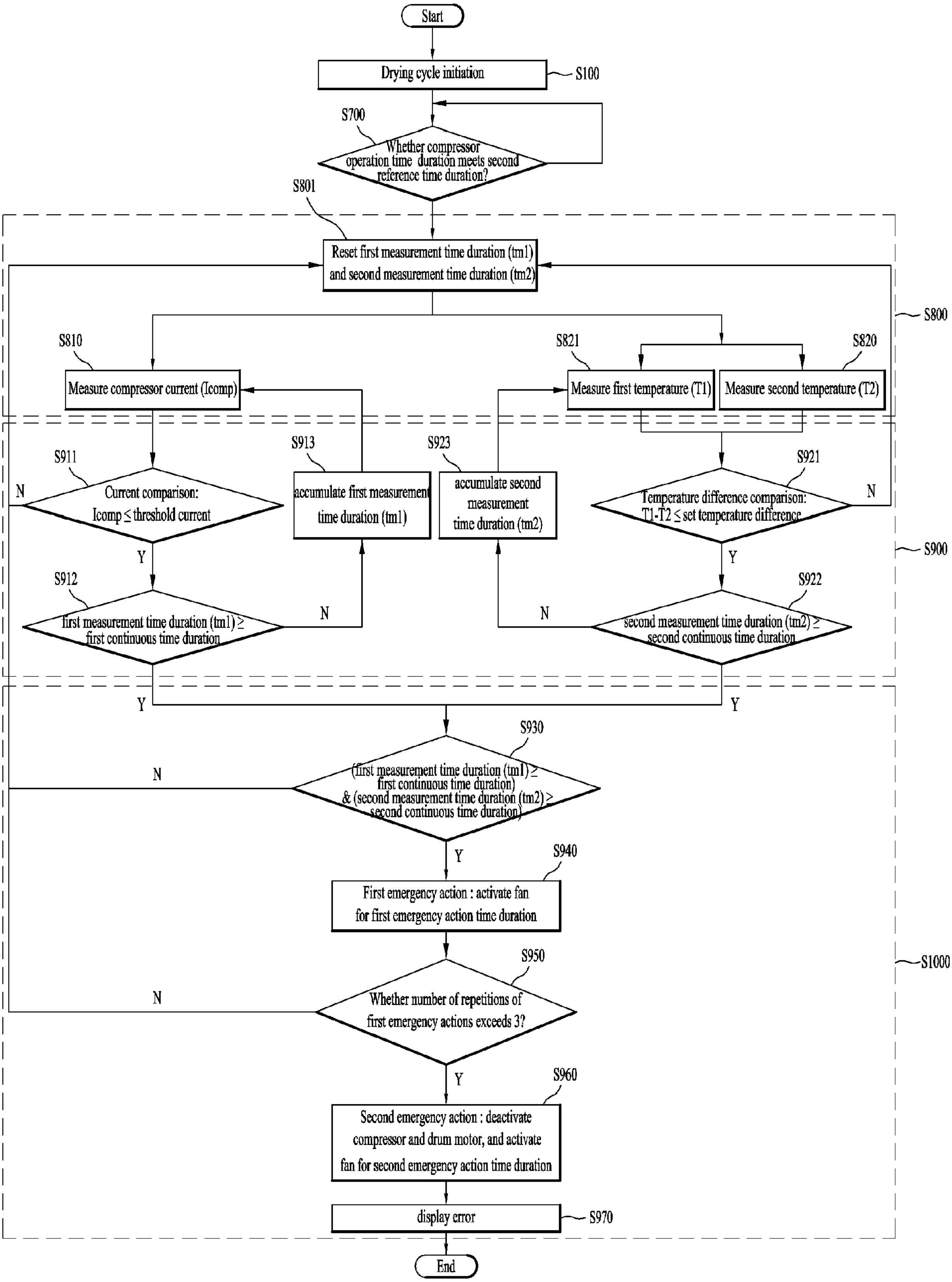
【FIG. 3】


Start
S110
Fan initiation: activate fan
S100
S130
Drum motor activation: when drum motor operation time duration has lapsed, activate drum motor
S150
Compressor activation: when each of compressor operation time duration and blowing fan operation time duration has lapsed, activate compressor
S171
Whether fan operation time duration has lapsed?
N
Y
S172
First fan deactivation: deactivate fan
S200
S210
Whether first refence time duration has lapsed?
N
Y
S221
first fan operation period(PT1) = 5min first fan operation time duration(OT1)= 10s
S222
first fan operation period (PT1) = 20 min first fan operation time duration(OT1)= 10s
S300
S301
Whether first fan operation period has lapsed?
Y
Activate fan(On)
S303
S305
Whether first fan operation time duration has lapsed?
N
Y
Deactivate fan(Off)
S307
S309
Whether drying cycle time duration (tl) has lapsed?
N
Y
Drying cycle termination: deactivate compressor Off
S310
Cooling cycle initiation
S330
End

【FIG. 4】


Start
Cooling cycle initiation: activate fan (On)
second fan operation period(PT2) = 20min
second fan operation time duration(OT2)= 10s
S400
S501
Whether second fan
operation period has lapsed?
N
Y
Activate fan(On)
S503
S505
Whether second fan
operation time duration has lapsed?
N
Y
S500
Deactivate fan(Off)
S507
S509
Whether
Whether cooling cycle time duration (t2)
has lapsed?
N
Y
Cooling cycle termination:
deactivate compressor and drum motor
S510
End

【FIG. 5】


Start
Drying cycle initiation
S100
S700
Whether compressor operation time duration meets second reference time duration?
S801
Reset first measurement time duration (tm1) and second measurement time duration (tm2)
S800
S810
Measure compressor current (Icomp)
S821
Measure first temperature (T1)
S820
Measure second temperature (T2)
S911
Current comparison: Icomp ≤ threshold current
N
Y
S913
accumulate first measurement time duration (tm1)
S923
accumulate second measurement time duration (tm2)
S921
Temperature difference comparison: T1-T2 ≤ set temperature difference
N
Y
S900
S912
first measurement time duration (tm1) ≥ first continuous time duration
N
S922
second measurement time duration (tm2) ≥ second continuous time duration
N
Y
Y
S930
(first measurement time duration (tm1) ≥ first continuous time duration) & (second measurement time duration (tm2) ≥ second continuous time duration)
N
Y
S940
First emergency action : activate fan for first emergency action time duration
S1000
S950
Whether number of repetitions of first emergency actions exceeds 3?
N
Y
S960
Second emergency action : deactivate compressor and drum motor, and activate fan for second emergency action time duration
display error
S970
End

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EUROPEAN SEARCH REPORT

Application Number
EP 22 20 2372

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	JP 2009 207673 A (TOSHIBA CORP; TOSHIBA CONSUMER ELECT HOLDING ET AL.) 17 September 2009 (2009-09-17) * paragraphs [0026] - [0028], [0042]; claims; figures *	1-14	INV. D06F58/50 ADD. D06F58/20 D06F103/32 D06F103/38 D06F103/44 D06F103/50 D06F105/30 D06F105/54 D06F105/58 D06F105/62
A	CN 102 767 071 A (HAIER GROUP CO LTD; QINDAO HAIER WASHING MACHINE) 7 November 2012 (2012-11-07) * claims; figures *	1-14	
A	WO 2009/020322 A2 (LG ELECTRONICS INC [KR]; MOON JUNG WOOK [KR] ET AL.) 12 February 2009 (2009-02-12) * paragraph [0027]; claims 1,2; figures 3,4 *	1-14	
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	20 February 2023	Popara, Velimir

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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20-02-2023

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