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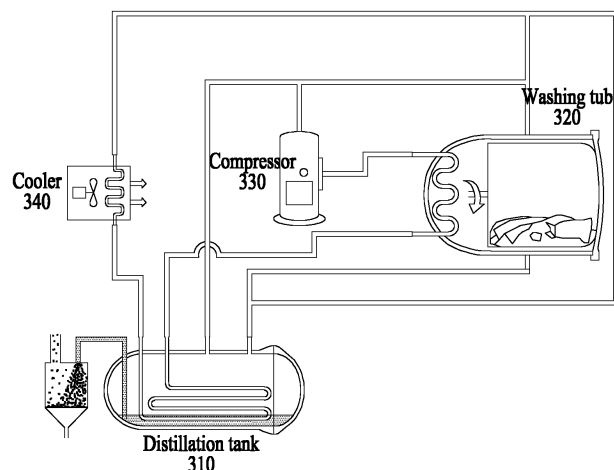
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LAUNDRY TREATING APPARATUS, AND CONTROL METHOD THEREOF

- (57)

Disclosed is a technology regarding a laundry treating apparatus having a 2-tank structure including a distillation tank and a washing tub rather than a laundry
- treating apparatus with a 3-tank structure including a stor-
age tank, a washing tub, and a distillation tank and a
control method thereof.

FIG. 3



Description

Technical Field

[0001] The present disclosure relates to a technology related to a laundry treating apparatus with a 2-tank structure including a distillation tank and a washing tub rather than a laundry treating apparatus with a 3-tank structure including a storage tank, a washing tub, and a distillation tank.

Background Art

[0002] Laundry (for example, clothes) may be cleaned using detergents and water or cleaned through dry cleaning using chemicals such as perchloroethylene (PCE), trichloroethylene, and CFC-113 instead of water when cleaning using water is not suitable.

[0003] In this case, all the chemicals used for dry cleaning are known as accompanied by health risks and safety risks and harmful to the environment. For example, PCE is assumed a carcinogen, and CFC-113 is known for having numerous side effects including having the possibility of destroying ozone.

[0004] The dry cleaning businesses are run usually by small stores in residential areas, and there is concern that many risks may be posed to the general public when using such chemicals. In addition, there is a problem that it is difficult to make profits since great costs are required to satisfy regulations about health risks, safety, and environmental constraints.

[0005] Therefore, research on using alternative materials such as liquid carbon dioxide is ongoing in order to make profits while suitable for health risks, safety, and environmental constraints.

[0006] With regard to dry cleaning using liquid carbon dioxide, related art 1 (Korean Patent No. 10-0622260) discloses a laundry treating apparatus having a structure using a 3-tank including i) a storage tank 300 storing liquid carbon dioxide, ii) a washing machine agitator 400 performing washings, and iii) a vaporizing separator 500 for recycling waste carbon dioxide after washings.

[0007] In addition, related art 2 (Japanese Patent No. 4394293) discloses a laundry treating apparatus having a structure using a 3-tank including i) a supply tank 18 for supplying liquid carbon dioxide, ii) a treatment vessel 10 cleaning clothes, and iii) an evaporation vessel 36 for recirculating used carbon dioxide.

[0008] However, there is a problem that such related arts using the 3-tank are required for a large space since miniaturizing a laundry treating apparatus is difficult due to the vertical arrangement of each tank.

[0009] In addition, as for a storage tank and an evaporator, managing internal pressure for safety is a requisite due to high pressure, so a mechanical safety device therefor is required to be installed separately for each tank, and thus there is a problem that a structure gets complicated.

Detailed Description of the Invention

Technical Goals

[0010] Example embodiments of the present disclosure are to provide a technology for causing a distillation tank of a laundry treating apparatus of a 2-tank structure to perform each function of a storage tank and a distillation tank of a laundry treating apparatus of a 3-tank structure. Therefore, according to example embodiments of the present disclosure, relatively less space may be required for installation due to a compact laundry treating apparatus.

[0011] Further, example embodiments of the present disclosure are to provide a technology for having an advantageous structure in respect of safety and cost by reducing the target of vessel pressure management for safety from a storage tank and a distillation tank to one tank.

[0012] Further, example embodiments of the present disclosure are to provide a technology for decreasing a total washing time by controlling to operate in a state where the internal pressure of a washing tub is relatively low, compared to the laundry treating apparatus of the 3-tank structure.

[0013] Specifically, example embodiments of the present disclosure are to provide a technology for decreasing a total washing time since operating in a state where the internal pressure of a washing tub is relatively low, compared to the laundry treating apparatus of the 3-tank structure, leads to a relative decrease in a time for reducing the internal pressure of the washing tub in a recovery process after a washing.

[0014] The technical goals to be achieved in the present disclosure are not limited to the technical goals described above, and other technical goals not mentioned herein will be clearly understood by those skilled in the art from the following description.

Technical solutions

[0015] According to an aspect of the present disclosure for having a 2-tank structure, there is provided a laundry treating apparatus including a washing tub that includes laundry in an inner space, a distillation tank in which liquid carbon dioxide is stored, a compressor that sucks and discharges gaseous carbon dioxide to which the liquid carbon dioxide is evaporated in the distillation tank, a cooler that cools the discharged gaseous carbon dioxide to supply the liquid carbon dioxide to the washing tub, and a controller.

[0016] In this case, the storage tank may further include impurities in addition to the liquid carbon dioxide, and the controller may be configured to control a distillation operation in order for gaseous carbon dioxide that the impurities are removed to be supplied to the washing tub.

[0017] Further, the controller, in order for relatively less

time to be required to reduce internal pressure of the washing tub after a washing cycle, may be configured to control the internal pressure of the washing tub as relatively low during the washing cycle.

[0018] Preferably, the controller may be configured to control the distillation operation of supplying the liquid carbon dioxide to the washing tub to operate in a state separated from a washing cycle.

[0019] Further, the controller may be configured to control the distillation operation in order for the liquid carbon dioxide supplied to the washing tub to correspond to a preset level.

[0020] Further, the controller may be configured to control that the liquid carbon dioxide included in the washing tub is discharged into the distillation tank when the washing cycle is ended.

[0021] Specifically, the controller may be configured to supply the liquid carbon dioxide to the washing tub through the distillation operation before the washing and control that the liquid carbon dioxide included in the washing tub is discharged into the distillation tank after the washing is ended.

[0022] In addition, the controller may be configured to supply the liquid carbon dioxide to the washing tub through the distillation operation before the rinse and control that the liquid carbon dioxide included in the washing tub is discharged into the distillation tank after the rinse is ended.

[0023] Further, the laundry treating apparatus may further include a vacuum pump, and the vacuum pump may reduce internal pressure of the washing tub before liquid carbon dioxide is supplied to the washing tub through a distillation operation.

[0024] Further, an amount of the liquid carbon dioxide stored in the storage tank may correspond to an amount required for a washing cycle of one time.

[0025] According to another aspect of the present disclosure for controlling a laundry treating apparatus having a 2-tank structure, there is provided a control method including controlling an inside of a washing tub in a vacuum state, first supplying liquid carbon dioxide to the washing tub based on a distillation operation, after performing a washing according to a set mode using the first supplied liquid carbon dioxide, first discharging the liquid carbon dioxide of the washing tub into a distillation tank, secondly supplying the liquid carbon dioxide to the washing tub based on the distillation operation, and after performing a rinse using the secondly supplied liquid carbon dioxide, secondly discharging the liquid carbon dioxide of the washing tub into the distillation tank.

[0026] Details of other example embodiments are included in the detailed description and drawings.

Effects of the Invention

[0027] A laundry treating apparatus according to example embodiments may have one or more of the following effects.

[0028] The laundry treating apparatus according to example embodiments of the present disclosure may be miniaturized using a 2-tank structure unlike a 3-tank, thereby having the advantage of requiring relatively less space for installment.

[0029] In this case, a distillation tank includes impurities such as sludge and used liquid carbon dioxide, but it is possible to supply pure gaseous carbon dioxide by removing the impurities through a distillation operation.

[0030] In addition, the internal pressure of a washing tub is maintained relatively low during a washing cycle, and relatively less time is required to reduce the internal pressure of the washing tub in a recovery process after the washing cycle, thereby having the advantage of decreasing the total washing time.

[0031] Specifically, compared to a laundry treating apparatus of a 3-tank structure in which the distillation operation and the washing cycle are executed in parallel, as for a laundry treating apparatus of the 2-tank structure, the distillation operation and the washing cycle are executed in series, but a time required for reduction of the internal pressure of a washing tub is decreased, having the advantage of decreasing the total washing time.

[0032] Further, the laundry treating apparatus according to example embodiments of the present disclosure, by reducing the target of vessel pressure management from a storage tank and a distillation tank to one tank, has an advantage in respect of safety and cost.

[0033] The effects to be obtained in the present disclosure are not limited to the aforementioned effects, and other effects not mentioned herein will be clearly understood by those skilled in the art from the attached claims.

Brief Description of Drawings

[0034]

FIG. 1 is a diagram illustrating a laundry treating apparatus of a structure using a 3-tank according to an example embodiment.

FIG. 2 is a diagram for explaining an operation process in a laundry treating apparatus of a structure using a 3-tank according to an example embodiment. FIG. 3 is a diagram illustrating a laundry treating apparatus of a structure using a 2-tank according to an example embodiment other than FIG. 1.

FIG. 4 is a diagram for explaining an operation process in a laundry treating apparatus of a structure using a 2-tank according to another example embodiment.

FIG. 5 is a diagram for explaining an operation process of a laundry treating apparatus according to an example embodiment.

FIG. 6 is a diagram for explaining a control method of a laundry treating apparatus according to an example embodiment.

Mode for Carrying Out the Invention

[0035] Terms used in example embodiments are selected from currently widely used general terms when possible while considering the functions in the present disclosure. However, the terms may vary depending on the intention of a person skilled in the art, precedents, emergence of new technologies, and the like. Further, in certain cases, there may be terms arbitrarily selected by the applicant, and in this case, the meaning of the term will be described in detail in the corresponding description. Therefore, the terms used in the present disclosure are not to be defined simply as its designation but based on the meaning of the term and the overall context of the present disclosure.

[0036] Throughout the specification, when a part is described as "comprising or including" a component, it does not exclude another component but may further include another component unless otherwise stated. Furthermore, terms such as "... unit" and "... module" described in the specification mean a unit that processes at least one function or operation, which may be implemented as hardware, software, or a combination thereof.

[0037] Expression "at least one of a, b, and c" described throughout the specification may include "a alone," "b alone," "c alone," "a and b," "a and c," "b and c," or "all of a, b, and c."

[0038] A "terminal" mentioned hereinafter may be implemented as, for example, a computer or a portable terminal capable of accessing a server or another terminal through a network. Here, the computer may include, for example, a notebook, a desktop computer, and/or a laptop computer which are equipped with a web browser. The portable terminal may be a wireless communication apparatus ensuring portability and mobility and include (but is not limited to) any type of handheld wireless communication apparatus, for example, a tablet PC, a smartphone, a communication-based terminal such as international mobile telecommunication (IMT), code division multiple access (CDMA), W-code division multiple access (W-CDMA), long term evolution (LTE), or the like.

[0039] Hereinafter, example embodiments of the present disclosure will be described in detail with reference to the accompanying drawings so that those of ordinary skill in the art to which the present disclosure pertains may easily implement them. However, the present disclosure may be implemented in multiple different forms and is not limited to the example embodiments described herein.

[0040] Hereinafter, example embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.

[0041] FIG. 1 is a diagram illustrating a laundry treating apparatus of a structure using a 3-tank according to an example embodiment.

[0042] Referring to FIG. 1, the laundry treating apparatus may be a drum-type laundry treating apparatus that laundry is inserted into a washing tub 120 from a direction

of the front. Alternatively, unlike FIG. 1, the laundry treating apparatus may be a laundry treating apparatus where laundry is inserted into the washing tub 120 from a direction of the top. Such laundry treating apparatus may be an apparatus that performs at least one of washing, rinsing, dehydrating, and drying as laundry is inserted.

[0043] The washing tub 120 of the laundry treating apparatus may include a cabinet that forms an outer surface, a tub that is positioned inside the cabinet and supported by the cabinet, a drum that is positioned inside the tub and in which laundry is washed, a motor that drives the drum, a supply device (not illustrated) that supplies liquid carbon dioxide inside the cabinet, and a drainage device (not illustrated) that is formed at a lower side of the tub and discharges the liquid carbon dioxide and impurities.

[0044] In this case, the drum may be formed of a plurality of through-holes for the liquid carbon dioxide to be supplied, and a lifter may be positioned on the inner side thereof so that the laundry is lifted up at a predetermined height and then dropped by gravity when the drum is rotated. The cabinet may include a cabinet body, a cabinet cover that is positioned at the front surface of the cabinet body and combined therewith, a control panel that is positioned at an upper side of the cabinet cover and combined with the cabinet body, and a top plate that is positioned at an upper side of the control panel and combined with the cabinet body. The cabinet cover may include a hole through which the laundry is capable of entry and exit and a door that is positioned as rotatable right and left in order for the hole to open and close. The control panel may include operating keys that operate operation states of the laundry treating apparatus and a display that is positioned at one side of the operating keys and displays the operation state of the laundry treating apparatus.

[0045] The operating keys and the display within the control panel are electrically connected to a controller (not illustrated), and the controller (not illustrated) may electrically control each element of the laundry treating apparatus. Details about the operation of the controller (not illustrated) are described hereinafter. Though not illustrated in the drawings, the laundry treating apparatus may further include various sensors and other apparatuses. For example, the laundry treating apparatus may further include a sensor that measures a water level of the liquid carbon dioxide supplied inside the washing tub 120. The motor may be driven by the controller, and the drum within the tub may be rotated according to the drive of the motor. The controller may control operation as inputted by an operation signal from the operating keys and, for example, may control a washing cycle including washing, rinsing, dehydrating, and drying. In addition, the controller may control the display to display operation states related to the washing cycle, such as a washing course, a washing time, a dehydrating time, and a rinsing time.

[0046] The laundry treating apparatus of FIG. 1 may

further include a storage tank 110, a distillation tank 130, a compressor 140, and a cooler 150, in addition to the washing tub 120. As such, the laundry treating apparatus may have a 3-tank structure including the storage tank 110, the washing tub 120, and the distillation tank 130.

[0047] The storage tank 110 stores liquid carbon dioxide, and the liquid carbon dioxide stored in the storage tank 110 may be supplied inside the washing tub 120 by gravity when a valve installed on a connection pipe between the storage tank 110 and the washing tub 120 is on. When the valve installed on the connection pipe between the storage tank 110 and the washing tub 120 is off, the liquid carbon dioxide stored in the storage tank 110 may not be supplied inside the washing tub 120 even by gravity.

[0048] For the laundry included in the drum inside the washing tub 120, a washing cycle including washing and rinsing by the liquid carbon dioxide may be processed.

[0049] When the washing cycle is ended, the liquid carbon dioxide and impurities included in the washing tub 120 may be moved into the distillation tank 130 by gravity when a valve installed on a connection pipe between the washing tub 120 and the distillation tank 130 is on, or the liquid carbon dioxide and impurities included in the washing tub 120 may not be moved into the distillation tank 130 even by gravity when the valve installed on the connection pipe between the washing tub 120 and the distillation tank 130 is off. Here, the impurities may include sludge generated in a washing cycle process.

[0050] The liquid carbon dioxide moved into the distillation tank 130 may be vaporized using the heat of the compressor 140, and through a distillation process as such, the impurities and gaseous carbon dioxide may be separated. In this case, the impurities located at the bottom of the distillation tank 130 and the gaseous carbon dioxide located at the upper portion of the distillation tank 130 may be separated without being mixed.

[0051] The compressor 140 may suck and discharge gaseous carbon dioxide, and the discharged gaseous carbon dioxide may be cooled and liquefied in the cooler 150 and converted into liquid carbon dioxide.

[0052] The cooler 150 may correspond to a condenser, and the condenser is a device included in a heat exchanger and may cool and condense the gaseous carbon dioxide passing through the compressor to discharge liquid carbon dioxide. The liquid carbon dioxide discharged from the cooler 150 may flow into the storage tank 110, and the storage tank 150 may store the liquid carbon dioxide. In the case of the laundry treating apparatus of the structure as in FIG. 1, a distillation operation may be performed in parallel during a washing cycle.

[0053] The storage tank 110 of the laundry treating apparatus using the 3-tank may store liquid carbon dioxide corresponding to 2A that includes an amount A of liquid carbon dioxide required for washing and an amount A of liquid carbon dioxide required for rinsing.

[0054] A recovery rate of liquid carbon dioxide discharged from the storage tank 110 during a washing cycle

of one time is about 98 %, and liquid carbon dioxide that is not recovered may be supplemented from the outside. Specifically, when a water level of liquid carbon dioxide is sensed in the storage tank 110 and the water level is less than a predetermined reference, liquid carbon dioxide may be supplemented from the outside, or when the number of times of washing cycles reaches a preset number of times, liquid carbon dioxide may be supplemented from the outside.

[0055] FIG. 2 is a diagram for explaining an operation process in a laundry treating apparatus of a structure using a 3-tank according to an example embodiment.

[0056] Referring to FIG. 2, liquid carbon dioxide may flow between the storage tank 110, the washing tub 120, and the distillation tank 130 by gravity using a height difference.

[0057] The liquid carbon dioxide stored in the storage tank 110 may flow into the washing tub 120 by gravity, and when a washing cycle is ended in the washing tub 120, the liquid carbon dioxide and impurities may flow into the distillation tank 130. The liquid carbon dioxide is evaporated into gaseous carbon dioxide in the distillation tank 130 by a second heat, the compressor 140 may suck and discharge the evaporated gaseous carbon dioxide into the cooler 150, and the cooler 150 may discharge the liquid carbon dioxide into the storage tank 110, emitting a first heat while cooling and condensing the gaseous carbon dioxide.

[0058] In the case of the laundry treating apparatus using the 3-tank of the structure as in FIG. 2, the storage tank 110, the washing tub 120, and the distillation tank 130 are required to be arranged in a vertical direction for the height difference, and due to this, there is a problem that miniaturization is difficult. Further, since the storage tank 110 and the distillation tank 130 may have the internal pressure of the tanks increased through heat transfer with the outside, managing internal pressure is a requisite for safety, and a mechanical safety device for this is required to be installed separately for each tank, which leads to a problem that a structure gets complicated.

[0059] FIG. 3 is a diagram illustrating a laundry treating apparatus of a structure using a 2-tank according to an example embodiment other than FIG. 1.

[0060] Referring to FIG. 3, the laundry treating apparatus may include a distillation tank 310, a washing tub 320, a compressor 330, and a cooler 340. The laundry treating apparatus is a 2-tank structure including the distillation tank 310 and the washing tub 320, and the distillation tank 310 may perform functions of the storage tank 110 and the distillation tank 130 of FIG. 1. The aforementioned descriptions may be applied to details regarding the washing tub 320, the compressor 330, and the cooler 340.

[0061] Specifically, unlike FIG. 1 in which the liquid carbon dioxide stored in the storage tank 110 may be supplied to the washing tub 120, liquid carbon dioxide stored in the distillation tank 310 is separated from impurities through a distillation process, and as pure gaseous car-

bon dioxide is sucked in and discharged from the compressor 330 and is cooled and liquefied in the cooler 340, liquid carbon dioxide may be supplied inside the washing tub 320. Unlike FIG. 1, as for the laundry treating apparatus of the structure as in FIG. 3, a washing cycle and a distillation operation may be performed in series.

[0062] In addition, unlike the laundry treating apparatus of FIG. 1 in which the liquid carbon dioxide corresponding to a total of 2A is stored for performing parallel operation of a washing cycle and a distillation operation, the storage tank 110 of the laundry treating apparatus using the 2-tank may store liquid carbon dioxide corresponding to a total of A due to serial operation. In other words, liquid carbon dioxide corresponding to A may be supplied through a distillation operation before washing, and after recovery, liquid carbon dioxide corresponding to A may be supplied again through the distillation operation before rinsing, which may be recovered again.

[0063] Unlike the laundry treating apparatus having the 3-tank structure of FIG. 1, in the case of the laundry treating apparatus having the 2-tank structure of FIG. 3, the distillation tank 310 performs all functions of the storage tank 110 and the distillation tank 130 and thus may be miniaturized relatively.

[0064] Further, unlike FIG. 1 including the storage tank 110 and the distillation tank 130 to be the target of pressure management for safety, in the case of the laundry treating apparatus having the 2-tank structure as in FIG. 3, a target of pressure management for safety may be one as the distillation tank 310. Accordingly, as the number of tanks to be the target of pressure management for safety is decreased, the laundry treating apparatus may be safe with a relatively simple structure.

[0065] FIG. 4 is a diagram for explaining an operation process in a laundry treating apparatus of a structure using a 2-tank according to another example embodiment.

[0066] Referring to FIG. 4, liquid carbon dioxide stored in the distillation tank 310 is supplied inside the washing tub 320 through a distillation operation, and the liquid carbon dioxide and impurities may be discharged from the washing tub 320 to the distillation tank 310 after a washing cycle is ended.

[0067] Specifically, the compressor 330 may suck (operation S401) gaseous carbon dioxide to which the liquid carbon dioxide stored in the distillation tank 310 is evaporated before washing or rinsing. The gaseous carbon dioxide discharged from the compressor 330 may move (operation S403) to the distillation tank 310, and the cooler 340 may suck (operation S405) the gaseous carbon dioxide discharged passing a pipe inside the distillation tank 310.

[0068] The cooler 340 may discharge (operation S407) the liquid carbon dioxide by cooling and condensing the sucked gaseous carbon dioxide, and the discharged liquid carbon dioxide may be supplied inside the washing tub 320. When washing or rinsing is ended in the washing tub 320, the impurities may flow (operation S409) togeth-

er with the liquid carbon dioxide from the washing tub 320 to the distillation tank 310 through an on/off control of a pipe.

[0069] While such a cycle is circulated, a recovery rate of liquid carbon dioxide is 98 %, and the liquid carbon dioxide that is lost may be separately supplemented from the outside.

[0070] FIG. 5 is a diagram for explaining an operation process of a laundry treating apparatus according to an example embodiment.

[0071] Referring to FIG. 5, in operation S501, the laundry treating apparatus may control the inside of a washing tub in a vacuum state. The laundry treating apparatus includes a vacuum pump (not illustrated), and as the vacuum pump sucks air inside the washing tub which is introduced together with laundry, the internal pressure of the washing tub may be reduced. Specifically, the inside of the washing tub may be controlled in the vacuum state by reducing pressure. If not controlled in a vacuum state, as a compressor sucks air together with gaseous carbon dioxide later, a breakdown due to this may occur.

[0072] In operation S503, the laundry treating apparatus may determine whether to supplement inside a distillation tank. Specifically, whether to supplement may be determined based on a comparison between a water level corresponding to an amount of liquid carbon dioxide inside the distillation tank and a reference water level. More specifically, in operation S505, liquid carbon dioxide may be supplemented from the outside when the water level inside the distillation tank is less than the reference water level. Alternatively, liquid carbon dioxide may not be supplemented from the outside when the water level is greater than the reference water level.

[0073] In this case, the reference water level may be a water level corresponding to an amount required for washing or rinsing of one time. Unlike FIG. 1 in which a total of 2A, the amount A of liquid carbon dioxide required for washing and the amount A of liquid carbon dioxide required for rinsing, is included in the storage tank, since the laundry treating apparatus of FIG. 3 performs serial operation rather than parallel operation, the distillation tank may store the amount of liquid carbon dioxide corresponding to a total of A. Accordingly, unlike FIG. 1, the size of the distillation tank may be relatively miniaturized.

[0074] In operation S507, the laundry treating apparatus may first supply liquid carbon dioxide to the washing tub. Specifically, until a water level of liquid carbon dioxide inside the washing tub which is required for a set washing operation mode reaches a set water level, liquid carbon dioxide may be supplied to the washing tub through a distillation operation. In this case, the amounts of liquid carbon dioxide required for each set washing operation mode may vary, and a water level corresponding to an amount required for each mode may be previously set. Here, the set water level may correspond to a preset level. Accordingly, until a water level of liquid carbon dioxide sensed through a sensor inside the washing tub reaches the preset level, liquid carbon dioxide may

be supplied to the washing tub through the distillation operation.

[0075] In operation S509, the laundry treating apparatus may perform washing among a washing cycle. For example, when it is previously set that washing is performed for 300 seconds, the laundry treating apparatus may perform washing by rotating a drum inside the washing tub for 300 seconds that is set.

[0076] In operation S511, the laundry treating apparatus may first discharge the liquid carbon dioxide inside the washing tub. After washing is ended, the laundry treating apparatus may discharge the liquid carbon dioxide and impurities inside the washing tub into the distillation tank through a valve on/off control of a pipe. In this case, the recovery rate of liquid carbon dioxide between operation S507 and operation S511 is about 98 %, and a portion of liquid carbon dioxide may be lost while a washing cycle is performed. When the amount of liquid carbon dioxide stored in the distillation tank is less than a predetermined water level due to the loss, the amount of liquid carbon dioxide may be supplemented through operation S503.

[0077] In operation S513, the laundry treating apparatus may secondly supply liquid carbon dioxide to the washing tub. Specifically, until a water level of liquid carbon dioxide inside the washing tub which is required for a set rinsing operation mode reaches the set water level, liquid carbon dioxide may be supplied to the washing tub through a distillation operation. In this case, the amounts of liquid carbon dioxide required for each set rinsing operation mode may vary, and a water level corresponding to an amount required for each mode may be previously set. Accordingly, until a water level of liquid carbon dioxide sensed through a sensor inside the washing tub reaches the set water level, liquid carbon dioxide may be supplied to the washing tub through the distillation operation.

[0078] In operation S515, the laundry treating apparatus may perform rinsing among a washing cycle. For example, when it is previously set that rinsing is performed for 300 seconds, the laundry treating apparatus may perform rinsing by rotating a drum inside the washing tub for 300 seconds that is set.

[0079] In operation S517, the laundry treating apparatus may secondly discharge the liquid carbon dioxide inside the washing tub. After washing is ended, the laundry treating apparatus may discharge the liquid carbon dioxide and impurities inside the washing tub into the distillation tank through a valve on/off control of a pipe. In this case, the recovery rate of liquid carbon dioxide between operation S513 and operation S517 is about 98 %, and a portion of liquid carbon dioxide may be lost while a washing cycle is performed.

[0080] After operation S517, the laundry treating apparatus may additionally perform a recovery process of the washing tub. The recovery process of the washing tub may include a process of converting the compression from 1-stage into 2-stage at the pressure inside the wash-

ing tub of X1 bar (for example, 30 bar), turning off the cooler at the pressure of the washing tub of X2 bar (for example, 15 bar), and discharging after the recovery is completed at the pressure of the washing tub X3 bar (for example, 2.5 bar). In other words, the laundry treating apparatus may perform a preset operation as described above when the internal pressure of the washing tub is reduced through the recovery process of the washing tub, and in the process, corresponds to a specific pressure.

[0081] In the case of the laundry treating apparatus of the 3-tank structure as in FIG. 1, the internal pressure of the washing tub is about Y bar (for example, 52 to 58 bar) in a washing cycle process, and a relatively long time may be required in a process that the internal pressure of the washing tub is reduced from Y bar to X1, X2, and X3 bar through a recovery process of the washing tub. On the other hand, in the case of the laundry treating apparatus of the 2-tank structure as in FIG. 3, the internal pressure of the washing tub is about Z bar (for example, 38 to 42 bar) in a washing cycle process, and relatively little time may be required in a process that the internal pressure of the washing tub is reduced from Z bar to X1, X2, and X3 bar through a recovery process of the washing tub. In other words, since the laundry treating apparatus of the 2-tank structure as in FIG. 3 operates in relatively low pressure in a washing cycle process compared to the 3-tank, the internal pressure of the washing tub is about 38 to 42 bar, and time for the internal pressure of the washing tub to decrease from Z bar to X1, X2, and X3 bar through a recovery process of the washing tub may be relatively little. After the recovery process of the washing tub, a user may open the washing tub and take out the laundry.

[0082] Accordingly, as for a laundry treating apparatus having a 2-tank structure compared to a laundry treating apparatus with a 3-tank structure, little time may be required using a relatively small pressure difference.

[0083] FIG. 6 is a diagram for explaining a control method of a laundry treating apparatus according to an example embodiment. Contents described above with regard to the laundry treating apparatus of the 2-tank may be applied to details about FIG. 6.

[0084] Referring to FIG. 6, in operation S610, the laundry treating apparatus may control the inside of a washing tub in a vacuum state using a vacuum pump. In operation S620, the laundry treating apparatus may first supply liquid carbon dioxide to the washing tub based on a distillation operation. The liquid carbon dioxide may be supplied to the washing tub based on the distillation operation until the water level inside the washing tub reaches a reference water level. In operation S630, after performing washing according to a set mode using the first supplied liquid carbon dioxide, the laundry treating apparatus may first discharge the liquid carbon dioxide of the washing tub into a distillation tank. In operation S640, the laundry treating apparatus may secondly supply liquid carbon dioxide to the washing tub based on the distillation opera-

tion. In operation S650, after performing rinsing using the secondly supplied liquid carbon dioxide, the laundry treating apparatus may secondly discharge the liquid carbon dioxide of the washing tub into the distillation tank. Later, the laundry treating apparatus may additionally perform a recovery process of the washing tub.

[0085] According to an example embodiment, an operation of supplying liquid carbon dioxide to a washing tub through a distillation operation in a laundry treating apparatus having a 2-tank structure may be executed in series in a state separated from a washing cycle separately. On the other hand, as for a laundry treating apparatus having a 3-tank structure, the distillation operation may be executed in parallel with a washing cycle. Although a difference in required time by serial execution or parallel execution of the distillation operation and the washing cycle may occur, relatively little time may be required in the laundry treating apparatus with the 2-tank structure using a small pressure difference in a recovery process of a washing tub.

[0086] According to an example embodiment, unlike a laundry treating apparatus having a 3-tank structure, a miniaturized structure may be designed by using a laundry treating apparatus having a 2-tank structure.

[0087] According to an example embodiment, a target tank of vessel pressure management for safety may be reduced from the storage tank 110 and the distillation tank 130 to the distillation tank 310, and thus a structure may be relatively simplified.

[0088] The electronic device or the terminal according to the above-described example embodiments may include a processor, a memory for storing and executing program data, a permanent storage such as a disk drive, a communication port that communicates with an external device, and a user interface device such as a touch panel, a key, and a button. Methods implemented as software modules or algorithms may be stored in a computer-readable recording medium as computer-readable codes or program instructions executable on the processor. Here, the computer-readable recording medium includes a magnetic storage medium (for example, read-only memory (ROM), random-access memory (RAM), floppy disks, and hard disks) and an optically readable medium (for example, CD-ROM and digital versatile discs (DVDs)). The computer-readable recording medium may be distributed among network-connected computer systems, so that the computer-readable codes may be stored and executed in a distributed manner. The medium may be readable by a computer, stored in a memory, and executed on a processor.

[0089] The example embodiments may be represented by functional block elements and various processing steps. The functional blocks may be implemented in any number of hardware and/or software configurations that perform specific functions. For example, an example embodiment may adopt integrated circuit configurations, such as memory, processing, logic, and/or look-up table, that may execute various functions by the control of one

or more microprocessors or other control devices. Similarly to that elements may be implemented as software programming or software elements, the example embodiments may be implemented in a programming or scripting language such as C, C++, Java, assembler, etc., including various algorithms implemented as a combination of data structures, processes, routines, or other programming constructs. Functional aspects may be implemented in an algorithm running on one or more processors. Further, the example embodiments may adopt the existing art for electronic environment setting, signal processing, and/or data processing. Terms such as "mechanism," "element," "means," and "configuration" may be used broadly and are not limited to mechanical and physical elements. The terms may include the meaning of a series of routines of software in association with a processor or the like.

[0090] The above-described example embodiments are merely examples, and other embodiments may be implemented within the scope of the claims to be described later.

Claims

1. A laundry treating apparatus comprising:

a washing tub that includes laundry in an inner space;
a distillation tank in which liquid carbon dioxide is stored;
a compressor that sucks and discharges gaseous carbon dioxide to which the liquid carbon dioxide is evaporated in the distillation tank;
a cooler that cools the discharged gaseous carbon dioxide to supply the liquid carbon dioxide to the washing tub; and
a controller.

2. The laundry treating apparatus of claim 1,

wherein the storage tank further includes impurities in addition to the liquid carbon dioxide, and wherein the controller is configured to control a distillation operation in order for gaseous carbon dioxide that the impurities are removed to be supplied to the washing tub.

3. The laundry treating apparatus of claim 1,

wherein the controller, in order for relatively less time to be required to reduce internal pressure of the washing tub after a washing cycle, is configured to control the internal pressure of the washing tub as relatively low during the washing cycle.

4. The laundry treating apparatus of claim 2,

wherein the controller
is configured to control the distillation operation
of supplying the liquid carbon dioxide to the
washing tub to operate in a state separated from
a washing cycle.

5. The laundry treating apparatus of claim 4,

wherein the controller
is configured to control the distillation operation
in order for the liquid carbon dioxide supplied to
the washing tub to correspond to a preset level.

6. The laundry treating apparatus of claim 4,

wherein the controller
is configured to control that the liquid carbon di-
oxide included in the washing tub is discharged
into the distillation tank when the washing cycle
is ended.

7. The laundry treating apparatus of claim 6,

wherein the washing cycle includes a washing
and a rinse, and
wherein the controller
is configured to supply the liquid carbon dioxide
to the washing tub through the distillation oper-
ation before the washing and control that the
liquid carbon dioxide included in the washing tub
is discharged into the distillation tank after the
washing is ended.

8. The laundry treating apparatus of claim 7,

wherein the controller
is configured to supply the liquid carbon dioxide
to the washing tub through the distillation oper-
ation before the rinse and control that the liquid
carbon dioxide included in the washing tub is
discharged into the distillation tank after the
rinse is ended.

9. The laundry treating apparatus of claim 1,

further comprising a vacuum pump,
wherein the vacuum pump
reduces internal pressure of the washing tub be-
fore liquid carbon dioxide is supplied to the
washing tub through a distillation operation.

10. The laundry treating apparatus of claim 1,

wherein an amount of the liquid carbon dioxide
stored in the storage tank corresponds to an amount
required for a washing cycle of one time.

11. A control method of a laundry treating apparatus, the
control method comprising:

controlling an inside of a washing tub in a vac-
uum state;
first supplying liquid carbon dioxide to the wash-
ing tub based on a distillation operation;
after performing a washing according to a set
mode using the first supplied liquid carbon diox-
ide, first discharging the liquid carbon dioxide of
the washing tub into a distillation tank;
secondly supplying the liquid carbon dioxide to
the washing tub based on the distillation opera-
tion; and
after performing a rinse using the secondly sup-
plied liquid carbon dioxide, secondly discharg-
ing the liquid carbon dioxide of the washing tub
into the distillation tank.

FIG. 1

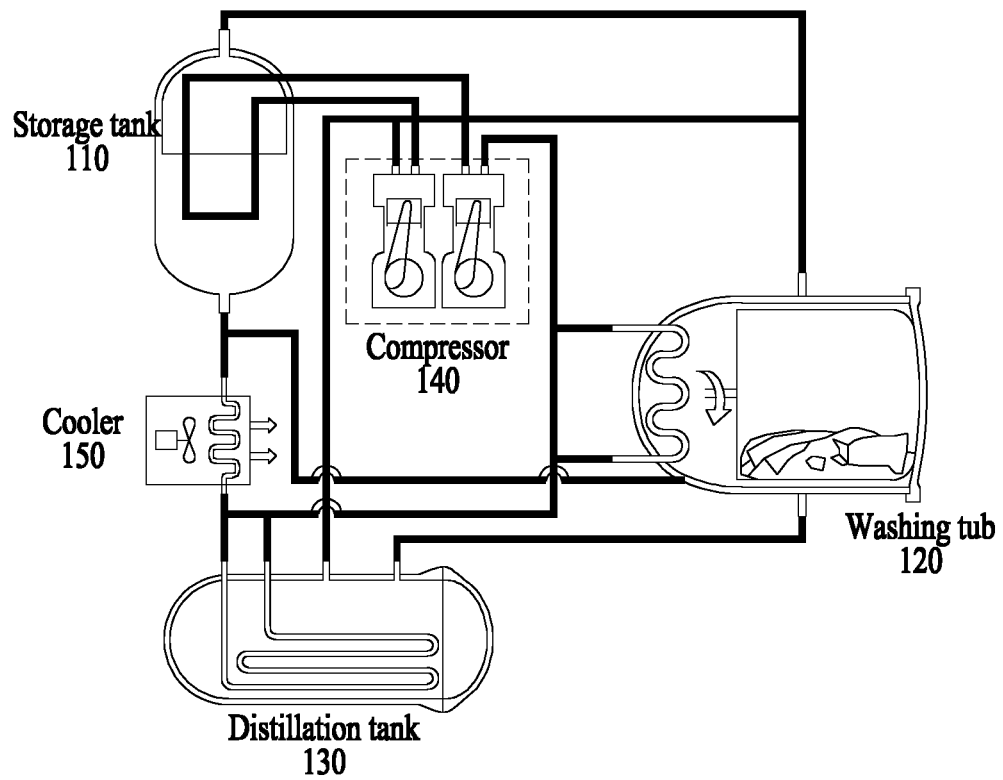


FIG. 2

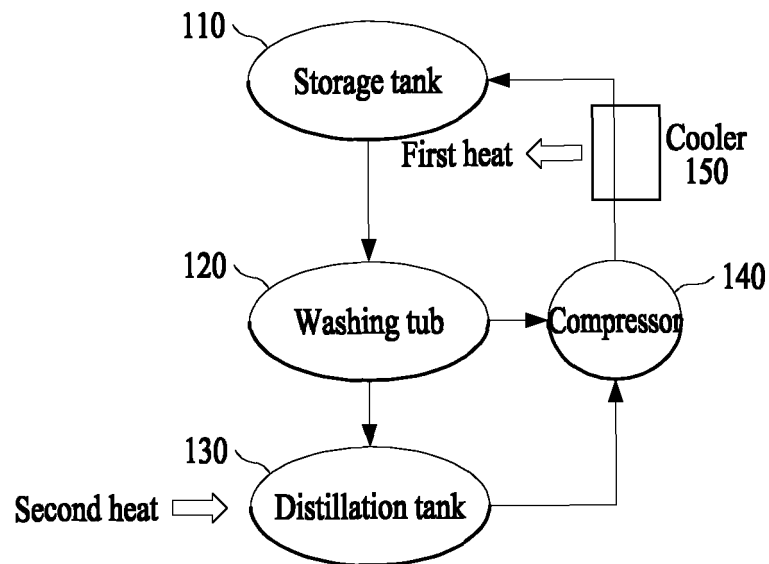


FIG. 3

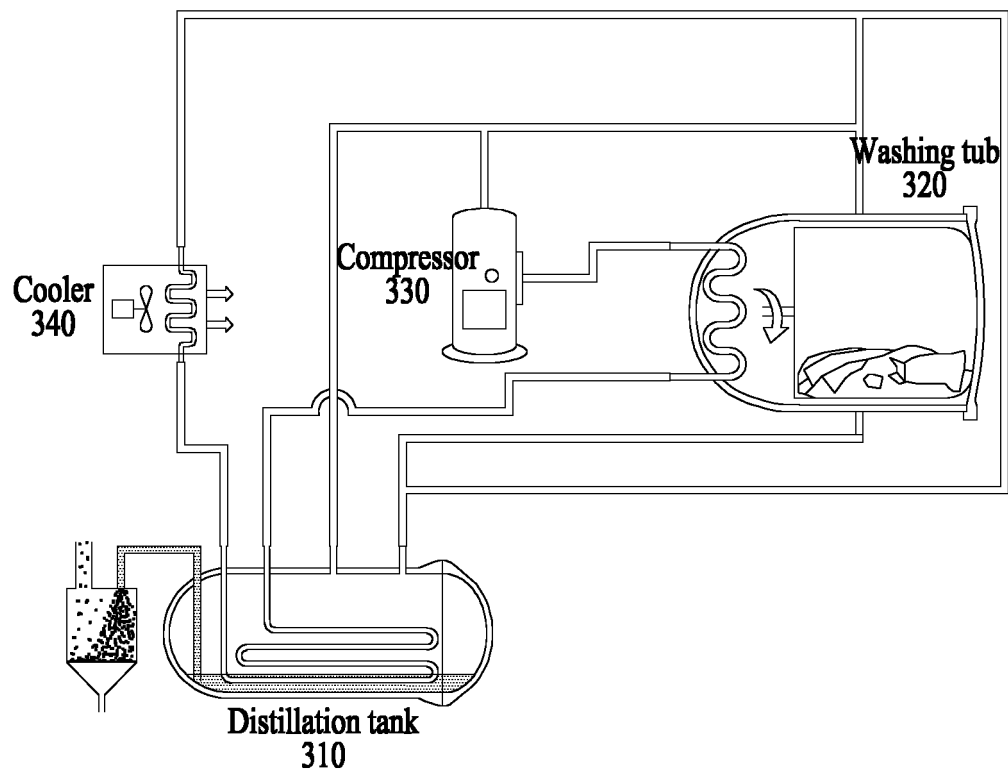


FIG. 4

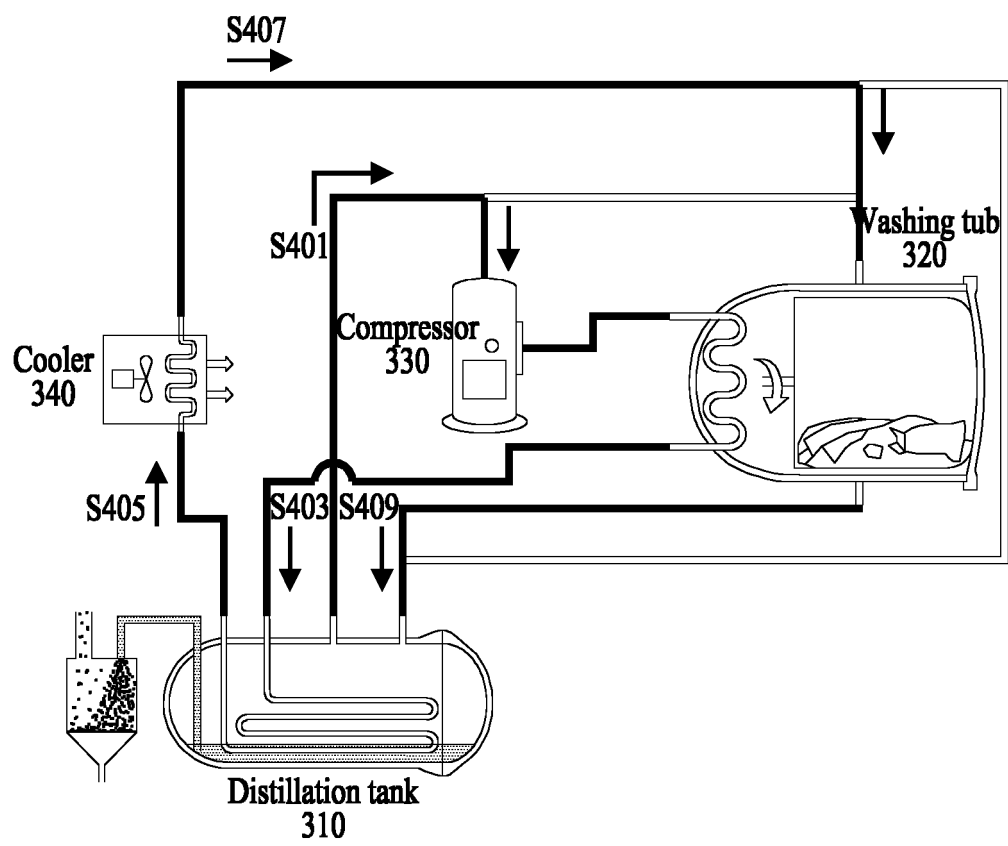


FIG. 5

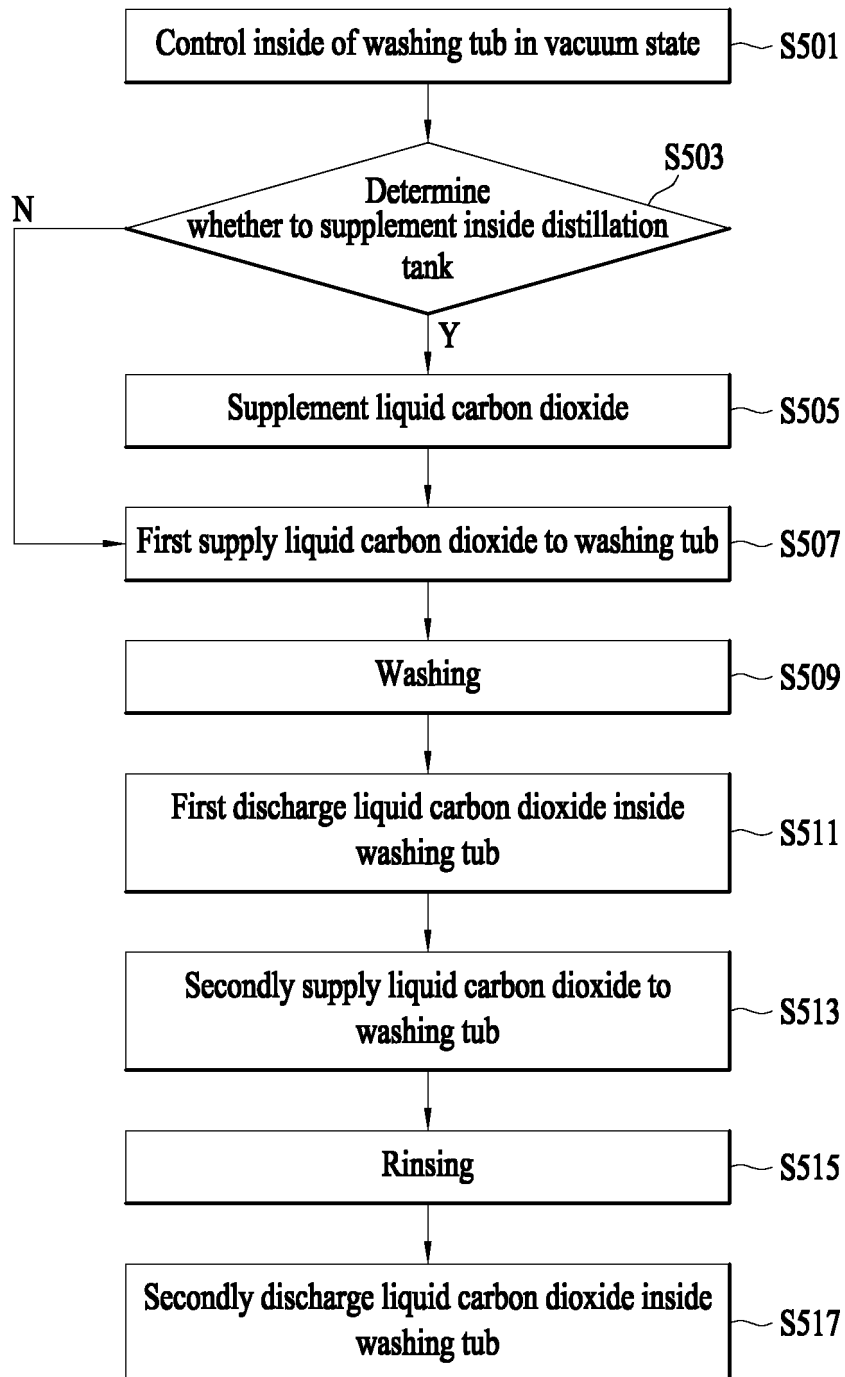
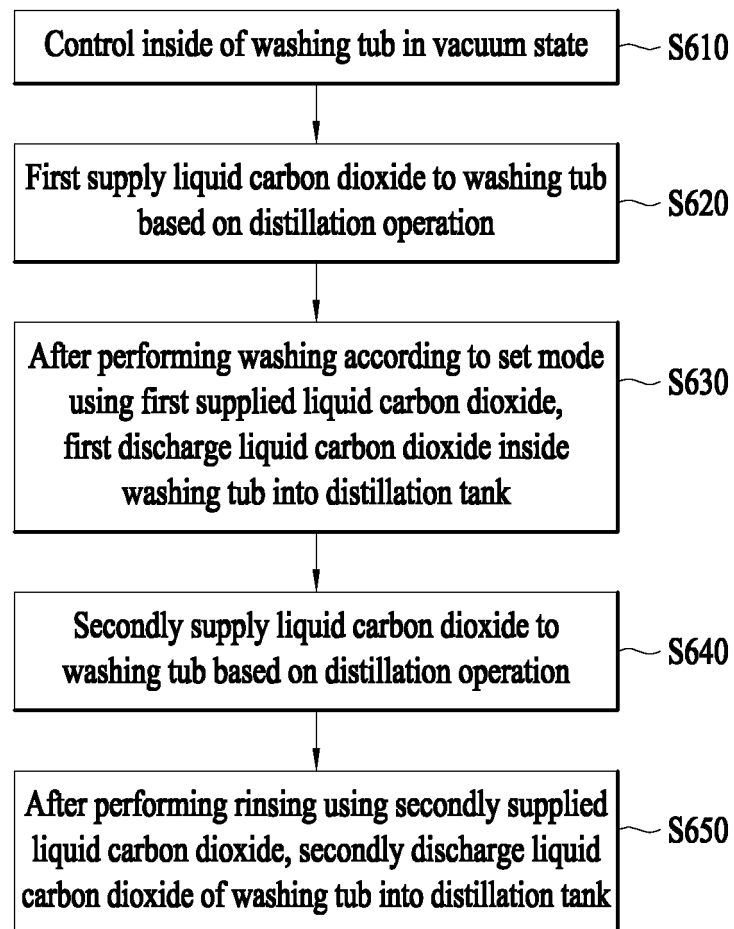


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2022/017020

A. CLASSIFICATION OF SUBJECT MATTER

D06F 43/00(2006.01)i; D06F 43/08(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D06F 43/00(2006.01); B01D 17/038(2006.01); B01D 3/00(2006.01); B08B 3/08(2006.01); B08B 7/00(2006.01);
D06F 43/08(2006.01); H01L 21/304(2006.01)

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

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

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

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

eKOMPASS (KIPO internal) & keywords: 액체 이산화탄소(liquid carbon dioxide), 압축기(compressor), 응축기(condenser),
드라이 클리닝(dry cleaning), 증류(distillation)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2009-262016 A (SHARP CORP.) 12 November 2009 (2009-11-12) See paragraphs [0037]-[0067], claim 3 and figures 1-3.	1-11
Y	KR 10-2012-0115533 A (CO2NEXUS, INC.) 18 October 2012 (2012-10-18) See paragraphs [0010] and [0047]-[0056] and figure 1.	1-11
A	JP 2005-313060 A (MITSUBISHI MATERIALS CORP.) 10 November 2005 (2005-11-10) See paragraphs [0016]-[0028] and figures 1-2.	1-11
A	JP 2009-285602 A (SHARP CORP.) 10 December 2009 (2009-12-10) See paragraphs [0037]-[0081] and figure 1.	1-11
A	US 2003-0182731 A1 (WORM, Steve Lee et al.) 02 October 2003 (2003-10-02) See paragraphs [0039]-[0061] and figure 1.	1-11

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

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 13 February 2023	Date of mailing of the international search report 13 February 2023
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon Building 4, 189 Cheongsaro, Seo-gu, Daejeon 35208 Facsimile No. +82-42-481-8578	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2022/017020

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2009-262016 A	12 November 2009	None	
KR 10-2012-0115533 A	18 October 2012	BR 112012016548 A2	19 April 2016
		CN 102753747 A	24 October 2012
		CN 102753747 B	08 April 2015
		EP 2521812 A1	14 November 2012
		EP 2521812 B1	21 May 2014
		ES 2491665 T3	08 September 2014
		JP 2013-516270 A	13 May 2013
		JP 5850856 B2	03 February 2016
		US 2012-0304401 A1	06 December 2012
		US 2015-0247277 A1	03 September 2015
		US 8984916 B2	24 March 2015
		WO 2011-084050 A1	14 July 2011
JP 2005-313060 A	10 November 2005	None	
JP 2009-285602 A	10 December 2009	None	
US 2003-0182731 A1	02 October 2003	AU 2000-75941 A1	30 April 2001
		AU 7594100 A	30 April 2001
		US 2007-0017557 A1	25 January 2007
		US 6314601 B1	13 November 2001
		US 6589592 B1	08 July 2003
		US 7114508 B2	03 October 2006
		WO 01-23657 A1	05 April 2001

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- KR 100622260 [0006]
- JP 4394293 B [0007]