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(54) **CLEANING APPLIANCE**

(57) Provided is a washing appliance (1), including: a tub (100) having an air inlet (101) and an air outlet (102); an air duct assembly (200) including a first air duct (210) and a second air duct (220); and a heat pump system (300). An evaporator (340) is at least partially disposed in the first air duct (210), and an air-cooled condenser (330) is at least partially disposed in the first air duct (210) and located downstream of the second air duct (220) in a gas flow direction.

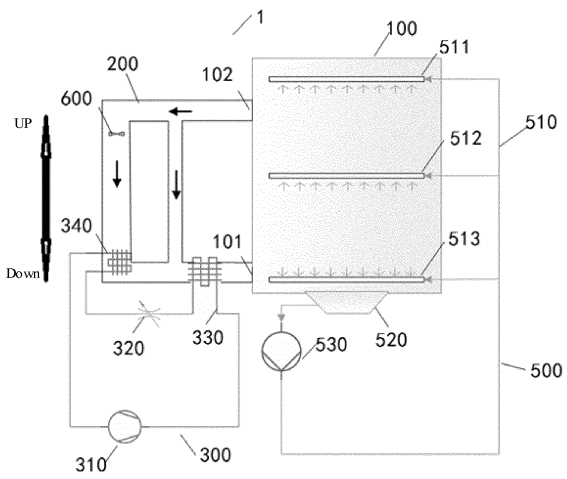

FIG. 1

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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is based on and claims priority to Chinese Patent Application No. 202020945940.9, filed on May 28, 2020, the entire content of which is incorporated herein by reference.

FIELD

[0002] The present disclosure relates to the field of electrical appliance manufacturing technologies, and more particularly, to a washing appliance.

BACKGROUND

[0003] The washing appliance in the related art has a drying mode for drying tableware. In the drying mode, a hot and humid airflow in a tub flows out from an outlet, passes through and is cooled down by an evaporator, and flows back to the tub after being reheated by an air-cooled condenser, to dry the tableware. However, since a fan, the evaporator, and the air-cooled condenser are connected in series, the hot and humid airflow flowing out of the tub is cooled down by the evaporator and heated by the air-cooled condenser successively, which increases power consumption of the washing appliance.

SUMMARY

[0004] The present disclosure aims to solve at least one of the technical problems in the related art. To this end, the present disclosure provides a washing appliance, which has advantages of good drying effect on tableware, safe and reliable drying process, and low energy consumption.

[0005] To achieve the above objects, according to an embodiment of the present disclosure, a washing appliance is provided. The washing appliance comprises: a tub comprising an air inlet and an air outlet; an air duct assembly comprising a first air duct, the first air duct comprising an inlet in communication with the air outlet and an outlet in communication with the air inlet; and a heat pump system comprising a compressor, a throttling device, an air-cooled condenser, and an evaporator. The evaporator is at least partially disposed in the first air duct. The air duct assembly further comprises a second air duct. The second air duct has an inlet in communication with the air outlet and an outlet in communication with the first air duct. The air-cooled condenser is at least partially disposed in the first air duct and located downstream of the second air duct in a gas flow direction.

[0006] The washing appliance according to the embodiment of the present disclosure has advantages of good drying effect on tableware, safe and reliable drying process, low energy consumption, etc.

[0007] In addition, the washing appliance according to the above embodiment of the present disclosure can further have the following additional technical features.

[0008] According to some embodiments of the present disclosure, the first air duct comprises a main air duct, an inflow segment, and an outflow segment. Two ends of the main air duct are in communication with the inflow segment and the outflow segment respectively. The outlet of the second air duct is in communication with the outflow segment; and the air-cooled condenser is at least partially disposed in the outflow segment.

[0009] According to some embodiments of the present disclosure, the inlet of the second air duct is in communication with the inflow segment to allow the inlet of the second air duct to be in communication with the air outlet via the inflow segment; or the inflow segment and the inlet of the second air duct are respectively in direct communication with the air outlet.

[0010] According to some embodiments of the present disclosure, a flow cross-section area of the main air duct is greater than a flow cross-section area of the second air duct.

[0011] According to some embodiments of the present disclosure, the air duct assembly comprises a first vent and a second vent, the first vent and the second vent being respectively in communication with an ambient environment. The washing appliance further comprises a first switching member and a second switching member, the first switching member controls the main air duct to be or not to be in communication with the first vent or the inflow segment, and the second switching member is configured to control the main air duct to be or not to be in communication with the second vent or the outflow segment.

[0012] According to some embodiments of the present disclosure, the washing appliance further comprises a washing system. The heat pump system further comprises a water-cooled condenser heating a washing liquid in the washing system. The washing appliance has a drying state and a heating state. In the drying state of the washing appliance, the first switching member communicates the main air duct with the inflow segment and shuts the first vent, and the second switching member communicates the main air duct with the outflow segment and shuts the second vent. In the heating state of the washing appliance, the first switching member communicates the main air duct with the first vent and blocks the main air duct from the inflow segment, and the second switching member communicates the main air duct with the second vent and blocks the main air duct from the outflow segment.

[0013] According to some embodiments of the present disclosure, the washing appliance further comprises a washing system. The heat pump system further comprises a water-cooled condenser heating a washing liquid in the washing system.

[0014] According to some embodiments of the present disclosure, the compressor, the throttling device, the air-cooled condenser, the water-cooled condenser, and the

evaporator are connected in series; and the water-cooled condenser is located upstream of the air-cooled condenser in a flow direction of a heat exchange medium in the heat pump system.

[0015] According to some embodiments of the present disclosure, the heat pump system comprises a first branch, a second branch, and a third branch, and two ends of the second branch and two ends of the third branch are respectively in communication with the first branch; the compressor, the evaporator, and the throttling device are connected in the first branch; the water-cooled condenser and a first on-off valve are connected in the second branch; and the air-cooled condenser and a second on-off valve are connected in the third branch.

[0016] According to some embodiments of the present disclosure, the throttling device comprises a first expansion valve and a second expansion valve; the heat pump system comprises a first branch, a second branch, and a third branch, and two ends of second branch and two ends of the third branch are respectively in communication with the first branch; the compressor and the evaporator are connected in the first branch; the water-cooled condenser and the first expansion valve are connected in the second branch; and the air-cooled condenser and the second expansion valve are connected in the third branch.

[0017] Additional aspects and advantages of the present disclosure will be provided at least in part in the following description, or will become apparent at least in part from the following description, or can be learned from practicing of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The above and/or additional aspects and advantages of the present disclosure will become more apparent and more understandable from the following description of embodiments in conjunction with the accompanying drawings.

FIG. 1 is a schematic diagram showing a structure of a washing appliance according to some embodiments of the present disclosure.

FIG. 2 is a schematic diagram showing a structure of a washing appliance according to some other embodiments of the present disclosure.

FIG. 3 is a schematic diagram showing a structure of a washing appliance according to some other embodiments of the present disclosure.

FIG. 4 is a schematic diagram showing a structure of a washing appliance according to some other embodiments of the present disclosure.

FIG. 5 is a schematic diagram showing a structure of a washing appliance according to some other embodiments of the present disclosure.

[0019] Reference numerals of the accompanying drawings: washing appliance 1, tub 100, air inlet 101, air outlet 102, third vent 103, air duct assembly 200, first air duct 210, main air duct 211, inflow segment 212, outflow segment 213, second air duct 220, first vent 230, second vent 240, heat pump system 300, compressor 310, throttling device 320, first expansion valve 321, second expansion valve 322, first on-off valve 323, second on-off valve 324, air-cooled condenser 330, evaporator 340, water-cooled condenser 350, first branch 361, second branch 362, third branch 363, first switching member 410, second switching member 420, washing system 500, spray arm assembly 510, top spray arm 511, middle spray arm 512, lower spray arm 513, water collection member 520, washing pump 530, first fan 600.

DETAILED DESCRIPTION

[0020] The embodiments of the present disclosure will be described in detail below with reference to examples thereof as illustrated in the accompanying drawings, throughout which same or similar elements, or elements having same or similar functions, are denoted by same or similar reference numerals. The embodiments described below with reference to the drawings are illustrative only, and are intended to explain, rather than limiting, the present disclosure.

[0021] A washing appliance 1 according to embodiments of the present disclosure is described below with reference to the accompanying drawings.

[0022] As illustrated in FIG. 1 to FIG. 5, the washing appliance 1 according to an embodiment of the present disclosure comprises a tub 100, an air duct assembly 200, and a heat pump system 300.

[0023] The tub 100 has an air inlet 101 and an air outlet 102. The air duct assembly 200 comprises a first air duct 210. The first air duct 210 has an inlet in communication with the air outlet 102 and an outlet in communication with the air inlet 101. The heat pump system 300 comprises a compressor 310, a throttling device 320, an air-cooled condenser 330, and an evaporator 340. The evaporator 340 is at least partially disposed in the first air duct 210 to facilitate heat exchange between the evaporator 340 and gas flowing through the evaporator 340. The air duct assembly 200 further comprises a second air duct 220. The second air duct 220 has an inlet in communication with the air outlet 102 and an outlet in communication with the first air duct 210. The air-cooled condenser 330 is at least partially disposed in the first air duct 210 and located downstream of the second air duct 220 in a gas flow direction to facilitate heat exchange between the air-cooled condenser 330 and gas flowing through the air-cooled condenser 330.

[0024] Specifically, in the gas flow direction, a position at which the outlet of the second air duct 220 is communicated with the first air duct 210 is located upstream of the air-cooled condenser 330 and downstream of the evaporator 340. That is, the gas in the first air duct 210, after being subject to dehumidification of the evaporator 340, may merge with the gas in the second air duct 220.

Both the gas in the first air duct 210 and the gas in the second air duct 220 are heated by the air-cooled condenser 330 before flowing into the tub 100 through the air inlet 101.

[0025] It should be understood that the expression "the air-cooled condenser 330 is located downstream of the second air duct 220 in the gas flow direction" means that the gas flowing out of the tub 100 flows through the second air duct 220 before flowing through the air-cooled condenser 330. The expression "a position at which the outlet of the second air duct 220 is communicated with the first air duct 210 is located upstream of the air-cooled condenser 330 in the gas flow direction" means that the gas flowing out of the tub 100 flows through the position at which the outlet of the second air duct 220 is communicated with the first air duct 210 before flowing through the air-cooled condenser 330.

[0026] According to the washing appliance 1 of the embodiments of the present disclosure, the heat pump system 300 is provided, the heat pump system 300 can be used to absorb heat from an external environment to heat the gas flowing in the air duct assembly 200 or a washing liquid in the washing appliance 1. That is, low-grade energy is converted into high-grade heat energy, and the high-grade heat energy is then released into the gas or the washing liquid, which achieves a purpose of efficient and low-energy heating. With the compressor 310, the throttling device 320, the air-cooled condenser 330, and the evaporator 340 in the heat pump system 200, a refrigerant in the heat pump system 300 is subject to processes of compression, condensation and heat release, throttling expansion, evaporation and heat absorption, low-grade energy is converted into high-grade heat energy, and the high-grade heat energy is then released into the gas in the air duct assembly 200 or the washing liquid in the washing appliance 1, to achieve the purpose of efficient and low-energy heating. Compared with an electric heating manner, such a manner has remarkable energy saving performance, and can significantly reduce energy consumption of the washing appliance 1.

[0027] In addition, by setting the first air duct 210 and the second air duct 220 in the air duct assembly 200, the highly humid gas flowing out of the tub 100 can flow into the first air duct 210 and the second air duct 220 through the air outlet 102. When a part of the highly humid gas flows through the evaporator 340 in the first air duct 210, water vapor in the highly humid gas is condensed into a liquid state to reduce the humidity of the gas, which achieves drying and dehumidification of the gas. In this case, a temperature of the gas decreases accordingly, and the highly humid gas becomes dry and cold air. Another part of the highly humid gas can flow directly through the second air duct 220 and merge with the processed dry and cold air in the first air duct 210. The mixed gas flows through and is heated by the air-cooled condenser 330 and flows back to the tub 100 via the air inlet 101 to facilitate drying of tableware in the tub 100.

[0028] By setting the first air duct 210 and the second air duct 220, the humidity and temperature of the highly humid gas flowing out of the tub 100 can be adjusted to allow the gas flowing back to the tub 100 to have a suitable temperature range and humidity range, which facilitates smooth drying of tableware inside the tub 100 by the gas and improves the drying performance of the washing appliance 1. In addition, not only an unnecessary increase in power consumption of the washing appliance 1 caused by drying and cooling all the highly humid gas flowing out of the tub 100 can be avoided, but also an internal circulation of the gas between the air duct assembly 200 and the tub 100 can be ensured in a process of drying the tableware, which prevents impurities such as dust in the external environment from entering the tub 100 and contaminating the tub 100 and the tableware inside the tub 100, and improves safety and reliability of the drying of the tableware.

[0029] That is, a part of the gas flowing out of the tub 100 passes through the evaporator 340 and another part does not pass through the evaporator 340. The gas of the two parts is mixed before flowing through the air-cooled condenser 330 and enters the tub 100 via the air inlet 101. In this way, a total amount of the part of gas flowing through the evaporator 340 is controlled, which facilitates control of the humidity and temperature of the gas flowing back to the tub 100, and improves a dehumidification capacity of the gas per unit.

[0030] The washing appliance 1 according to the embodiments of the present disclosure has advantages of good drying effect on tableware, safe and reliable drying process, and low energy consumption.

[0031] The washing appliance 1 according to specific embodiments of the present disclosure is described below with reference to the accompanying drawings.

[0032] In some specific embodiments of the present disclosure, as illustrated in FIG. 1 to FIG. 5, the washing appliance 1 according to the embodiments of the present disclosure comprises the tub 100, the air duct assembly 200, and the heat pump system 300.

[0033] Specifically, as illustrated in FIG. 3, the first air duct 210 comprises a main air duct 211, an inflow segment 212, and an outflow segment 213. The main air duct 211 has two ends and the two ends are in communication with the inflow segment 212 and the outflow segment 213 respectively. The outlet of the second air duct 220 is in communication with the outflow segment 213. The air-cooled condenser 330 is at least partially disposed in the outflow segment 213. In this way, it is not only convenient for the first air duct 210 to be communicated with the tub 100 via the inlet and the outlet to form a circulation loop, but also convenient for the gas in the first air duct 210 and the gas in the second air duct 220 to merge with each other and then flow through the air-cooled condenser 330 to be heated.

[0034] Specifically, the first air duct 210 comprises the main air duct 211, the inflow segment 212, and the outflow segment 213. The main air duct 211 has the two ends in communication with the inflow segment 212 and

the outflow segment 213 respectively. The inlet of the first air duct 210 is formed on the inflow segment 212. The inflow segment 212 is in communication with the air outlet 102 through the inlet of the first air duct 210. The outlet of the first air duct 210 is formed on the outflow segment 213. The outflow segment 213 is in communication with the air inlet 101 through the outlet of the first air duct 210. The evaporator 340 is disposed in the main air duct 211 or the outflow segment 213. The inlet of the second air duct 220 is in communication with the first air duct 210. The outlet of the second air duct 220 is in communication with the outflow segment 213. The air-cooled condenser 330 is at least partially disposed in the outflow segment 213. In the gas flow direction, a connection of the second air duct 220 and the outflow segment 213 is located upstream of the air-cooled condenser 330, and a connection of the second air duct 220 and the outflow segment 213 is located downstream of the evaporator 340. That is, the gas in the first air duct 210 flows through the air-cooled condenser 330 after flowing through the evaporator 340, and then flows back to the tub 100. The gas in the second air duct 220 flows back to the tub 100 after flowing through the air-cooled condenser 330.

[0035] In some specific embodiments, as illustrated in FIG. 3, the inlet of the second air duct 220 is in communication with the inflow segment 212 to allow the inlet of the second air duct 220 to be in communication with the air outlet 102 via the inflow segment 212. In this way, the highly humid gas in the tub 100 can be guided, via the inflow segment 212, to the main air duct 211 of the first air duct 210 and the second air duct 220, in such a manner that the first air duct 210 and the second air duct 220 are in communication with the tub 100 to form a circulation loop.

[0036] In some other specific embodiments, the inflow segment 212 and the inlet of the second air duct 220 are respectively in direct communication with the air outlet 102. In this way, the highly humid gas in the tub 100 can flow into each of the first air duct 210 and the second air duct 220 separately to prevent normal flow of the gas from being affected by mutual interference of the gas in the first air duct 210 and the gas in the second air duct 220.

[0037] In some embodiments, a flow cross-section area of the main air duct 211 is greater than a flow cross-section area of the second air duct 220. In this way, it can be ensured that most of the highly humid gas flowing out of the tub 100 can pass through the evaporator 340 for drying and dehumidification, which facilitates a reduction of humidity of the gas and improves the drying performance of the gas on the tableware.

[0038] In some embodiments, as illustrated in FIG. 3, the air duct assembly 200 comprises a first vent 230 and a second vent 240. The first vent 230 and the second vent 240 are respectively in communication with an ambient environment. Here, the washing appliance 1 further comprises a first switching member 410 and a second switching member 420. The first switching member 410 is configured to control the main air duct 211 to be or not to be in communication with the first vent 230 or the inflow segment 212. The second switching member 420 is configured to control the main air duct 211 to be or not to be in communication with the second vent 240 or the outflow segment 213. In this way, the main air duct 211 of the first air duct 210 can be in communication with the external environment or the tub 100 to form a circulation loop as desired, which is convenient to enhance circulation flexibility of the gas circulating in the first air duct 210 and improve functionality and applicability of the air duct assembly 200.

[0039] In some embodiments, the first vent 230 and the second vent 240 may be disposed at positions of a side panel, a skirting board, or a housing of the washing appliance 1 that are not obscured by a cabinet or an external object. The air inlet 101 and the air outlet 102 may be disposed on positions of a side wall surface or a top surface of the tub 100 that are easily accessible to the tub 100.

[0040] In some embodiments, as illustrated in FIG. 3, the washing appliance 1 further comprises a washing system 500. The heat pump system 300 further comprises a water-cooled condenser 350 configured to heat a washing liquid in the washing system 500. The washing appliance 1 has a drying state and a heating state. In the drying state of the washing appliance 1, the first switching member 410 communicates the main air duct 211 with the inflow segment 212 and shuts the first vent 230, and the second switching member 420 communicates the main air duct 211 with the outflow segment 213 and shuts the second vent 240. In the heating state of the washing appliance 1, the first switching member 410 communicates the main air duct 211 with the first vent 230 and blocks the main air duct 211 from the inflow segment 212, and the second switching member 420 communicates the main air duct 211 with the second vent 240 and blocks the main air duct 211 from the outflow segment 213. In this way, when the washing appliance 1 is in the drying state, the air duct assembly 200 can form an inner circulation with the tub 100 to facilitate drying and dehumidification of the highly humid gas flowing out of the tub 100, which can not only improve the drying performance of the washing appliance 1, but also prevent the dust in the external environment from entering the tub 100 and causing pollution to the tub 100 and the tableware. When the washing appliance 1 is in the heating state, the air duct assembly 200 can be in communication with the external environment to facilitate the evaporator 340 to collect heat from air in the external environment, which improves the heating efficiency of the heat pump system 300, and enhances washing performance of the washing appliance 1.

[0041] For example, the evaporator 340 is disposed in the main air duct 211. When the washing appliance 1 is in the heating state and needs to heat the washing liquid, two ends of the main air duct 211 can be in communication with the external environment through the first vent

230 and the second vent 240 respectively, by means of the first switching member 410 and the second switching member 420, to allow the air in the external environment to continuously flow through the evaporator 340, which facilitates the evaporator 340 to absorb the heat of the air in the external environment. When the washing appliance 1 is in the drying state and needs to dry the tableware inside the tub 100, the two ends of the main air duct 211 can be in communication with the inflow segment 212 and the outflow segment 213 respectively, by means of the first switching member 410 and the second switching member 420, to form an inner circulation loop between the air duct assembly 200 and the tub 100, in such a manner that drying and dehumidification can be performed, using the evaporator 340, on the highly humid gas flowing out of the tub 100, and the dried and dehumidified gas flows back to the tub 100 to dry the tableware.

[0042] In some embodiments,, as illustrated in FIG. 3, the washing appliance 1 further comprises the washing system 500. The heat pump system 300 comprises the water-cooled condenser 350 configured to heat the washing liquid in the washing system 500. In this way, the water-cooled condenser 350 can be used to heat the washing liquid in the washing system 500. The high-temperature washing liquid washes away contaminants on the tableware and brings heat to the tableware to allow the washing appliance 1 to obtain a high abluent rate and a dry rate in a short washing period.

[0043] In some specific embodiments, as illustrated in FIG. 2, the compressor 310, the throttling device 320, the air-cooled condenser 330, the water-cooled condenser 350, and the evaporator 340 are connected in series. The water-cooled condenser 350 is located upstream of the air-cooled condenser 330 in a flow direction of a heat exchange medium in the heat pump system 300. In this way, after absorbing heat, the heat exchange medium flows through the water-cooled condenser 350 and then flows through the air-cooled condenser 330, which can ensure that the heat pump system 300 preferentially heats the washing liquid in the washing system 500 using the water-cooled condenser 350. Therefore, the washing performance of the washing appliance 1 is guaranteed.

[0044] It should be understood that the expression "the water-cooled condenser 350 is located upstream of the air-cooled condenser 330 in a flow direction of a heat exchange medium in the heat pump system 300" means that after absorbing heat through the evaporator 340, the heat exchange medium flows through the water-cooled condenser 350 and then flows through the air-cooled condenser 330.

[0045] Specifically, the evaporator 340, the compressor 310, the water-cooled condenser 350, the air-cooled condenser 330, and the throttling device 320 are connected sequentially in series to form a circulation loop. The throttling device 320 may be an expansion valve. Further, the throttling device 320 may be an electronic expansion valve.

[0046] In some other specific embodiments, as illustrated in FIG. 3, the heat pump system 300 comprises a first branch 361, a second branch 362, and a third branch 363. Two ends of the second branch 362 and two ends of the third branch 363 are respectively in communication with the first branch 361. The compressor 310, the evaporator 340, and the throttling device 320 are connected in the first branch 361. The water-cooled condenser 350 and a first on-off valve 323 are connected in the second branch 362. The air-cooled condenser 330 and a second on-off valve 324 are connected in the third branch 363. In this way, when the heat pump system 300 heats the washing liquid, the first on-off valve 323 can be opened and the second on-off valve 324 can be closed. In this case, no heat exchange medium flows in the third branch 363, which can reduce flowing resistance in pipelines of the heat pump system 300 and reduce energy consumption of the heat pump system 300 when heating the washing liquid. At a stage of drying or storing the tableware, the second on-off valve 324 can be opened and the first on-off valve 323 can be closed. In this case, no heat exchange medium flows in the second branch 362, which can reduce the flowing resistance in the pipelines of the heat pump system 300, and reduce energy consumption of the heat pump system 300 at the stage of drying or storing the tableware. Therefore, an energy efficiency of the washing appliance 1 can be increased to reduce the energy consumption.

[0047] In some other specific embodiments, as illustrated in FIG. 4, the throttling device 320 comprises a first expansion valve 321 and a second expansion valve 322. The heat pump system 300 comprises a first branch 361, a second branch 362, and a third branch 363. Two ends of the second branch 362 and two ends of the third branch 363 are respectively in communication with the first branch 361. The compressor 310 and the evaporator 340 are connected in the first branch 361. The water-cooled condenser 350 and the first expansion valve 321 are connected in the second branch 362. The air-cooled condenser 330 and the second expansion valve 322 are connected in the third branch 363. In this way, a dual throttling device 320 system can be formed using the first expansion valve 321 and the second expansion valve 322. When the heat pump system 300 heats the washing liquid, the first expansion valve 321 enters a normal operation state, and the second expansion valve 322 is closed completely or in a state with a minimum opening. In this case, no heat exchange medium flows in the third branch 363, which can reduce the flowing resistance in the pipelines of the heat pump system 300 and reduce energy consumption of the heat pump system 300 when heating the washing liquid. At a stage of drying or storing the tableware, the second expansion valve 322 enters a normal operation state, and the first expansion valve 321 is closed completely or in a state with a minimum opening. In this case, no heat exchange medium flows in the second branch 362, which can reduce the flowing resistance

in the pipelines of the heat pump system 300, and reduce energy consumption of the heat pump system 300 at the stage of drying or storing the tableware. Therefore, an energy efficiency of the washing appliance 1 can be increased to reduce the energy consumption.

[0048] Specifically, as illustrated in FIG. 1, the washing system 500 comprises a spray arm assembly 510, a water collection member 520, and a washing pump 530. The spray arm assembly 510 is disposed in the tub 100. The water collection member 520 is disposed in the tub 100 and located below the spray arm assembly 510 (an up-down direction of the tub 100 is as illustrated in FIG. 1). The washing pump 530 is in communication with the spray arm assembly 510 and the water collection member 520 respectively. In this way, the washing pump 530 can be used to deliver the washing liquid in the washing system 500 to the spray arm assembly 510. The spray arm assembly 510 can be used to continuously impose jet washing on the tableware to achieve a purpose of cleaning the tableware. The water collection member 520 can collect the washing liquid in the tub 100 to achieve circulation and flowing of the washing liquid in the washing system 500.

[0049] It should be understood that the up-down direction in FIG. 1 is only to facilitate description of upper and lower positions of an internal structure of the tub 100, rather than limit an actual structure of the washing appliance 1.

[0050] More specifically, as illustrated in FIG. 3, the spray arm assembly 510 comprises a top spray arm 511, a middle spray arm 512, and a lower spray arm 513. The water collection member 520 is formed as a water-cup collection tank located in a lower part of the tub 100.

[0051] In some embodiments,, as illustrated in FIG. 3, a first fan 600 is provided in the first air duct 210. The first fan 600 is located upstream of the evaporator 340 in the gas flow direction. In this way, under the action of the first fan 600, the gas can flow through the evaporator 340 smoothly to increase a ventilation quantity in the air duct assembly 200 and improve a heat exchange efficiency of the heat pump system 300.

[0052] Further, the first fan 600 is disposed in the main air duct 211 of the first air duct 210.

[0053] In some embodiments,, as illustrated in FIG. 3, the tub 100 has a third vent 103. The third vent 103 is in communication with the external environment and located at a top end of the tub 100. A movable seal is disposed at the third vent 103. When an internal pressure of the tub 100 is greater than a predetermined pressure, the seal is pushed away to expose the third vent 103, in which case the third vent 103 is in communication with the tub 100, and the gas inside the tub 100 can be discharged to the external environment via the third vent 103. When the internal pressure of the tub 100 is smaller than or equal to the predetermined pressure, the seal seals the third vent 103 to form a sealed space inside the tub 100.

[0054] In some embodiments, when the washing appliance 1 is in a state for heating the washing liquid, the compressor 310 in the heat pump system 300 operates to pump the high-temperature and high-pressure heat exchange medium to the water-cooled condenser 350 to heat the washing liquid in the washing system 500. The heat exchange medium flows out of the water-cooled condenser 350 after exchanging heat with the washing liquid, and then flows into the air-cooled condenser 330. After being throttled by the throttling device 320, the heat exchange medium becomes a low-temperature and low-pressure heat exchange medium which then flows into the evaporator 340. The heat exchange medium exchanges heat with the gas in the evaporator 340, and then flows back to the compressor 310 to complete a heating cycle of the whole heat pump system 300.

[0055] In this mode, the washing pump 530 operates to pump the washing liquid from the water collection member 520 to the water-cooled condenser 350 in the heat pump system 300 to heat the washing liquid, and then supplies the heated washing liquid to the spray arm assembly 510 to wash the tableware.

[0056] In this mode, the first fan 600 is activated, the first switching member 410 communicates the main air duct 211 with the first vent 230, and the second switching member 420 communicates the main air duct 211 with the second vent 240. Under the action of the first fan 600, the air in the external environment flows from the first vent 230 into the main air duct 211, flows through the evaporator 340, and is then discharged from the second vent 240.

[0057] In some other embodiments, when the washing appliance 1 is in the drying state for drying the tableware, the first fan 600 is activated, and the compressor 310 in the heat pump system 300 is also activated. In this mode, the high-temperature and high-pressure heat exchange medium is pumped by the compressor 310 to the water-cooled condenser 350 to dry internal components of the water-cooled condenser 350 and the washing system 500, and then flows into the air-cooled condenser 330 to circulate and heat the gas in the tub 100. Therefore, faster evaporation and drying of water droplets on the tableware can be realized and a temperature of the tableware per se can be increased.

[0058] Further, the heat exchange medium that has undergone the condensation by the air-cooled condenser 330 is throttled by the throttling device 320 and then flows into the air-cooled evaporator 340. Under the action of the first fan 600, the highly humid gas in the tub 100 flows into the air duct assembly 200 via the air outlet 102. A part of the highly humid gas passes through and is cooled and dehumidified in the air-cooled evaporator 340, and is then mixed with the other part of the highly humid gas that has not passed through the evaporator 340. The mixed gas flows towards the air-cooled condenser 330, and then enters the tub 100 via the air inlet 101 to be mixed with high-temperature and high-humidity gas in the tub 100 or to squeeze out the high-temperature and high-humidity gas from the air outlet 102. The above processes are cycled to achieve humidity reduction of

the gas in the tub 100, improving the drying efficiency and shortening the drying time.

[0059] According to a specific embodiment of the present disclosure, the washing appliance 1 comprises the tub 100, the air duct assembly 200, and the heat pump system 300. The tub 100 has the air inlet 101 and the air outlet 102. The air duct assembly 200 comprises the first air duct 210. The inlet of the first air duct 210 is in communication with the air outlet 102. The outlet of the first air duct 210 is in communication with the air inlet 101. The heat pump system 300 comprises the compressor 310, the throttling device 320, the air-cooled condenser 330, and the evaporator 340. The evaporator 340 is at least partially disposed in the first air duct 210. The air duct assembly 200 further comprises the second air duct 220. The inlet of the second air duct 220 is in communication with the air outlet 102. The outlet of the second air duct 220 is in communication with the first air duct 210. The air-cooled condenser 330 is at least partially disposed in the first air duct 210 and located downstream of the second air duct 220 in the gas flow direction.

[0060] The first air duct 210 comprises the main air duct 211, the inflow segment 212, and the outflow segment 213. The two ends of the main air duct 211 are in communication with the inflow segment 212 and the outflow segment 213 respectively. The outlet of the second air duct 220 is in communication with the outflow segment 213. The air-cooled condenser 330 is at least partially disposed in the outflow segment 213. The inlet of the second air duct 220 is in communication with the inflow segment 212 to allow the inlet of the second air duct 220 to be in communication with the air outlet 102 via the inflow segment 212. The flow cross-section area of the main air duct 211 is greater than the flow cross-section area of the second air duct 220.

[0061] The air duct assembly 200 comprises the first vent 230 and the second vent 240. The first vent 230 and the second vent 240 are respectively in communication with the ambient environment. The washing appliance 1 further comprises the first switching member 410 and the second switching member 420. The first switching member 410 is configured to control the main air duct 211 to be or not to be in communication with the first vent 230 or the inflow segment 212. The second switching member 420 is configured to control the main air duct 211 to be or not to be in communication with the second vent 240 or the outflow segment 213.

[0062] Further, the washing appliance 1 further comprises the washing system 500. The heat pump system 300 further comprises the water-cooled condenser 350 configured to heat the washing liquid in the washing system 500. The washing appliance 1 has the drying state and the heating state. In the drying state of the washing appliance 1, the first switching member 410 communicates the main air duct 211 with the inflow segment 212 and shuts the first vent 230, and the second switching member 420 communicates the main air duct 211 with the outflow segment 213 and shuts the second vent 240. In the heating state of the washing appliance 1, the first switching member 410 communicates the main air duct 211 with the first vent 230 and blocks the main air duct 211 from the inflow segment 212, and the second switching member 420 communicates the main air duct 211 with the second vent 240 and blocks the main air duct 211 from the outflow segment 213.

[0063] The compressor 310, the throttling device 320, the air-cooled condenser 330, the water-cooled condenser 350, and the evaporator 340 are connected in series. The water-cooled condenser 350 is located upstream of the air-cooled condenser 330 in the flow direction of the heat exchange medium in the heat pump system 300.

[0064] In some embodiments, the heat pump system 300 comprises the first branch 361, the second branch 362, and the third branch 363. Two ends of the second branch 362 and two ends of the third branch 363 are respectively in communication with the first branch 361. The compressor 310, the evaporator 340, and the throttling device 320 are connected in the first branch 361. The water-cooled condenser 350 and the first on-off valve 323 are connected in the second branch 362. The air-cooled condenser 330 and the second on-off valve 324 are connected in the third branch 363.

[0065] In some embodiments, the throttling device 320 comprises the first expansion valve 321 and the second expansion valve 322. The heat pump system 300 comprises the first branch 361, the second branch 362, and the third branch 363. Two ends of the second branch 362 and two ends of the third branch 363 are respectively in communication with the first branch 361. The compressor 310 and the evaporator 340 are connected in the first branch 361. The water-cooled condenser 350 and the first expansion valve 321 are connected in the second branch 362. The air-cooled condenser 330 and the second expansion valve 322 are connected in the third branch 363.

[0066] The washing system 500 comprises the spray arm assembly 510, the water collection member 520, and the washing pump 530. The spray arm assembly 510 is disposed in the tub 100. The water collection member 520 is disposed in the tub 100 and located below the spray arm assembly 510. The washing pump 530 is in communication with the spray arm assembly 510 and the water collection member 520 respectively. The spray arm assembly 510 comprises the top spray arm 511, the middle spray arm 512, and the lower spray arm 513. The water collection member 520 is formed as the water-cup collection tank located in the lower part of the tub 100.

[0067] The first fan 600 is provided in the first air duct 210. The first fan 600 is located upstream of the evaporator 340 in the gas flow direction. The first fan 600 is disposed in the main air duct 211 of the first air duct 210.

[0068] The tub 100 has the third vent 103. The third vent 103 is in communication with the external environment and located at the top end of the tub 100. The movable seal is disposed at the third vent 103. When the

internal pressure of the tub 100 is greater than the predetermined pressure, the seal is pushed away to expose the third vent 103, in which case the third vent 103 is in communication with the tub 100, and the gas inside the tub 100 can be discharged to the external environment via the third vent 103. When the internal pressure of the tub 100 is smaller than or equal to the predetermined pressure, the seal seals the third vent 103.

[0069] Other compositions and operations of the washing appliance 1 according to the embodiments of the present disclosure are known to those skilled in the art and are not described in detail here.

[0070] It should be understood that in the description of the present disclosure, the orientation or position relationship indicated by the terms "center", "longitudinal", "transverse", "length", "width", "thickness", "upper", "lower", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", "outer", "clockwise", "counterclockwise", "axial", "radial", "circumferential" etc., is based on the orientation or position relationship shown in the drawings, and is only for the convenience of describing the present disclosure and simplifying the description, rather than indicating or implying that the indicated device or element must have a specific orientation, or be constructed and operated in a specific orientation, and cannot be construed as limiting the present disclosure. In addition, the features defined with "first" and "second" may explicitly or implicitly comprise at least one of the features. In the description of the present disclosure, "plurality" means two or more, unless otherwise specifically defined. In the description of the present disclosure, the first feature "on" or "under" the second feature may mean that the first feature is in direct contact with the second feature, or the first and second features are in indirect contact through another feature between them.

[0071] In the description of the present disclosure, the first feature "above" the second feature may mean that the first feature is directly above or obliquely above the second feature, or simply mean that the level of the first feature is higher than that of the second feature.

[0072] It should be noted that in the description of the present disclosure, terms such as "install", "connect", "connected" and the like should be understood in a broad sense, unless otherwise clearly specified and limited. For example, it may be a fixed connection or a detachable connection or connection as one piece; mechanical connection or electrical connection; direct connection or indirect connection through an intermediate; or internal communication of two components. For those skilled in the art, the specific meaning of the above-mentioned terms in the present disclosure can be understood according to specific circumstances.

[0073] In the description of this specification, descriptions with reference to the terms "an embodiment", "some embodiments", "example embodiments", "examples", "specific examples", or "some examples" etc. mean that specific features, structure, materials, or characteristics described in conjunction with the embodiment or example are comprised in at least one embodiment or example of the present disclosure. In this specification, the schematic representations of the above terms do not necessarily refer to the same embodiment or example. Moreover, the described specific features, structures, materials, or characteristics may be combined in any one or more embodiments or examples in a suitable manner.

[0074] Although embodiments of the present disclosure have been illustrated and described, it is conceivable for those skilled in the art that various changes, modifications, replacements, and variations can be made to these embodiments without departing from the principles and ideas of the present disclosure. The scope of the present disclosure shall be defined by the claims and their equivalents.

Claims

1. A washing appliance, comprising:

a tub comprising an air inlet and an air outlet;
an air duct assembly comprising a first air duct, the first air duct comprising an inlet in communication with the air outlet and an outlet in communication with the air inlet; and
a heat pump system comprising a compressor, a throttling device, an air-cooled condenser, and an evaporator, the evaporator being at least partially disposed in the first air duct, wherein:

the air duct assembly further comprises a second air duct, the second air duct comprising an inlet in communication with the air outlet and an outlet in communication with the first air duct; and
the air-cooled condenser is at least partially disposed in the first air duct and located downstream of the second air duct in a gas flow direction.

2. The washing appliance according to claim 1, wherein:

the first air duct comprises a main air duct, an inflow segment, and an outflow segment, two ends of the main air duct being in communication with the inflow segment and the outflow segment respectively;
the outlet of the second air duct is in communication with the outflow segment; and
the air-cooled condenser is at least partially disposed in the outflow segment.

3. The washing appliance according to claim 2, wherein

the inlet of the second air duct is in communication with the inflow segment to allow the inlet of

the second air duct to be in communication with the air outlet via the inflow segment; or
the inflow segment and the inlet of the second air duct are respectively in direct communication with the air outlet.

4. The washing appliance according to claim 2, wherein a flow cross-section area of the main air duct is greater than a flow cross-section area of the second air duct.

5. The washing appliance according to claim 2, wherein the air duct assembly comprises a first vent and a second vent, the first vent and the second vent being respectively in communication with an ambient environment,
wherein the washing appliance further comprises a first switching member and a second switching member, the first switching member controlling the main air duct to be or not to be in communication with the first vent or with the inflow segment, and the second switching member controlling the main air duct to be or not to be in communication with the second vent or the outflow segment.

6. The washing appliance according to claim 5, further comprising a washing system, wherein:

the heat pump system further comprises a water-cooled condenser heating a washing liquid in the washing system;
the washing appliance has a drying state and a heating state;
in the drying state of the washing appliance, the first switching member communicates the main air duct with the inflow segment and shuts the first vent, and the second switching member communicates the main air duct with the outflow segment and shuts the second vent; and
in the heating state of the washing appliance, the first switching member communicates the main air duct with the first vent and blocks the main air duct from the inflow segment, and the second switching member communicates the main air duct with the second vent and blocks the main air duct from the outflow segment.

7. The washing appliance according to any one of claims 1 to 5, further comprising a washing system, wherein the heat pump system further comprises a water-cooled condenser heating a washing liquid in the washing system.

8. The washing appliance according to claim 7, wherein:

the compressor, the throttling device, the air-cooled condenser, the water-cooled condenser, and the evaporator are connected in series; and
the water-cooled condenser is located upstream of the air-cooled condenser in a flow direction of a heat exchange medium in the heat pump system.

9. The washing appliance according to claim 7, wherein:

the heat pump system comprises a first branch, a second branch, and a third branch, wherein two ends of the second branch and two ends of the third branch being respectively in communication with the first branch;
the compressor, the evaporator, and the throttling device are connected in the first branch;
the water-cooled condenser and a first on-off valve are connected in the second branch; and
the air-cooled condenser and a second on-off valve are connected in the third branch.

10. The washing appliance according to claim 7, wherein:

the throttling device comprises a first expansion valve and a second expansion valve;
the heat pump system comprises a first branch, a second branch, and a third branch, two ends of the second branch and two ends of the third branch being respectively in communication with the first branch;
the compressor and the evaporator are connected in the first branch;
the water-cooled condenser and the first expansion valve are connected in the second branch; and
the air-cooled condenser and the second expansion valve are connected in the third branch.

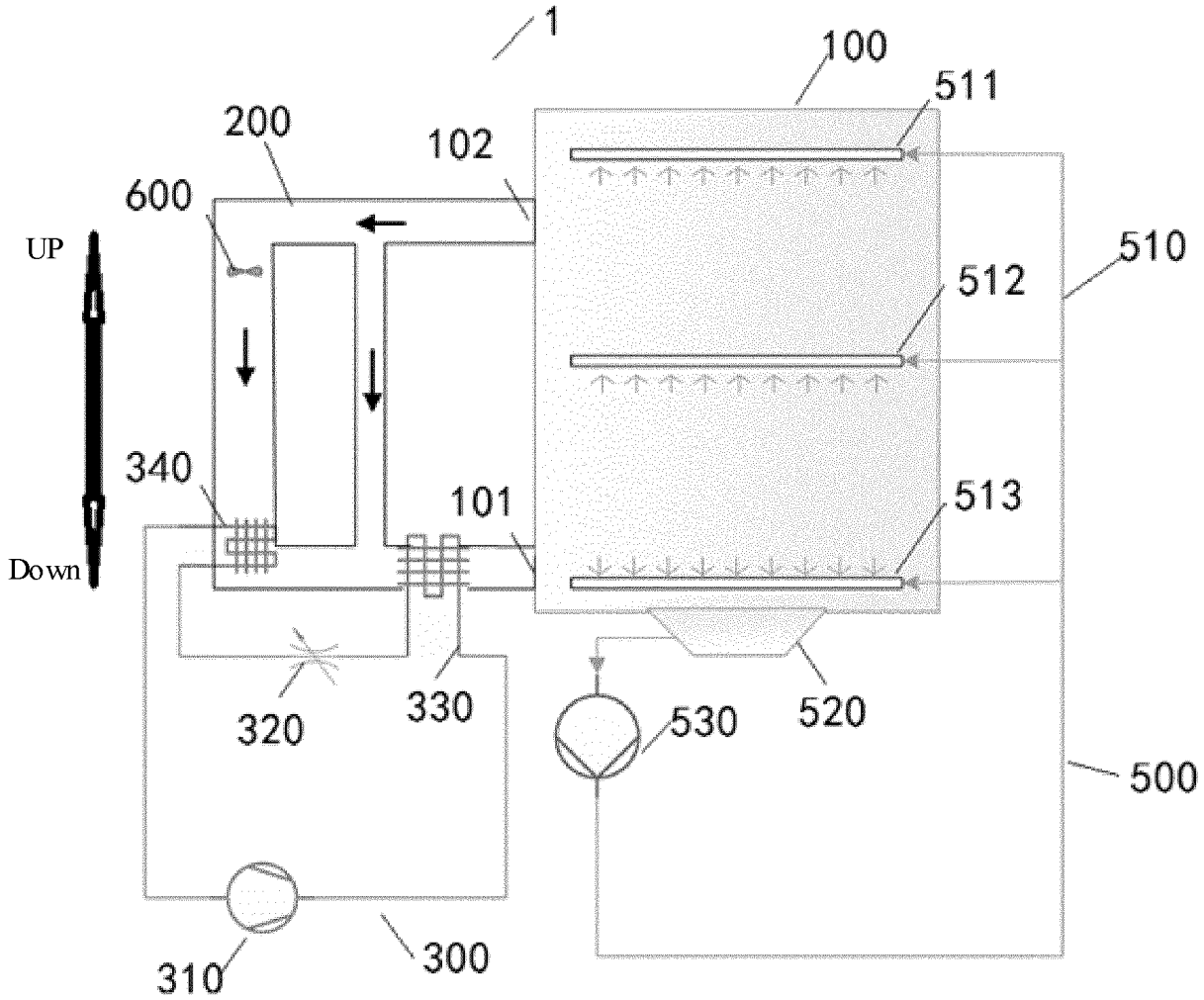
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FIG. 1

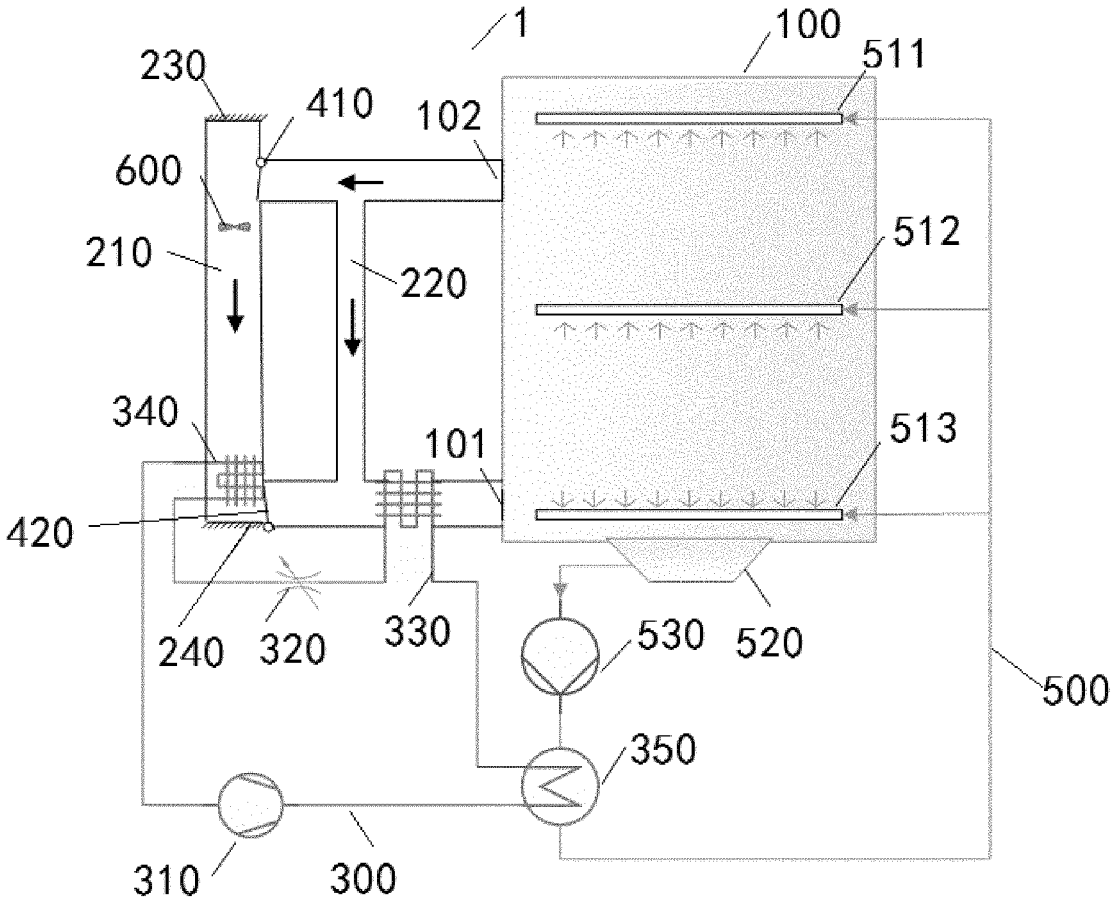
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FIG. 2

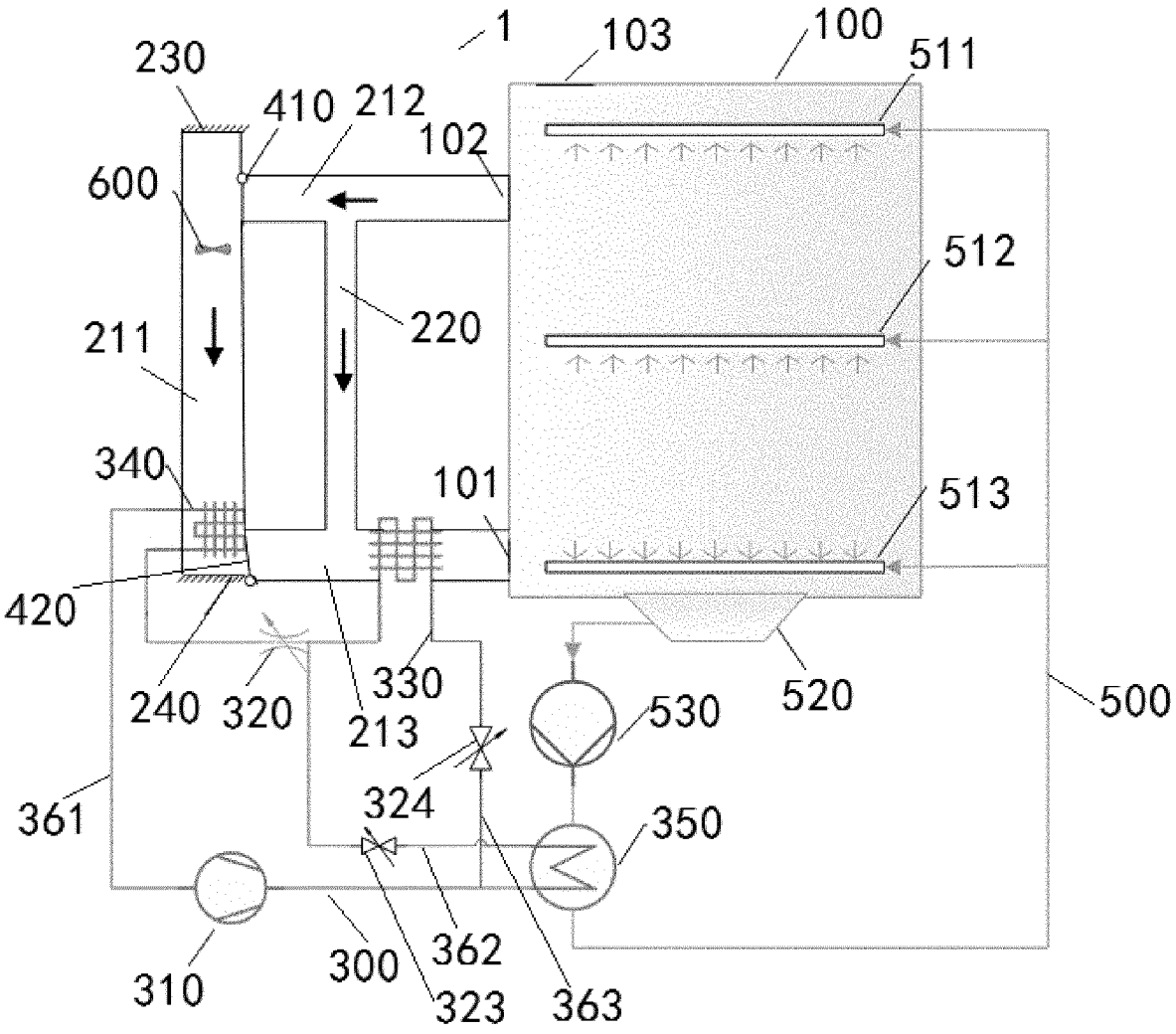
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FIG. 3

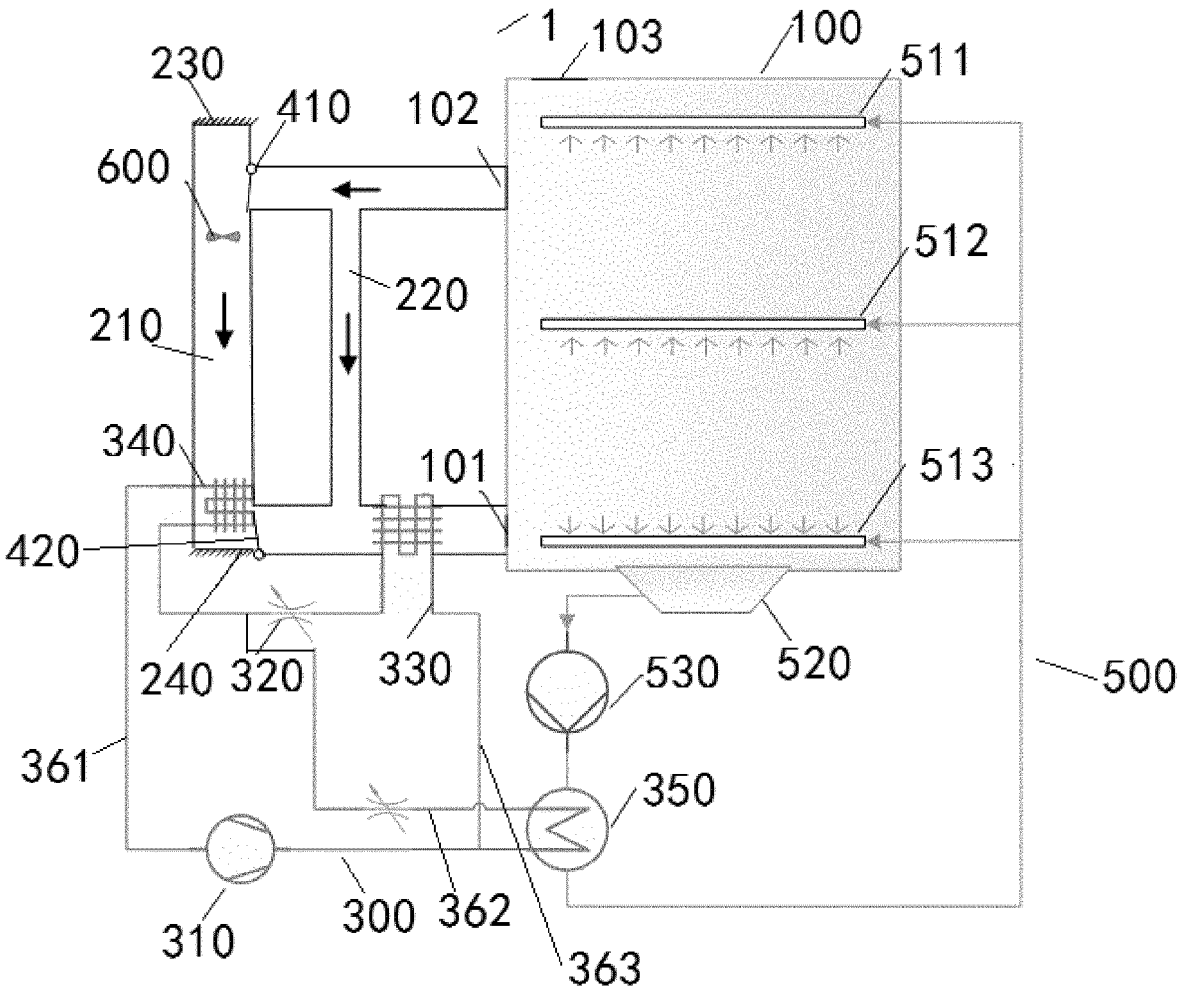
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FIG. 4

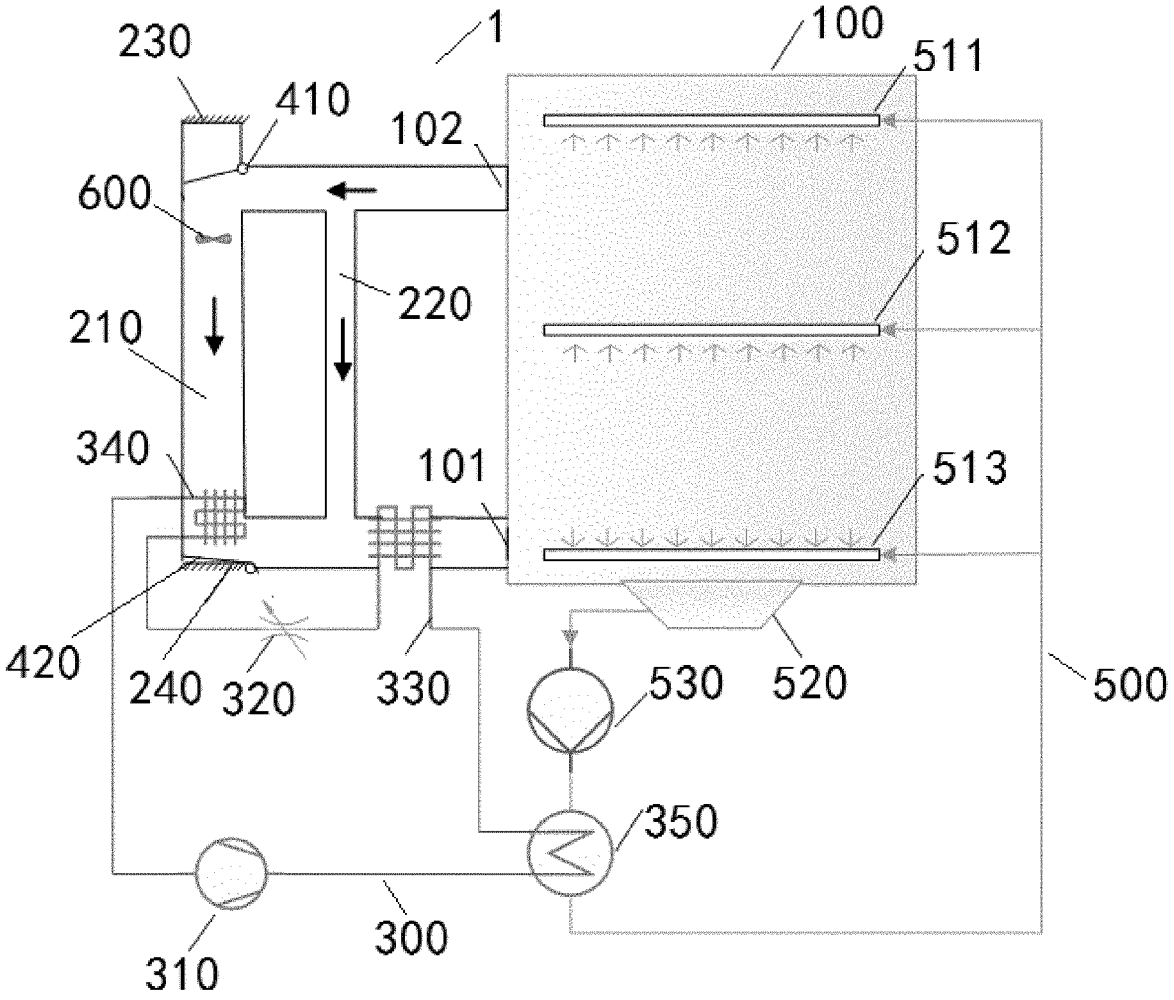
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FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/096869

A. CLASSIFICATION OF SUBJECT MATTER

A47L 15/14(2006.01)i; A47L 15/42(2006.01)i; A47L 15/48(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)

A47L15; D06F

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

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

VEN; CNABS; CNTXT: 洗碗机, 洗涤, 餐具, 热泵, 风道, 冷凝器, 蒸发器, 换热, 切换, 进风, 出风, 支路, 阀, 干燥, 热交换, 第二, dishwasher, dry, switch, air passage, heat, exchange, second, refrigerate, channel, washing, dish, evaporator, condenser, heat pump, inlet, outlet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 106264409 A (FOSHAN SHUNDE MIDEA WASHING APPLIANCES MFG CO., LTD. et al.) 04 January 2017 (2017-01-04) description, paragraphs [0030]-[0073] and figures 1-7	1-10
X	CN 108403062 A (FOSHAN SHUNDE MIDEA WASHING APPLIANCES MFG CO., LTD. et al.) 17 August 2018 (2018-08-17) description, paragraphs [0038]-[0069] and figures 1-13	1-10
PX	CN 212591996 U (FOSHAN SHUNDE MIDEA WASHING APPLIANCES MFG CO., LTD.) 26 February 2021 (2021-02-26) entire document	1-10
A	CN 108888215 A (GUANGDONG MIDEA KITCHEN APPLIANCES MANUFACTURING CO., LTD. et al.) 27 November 2018 (2018-11-27) entire document	1-10
A	CN 209315776 U (FOSHAN SHUNDE MIDEA WASHING APPLIANCES MFG CO., LTD. et al.) 30 August 2019 (2019-08-30) entire document	1-10

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

* Special categories of cited documents:
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"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
"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
"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
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 July 2021	**28 July 2021**

Name and mailing address of the ISA/CN	Authorized officer
China National Intellectual Property Administration (ISA/CN) **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** **China**	
Facsimile No. **(86-10)62019451**	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/096869

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2019208982 A1 (HAIER US APPLIANCE SOLUTIONS, INC.) 11 July 2019 (2019-07-11) entire document	1-10
A	EP 2921098 A1 (SAMSUNG ELECTRONICS CO., LTD.) 23 September 2015 (2015-09-23) entire document	1-10

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2021/096869

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	106264409	A	04 January 2017	CN	106264409	B	18 January 2019
				WO	2018040679	A1	08 March 2018
CN	108403062	A	17 August 2018	CN	208784673	U	26 April 2019
CN	212591996	U	26 February 2021		None		
CN	108888215	A	27 November 2018	CN	209153520	U	26 July 2019
				WO	2019233494	A1	12 December 2019
CN	209315776	U	30 August 2019		None		
US	2019208982	A1	11 July 2019	US	10758108	B2	01 September 2020
EP	2921098	A1	23 September 2015	US	10039434	B2	07 August 2018
				US	2015257627	A1	17 September 2015
				EP	2921098	B1	28 June 2017
				KR	20150108188	A	25 September 2015
				CN	104921680	A	23 September 2015
				CN	104921680	B	16 February 2018
				EP	2921098	B8	16 August 2017
				KR	102094340	B1	30 March 2020

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202020945940 **[0001]**