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(54) **AIR CONDITIONER**

(57) An air conditioner. The air conditioner comprises an outdoor unit and an indoor unit. The indoor unit is connected to the outdoor unit, and the indoor unit comprises a first housing, an indoor heat exchanger, a piping box, and a nano water ion generation apparatus. The first housing comprises a first accommodating space, a return air opening, and an air outlet, the return air opening and the air outlet being respectively communication with the first accommodating space to form an air duct. The indoor heat exchanger is disposed in the air duct. The piping box is disposed in the first accommodating space, and the inner cavity of the piping box is independent of the air duct. The nano water ion generation apparatus is disposed at the air outlet, and comprises an emitter electrode and a refrigeration portion, the refrigeration portion being configured to generate condensate water for ionization of the emitter electrode. The air duct comprises a first air duct and a second air duct communicated with each other, and a part of the air in the first air duct directly flows to the refrigeration portion via the piping box without exchanging heat through the indoor heat exchanger.

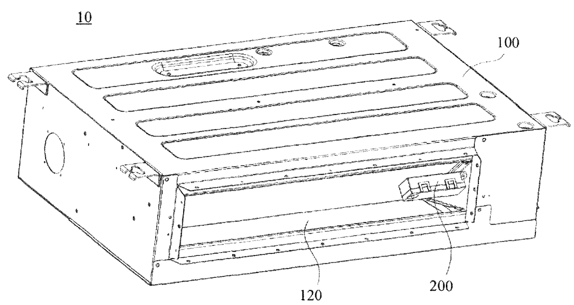

FIG. 1B

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Description

[0001] This application claims priority to Chinese Patent Application No. 202220715340.2, filed on March 30, 2022; Chinese Patent Application No. 202210324187.5, filed on March 30, 2022; Chinese Patent Application No. 202220733579.2, filed on March 31, 2022; and Chinese Patent Application No. 202220731725.8, filed on March 31, 2022; which are incorporated herein by reference in their entireties.

TECHNICAL FIELD

[0002] The present disclosure relates to the field of air conditioning technologies, and in particular, to an air conditioner.

BACKGROUND

[0003] With the advancement of science and technology and the improvement of people's living standards, air conditioners have gradually entered people's life and become an indispensable product in people's work and life.

[0004] Split air conditioner includes an indoor unit and an outdoor unit. The indoor unit and the outdoor unit are installed indoors and outdoors respectively, and are connected to each other through pipelines and wires. Generally, in order to improve indoor air quality, the air conditioners are also provided with air purification functions.

SUMMARY

[0005] An air conditioner is provided. The air conditioner includes an outdoor unit and an indoor unit. The indoor unit is connected to the outdoor unit, and the indoor unit includes a first housing, an indoor heat exchanger, a piping box and a nano water ion generating apparatus. The first housing includes a first accommodating space, a return air inlet and an air outlet. And the return air inlet and the air outlet each are communicated with the first accommodating space, so as to form an air duct. The indoor heat exchanger is disposed in the air duct. The piping box is provided in the first accommodating space, and the inner cavity of the piping box is independent of the air duct. The nano water ion generating apparatus is disposed at the air outlet and is configured to generate nano water ions with negative charges and hydroxyl radicals generated by ionized water. The nano water ion generating apparatus includes an emitter electrode and a refrigeration portion, the refrigeration portion is configured to generate condensed water for ionization the emitter electrode. The air duct includes a first air duct and a second air duct that are communicated to each other. The first air duct is further away from the air outlet than the second air duct, and a part of the air in the first air duct directly flows to the refrigeration portion through the piping box without exchanging heat with the indoor heat exchanger, so as to avoid a change in temperature and humidity of air at the air outlet from affecting a water condensation ability of the nano water ion generating apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

FIG. 1A is a schematic diagram of an air conditioner, in accordance with some embodiments;
FIG. 1B is a diagram showing a structure of an indoor unit of an air conditioner, in accordance with some embodiments;
FIG. 2 is a diagram showing a structure of an indoor unit without a top cover, in accordance with some embodiments;
FIG. 3 is a diagram showing a structure of an indoor unit without a top cover and a front side wall from another perspective, in accordance with some embodiments;
FIG. 4 is a diagram showing a gas flow path of an indoor unit of an air conditioner, in accordance with some embodiments;
FIG. 5 is a diagram showing a gas flow path in a nano water ion generating apparatus, in accordance with some embodiments;
FIG. 6 is a diagram showing a structure of a nano water ion generating apparatus, in accordance with some embodiments;
FIG. 7 is an exploded view of the nano water ion generating apparatus in FIG. 6;
FIG. 8 is an assembly diagram of a nano water ion generating apparatus and a connecting plate, in accordance with some embodiments;
FIG. 9 is another assembly diagram of a nano water ion generating apparatus and the connecting plate, in accordance with some embodiments;
FIG. 10 is a diagram showing a structure of a connecting plate, in accordance with some embodiments;
FIG. 11 is a schematic structural diagram of an installation direction of a nano water ion generating apparatus at an air outlet, in accordance with some embodiments;
FIG. 12 is another schematic structural diagram of an installation direction of a nano water ion generating apparatus at an air outlet, in accordance with some embodiments;
FIG. 13 is yet another schematic structural diagram of an installation direction of a nano water ion generating apparatus at an air outlet, in accordance with some embodiments;
FIG. 14 is a schematic diagram of a nano water ion generating apparatus and an air pretreatment apparatus, in accordance with some embodiments;
FIG. 15 is a diagram showing a gas flow path of the air pretreatment apparatus disposed in a piping box,

in accordance with some embodiments;

FIG. 16 is a diagram showing a structure of an air pretreatment apparatus disposed in the piping box, in accordance with some embodiments;

FIG. 17 is an installation structural diagram of an air pretreatment apparatus and a nano water ion generating apparatus, in accordance with some embodiments;

FIG. 18 is a diagram showing a gas flow path of an air pretreatment apparatus disposed in a nano water ion generating apparatus, in accordance with some embodiments;

FIG. 19 is a diagram showing a structure of a nano water ion generating apparatus and an air pretreatment apparatus, in accordance with some embodiments;

FIG. 20 is an exploded view of the nano water ion generating apparatus and the air pretreatment apparatus in FIG. 19;

FIG. 21 is another diagram showing a structure of a connecting plate, in accordance with some embodiments;

FIG. 22 is a diagram showing a structure of an air pretreatment apparatus, in accordance with some embodiments;

FIG. 23 is a partial structural diagram of a nano water ion generating apparatus, in accordance with some embodiments;

FIG. 24 is a sectional view of the nano water ion generating apparatus in FIG. 23;

FIG. 25 is a diagram showing a structure of a conductive portion, in accordance with some embodiments;

FIG. 26 is a sectional view of the conductive portion in FIG. 25; and

FIG. 27 is a control flow chart of a nano water ion generating apparatus and an air pretreatment apparatus, in accordance with some embodiments.

DETAILED DESCRIPTION

[0007] The technical solutions in some embodiments of the present disclosure will be described clearly and completely with reference to the accompanying drawings; however, the described embodiments are merely some but not all embodiments of the present disclosure. All other embodiments obtained by a person of ordinary skill in the art based on embodiments of the present disclosure shall be included in the protection scope of the present disclosure.

[0008] Unless the context requires otherwise, throughout the specification and the claims, the term "comprise" and other forms thereof such as the third-person singular form "comprises" and the present participle form "comprising" are construed as an open and inclusive meaning, i.e., "including, but not limited to." In the description of the specification, the terms such as "one embodiment," "some embodiments," "exemplary embodiments," "example," "specific example," or "some examples" are intended to indicate that specific features, structures, materials, or characteristics related to the embodiment(s) or example(s) are included in at least one embodiment or example of the present disclosure. Schematic representations of the above terms do not necessarily refer to the same embodiment(s) or example(s). In addition, the specific features, structures, materials, or characteristics may be included in any one or more embodiments or examples in any suitable manner.

[0009] The terms "first" and "second" are used for descriptive purposes only, and are not to be construed as indicating or implying a relative importance or implicitly indicating a number of indicated technical features. Therefore, features defined by "first" or "second" may explicitly or implicitly include one or more of the features. In the description of the embodiments of the present disclosure, the term "a plurality of" or "the plurality of" means two or more unless otherwise specified.

[0010] In the description of some embodiments, the expressions "coupled," "connected," and derivatives thereof may be used. The term "connected" should be understood in a broad sense. For example, the term "connected" may represent a fixed connection, a detachable connection, or a one-piece connection, or may represent a direct connection, or may represent an indirect connection through an intermediate medium. The term "coupled" may be used in the description of some embodiments to indicate that two or more components are in direct physical or electrical contact with each other. However, the term "coupled" or "communicatively coupled" may also mean that two or more elements are not in direct contact with each other, but still cooperate or interact with each other. The embodiments disclosed herein are not necessarily limited to the contents herein.

[0011] The phrase "at least one of A, B, and C" has the same meaning as the phrase "at least one of A, B, or C", both including the following combinations of A, B, and C: only A, only B, only C, a combination of A and B, a combination of A and C, a combination of B and C, and a combination of A, B, and C.

[0012] The phrase "A and/or B" includes the following three combinations: only A, only B, and a combination of A and B.

[0013] The use of the phrase "applicable to" or "configured to" herein means an open and inclusive expression, which does not exclude devices that are applicable to or configured to perform additional tasks or steps.

[0014] The term such as "about," "substantially," and "approximately" as used herein includes a stated value and an average value within an acceptable range of deviation of a particular value. The acceptable range of deviation is determined by a person of ordinary skill in the art, considering measurement in question and errors associated with measurement of a particular quantity (i.e., limitations of a measurement system).

[0015] The term such as "parallel," "perpendicular," or "equal" as used herein includes a stated condition and a condition similar to the stated condition. A range of the similar condition is within an acceptable deviation range, and the acceptable deviation range is determined by a person of ordinary skill in the art, considering measurement in question and errors associated with measurement of a particular quantity (i.e., the limitations of a measurement system). For example, the term "parallel" includes absolute parallelism and approximate parallelism, and an acceptable range of deviation of the approximate parallelism may be, for example, a deviation within 5°; the term "perpendicular" includes absolute perpendicularity and approximate perpendicularity, and an acceptable range of deviation of the approximate perpendicularity may also be, for example, a deviation within 5°. The term "equal" includes absolute equality and approximate equality, and an acceptable range of deviation of the approximate equality may be that, for example, a difference between the two that are equal is less than or equal to 5% of either of the two.

[Basic operating principles of air conditioners]

[0016] In some embodiments of the present disclosure, an air conditioner is provided. As shown in FIG. 1A, the air conditioner 1000 includes an indoor unit 10 and an outdoor unit 20. The indoor unit 10 and the outdoor unit 20 are connected to each other through a pipe, so as to transport a refrigerant.

[0017] The indoor unit 10 includes an indoor heat exchanger 130. The outdoor unit 20 includes an outdoor heat exchanger 21, a compressor 22, a four-way valve 23 and a throttling mechanism 24. In some embodiments, the throttling mechanism 24 may also be provided in the indoor unit 10. The throttling mechanism 24 may be composed of at least one of a throttling valve, an expansion valve, or a pressure reducer. For example, the throttling mechanism 24 may be composed of the expansion valve, the expansion valve and the throttling valve connected in series, or the expansion valve and the pressure reducer connected in series, and the present disclosure is not limited thereto.

[0018] A refrigerant cycle is formed by the compressor 22, the outdoor heat exchanger 21, the throttling mechanism 24 and the indoor heat exchanger 130 connected in sequence. The refrigerant circulates in the refrigerant cycle and exchanges heat with the air through the outdoor heat exchanger 21 and the indoor heat exchanger 130, so as to achieve a cooling mode or a heating mode of the air conditioner 1000.

[0019] The compressor 22 is configured to compress the refrigerant, so that a refrigerant with low temperature and low pressure is compressed to form a refrigerant with high temperature and high pressure.

[0020] The outdoor heat exchanger 21 is configured to perform heat-exchange between outdoor air and the refrigerant conveyed in the outdoor heat exchanger 21. For example, the outdoor heat exchanger 21 operates as a condenser in a cooling mode of the air conditioner 1000, so that the refrigerant compressed by the compressor 22 passes through the outdoor heat exchanger 21 to dissipate heat into the outdoor air to be condensed. The outdoor heat exchanger 21 operates as an evaporator in a heating mode of the air conditioner 1000, so that the decompressed refrigerant passes through the outdoor heat exchanger 21 to absorb heat in the outdoor air to be evaporated.

[0021] Generally, the outdoor heat exchanger 21 further includes heat exchange fins, so as to enlarge a contact area between the outdoor air and the refrigerant conveyed in the outdoor heat exchanger 21, thereby improving heat exchange efficiency between the outdoor air and the refrigerant.

[0022] The throttling mechanism 24 is connected between the outdoor heat exchanger 21 and the indoor heat exchanger 130, a pressure of a refrigerant flowing between the outdoor heat exchanger 21 and the indoor heat exchanger 130 is adjusted by an opening degree of the throttling mechanism 24, so as to adjust the flow rate of the refrigerant flowing between the outdoor heat exchanger 21 and the indoor heat exchanger 130. The flow rate and pressure of the refrigerant flowing between the outdoor heat exchanger 21 and the indoor heat exchanger 130 will affect the heat exchange performance of the outdoor heat exchanger 21 and the indoor heat exchanger 130. The throttling mechanism 24 may be an electronic valve. The opening degree of the throttling mechanism 24 may be adjustable, so as to control the flow rate and pressure of the refrigerant flowing through the throttling mechanism 24. In a case where the air conditioner 1000 operates in the cooling mode, the throttling mechanism 24 is configured to throttle a supercooled liquid refrigerant flowing out of the outdoor heat exchanger 21 into a gas-liquid two-phase refrigerant with low temperature and low pressure, and the flow direction of the refrigerant is shown by solid arrows in FIG. 1A. In a case where the air conditioner 1000 operates in the heating mode, the throttling mechanism 24 is configured to throttle the supercooled liquid refrigerant flowing out of the indoor heat exchanger 130 into the gas-liquid two-phase refrigerant with low temperature and low pressure, and the flow direction of the refrigerant is shown by dashed arrows in FIG. 1A.

[0023] The four-way valve 23 is connected in the refrigerant circle, and is configured to switch a flow direction of the refrigerant in the refrigerant circle, so that the air conditioner 1000 may perform the cooling mode or the heating mode.

[0024] The indoor heat exchanger 130 is configured to perform heat-exchange between indoor air and the refrigerant conveyed in the indoor heat exchanger 130. For example, the indoor heat exchanger 130 operates as an evaporator in a cooling mode of the air conditioner 1000, so that the refrigerant that has been heat-dissipated via the outdoor heat exchanger 21 passes through the indoor heat exchanger 130 to absorb heat in the indoor air to be evaporated. The indoor heat exchanger 130 operates as a condenser in a heating mode of the air conditioner 1000, so that the refrigerant that has absorbed heat via the outdoor heat exchanger 21 passes through the indoor heat exchanger 130 to dissipate heat into the indoor air to be condensed.

[0025] Generally, the indoor heat exchanger 130 further includes heat exchange fins, so as to enlarge a contact area between the indoor air and the refrigerant conveyed in the indoor heat exchanger 130, thereby improving heat exchange efficiency between the indoor air and the refrigerant.

[0026] Operation manners of the cooling mode and the heating mode of the air conditioner 1000 will be mainly described below with reference to FIG. 1A.

[0027] As shown in FIG. 1A, when the air conditioner 1000 operates in the cooling mode, the refrigerant is compressed by the compressor 22 and becomes a superheated gaseous refrigerant with high temperature and high pressure, and the superheated gaseous refrigerant with high temperature and high pressure is discharged into the outdoor heat exchanger 21 for condensation. In the outdoor heat exchanger 21, the superheated gaseous refrigerant is cooled into a supercooled liquid refrigerant, and the supercooled liquid refrigerant flows into the throttling mechanism 24. The throttling mechanism 24 may throttle the supercooled liquid refrigerant into the gas-liquid two-phase refrigerant with low temperature and low pressure. The gas-liquid two-phase refrigerant with low temperature and low pressure flows into the indoor heat exchanger 130 to evaporate and absorb heat. In the indoor heat exchanger 130, the refrigerant is evaporated into superheated gas again, and returned to a suction end of the compressor 22 to accomplish a cycle.

[0028] As shown in FIG. 1A, when the air conditioner 1000 operates in the heating mode, after passing through the four-way valve 23, the gaseous refrigerant with high temperature and high pressure is directly discharged into the indoor heat exchanger 130 for heating. After being cooled into supercooled liquid refrigerant, the supercooled liquid refrigerant flows into the throttling mechanism 24, and is throttled into the gas-liquid two-phase refrigerant with low temperature and low pressure by the the throttling mechanism 24. The gas-liquid two-phase refrigerant with low temperature and low pressure flows into the outdoor heat exchanger 21 for heat absorption and evaporation.

[The indoor unit]

[0029] The outer contour of the indoor unit 10 is formed by a first housing 100. Referring to FIGS. 1B to 3, the first housing 100 is provided with a return air inlet 110 on a side and an air outlet 120 on another side. The return air inlet 110 and the air outlet 120 are communicated to each other, so as to form an air duct, and the indoor heat exchanger 130 is disposed in the air duct formed by the communication between the return air inlet 110 and the air outlet 120.

[0030] The indoor air flows into a first accommodating space 101 of the first housing 100 through the return air inlet 110. After exchanging heat with the indoor heat exchanger 130, the indoor air flows into the indoor space through the air outlet 120, so as to cool or heat the indoor air.

[0031] The indoor unit 10 includes a first partition plate 150, the first partition plate 150 is disposed in the first accommodating space 101 of the first housing 100, and is configured to divide the first accommodating space 101 into a first subspace 161 and a second subspace 162. The first subspace 161 may be a front cavity of the first accommodating space 101, and the second subspace 162 may be a rear cavity of the first accommodating space 101.

[0032] The indoor unit 10 further includes a blower 140. The blower 140 is installed in the second subspace 162, and the return air inlet 110 is communicated to the second subspace 162. The indoor heat exchanger 130 is installed in the first subspace 161, and the air outlet 120 is communicated to the first subspace 161.

[Piping box]

[0033] The indoor unit 10 further includes a piping box 170. The first accommodating space 101 (e.g., the first subspace 161) of the first housing 100 is provided with the piping box 170. The piping box 170 is used to install a water suction pump, water pipes, float switches, etc.

[0034] The air duct of the indoor unit 10 includes a first air duct and a second air duct that are communicated with each other. And the first air duct is further away from the air outlet 120 than the second air duct. For example, the first air duct is located on an upstream side of the indoor heat exchanger 130, and the second air duct is located on a downstream side of the indoor heat exchanger 130.

[0035] In the related art, a side of the piping box 170 away from the air outlet 120 (e.g., the rear side) is communicated to the first air duct (e.g., the upstream air duct), and a side of the piping box 170 proximate to the air outlet 120 (e.g., the front side) is closed. A part of the air flowing into the air duct from the return air inlet 110 does not pass through the indoor heat exchanger 130, but flows directly into the piping box 170. Since the front side of the piping box 170 is closed, the air in the piping box 170 will not continue to flow out of the piping box 170, most of the air filled in the piping box 170 is still the air before heat exchange.

[0036] For this reason, some embodiments of the present disclosure make full use of the space in the piping box 170 and a first vent 1701 is provided on the piping box 170, so as to communicate the piping box 170 with the air outlet 120 through the first vent 1701. In this way, a part of air that flows into the air duct from the return air inlet 110 is not heat exchanged by the indoor heat exchanger 130, the part of air flows into the piping box 170 and then flows to a nano water ion generating apparatus 200 at the air outlet 120 through the first vent 1701.

[0037] Therefore, the piping box 170 serves as a role of branch and flow guide, that is, part of the unheat exchanged air in the first air duct may be guided to the nano water ion generating apparatus 200 through the piping box 170.

[Nano water ion generating apparatus]

[0038] Referring to FIGS. 1B to 3, the nano water ion generating apparatus 200 is configured to generate nano water ions with negative charges and hydroxyl radicals generated by ionized water.

[0039] Negative charges may make the particles in the air charged, and promote the particles in the air to agglomerate, which increases the volume and weight of the particles and then settle the particles to the ground; or, the charged particles may be adsorbed to the nearest zero potential (earth), so as to remove the particles in the air (e.g., PM2.5, etc.).

[0040] The hydroxyl radicals generated by ionized water in nano water ions have extremely strong oxidizability. When the hydroxyl radicals are in contact with bacterial virus on the surface of particles or bacterial virus in the air, the hydroxyl radicals capture hydrogen elements from the bacterial cell walls, which destroys the structure of the cell walls and inactivates cells, and due to their strong oxidation, the protein is denatured, thereby playing the role of sterilization and disinfection.

[0041] The nano water ion generating apparatus 200 is disposed at the air outlet 120, and the nano water ions generated by the nano water ion generating apparatus 200 are directly blown into the indoor space to improve the air purification effect.

[0042] Referring to FIGS. 5 to 7, the nano water ion generating apparatus 200 includes an emitter electrode 210, a refrigeration portion 220 and a power supply portion 230.

[0043] As shown in FIG. 14, the refrigeration portion 220 is configured to generate condensed water for ionization of the emitter electrode 210. The power supply portion 230 is coupled to the emitter electrode 210 and configured to provide negative high voltage to the emitter electrode 210, so as to excite the moisture on the emitter electrode 210 through high-voltage ionization to produce negatively charged nano water ions. The potential of the voltage provided by the power supply portion 230 is negative potential, and the absolute value of the voltage ranges from 10 kV to 220 kV, inclusive, which is negative high voltage.

[0044] In some embodiments, the emitter electrode 210 is designed to be hydrophilic in order to direct the condensed water generated by the refrigeration portion 220 to its emitter tip. After the emitter electrode 210 is connected to the negative high voltage, negatively charged nano water ions may be ionized and excited at the emitter tip.

[0045] In some embodiments, the emitter electrode 210 includes a water-absorbing member, and bactericidal materials (e.g., silver ions, etc.) are added to the water-absorbing member. The emitter electrode 210 is charged by receiving the negative high voltage provided by the power supply portion 230. The water in the water-absorbing member in the emitter electrode 210 is excited by high-voltage ionization to generate nano water ions. The nano water ions carry negative charges and hydroxyl radicals generated by the ionized water.

[0046] The refrigeration portion 220 is configured to generate condensed water. Referring to FIG. 5, the nano water ion generating apparatus 200 includes a water storage gap 260. The water storage gap 260 is located between an end of the emitter electrode 210 and the refrigeration portion 220. The condensed water generated by the refrigeration portion 220 is stored in the water storage gap 260, and the emitter electrode 210 uses hydrophilicity to direct the condensed water in the water storage gap 260 to its emitter tip.

[0047] The ability of the refrigeration portion 220 to generate condensed water is related to the temperature difference of the surrounding air. The greater the temperature difference, the stronger the ability to generate condensed water; on the contrary, the smaller the temperature difference, the weaker the ability to generate condensed water.

[0048] In some embodiments, referring to FIGS. 6 and 7, the nano water ion generating apparatus 200 further includes a second housing 240 (i.e., the apparatus housing, see FIG. 17). The emitter electrode 210, the refrigeration portion 220, and the power supply portion 230 each are provided in the second housing 240.

[0049] The second housing 240 may be made of insulation materials (e.g., polypropylene, etc.). The second housing 240 includes a nano water ion release port 244 for exposing the emitter tip of the emitter electrode 210. In some embodiments, the nano water ion release port 244 faces the air outlet 120.

[0050] The size of the nano water ion release port 244 gradually increases in a direction proximate to the tip of the emitter electrode 210. By gradually enlarging the nano water ion release port 244, the static electricity accumulation on the second housing 240 may be effectively avoided, and thus higher concentration of negative oxygen ions may be released.

[0051] When the air in the air duct flows out through the air outlet 120, it will not blow directly onto the emitter electrode 210, so as to avoid affecting the outlet air temperature, and then affecting the condensation of the air in the refrigeration portion 220.

[0052] In some embodiments, as shown in FIG. 5, the nano water ion generating apparatus 200 includes a second partition plate 243, the second partition plate 243 is disposed in a second accommodating space 202 of the second housing 240. The second partition plate 243 is configured to divide the second accommodating space 202 into a third subspace 241 and a fourth subspace 242, and the second partition plate 243 includes an opening 2431 for gas flow.

[0053] The emitter electrode 210 and the refrigeration portion 220 are disposed in the third subspace 241, and the power supply portion 230 is disposed in the fourth subspace 242. The second housing 240 includes a second vent 280, and the second vent 280 is communicated to the fourth subspace 242.

[0054] The air outside the nano water ion generating apparatus 200 flows into the second accommodating space 202 of the second housing 240 through the second vent 280, the air flows through the fourth subspace 242 and the third subspace 241 in order, and then reaches the refrigeration portion 220. Condensed water is generated at the refrigeration portion 220, and is supplied to the emitter tip of the emitter electrode 210. The nano water ions excited by high-voltage ionization flow out through the nano water ion release port 244, and then flow into the indoor space through the air outlet 120. The flow direction of the air may refer to the arrow in FIG. 5.

[0055] In some embodiments, referring to FIGS. 6 and 7, the second housing 240 includes a bottom shell 247 and a cover 248. The bottom shell 247 includes a clamping portion 2471, and the cover 248 includes a buckle 2481. The fixed connection between the bottom shell 247 and the cover 248 may be implemented though the clamping between the buckle 2481 and the clamping portion 2471.

[0056] The second housing 240 includes a wiring opening 245. The wiring opening 245 is provided on the side edge of the bottom shell 247 proximate to the cover 248, which is convenient for wiring. The nano water ion release port 244 is disposed on the cover 248.

[0057] In some embodiments, referring to FIGS. 5 and 7, the nano water ion generating apparatus 200 further includes an insulated electrode fixing base 270, and the electrode fixing base 270 is disposed in the third subspace 241. The electrode fixing base 270 includes an electrode mounting hole 21A, and the emitter electrode 210 is inserted in the electrode mounting hole 21A.

[0058] The nano water ion generating apparatus 200 further includes a conductive portion 250, the conductive portion 250 is disposed on an end of the electrode fixing base 270 proximate to the cover 248. The conductive portion 250 includes an elastic clamping arm 22A. The elastic clamping arm 22A is inserted into the electrode mounting hole 21A, and is in contact with the emitter electrode 210. The conductive portion 250 is electrically connected to the power supply portion 230.

[0059] The refrigeration portion 220 is disposed at an end of the electrode fixing base 270 away from the cover 248, and the refrigeration portion 220 faces the electrode mounting hole 21A. The water storage gap 260 is formed among the refrigeration portion 220, the electrode mounting hole 21A, and the end of the emitter electrode 210 proximate to the refrigeration portion 220.

[0060] In some embodiments, referring to FIGS. 7 to 9, the second housing 240 includes protrusions 246, and the protrusions 246 are fixed on a connecting plate 180 through connectors (e.g., screws, etc.), so as to realize the fixation of the nano water ion generating apparatus 200 at the air outlet 120.

[0061] In some embodiments, referring to FIG. 3, FIG. 8 and FIG. 10, the indoor unit 10 further includes a connecting plate 180, the connecting plate 180 is disposed in the first accommodating space 101 of the first housing 100, and the connecting plate 180 is connected with an end of the indoor heat exchanger 130. The second housing 240 is fixedly disposed on the connecting plate 180, so as to realize the fixation of the nano water ion generating apparatus 200 at the air outlet 120.

[0062] Since the nano water ion generating apparatus 200 is disposed at the air outlet 120, the temperature of the surrounding air is greatly affected by the air outlet temperature of the air outlet 120, which affects the water condensation capacity of the refrigeration portion 220.

[0063] Therefore, in some embodiments of the present disclosure, a part of the air flowing into the air duct from the return air inlet 110 does not pass through the indoor heat exchanger 130, but flows into the piping box 170, and the part of air flows into the second accommodating space 202 of the second housing 240 through the second vent 280, then reaches the refrigeration portion 220. The other part of air flows out from the air outlet 120 after being heat exchanged by the indoor heat exchanger 130. In this way, the air after heat exchange with the indoor heat exchanger 130 and the air directly flowing out from the piping box 170 will generate a temperature difference at the refrigeration portion 220, thereby improving the water condensation capacity of the refrigeration portion 220, ensuring that the emitter electrode 210 may still obtain sufficient moisture for tip discharge in low humidity conditions, to generate nano water ions and improve the air purification effect of the air conditioner 1000.

[0064] In a case where the air conditioner 1000 is in the cooling mode, the return air temperature of the air conditioner 1000 is higher than the outlet air temperature, and the temperature at the air outlet 120 is lower. In this case, the air temperature in the piping box 170 is higher than the air temperature at the air outlet 120, a temperature difference between the two air channels is generated at the refrigeration portion 220, which increase the temperature difference at the refrigeration portion 220, and enhances the water condensation capacity of the refrigeration portion 220.

[0065] Similarly, in a case where the air conditioner 1000 is in the heating mode, the return air temperature of the air conditioner 1000 is lower than the outlet air temperature, and the temperature at the air outlet 120 is higher. In this case, the air temperature in the piping box 170 is lower than the air outlet 120, a temperature difference in the two air channels is generated at the refrigeration portion 220, which increases the temperature difference at the refrigeration portion 220, and enhances the water condensation capacity of the refrigeration portion 220.

[0066] In some embodiments, referring to FIGS. 3 and 4, the piping box 170 is disposed on a side of the first housing 100, and is located in the first subspace 161. There is an opening at a side of the piping box 170 away from the air outlet 120 (e.g., the rear side), the opening is provided toward the air duct, and a region among the opening, the indoor heat exchanger 130 and the first partition plate 150 forms an air inlet 171 of the piping box 170.

[0067] Referring to FIGS. 4 and 16, the connecting plate 180 is provided on the side of the indoor heat exchanger 130 proximate to the air outlet 120 (e.g., the front side). The first housing 100 includes an inner bottom wall 190 and a front side wall. The front side wall is a side wall provided with the air outlet 120, and the connecting plate 180 is connected to the inner bottom wall 190 of the first housing 100 and the front side wall of the first housing 100, so as to separate the piping box 170 and the second air duct (e.g., the downstream air duct), and the nano water ion generating apparatus 200 is disposed on the connecting plate 180.

[0068] In some embodiments, referring to FIG. 3, the portion (e.g., the top) of the indoor heat exchanger 130 away from the inner bottom wall 190 is inclined along a direction proximate to the air outlet 120. The connecting plate 180 is provided in an area formed among the indoor heat exchanger 130, the inner bottom wall 190 of the first housing 100, and the front side wall of the first housing 100.

[0069] It will be noted that, the inner bottom wall 190 may be an indoor water pan, and is configured to receive condensed water generated by the indoor heat exchanger 130. The inner bottom wall 190 is connected to a bottom wall of the indoor unit 10, and the inner bottom wall 190 of the first housing 100 is closer to the first accommodating space 101 than the bottom wall.

[Installation of the nano water ion generating apparatus]

[0070] In some embodiments, referring to FIGS. 8 and 10, the second housing 240 includes the second vent 280, the connecting plate 180 includes a third vent 181. The second housing 240 is disposed on a surface of the connecting plate 180 away from the piping box 170, the second vent 280 is opposite to and communicated with the third vent 181, so that the inner cavity of the piping box 170 may be communicated with the second accommodating space 202 of the second housing 240. The air in the piping box 170 flows into the second housing 240 through the second vent 280 and the third vent 181.

[0071] In some embodiments, referring to FIG. 9, the connecting plate 180 includes a mounting portion 182 (e.g., a mounting opening), the second housing 240 is inserted into the the mounting portion 182 and disposed at the mounting portion 182. A first portion of the second housing 240 is located in the piping box 170, and a second portion of the second housing 240 is located outside the piping box 170 (e.g., the air outlet 120 side).

[0072] The second vent 280 is provided on a side wall of the first portion of the second housing 240, and the nano water ion release port 244 is provided on a side wall of the second portion of the second housing 240.

[0073] The air in the piping box 170 directly flows into the inner cavity of the second housing 240 through the second vent 280, and then the air flows out from the nano water ion release port 244.

[0074] In some embodiments, FIGS. 11 to 13 illustrate three different installation orientations of the nano water ion generating apparatus 200 at the air outlet 120. In FIG. 11, the emitter electrode 210 is in an inclined state, which is tilted toward the air outlet 120 side. In FIG. 12, the emitter electrode 210 is in a horizontal state, which is facing the air outlet 120. In FIG. 13, the emitter electrode 210 is in a vertical state, whose emitter tip is facing downward. In this way, the installation manner of the emitter electrode 210 may be selected according to actual needs. In addition, any of the above installation manners of the nano water ion generating apparatus 200 may prevent the air from the air outlet 120 from blowing directly onto the emitter electrode 210, avoid affecting the air outlet temperature, and thus affect the condensation effect of the refrigeration portion 220 on the air.

[0075] According to the air conditioner 1000 provided by some embodiments of the present disclosure, the space area of the piping box 170 is fully used, and the first vent 1701 is provided on a front side of the piping box 170. The piping box 170 serves as the role of branch and flow guide, part of the unheated air in an upstream air duct of the indoor heat exchanger 130 may be directed to the nano water ion generating apparatus 200 through the piping box 170. The air after heat exchange with the indoor heat exchanger 130 and the air directly flowing out from the piping box 170 will generate a temperature difference at the refrigeration portion 220, so that the water condensation capacity of the refrigeration portion 220 may be improved, and sufficient moisture for tip discharge may still be obtained to generate nano water ions and improve the air purification effect of the air conditioner 1000, even though the emitter electrode 210 is in the case of low humidity.

[0076] In addition, the nano water ion generating apparatus 200 is disposed at the air outlet 120, and the emitter electrode 210 faces toward the air outlet 120, which effectively prevents the outlet air at the outlet 120 from blowing the emitter electrode 210 directly, so as to avoid affecting the outlet air temperature and affecting the air condensation of the refrigeration part 220.

[0077] Moreover, the nano water ion generating apparatus 200 is disposed on the connecting plate 180 for fixing a front end of the indoor heat exchanger 130. The connecting plate 180 also serves as a role of communicating the piping box 170 with the inner cavity of the nano water ion generating apparatus 200, as a result, the existing structure of the air conditioner 1000 may be fully used, and the structure is compact, which is also conducive to reducing the space occupied by the apparatus.

[The air pretreatment apparatus]

[0078] Since the nano water ion generator 200 is disposed at the air outlet 120, the temperature of the surrounding air is greatly affected by the air outlet temperature of the air outlet 120, which may affect the water condensation capacity of the refrigeration portion 220. In order to solve the above problem, in some embodiments of the present disclosure, the indoor unit 10 further includes an air pretreatment apparatus 300. The air pretreatment apparatus 300 will be described below.

[0079] In some embodiments, the air pretreatment apparatus 300 is provided in the air flow path that the air in the air duct flows to the nano water ion generating apparatus 200, and configured to preheat or precool the air flowing through the refrigeration portion 220, so as to improve the temperature difference of the surrounding air of the refrigeration portion 220, and improve the water condensation capacity of the refrigeration portion 220 , and thus sufficient moisture for tip discharge may still be obtained to generate nano water ions and improve the air purification effect of the air conditioner 1000, even though the emitter electrode 210 is in the case of low humidity.

[0080] In some embodiments, a flow guide channel 400 is branched out from the air duct, so that a part of the air in the air duct flows to the nano water ion generating apparatus 20. The air pretreatment apparatus 300 is configured to preheat or precool the air in the flow guide channel 400.

[0081] An inlet of the flow guide channel 400 is located at an upstream of the indoor heat exchanger 130, and an outlet of the flow guide channel 400 is communicated to the second vent 280 of the second housing 240.

[0082] The air pretreatment apparatus 300 is disposed on the air flow path between the inlet of the flow guide channel 400 and the refrigeration portion 220.

[0083] A part of the air flowing into the air duct from the return air inlet 110 does not pass through the indoor heat exchanger 130, but flows into the flow guide channel 400, and then the part of air flows into the second accommodating space 202 of the second housing 240 through the second vent 280. The other part of the air flows out from the air outlet 120 after being heat exchanged by the indoor heat exchanger 130. In this way, during the air flowing from the flow guide channel 400 to the refrigeration portion 220, it will flow through the air pretreatment apparatus 300, and be preheated or precooled by the air pretreatment apparatus 300, thereby increasing the air temperature difference at the refrigeration portion 220, and improving the capacity to generate condensed water of the refrigeration portion 220.

[0084] It will be noted that, the gas flow space formed in the piping box 170 may be the flow guide channel 400 mentioned above. The inlet of the flow guide channel 400 corresponds to the air inlet 171 of the piping box 170, and the outlet of the flow guide channel 400 corresponds to the first vent 1701 of the piping box 170.

[0085] In some embodiments, referring to FIG. 22, the air pretreatment apparatus 300 includes a refrigeration plate 310, a first heat exchange plate 320 and a second heat exchange plate 330. Two opposite sides of the refrigeration plate 310 along a thickness direction of the refrigeration plate 310 are the first side and the second side, respectively. The first heat exchange plate 320 is disposed on the first side of the refrigeration plate 310, and the second heat exchange plate 330 is disposed on the second side of the refrigeration plate 310.

[0086] The first heat exchange plate 320 is located in the air flow channel between the inlet of the flow guide channel 400 and the refrigeration portion 220. The second heat exchange plate 330 is located outside the air flow channel between the inlet of the flow guide channel 400 and the refrigeration portion 220.

[0087] In a case where the first side of the refrigeration plate 310 is cooled and the second side is heated, the first heat exchange plate 320 may be a heat absorption plate, and the second heat exchange plate 330 may be a heat dissipation plate. In a case where the first side of the refrigeration plate 310 is heated and the second side is cooled, the first heat exchange plate 320 may be the heat dissipation plate, and the second heat exchange plate 330 may be the heat absorption plate.

[0088] In a case where the air conditioner 1000 is in the cooling mode, the temperature at the air outlet 120 is relatively low. In this case, the air pretreatment apparatus 300 turns on the preheating mode, and then it preheats the air flowing from the flow guide channel 400 toward the refrigeration portion 220. In this case, the first heat exchange plate 320 served as the heat sink plate, the second heat exchange plate 330 served as the heat absorption plate. During the air flowing through the air pretreatment apparatus 300, it is heated by the emitted heat of the first heat exchange plate 320, and the temperature rises, thereby increasing the temperature difference at the refrigeration portion 220, and improving the water condensation capacity of the refrigeration portion 220.

[0089] In a case where the air conditioner 1000 is in the heating mode, the temperature at the air outlet 120 is relatively high. In this case, the air pretreatment apparatus 300 turns on the precooling mode, and then it precools the air flowing from the flow guide channel 400 toward the refrigeration portion 220. In this case, the first heat exchange plate 320 served as the heat absorption plate, the second heat exchange plate 330 served as the heat sink plate. During the air flows through the air pretreatment apparatus 300, the heat of the air is absorbed by the first heat exchange plate 320, and the temperature decreases, thereby increasing the temperature difference at the refrigeration portion 220, and improving the water condensation capacity of the refrigeration portion 220.

[0090] In some embodiments, referring to FIG. 22, the air pretreatment apparatus 300 includes a first ventilating gap 321 and a plurality of first heat exchange plates 320 arranged at intervals, and the first ventilating gap 321 is formed between two adjacent first heat exchange plates 320. The air flows through the first ventilating gap 321, so as to improve the heat exchange efficiency.

[0091] The air pretreatment apparatus 300 includes a second ventilating gap 331 and a plurality of second heat exchange plates 330 arranged at intervals. The second ventilating gap 331 is formed between two adjacent second heat exchange plates 330, so as to improve the heat exchange efficiency.

[Installation position of the air pretreatment apparatus]

[0092] The air pretreatment apparatus 300 may be disposed in the piping box 170. Alternatively, the air pretreatment apparatus 300 may be disposed in the nano water ion generating apparatus 200.

[0093] In some embodiments, referring to FIGS. 15 to 17, the air pretreatment apparatus 300 is disposed in the piping box 170.

[0094] Referring to FIG. 21, the connecting plate 180 includes a body, a third vent 181 and a mounting portion 182 (e.g., mounting hole). The third vent 181 penetrates through the body along a thickness direction thereof. The mounting portion 182 is disposed at the third vent 181. For example, the first portion of the mounting portion 182 is located in the piping box 170, and the second portion of the mounting portion 182 is opposite to and communicated with the second vent 280. In this case, the inner cavity of the piping box 170 and the second accommodating space 202 of the second housing 240 may be communicated with each other.

[0095] Referring to FIGS. 17 and 22, the refrigeration plate 310 is disposed on a portion of the mounting portion 182 located in the piping box 170, the first heat exchange plate 320 is located in the inner cavity of the mounting portion 182, and the second heat exchange plate 330 is located outside the mounting portion 182.

[0096] The air in the piping box 170 flows into the second accommodating space 202 of the second housing 240 through the inner cavity of the mounting portion 182. During flowing through the inner cavity of the mounting portion 182, the air is in contact with the first heat exchange plate 320, and flows through the ventilating gap 321, so as to achieve preheating or precooling of the air.

[0097] In other embodiments, referring to FIGS. 18 to 20, the main difference between FIGS. 16 to 17 and FIGS. 18 to 20 lies in the arrangement position of the air pretreatment apparatus 300. The air pretreatment apparatus 300 is disposed in the nano water ion generating apparatus 200.

[0098] The refrigeration plate 310 is disposed on the cover 248 of the second housing 240. The first heat exchange plate 320 is located in the second accommodating space 202 (e.g., the fourth subspace 242) of the second housing 240. The second heat exchange plate 330 is located outside the second housing 240.

[0099] The air in the piping box 170 flows into the fourth subspace 242 of the second housing 240 through the inner cavity of the mounting portion 182, and then continues to flow to the third subspace 241. In this process, the air is in contact with the first heat exchange plate 320, and flows through the first ventilating gap 321, so as to achieve preheating or precooling of the air.

[Control method of the air pretreatment apparatus]

[0100] In some embodiments, referring to FIG. 27, the control method includes steps S101 to S105.

[0101] Step S101: Control the nano water ion generating apparatus 200 to be turned on.

[0102] Step S102: Calculate the difference ΔT between the first temperature T11 of the air at the air outlet and the second temperature T12 of the air in the flow guide channel. Here, the flow guide channel refers to the inner cavity of the piping box 170.

[0103] Step S103: Whether ΔT is positive or negative is determined. If ΔT is greater than 0, step S104 is performed; if ΔT is less than 0, step S105 is performed.

[0104] Step S104: If it is determined that ΔT is greater than 0, the precooling mode of the air pretreatment apparatus 300 is turned on, which performs temperature decrease on the air flowing to the refrigeration portion 220 in the nano water ion generating apparatus 200, so as to increase the temperature difference.

[0105] Step S105: If it is determined that ΔT is less than 0, the preheating mode of the air pretreatment apparatus 300 is turned on, which performs temperature increase on the air flowing to the refrigeration portion 220 in the nano water ion generating apparatus 200, so as to increase the temperature difference.

[0106] That is to say, in a case where the difference ΔT between the first temperature T11 of the air at the air outlet 120 and the second temperature T12 of the air in the piping box 170 is greater than 0, it indicates that the air conditioner 1000 is in the heating mode, and the air pretreatment apparatus 300 precools the air flowing through the refrigeration portion 220.

[0107] In a case where the difference ΔT between the first temperature T11 of the air at the air outlet 120 and the second temperature T12 of the air in the piping box 170 is less than 0, it indicates that the air conditioner 1000 is in the cooling mode, and the air pretreatment apparatus 300 preheats the air flowing through the refrigeration portion 220.

[0108] In other embodiments, the control system (e.g., a controller) of the air conditioner 1000 may also directly read the cooling or heating control command of the air conditioner 1000, so as to determine whether the air conditioner 1000 is in the cooling or heating mode directly, thereby further controlling the air pretreatment apparatus 300 to precool or preheat the air flowing through the refrigeration portion 220.

[0109] In some embodiments, the air conditioner 1000 further includes a humidity sensor, the humidity sensor is configured to detect the relative humidity of the air at the air outlet 120. The controller is coupled to the humidity sensor and the air pretreatment apparatus 300, respectively, and the controller is configured to precool or preheat the air passing through the air pretreatment apparatus 300 based on the relative humidity feedback from the humidity sensor.

[0110] In some embodiments, the controller obtains the relative humidity Rh of the air at the air outlet 120, and adjusts the switch of the air pretreatment apparatus 300 according to the relative humidity Rh. The controller switches between the precooling mode and the preheating mode of the air pretreatment apparatus 300, according to the difference ΔT between the first temperature T11 of the air at the air outlet 120 and the second temperature T12 of the air in the piping box 170. In addition, the controller adjusts the working power of the precooling or preheating mode of the air pretreatment apparatus 300 to adjust the cooling capacity or heating capacity, and precools or preheats the air flowing through the air pretreatment apparatus 300, so as to increase the temperature difference at the refrigeration portion 220, and improve the water condensation capacity of the refrigeration portion 220.

[0111] In a case where the relative humidity fed back by the humidity sensor varies, the working mode of the air pretreatment apparatus 300 (e.g., precooling or preheating the air flowing through it) is also varies due to the control of the controller. By adjusting the working mode of the air pretreatment apparatus 300, the temperature difference at the refrigeration portion 220 may be adjusted, thereby the water condensation capacity of the refrigeration portion 220 may be improved.

[0112] For example, in a case where the relative humidity is greater than or equal to a preset relative humidity (i.e., Rh ≥ Rh1), it indicates that the humidity is relatively high, the air pretreatment apparatus 300 is turned off, and the moisture may be condensed from the air by the cooling capacity of the refrigeration portion 220.

[0113] In a case where the relative humidity is less than the preset relative humidity (i.e. Rh<Rh1), it indicates that the humidity is relatively low. If the air conditioner 1000 is in the cooling mode, the preheating mode of the air pretreatment apparatus 300 is turned on; if the air conditioner 1000 is in the heating mode, then the precooling mode of the air pretreatment apparatus 300 is turned on.

[0114] In some embodiments, the heating capacity or the cooling capacity of the air pretreatment apparatus 300 is inversely proportional to the relative humidity Rh.

[0115] For ease of understanding, assuming that the second relative humidity is less than the first relative humidity (i.e. Rh2<Rh1, the first relative humidity corresponds to the above-mentioned preset relative humidity).

[0116] In a case where the relative humidity is greater than the second relative humidity and less than the first relative humidity (i.e. Rh2<Rh<Rh1),

if the indoor unit is in the cooling mode, the preheating mode of the air pretreatment apparatus 300 is turned on, and the heating capacity is Q1;
if the indoor unit is in the heating mode, the precooling mode of the air pretreatment apparatus 300 is turned on, and the cooling capacity is Q2;
in a case where the relative humidity is less than or equal to the second relative humidity (i.e. Rh≤Rh2),
if the indoor unit is in the cooling mode, the preheating mode of the air pretreatment apparatus 300 is turned on, and the heating capacity is Q3;
if the indoor unit is in the heating mode, the precooling mode of the air pretreatment apparatus 300 is turned on, and the cooling capacity is Q4;
Q3 is greater than Q1 (i.e., Q3> Q1), and Q4 is greater than Q2 (i.e., Q4> Q2).

[0117] In some embodiments, in a case where the difference ΔT between the first temperature T11 of the air at the air outlet 120 and the second temperature T12 of the air in the flow guide channel 400 is less than a first preset threshold T10, it indicates that the temperature difference is relatively small, in this case, the air pretreatment apparatus 300 is turned on, and the air flowing from the flow guide channel 400 to the refrigeration portion 220 needs to be pretreated.

[0118] In a case where the difference ΔT between the first temperature T11 of the air at the air outlet 120 and the second temperature T12 of the air in the flow guide channel 400 is greater than the second preset threshold T20, it indicates that the temperature difference is relatively large, in this case, the air pretreatment apparatus 300 is turned off, and the moisture may be condensed from the air by the cooling capacity of the refrigeration portion 220.

[0119] In some embodiments, the heating capacity or the cooling capacity of the air pretreatment apparatus 300 is inversely proportional to the difference ΔT between the first temperature T11 of the air at the air outlet 120 and the second temperature T12 of the air in the flow guide channel 400.

[0120] For ease of understanding, assuming that T1 is less than T2 (T1<T2, T is a positive value).

(1) In a case where the relative humidity Rh is greater than the second relative humidity Rh2 and less than the first relative humidity Rh1 (i.e. Rh2 < Rh < Rh1), and ΔT is a positive value,
in a case where T1 is greater than or equal to T2 (i.e., ΔT≥T2), the air pretreatment apparatus 300 is turned off.

[0121] In a case where ΔT is greater than or equal to T1 and less than or equal to T2 (i.e., T1≤ΔT≤T2), the precooling mode of the air pretreatment apparatus 300 is turned on, and the cooling capacity is Q11.

[0122] In a case where ΔT is greater than or equal to 0 and less than or equal to T1 (i.e., 0≤ΔT≤T1), the precooling mode of the air pretreatment apparatus 300 is turned on, and the cooling capacity is Q12.

[0123] Where the refrigeration capacity Q12 is greater than the refrigeration capacity Q11 (i.e., Q12> Q11).

[0124] In a case where ΔT is less than or equal to -T2 (i.e., ΔT≤-T2), the air pretreatment apparatus 300 is turned off.

[0125] In a case where ΔT is greater than or equal to T2 and less than or equal to -T1 (i.e., -T2≤ΔT≤-T1), the preheating mode of the air pretreatment apparatus 300 is turned on, and the heating capacity is Q21.

[0126] In a case where ΔT is greater than or equal to -T1 and less than or equal to 0 (i.e., -T1≤ΔT≤0), the preheating mode of the air pretreatment apparatus 300 is turned on, and the heating capacity is Q22.

[0127] Where the heating capacity Q22 is greater than the heating capacity Q21 (i.e., Q22>Q21).

[0128] (2) In a case where the relative humidity Rh is less than or equal to the second relative humidity Rh2 (i.e., Rh ≤ Rh2), and ΔT is a positive value,

in a case where T is greater than or equal to T2 (i.e., T≥T2), the air pretreatment apparatus 300 is turned off.

[0129] In a case where ΔT is greater than or equal to T1 and less than or equal to T2 (i.e., T1≤ΔT≤T2), the pre-cooling mode of the air pretreatment apparatus 300 is turned on, and the cooling capacity is Q31.

[0130] In a case where ΔT is greater than or equal to 0 and less than or equal to T1 (i.e., 0≤ΔT≤T1), the precooling mode of the air pretreatment apparatus 300 is turned on, and the cooling capacity is Q32.

[0131] Where the refrigeration capacity Q32 is greater than the refrigeration capacity Q31, the refrigeration capacity Q31 is greater than the refrigeration capacity Q12, and the refrigeration capacity Q12 is greater than the refrigeration capacity Q11 (i.e., Q32> Q31 >Q12>Q11).

[0132] In a case where ΔT is less than or equal to -T2 (i.e., ΔT≤-T2), the air pretreatment apparatus 300 is turned off.

[0133] In a case where ΔT is greater than or equal to -T2 and less than or equal to -T1 (i.e., -T2≤ΔT≤-T1), the preheating mode of the air pretreatment apparatus 300 is turned on, and the heating capacity is Q41.

[0134] In a case where ΔT is greater than or equal to -T1 and less than or equal to 0 (i.e., -T1≤ΔT≤0), the preheating mode of the air pretreatment apparatus 300 is turned on, and the heating capacity is Q42.

[0135] Where the heating capacity Q42 is greater than the heating capacity Q41, the heating capacity Q41 is greater than the heating capacity Q22, and the heating capacity Q22 is greater than the heating capacity Q21 (i.e., Q42>Q41>Q22>Q21).

[0136] The air pretreatment apparatus 300 may not only prevent the excessive water condensation of the refrigeration portion 220, but also improve the water condensation capacity of the refrigeration portion 220 under dry conditions.

[Emitter electrode]

[0137] In some embodiments, referring to FIG. 23, in addition to the emitter electrode 210, the conductive portion 250 (e.g., a metal clamping portion) and a electrode fixing base 270, the nano water ion generating apparatus 200 further includes a wiring bolt 3.

[0138] Referring to FIGS. 24 and 25, the electrode fixing base 270 includes a first connecting hole 41 and a second connecting hole 42. The conductive portion 250 includes a clamping portion body, an electrode mounting hole 21A, an elastic clamping arm 22A, and a fixed mounting arm 24A. The electrode mounting hole 21A runs through the clamping portion body along a thickness direction, and the emitter electrode 210 is installed in the electrode mounting hole 21A. The elastic clamping arm 22A is disposed proximate to the electrode mounting hole 21A and is connected to the clamping portion body. The emitter electrode 210 is located inside the elastic clamping arm 22A, and at least a portion of the emitter electrode 210 is in contact with the elastic clamping arm 22A. The elastic clamping arm 22A is located in the first connecting hole 41. The fixed mounting arm 24A is connected to the clamping portion body and extends in a direction away from the clamping portion body (or the electrode mounting hole 21A). The fixed mounting arm 24A is connected to the second connecting hole 42 through the wiring bolt 3.

[0139] The elastic clamping arm 22A extends substantially in a direction parallel to a center line of the electrode mounting hole 21A, and the fixed mounting arm 24A extends in a radial direction of the electrode mounting hole 21A.

[0140] In some embodiments, the conductive portion 250 further includes a mounting chamfer 23A located between the clamping portion body and the elastic clamping arm 22A. The installation chamfer 23A may not only guide the assembly of the emitter electrode 210, but also achieve the protection of the emitter electrode 210.

[0141] The emitter electrode 210 has the ability to absorb and conduct water, and is a porous columnar electrode mainly formed by solidifying conductive fiber bundles through a curing agent and carbonizing under high temperature conditions. In an environment with high air humidity, the emitter electrode 210 may directly absorb moisture in the air.

[0142] Therefore, the nano water ion generating apparatus 200 is capable of achieving the air purification, disinfection and sterilization. Correspondingly, the air conditioner 1000 with the nano water ion generating apparatus 200 also has a good air purification effect.

[0143] In some embodiments, the conductive portion 250 includes two, three or more elastic clamping arms 22A. In this way, it is conducive to improving the reliability of the conductive portion 250.

[0144] Referring to FIGS. 23 to 26, an outer diameter of the emitter electrode 210 is D1. The elastic clamping arm

22A includes a first segment 221 and a second segment 222 that are connected with each other. The second segment 222 is further away from the clamping portion body than the first segment 221, and a portion of the second segment 222 is configured to contract in a direction proximate to a center line of the electrode fixing hole 21A. For example, the first segment 221 is a straight segment, the second segment 222 is a curved segment. The first segment 221 forms an inner diameter D2 around the electrode fixing hole 21A, and the second segment 222 forms an inner diameter D3 (e.g., a minimum inner diameter) around the electrode fixing hole 21A. D1, D2 and D3 satisfy a relationship that D2 is greater than D1, and D1 is greater than D3 (i.e., D2>D1>D3). A bottom end of the emitter electrode 210 is inserted into the electrode fixing hole 21A from the first segment 221, and the outer side wall of the emitter electrode 210 is in contact with the portion of the second segment 222.

[0145] The bottom end of the emitter electrode 210 is inserted into the conductive portion 250 from the electrode mounting hole 21A, and is elastically fixed by abutting the elastic clamping arm 22A. The installation chamfer 23A may prevent the collision of the electrode material and the fiber damage caused by the insertion of the emitter electrode 210 into the conductive portion 250. This manner of fixing the electrode allows the emitter electrode 210 to be plug-and-play, and is convenient and fast. In this way, it may implement rapid assembly and replacement of the emitter electrode 210, and solve a problem of poor conductive connection of water absorbing electrode materials.

[0146] In some embodiments, the elastic clamping arm 22A of the conductive portion 250 extends into the first connecting hole 41. The fixed installation arm 24A includes a fixing hole 25, and the wiring bolt 3 is inserted into the fixing hole 25. In one aspect, the wiring bolt 3 plays a role in fixing the conductive portion 250. In another aspect, the high voltage wire 31 (referring to FIG. 23) is also fixed to the electrode fixing base 270 through the wiring bolt 3.

[0147] For example, referring to FIGS. 23 and 24, an end of the emitter electrode 210 is coupled to the power supply portion 230 through a high voltage line 31, thus facilitating the electrical connection between the power supply portion 230 and the emitter electrode 210.

[0148] In some embodiments, referring to FIG. 24, the electrode fixing base 270 further includes a first boss portion 43, the first boss portion 43 is located at the bottom of the first connecting hole 41, and the bottom end of the emitter electrode 210 is in contact with the first boss portion 43. The first boss portion 43 is configured to control a height of a water absorbing portion of the emitter electrode 210 and play a role in positioning the emitter electrode 210.

[0149] Referring to FIG. 24, a distance between the first boss portion 43 and the fixed mounting arm 24A is H1, and a height of the emitter electrode 210 is H2. H1 and H2 satisfy a relationship that H1 is less than H2 (i.e., H1<H2). In this way, the top of the emitter electrode 210 is higher than the upper surface of the electrode fixing base 270, the emitter electrode 210 exposed in the air may directly absorb moisture in the air.

[0150] The generation process of the nano water ions in the nano water ion generating apparatus 200 includes that the wiring bolt 3 is connected to the power supply portion 230, the electrode fixing base 270 is made of insulating material (e.g., polypropylene), and the negative high voltage electricity output by the power supply portion 230 is directly transmitted to the conductive portion 250 through the wiring bolt 3, and then transmitted to the emitter electrode 210 through the elastic clamping arm 22A of the conductive portion 250. After the negative high voltage is applied to the emitter electrode 210, there are countless micropores on the surface of the water absorbing material, and countless nano water ion release points are formed due to the action of the high voltage electric field. The negative high voltage provided by the power supply portion 230 generates corona discharge, thereby ionizing the water to generate the negatively charged nano water ions and sprayed the nano water ions into the air.

[0151] The nano water ion generating apparatus 200 in some embodiments of the present disclosure directly uses the ground or surrounding grounded objects as the counter electrode of the emitter electrode 210. There is no need to provide an additional counter electrode. Therefore, the generated negatively charged nano water ions will not be absorbed by the counter electrode.

[0152] In some embodiments, the nano water ion generating apparatus 200 does not include the cooling portion 220. In some other embodiments, the nano water ion generating apparatus 200 includes the cooling portion 220. For example, when it is necessary to provide condensed water for the emitter electrode 210, the nano water ion generating apparatus 200 including the cooling portion 220 may be selected. When it is not necessary to provide condensed water for the emitter electrode 210, the nano water ion generating apparatus 200 which does not include the cooling portion 220 may be selected. Hereinafter, the nano water ion generating apparatus 200 including the cooling portion 220 will be introduced.

[0153] The electrode fixing base 270 further includes a second boss portion 44 and an accommodating cavity 43A communicated to the first connecting hole 41. In a case where the nano water ion generating apparatus 200 includes the cooling portion 220, the cooling portion 220 is located in the accommodating cavity 43A at the bottom of the electrode fixing base 270, and a portion of the cooling portion 220 abuts against the second boss portion 44. There is a gap (e.g., the water storage gap) between the emitter electrode 210 and the cooling portion 220.

[0154] Referring to FIG. 24, the cooling portion 220 includes a ceramic insulating sheet 51, a PN junction 52, a metal conductor sheet 53, and a heat sink 54. The ceramic insulating sheet 51 is connected to a cold end of the PN junction 52, therefore, the condensed water will be generated in the water storage gap between the emitter electrode 210 and the cooling portion 220.

[0155] In some embodiments, the ceramic insulating sheet 51 is located on a surface (e.g., an upper surface) of the PN junction 52 proximate to the first boss portion 43 to insulate the emitter electrode 210 from the PN junction 52, so as to avoid the negative high voltage transmitted to the emitter electrode 210 from affecting semiconductor cooling. A surface (e.g., a lower surface) of the PN junction 52 away from the first boss portion 43 is connected to the metal conductor sheet 53, and the metal conductor sheet 53 is connected to a power source to form an electrical circuit with the PN junction 52. The heat sink 54 is located at a side (e.g., the bottom) of the metal conductor sheet 53 away from the PN junction 52. The metal conductor sheet 53 may abut against the second boss portion 44.

[0156] Here, when current flows through the thermocouple formed by connecting the N-type semiconductor material and the P-type semiconductor material in the cooling portion 220, heat transfer will occur between the two ends of the PN junction 52, and the heat will be transferred from an end to another end of the PN junction 52, thereby generating a temperature difference to form a cold end and a hot end. In a case where the air is in contact with the cold end, the condensed water will be generated.

[0157] The nano water ion generating apparatus 200 in some embodiments of the present disclosure controls a distance between the emitter electrode 210 and the ceramic insulating sheet 51 by controlling a distance between the first boss portion 43 and the second boss portion 44 (e.g., a distance in a height direction of the emitter electrode 210), and there is a water storage gap in a range from 0.2 mm to 0.8 mm (e.g., 0.2 mm, 0.4 mm, 0.6 mm or 0.8 mm) between the emitter electrode 210 and the ceramic insulating sheet 51. The ceramic insulating sheet 51 is located at a cooling surface on the upper surface of the PN junction 52. In a case where the condensed water 6 is generated on the cooling portion 220, the condensed water 6 is in contact with the emitter electrode 210 and is absorbed by the emitter electrode 210, thereby continuously providing moisture to the emitter electrode 210.

[0158] In the nano water ion generating apparatus 200 in some embodiments of the present disclosure, the emitter electrode 210 may not only absorb moisture directly from the air, but also utilize the condensed water provided by the cooling portion 220, thereby fully ensuring the water supply of the emitter electrode 210, so that the nano water ion generating apparatus 200 may stably generate the nano water ions with negative oxygen ions.

[0159] The electrode fixing base 270 includes a fourth vent communicated with the accommodating cavity 43A. The fourth vent may circulate the air between the cooling portion 220 and the electrode fixing base 270, so that the cooling portion 220 condenses water in the air.

[0160] In some embodiments of the nano water ion generating apparatus 200 of the present disclosure, in an environment with high air humidity, the emitter electrode 210 directly absorbs moisture in the air to supply water to the emitter electrode 210. The emitter electrode 210 uses the surrounding ground or grounded objects as the counter electrode and directly ionizes water by using the negative high voltage, so as to generated the nano water ions containing the negative oxygen ions, thereby improving the air purification capability.

[0161] The foregoing descriptions are merely specific implementations of the present disclosure, but the protection scope of the present disclosure is not limited thereto. Changes or replacements that any person skilled in the art could conceive of within the technical scope of the present disclosure shall be included in the protection scope of the present disclosure. Therefore, the protection scope of the present disclosure shall be subject to the protection scope of the claims.

[0162] A person skilled in the art will understand that the scope of disclosure in the present disclosure is not limited to specific embodiments discussed above, and may modify and substitute some elements of the embodiments without departing from the spirits of this application. The scope of this application is limited by the appended claims.

Claims

1. An air conditioner, comprising:

an outdoor unit; and
an indoor unit, the indoor unit being connected to the outdoor unit, and the indoor unit including:

a first housing, wherein the first housing includes a first accommodating space, a return air inlet and an air outlet, and the return air inlet and the air outlet each are communicated with the first accommodating space, so as to form an air duct;
an indoor heat exchanger, the indoor heat exchanger being disposed in the air duct;
a piping box, the piping box being provided in the first accommodating space, and the inner cavity of the piping box being independent of the air duct; and
a nano water ion generating apparatus, wherein the nano water ion generating apparatus is disposed at the air outlet and is configured to generate nano water ions with negative charges and hydroxyl radicals generated by ionized water, the nano water ion generating apparatus includes an emitter electrode and a refrigeration portion, the refrigeration portion being configured to generate condensed water for ionization

of the emitter electrode; wherein

the air duct includes a first air duct and a second air duct that are communicated to each other, the first air duct is further away from the air outlet than the second air duct, and a part of the air in the first air duct flows to the refrigeration portion through the piping box without exchanging heat with the indoor heat exchanger, so as to avoid a change in temperature and humidity of air at the air outlet from affecting a water condensation ability of the nano water ion generating apparatus.

2. The air conditioner according to claim 1, wherein

the piping box is disposed on a side of the first housing, the piping box includes an air inlet, the air inlet is disposed on a side of the piping box away from the air outlet, and disposed toward the air duct, so that the part of the air in the first air duct flows into the inner cavity of the piping box through the air inlet;

the indoor unit further includes a connecting plate, the connecting plate is disposed on a side of the indoor heat exchanger proximate to the air outlet, the first housing includes an inner bottom wall and a front side wall, and the front side wall is a side wall of the first housing provided with the air outlet, and the connecting plate is connected to the inner bottom wall and the front side wall, so as to separate the piping box from the second air duct, and the nano water ion generating apparatus is disposed on the connecting plate.

3. The air conditioner according to claim 2, wherein

the indoor unit includes a first partition plate and a blower, the first partition plate is configured to divide the first accommodating space into a first subspace and a second subspace, the indoor heat exchanger and the piping box is disposed in the first subspace, and the air outlet is communicated to the first subspace;

the blower is disposed in the second subspace, and the return air inlet is communicated to the second subspace.

4. The air conditioner according to claim 2, wherein the indoor heat exchanger is inclined and disposed in the air duct, a top of the indoor heat exchanger is inclined along a direction close to the air outlet, and the connecting plate is disposed in a space provided among the indoor heat exchanger, the inner bottom wall, and the front side wall.

5. The air conditioner according to claim 2, wherein

the nano water ion generating apparatus further includes a second housing, the emitter electrode and the refrigeration portion each are disposed in the second housing, the second housing includes a nano water ion release port, the nano water ion release port being capable of exposing an emitter tip of the emitter electrode; the second housing is fixedly disposed on the connecting plate, and the nano water ion release port faces toward the air outlet; wherein

the part of the air in the first air duct flows into the second housing through the piping box, and then flows out through the nano water ion release port.

6. The air conditioner according to claim 5, wherein the second housing includes a second vent, the connecting plate includes a third vent, the second housing is disposed on a side of the connecting plate away from the piping box, the second vent is opposite to and communicated with the third vent, so that the air in the piping box flows into the second housing through the second vent and the third vent.

7. The air conditioner according to claim 5, wherein

the connecting plate includes a mounting portion, and the second housing is disposed at the mounting portion, so that the second housing is connected to the connecting plate through the mounting portion; a first portion of the second housing is located inside the piping box, and a second portion of the second housing is located outside the piping box and proximate to the air outlet;

the second housing includes a second vent disposed on a side wall of the first portion, and the nano water ion release port is disposed on a side wall of the second portion of the second housing.

8. The air conditioner according to claim 5, wherein

the nano water ion generating apparatus further includes a second partition plate disposed in the second accommodating space of the second housing, and configured to divide the second accommodating space into a third subspace and a fourth subspace, and the second partition plate includes an opening for gas circulation; wherein

the emitter electrode and the refrigeration portion are disposed in the third subspace;

the nano water ion generating apparatus further includes a power supply portion disposed in the fourth subspace, wherein the power supply portion is coupled to the emitter electrode, and is configured to provide negative high voltage to the emitter electrode, so as to excite the moisture on the emitter electrode by high-voltage ionization to produce negatively charged nano water ions.

9. The air conditioner according to claim 5, wherein the second housing includes a bottom shell and a cover, the bottom shell includes a wiring opening disposed proximate to the cover, the cover includes the nano water ion release port, a size of the nano water ion release port increases in a direction proximate to the tip of the emitter electrode.

10. The air conditioner according to any one of claims 1 to 9, wherein
the nano water ion generating apparatus further includes a water storage gap located between an end of the emitter electrode and the refrigeration portion, the emitter electrode has hydrophilicity, the condensed water generated by the refrigeration portion is stored in the water storage gap, and the emitter electrode directs the condensed water in the water storage gap to the emitter tip of the emitter electrode.

11. The air conditioner according to any one of claims 1 to 10, further comprising:
an air pretreatment apparatus, wherein the air pretreatment apparatus is disposed in an air flow path that the air in the air duct flows to the nano water ion generating apparatus, and the air pretreatment apparatus is configured to preheat or precool the air flowing through the refrigeration portion, so as to increase a temperature difference of surrounding air of the refrigeration portion.

12. The air conditioner according to claim 11, wherein

the nano water ion generating apparatus further includes a second housing, the second housing includes a second vent, the air conditioner includes a flow guide channel, and an inlet of the flow guide channel is located at an upstream of the indoor heat exchanger, an outlet of the flow guide channel is communicated to the second vent; wherein
the air pretreatment apparatus is disposed on the air flow path between the inlet of the flow guide channel and the refrigeration portion.

13. The air conditioner according to claim 12, wherein the flow guide channel is defined in the piping box, the air conditioner further comprises:

a humidity sensor configured to detect a relative humidity of the air at the air outlet; and
a controller coupled to the humidity sensor and the air pretreatment apparatus, and the controller being configured to precool or preheat the air passing through the air pretreatment apparatus, based on the relative humidity feedback from the humidity sensor, so as to provide cooling capacity or heating capacity.

14. The air conditioner according to claim 12 or 13, further comprising:
a controller, the controller is configured to:

obtain a relative humidity of the air at the air outlet;
in a case where the relative humidity is greater than or equal to a preset relative humidity, the air pretreatment apparatus is turned off;
in a case where the relative humidity is less than the preset relative humidity, if the indoor unit of the air conditioner is in a cooling mode, the air pretreatment apparatus is controlled to be turned on and preheated, so as to provide heating capacity; if the indoor unit of the air conditioner is in a heating mode, the air pretreatment apparatus is controlled to be turned on and precooled, so as to provide cooling capacity.

15. The air conditioner according to claim 14, wherein the heating capacity or the cooling capacity of the air pretreatment apparatus is inversely proportional to the relative humidity.

16. The air conditioner according to claim 14, wherein a difference between a first temperature of the air in the air outlet and a second temperature of the air in the flow guide channel is ΔT;
the heating capacity or the cooling capacity of the air pretreatment apparatus is inversely proportional to ΔT.

17. The air conditioner according to claim 14, wherein the controller is further configured to:

in a case where a difference ΔT between a first temperature of the air at the air outlet and a second temperature of the air in the flow guide channel is less than a first preset threshold, the air pretreatment apparatus is turned on;
in a case where the difference ΔT between the first temperature of the air at the air outlet and the second temperature of the air in the flow guide channel is greater than a second preset threshold, the air pretreatment apparatus is turned off.

18. The air conditioner according to claim 16 or 17, wherein the controller is further configured to:

in a case where the difference ΔT between the first temperature of the air at the air outlet and the second temperature of the air in the flow guide

channel is greater than 0, the air pretreatment apparatus is controlled to precool the air flowing through the refrigeration portion;
in a case where the difference ΔT between the first temperature of the air at the air outlet and the second temperature of the air in the flow guide channel is less than 0, the air pretreatment apparatus is controlled to preheat the air flowing through the refrigeration portion.

19. The air conditioner according to claim 18, wherein the air pretreatment apparatus further includes:

a first heat exchange plate located in the air flow channel between the piping box and the refrigeration portion;
a second heat exchange plate located outside the air flow channel between the piping box and the refrigeration portion; and
a refrigeration plate, wherein a side of the refrigeration plate is provided with the first heat exchange plate, and another side of the refrigeration plate is provided with the second heat exchange plate.

20. The air conditioner according to claim 19, wherein

the air pretreatment apparatus includes a first ventilating gap and a plurality of first heat exchange plates arranged at intervals, and the first ventilating gap is provided between two adjacent first heat exchange plates;
the air pretreatment apparatus includes a second ventilating gap and a plurality of second heat exchange plates arranged at intervals, and the second ventilating gap is provided between two adjacent second heat exchange plates.

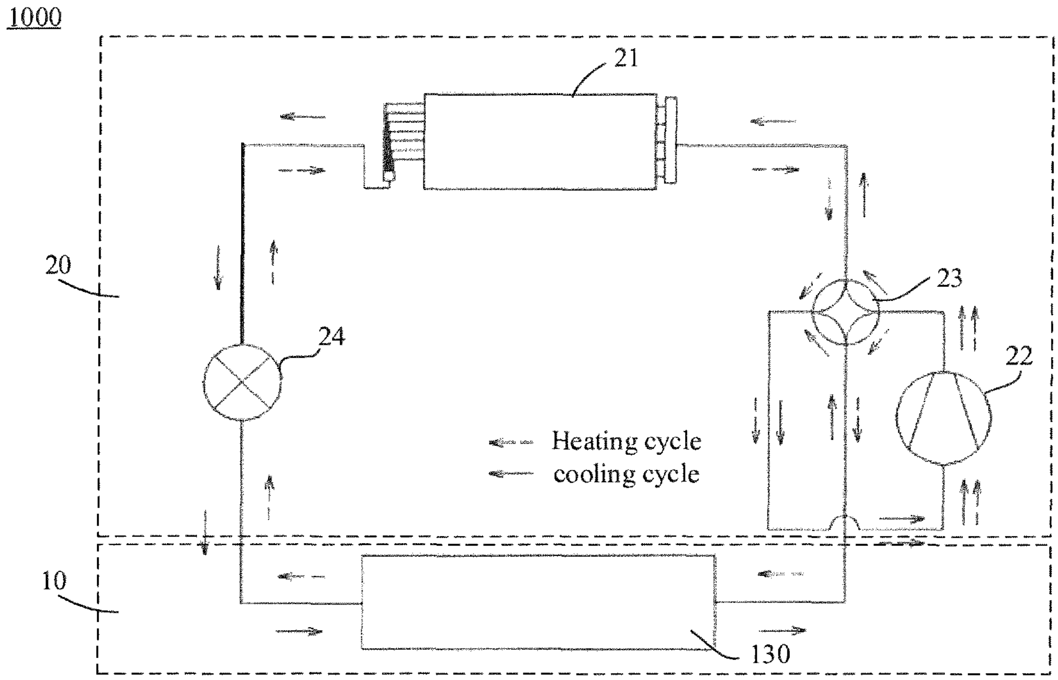

1000
21
20
23
24
22
Heating cycle
cooling cycle
10
130

FIG. 1A

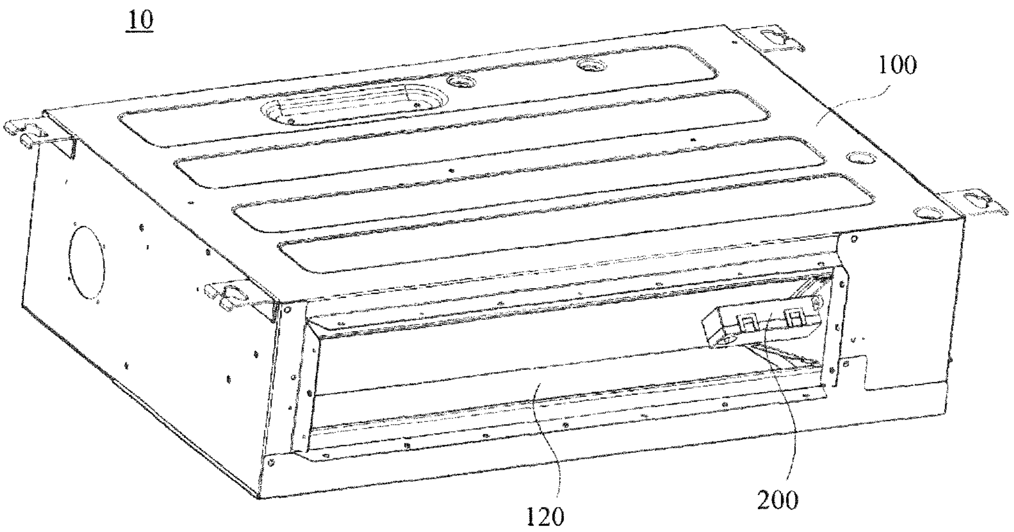
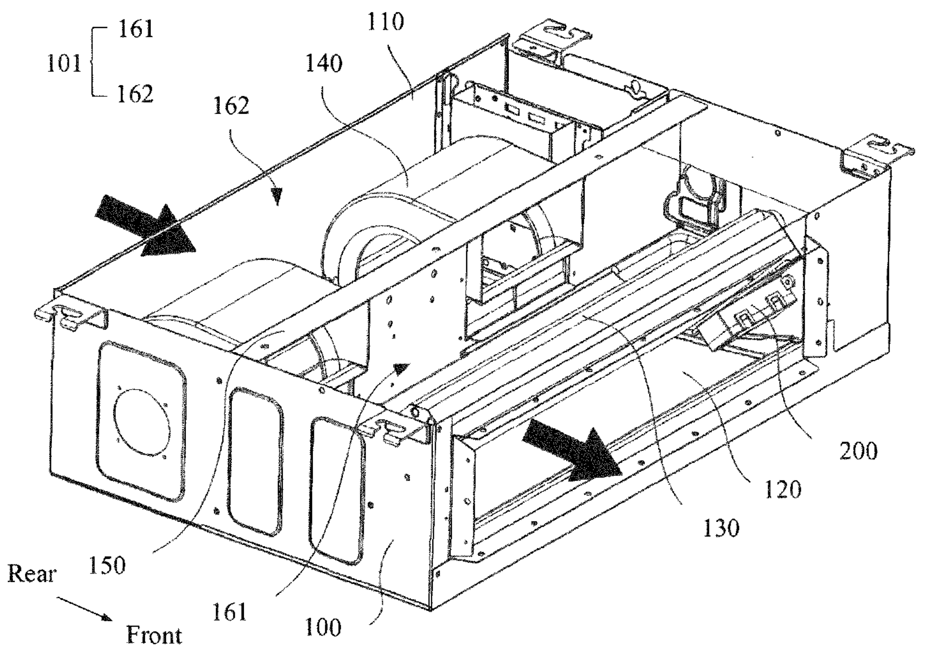
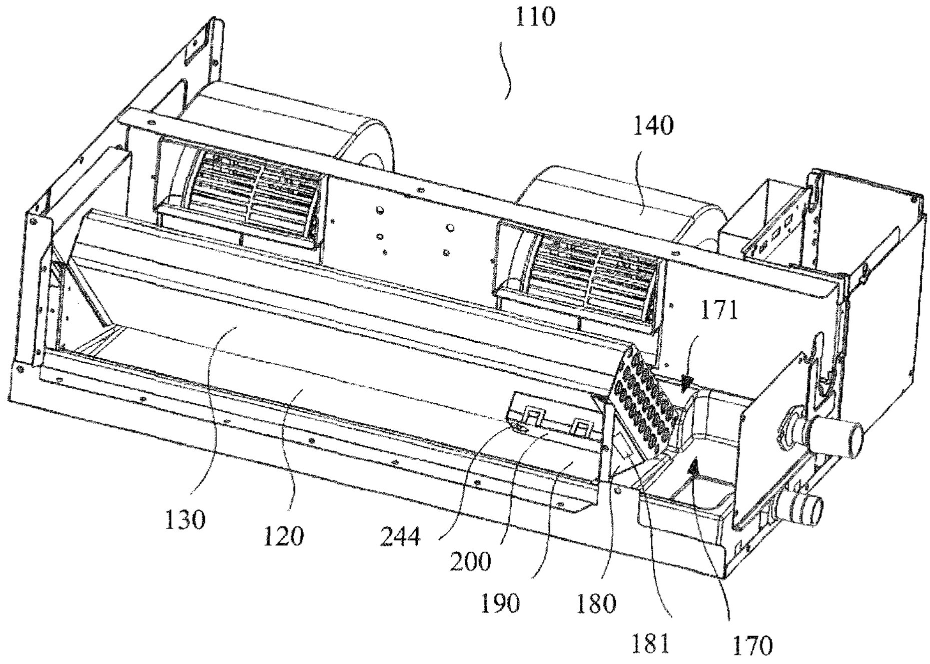

10
100
120
200

FIG. 1B



101
161
162
110
140
162
150
161
100
130
120
200
Rear
Front

FIG. 2



110
140
171
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244
200
190
180
181
170

FIG. 3

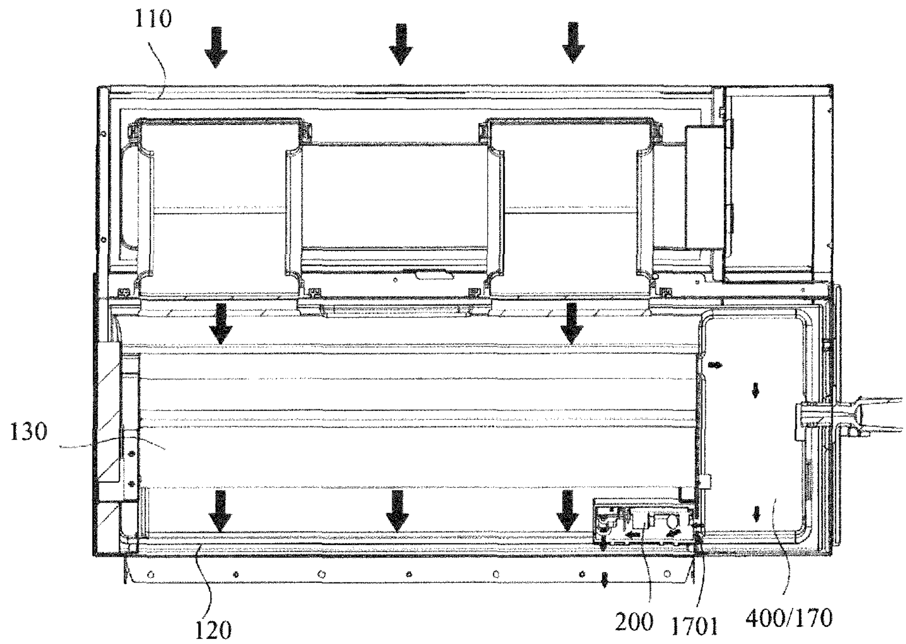


FIG. 4

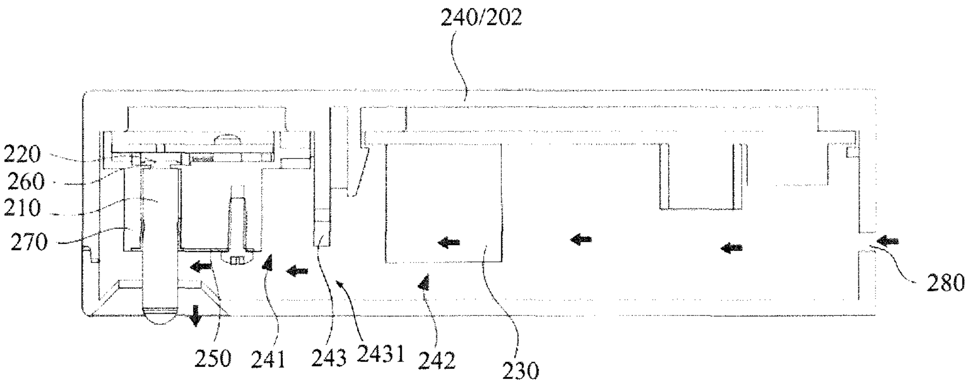


FIG. 5

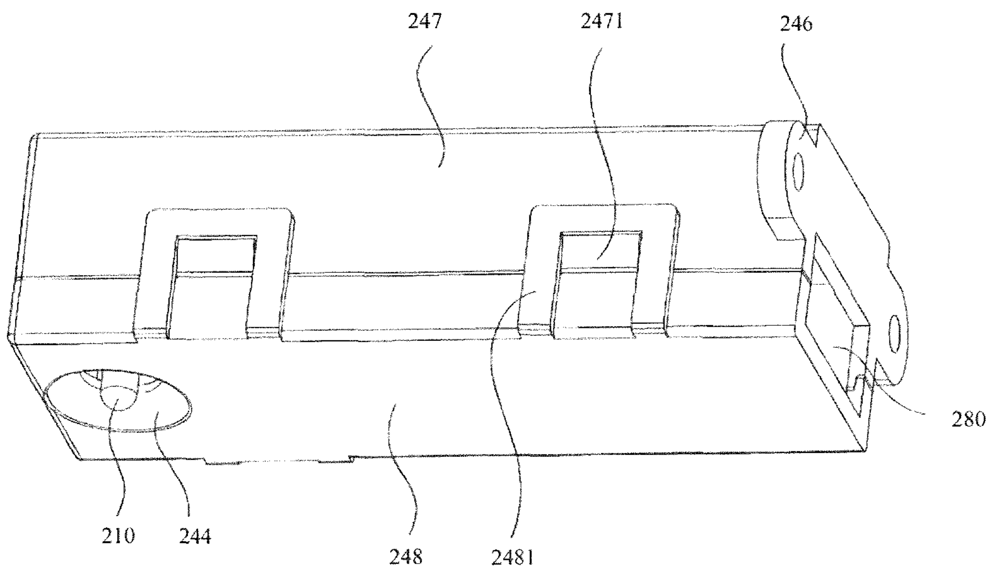
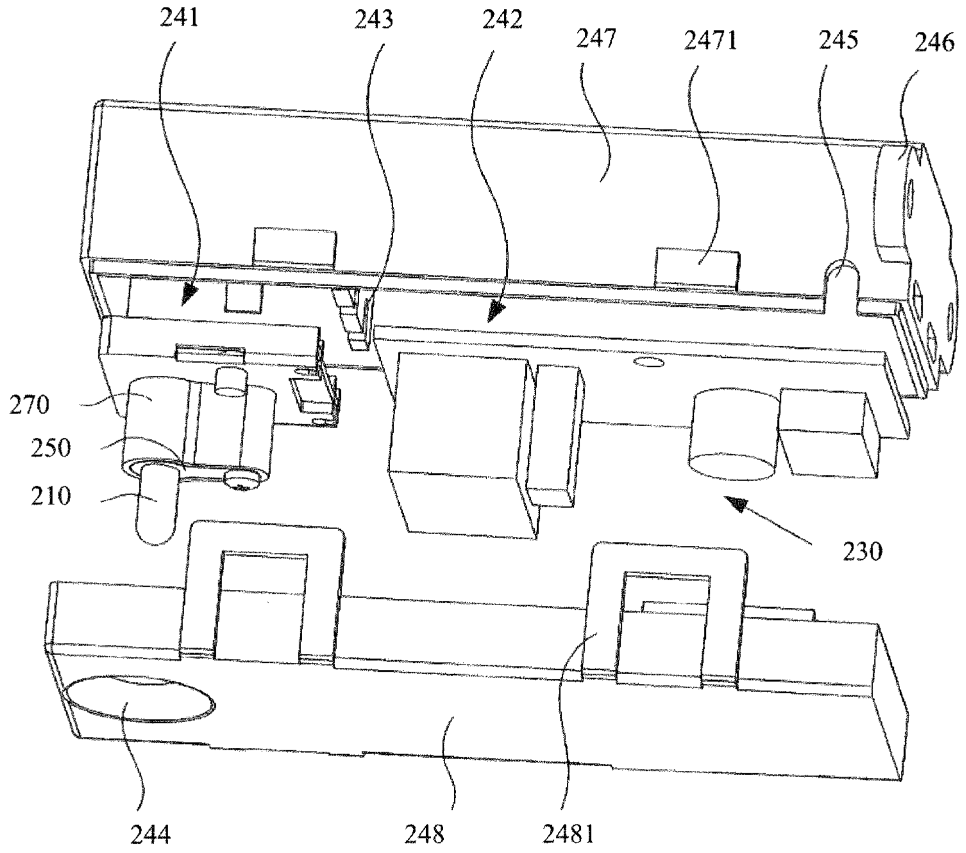


FIG. 6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270
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244
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2481

FIG. 7

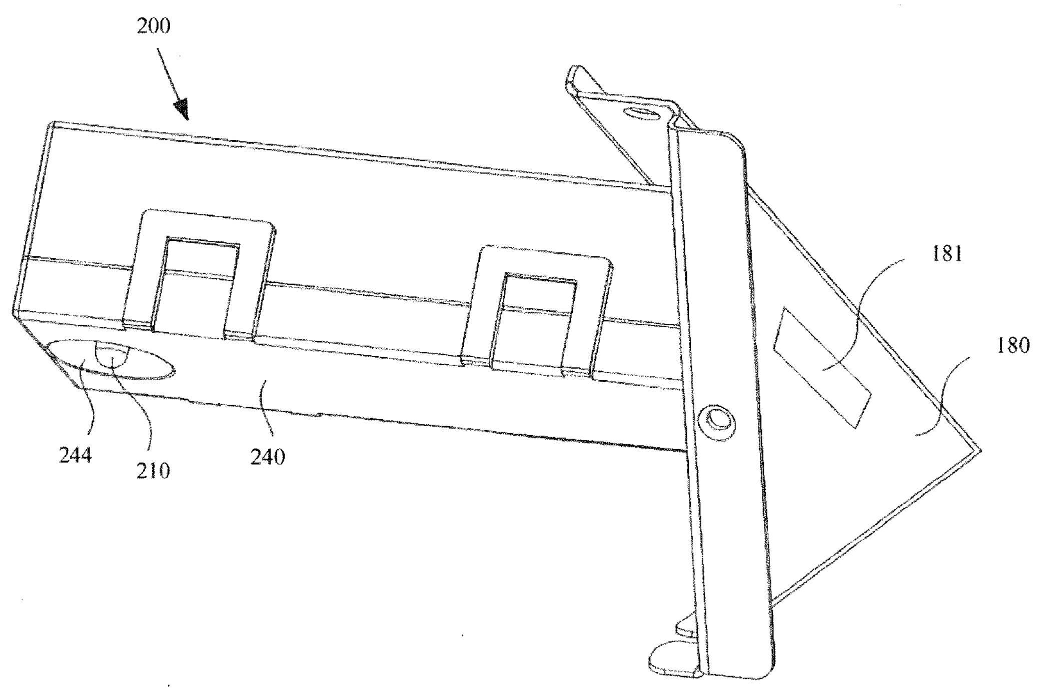

200
181
180
244
210
240

FIG. 8

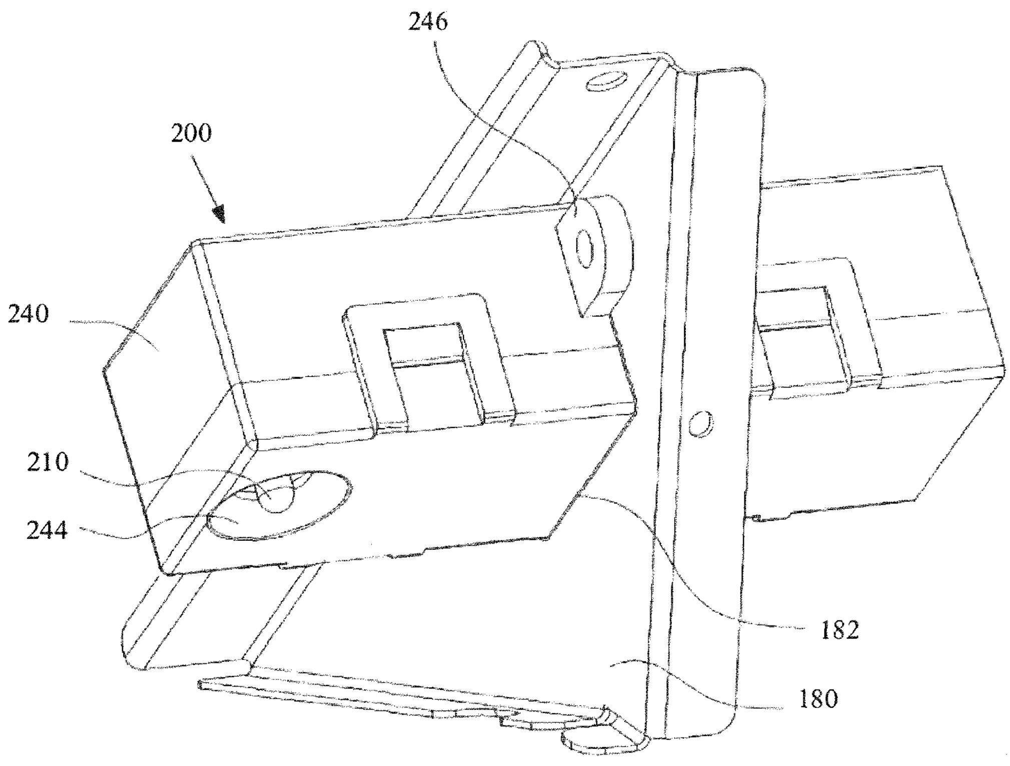


FIG. 9

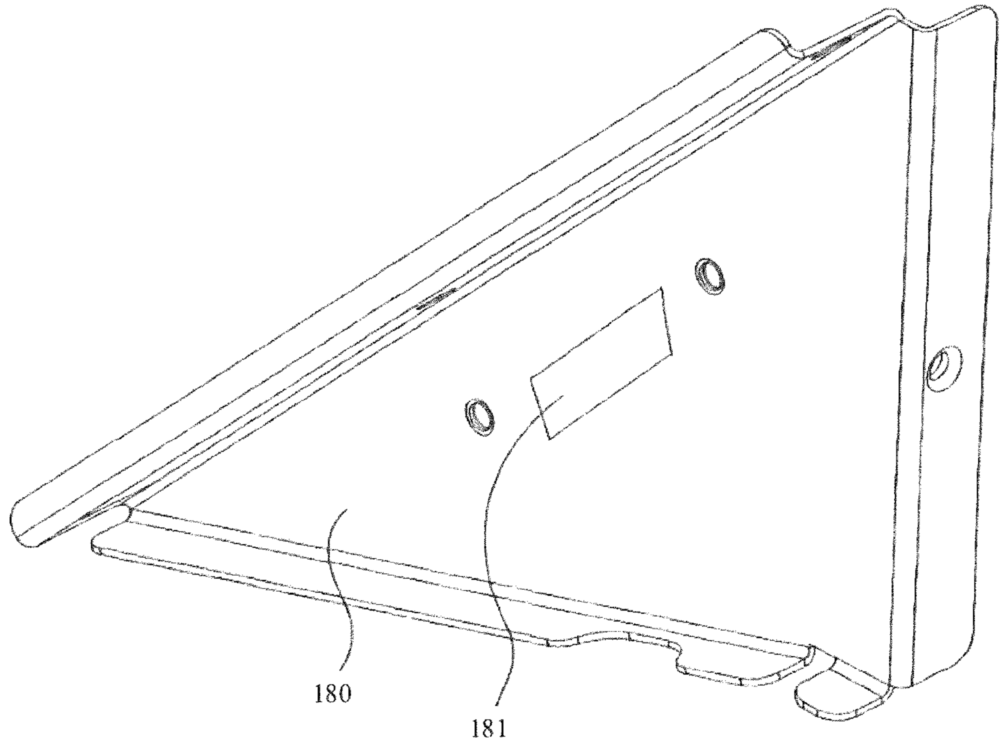


FIG. 10

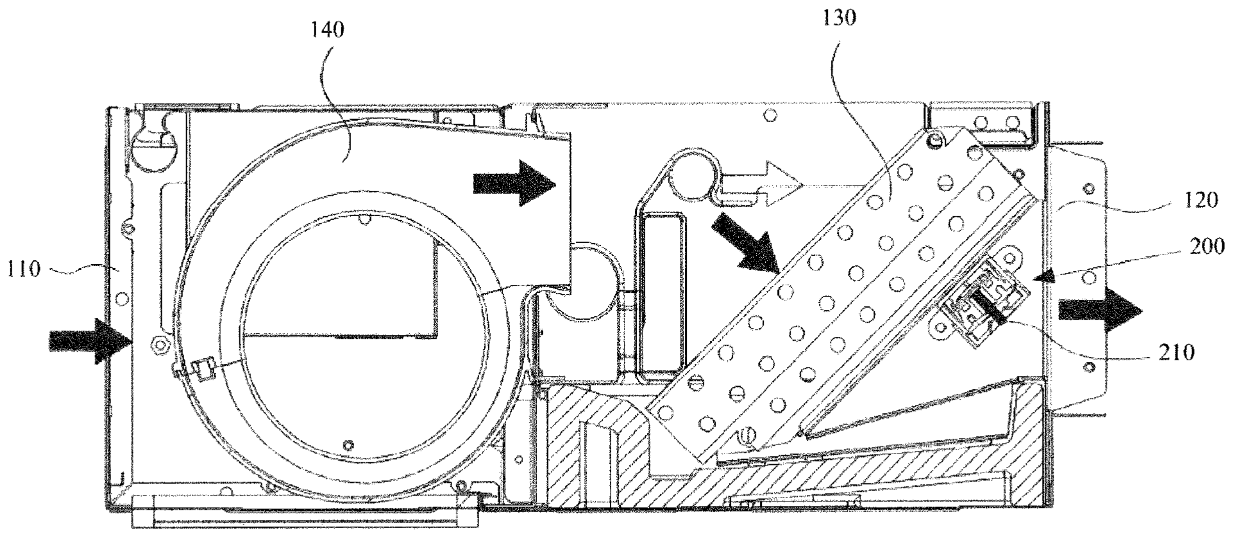


FIG. 11

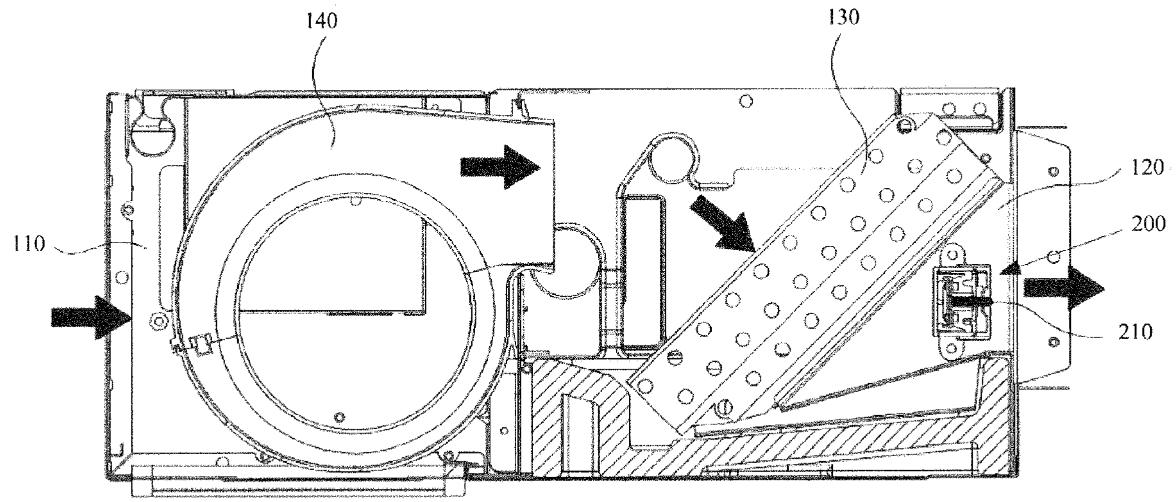


FIG. 12

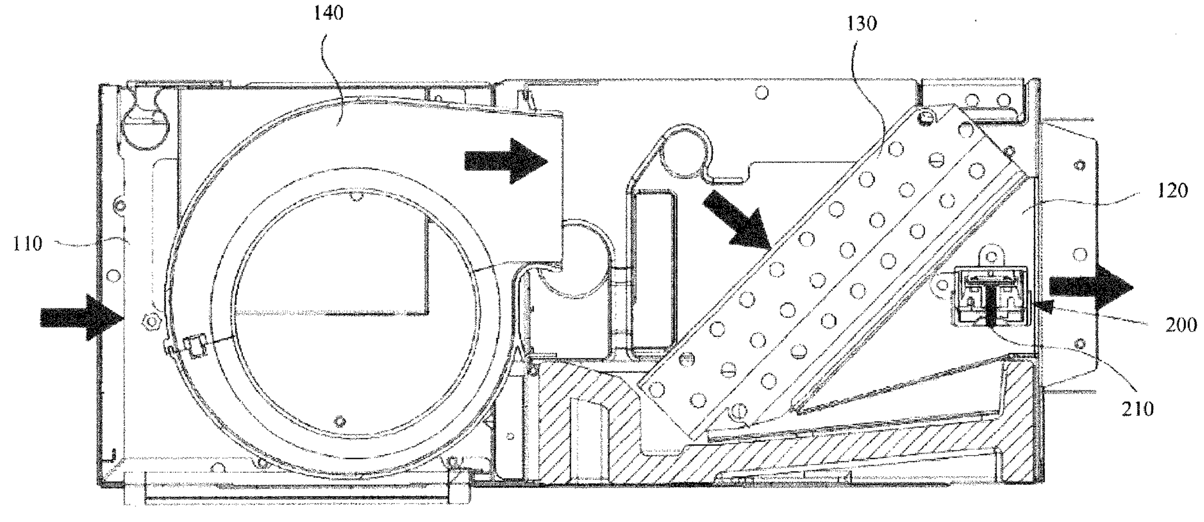


FIG. 13

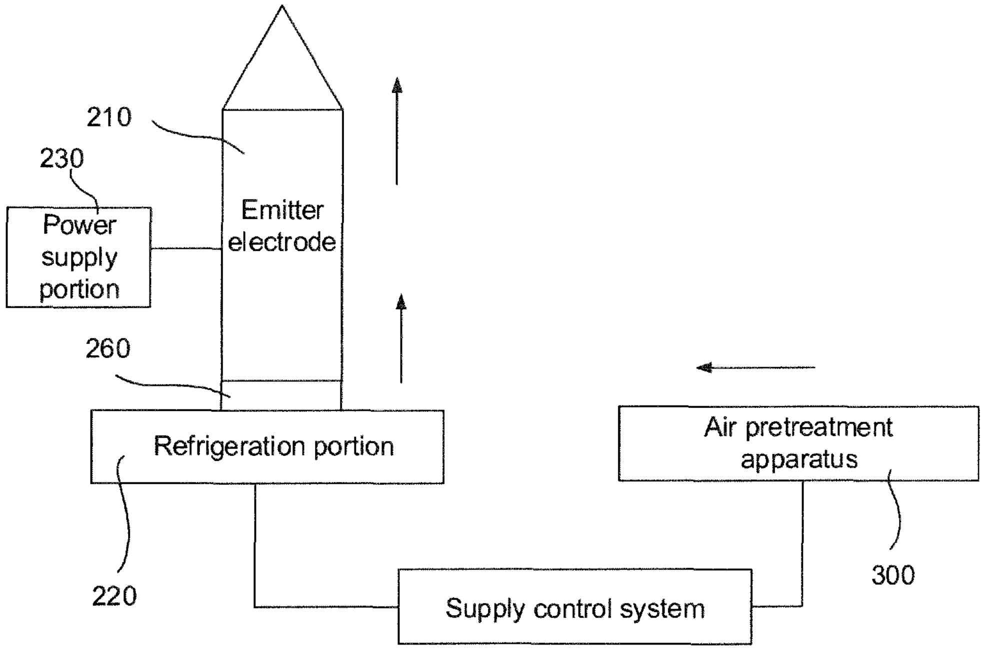
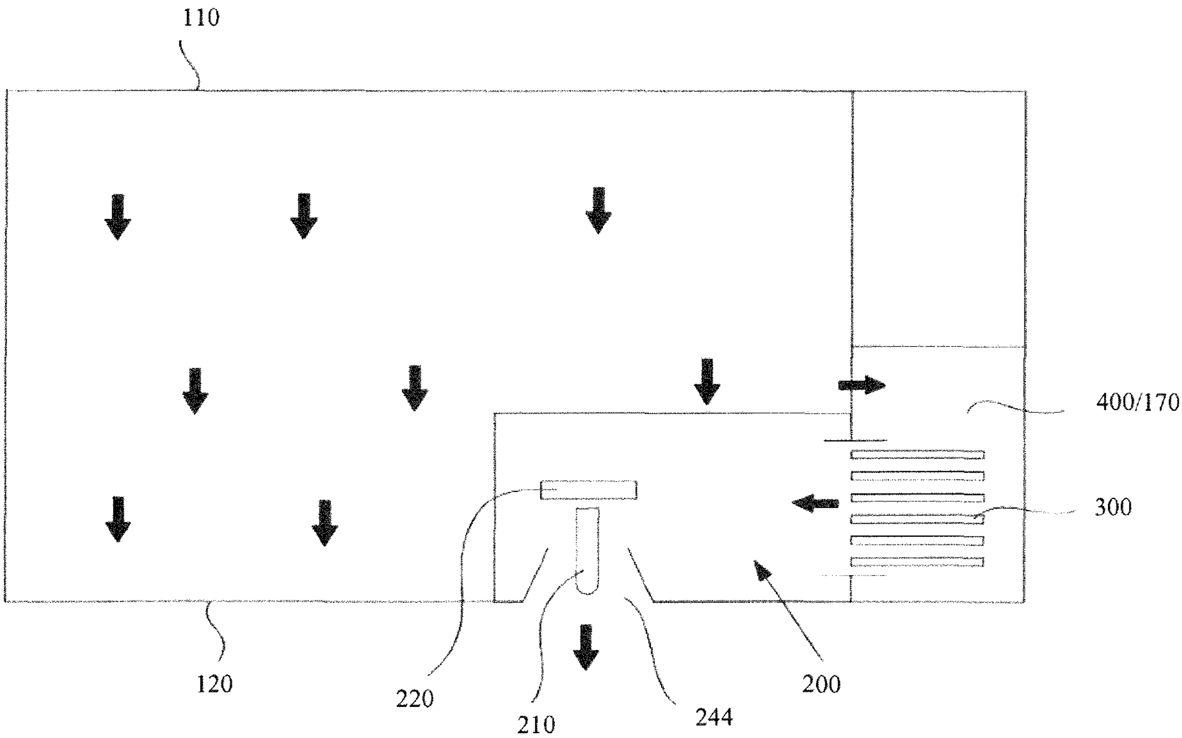

210
230
Power supply portion
Emitter electrode
260
Refrigeration portion
220
Air pretreatment apparatus
300
Supply control system

FIG. 14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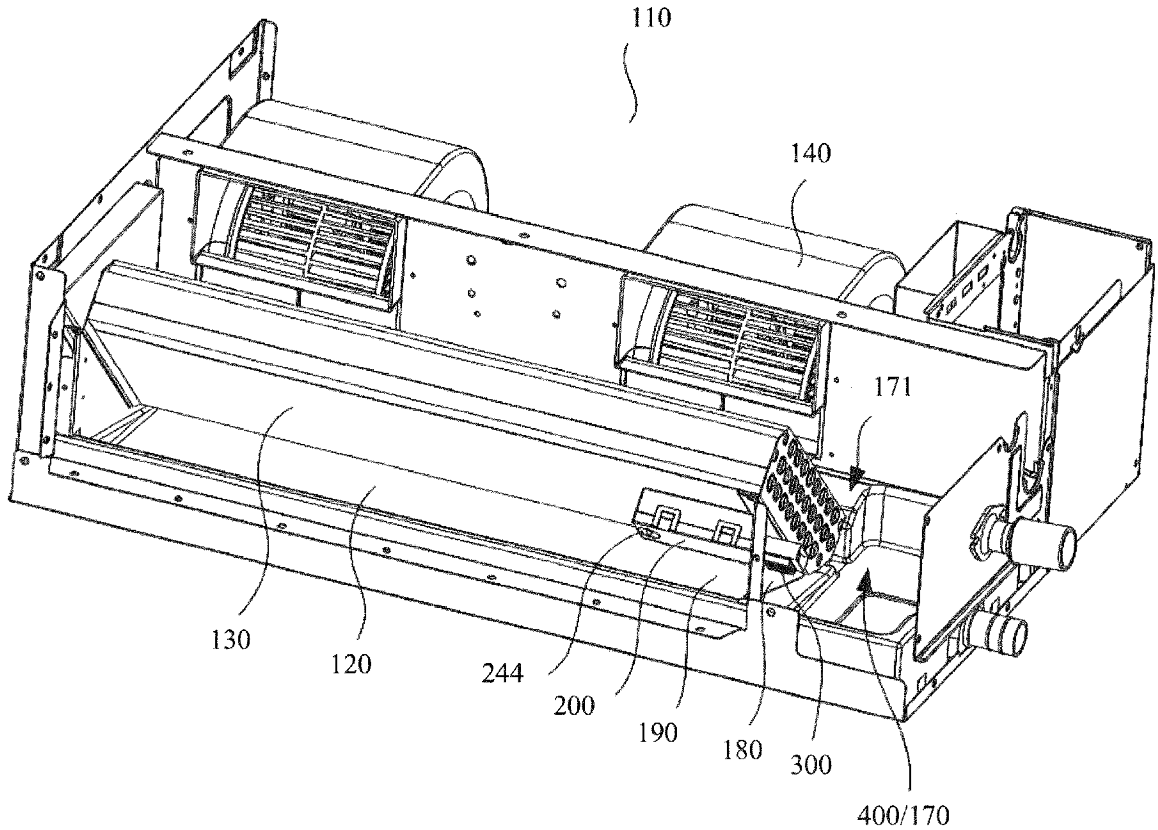
244
200

FIG. 15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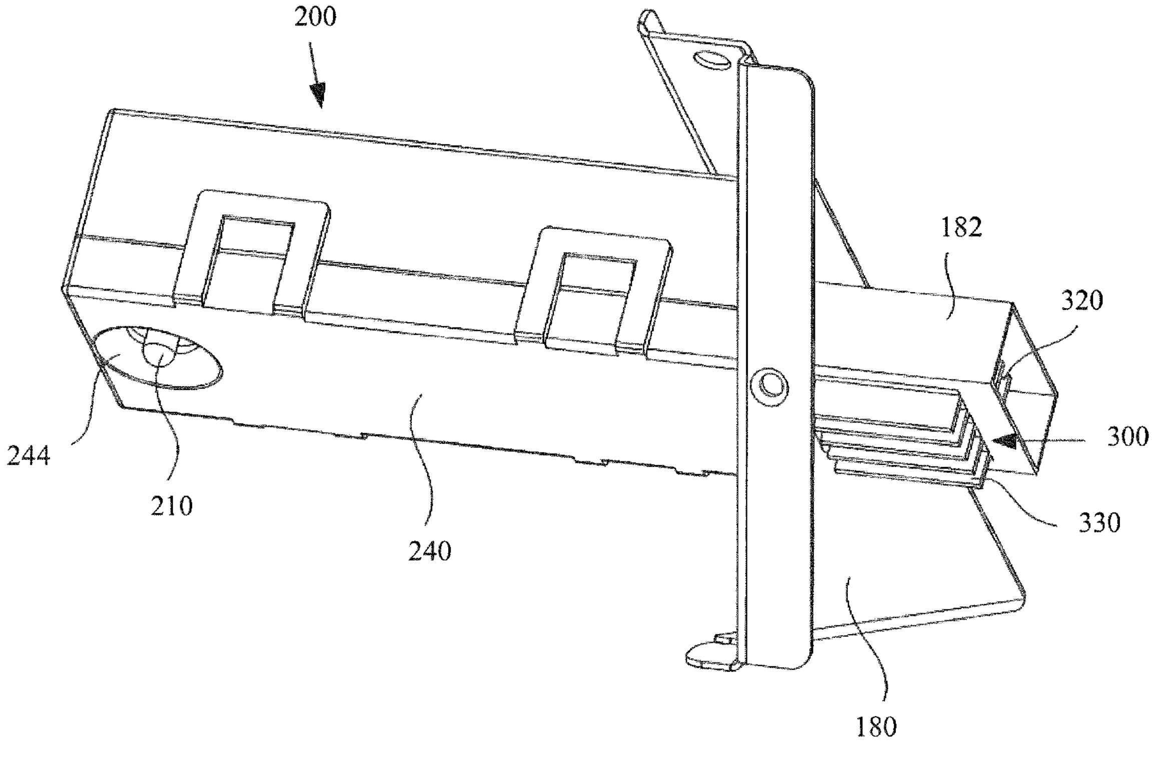
400/170

FIG. 16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180

FIG. 17

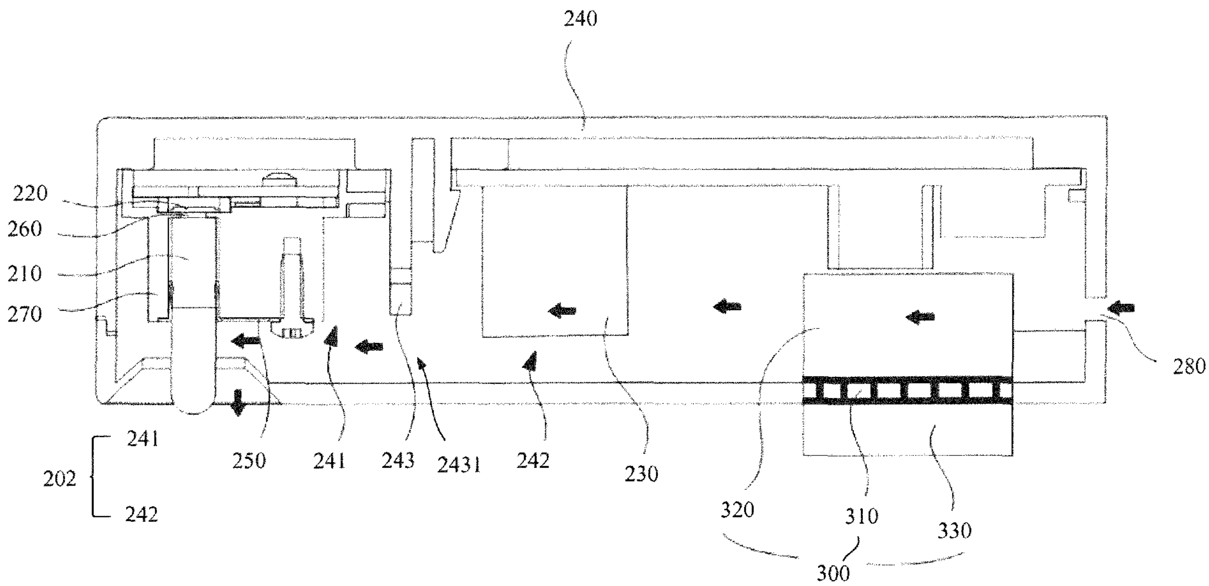
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FIG. 18

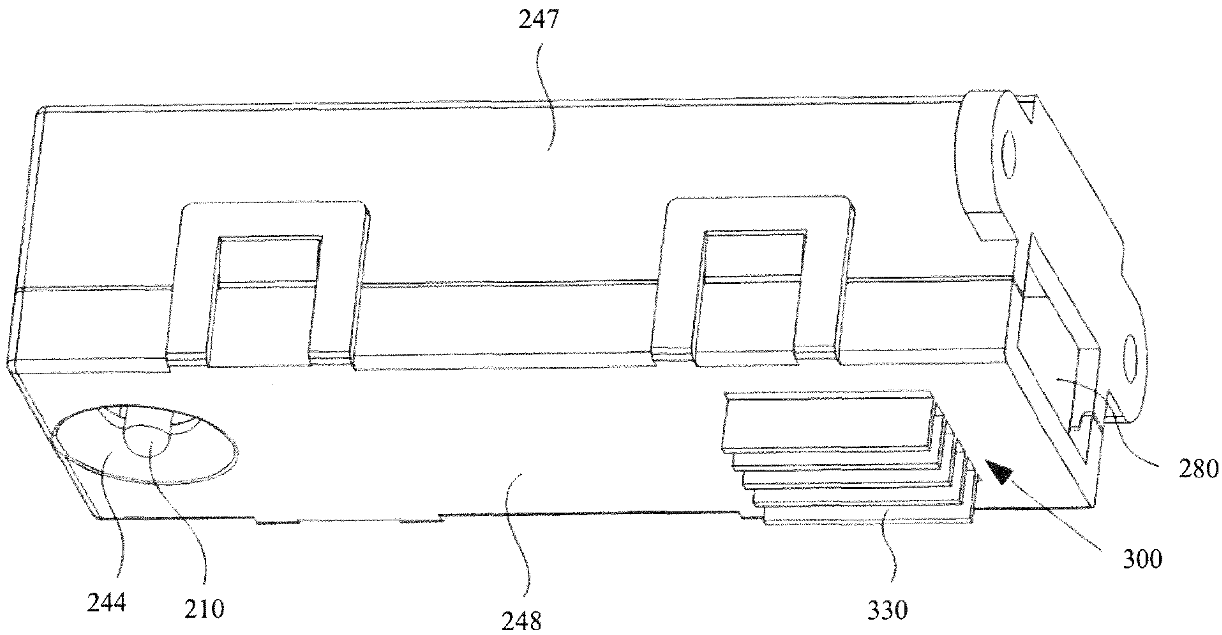
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FIG. 19

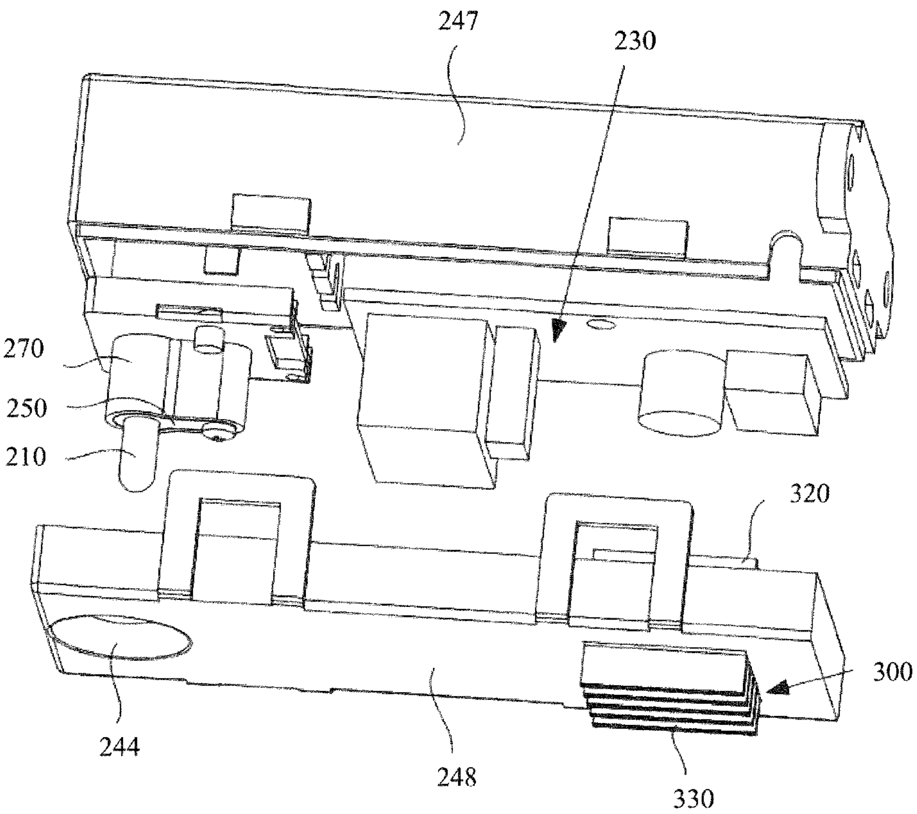

FIG. 20

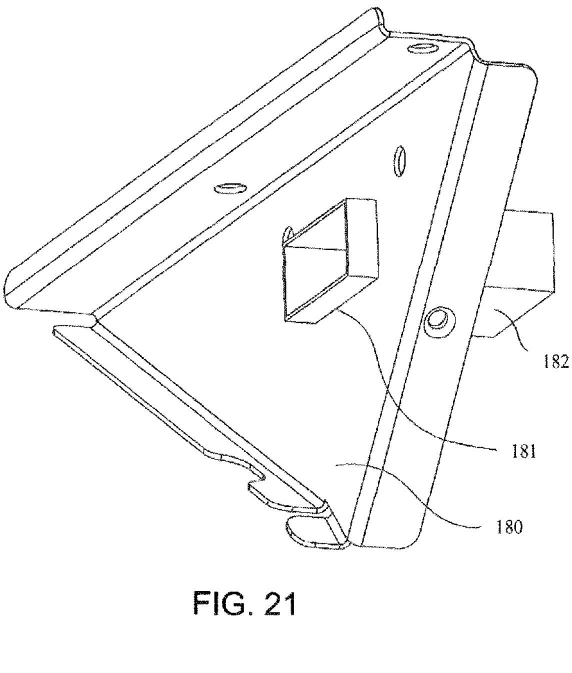

FIG. 21

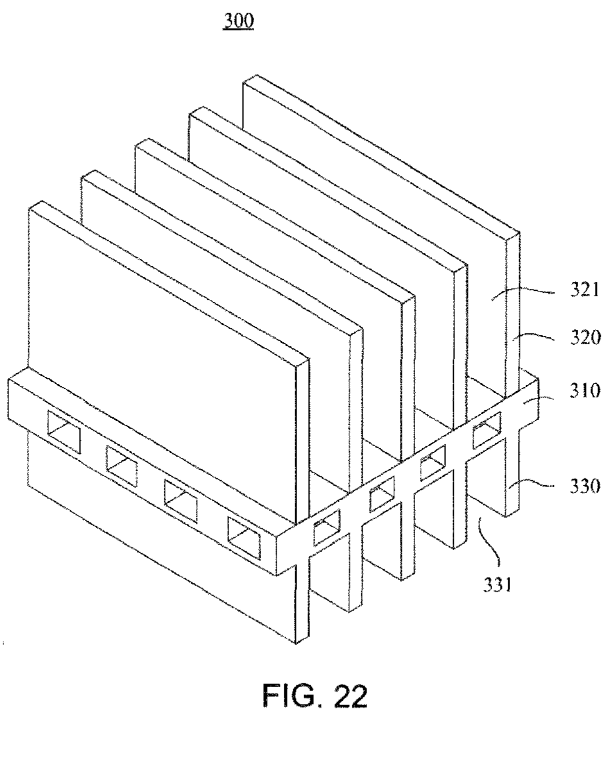

FIG. 22

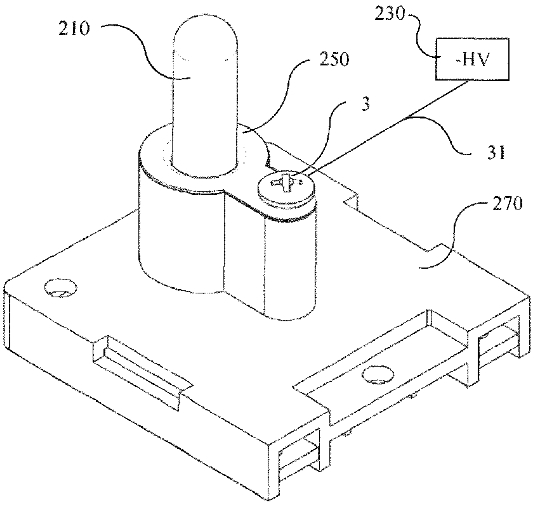

FIG. 23

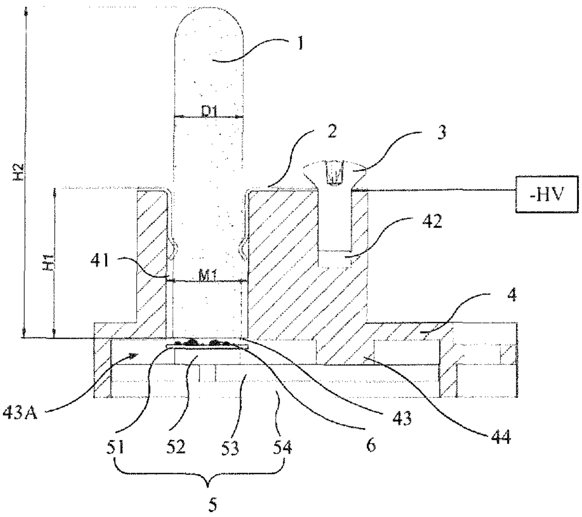

FIG. 24

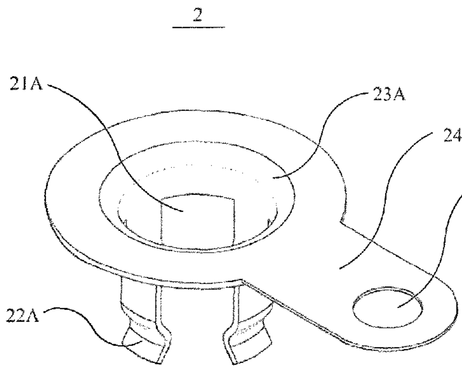

FIG. 25

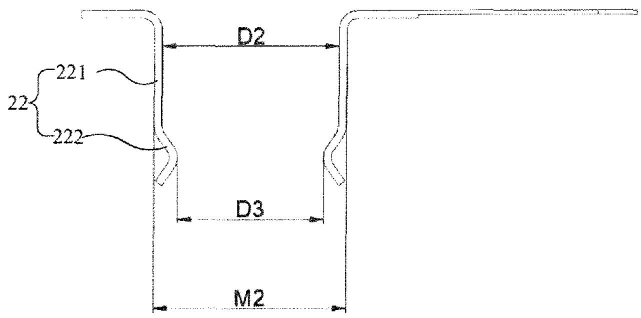

FIG. 26

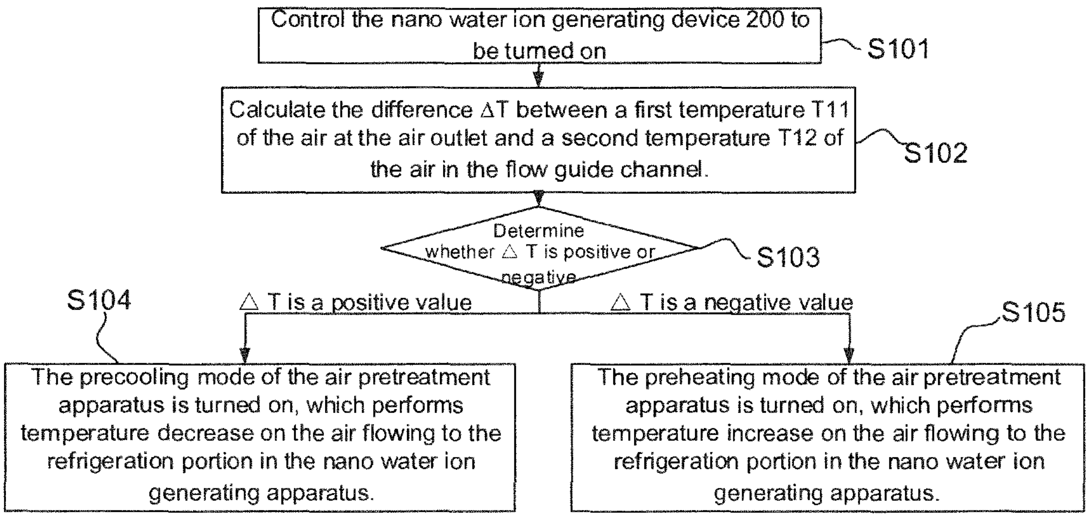

FIG. 27

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/136313

A. CLASSIFICATION OF SUBJECT MATTER

F24F 1/0076(2019.01)i; F24F 8/30(2021.01)i; F24F 13/22(2006.01)i; F25B 21/02(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24F; F25B

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)

CNABS, CNTXT, CNKI, VEN, DWPI, ENTXT, ENTXTC: 青岛海信日立空调, 柴方刚, 孙铁军, 邱倩, 赵玉垒, 空调, 室内机, 纳米, 水离子, 湿度, 不经, 换热, 不流经, 冷凝水, 凝结水, air condition+, ion+, water, emit+ s electrode?, dampness, wetness, moisture, humidity, humidness, condens+, condenat+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 114893828 A (QINGDAO HISENSE HITACHI AIR CONDITIONING SYSTEM CO., LTD.) 12 August 2022 (2022-08-12) description, paragraphs 0028-0104, and figures 1-15	1-20
PX	CN 217082726 U (QINGDAO HISENSE HITACHI AIR CONDITIONING SYSTEM CO., LTD.) 29 July 2022 (2022-07-29) description, paragraphs 0058-0122, and figures 1-13	1-10
A	CN 113719906 A (QINGDAO HISENSE HITACHI AIR CONDITIONING SYSTEM CO., LTD.) 30 November 2021 (2021-11-30) description, paragraphs 0030-0079, and figures 1-6	1-20
A	CN 107894028 A (QINGDAO HISENSE HITACHI AIR CONDITIONING SYSTEM CO., LTD.) 10 April 2018 (2018-04-10) entire document	1-20
A	JP 2002310531 A (IHARA, T.) 23 October 2002 (2002-10-23) entire document	1-20

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"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
11 January 2023	**19 January 2023**

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
Information on patent family members

International application No.
PCT/CN2022/136313

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 114893828 A	12 August 2022	CN 217082727 U	29 July 2022
CN 217082726 U	29 July 2022	None	
CN 113719906 A	30 November 2021	CN 216346688 U	19 April 2022
CN 107894028 A	10 April 2018	CN 107894028 B	13 March 2020
JP 2002310531 A	23 October 2002	None	

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

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- CN 202220715340 **[0001]**
- CN 202210324187 **[0001]**
- CN 202220733579 **[0001]**
- CN 202220731725 **[0001]**