

(22) Date of filing: **27.11.2024**

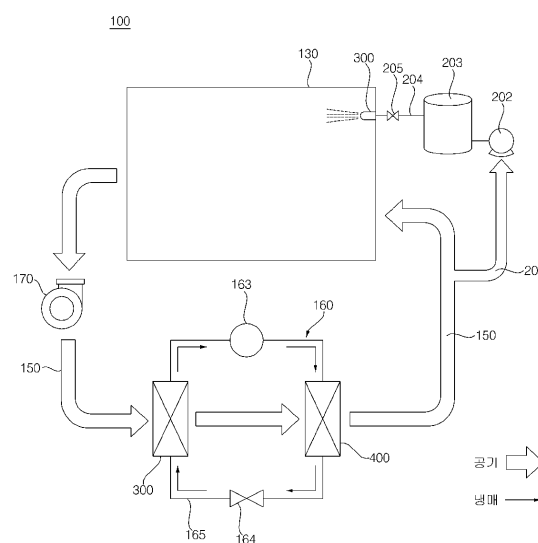
- Lee, Yohan
08592 Seoul (KR)
- Maeng, Heegyu
08592 Seoul (KR)
- Cho, Sangwon
08592 Seoul (KR)
- Park, Taegyun
08592 Seoul (KR)
- Kim, Juhyok
08592 Seoul (KR)

(74) Representative: **Vossius & Partner**
Patentanwälte Rechtsanwälte mbB
Siebertstrasse 3
81675 München (DE)

(72) Inventors:
• **Choi, Jiwon**
08592 Seoul (KR)

(57) A heat exchanger of the present disclosure includes: a plurality of refrigerant tubes through which refrigerant flows; and a fin which is arranged between adjacent refrigerant tubes, conducts heat, and extends in a first direction, wherein the fin includes: a flat portion defining a surface parallel to the first direction; a first mountain portion having a step from the flat portion; and a second mountain portion having a step from the flat portion, wherein the first mountain portion and the second mountain portion are arranged symmetrically with respect to a center of the fin.

Fig. 1



Description

TECHNICAL FIELD

[0001] This disclosure relates to a heat exchanger having excellent heat exchange efficiency without tint or foreign matter being caught between fins.

BACKGROUND

[0002] In general, a heat exchanger can be used as a condenser or evaporator in a refrigeration cycle device consisting of a compressor, a condenser, an expansion device, and an evaporator.

[0003] In addition, a heat exchanger is installed in vehicles, refrigerators, and clothing processing equipments to exchange heat between refrigerant and air.

[0004] In general, a clothing processing equipment is a device that evaporates moisture contained in laundry by blowing hot air generated by a heater into the inside of a drum to dry laundry.

[0005] Depending on a method of processing the moist air that passed through a drum after drying a laundry, a clothing processing equipment can be classified into an exhaust type clothing processing equipment and a condensation type clothing processing equipment.

[0006] The exhaust type clothing processing equipment exhausts the humid air passed through a drum to the outside of the clothing processing equipment. The condensation type clothing processing equipment does not exhaust the humid air passed through a drum to the outside of the clothing processing equipment, but circulates it, and cools the humid air to below a dew point temperature through a condenser to condense the moisture contained in the humid air.

[0007] The condensation type clothing processing equipment heats the condensed water condensed in the condenser by a heater before resupplying it to a drum, and then flows the heated air into the drum. Here, the humid air is cooled during the condensation process, so that a loss of thermal energy contained in the air occurs, and a separate heater, etc., is required to heat it to the temperature required for drying.

[0008] The exhaust-type clothing processing equipment also needs to discharge a high-temperature humid air to the outside and bring in a room temperature outside air to heat it to a required temperature level through a heater or the like. In particular, as drying progresses, the humidity of the air discharged from a drum outlet decreases, thereby losing the heat of the air that is discharged to the outside without being used to dry a drying target in a drum, so that the thermal efficiency is reduced.

[0009] Therefore, recently, a clothing processing equipment having a heat pump cycle that can increase energy efficiency by recovering the energy discharged from a drum and using it to heat the air flowing into the drum has been introduced.

[0010] The condensation type clothing processing

equipment of Patent Document 1 (Korean Publication No. 2016-0069333) includes a drum 1 into which a drying target flows, a circulation duct 2 providing a path for air to circulate through the drum 1, a circulation fan 3 for flowing a circulating air along the circulation duct 2, and a heat pump cycle 4 equipped with an evaporator 5 and a condenser 6 that are installed in series in the circulation duct 2 so that the air circulating along the circulation duct 2 passes through.

[0011] The heat pump cycle 4 may be equipped with a circulation pipe forming a circulation path for refrigerant to circulate through the evaporator 5 and the condenser 6, and a compressor 7 and an expansion valve 8 that are installed in the circulation pipe between the evaporator 5 and the condenser 6.

[0012] The heat pump cycle 4, configured as described above, transmits the heat energy of the air passed through the drum 1 to the refrigerant through the evaporator 5, and then transmits the heat energy of the refrigerant to the air flowing into the drum 1 through the condenser 6.

[0013] Here, one of the evaporator and the condenser uses a general microchannel heat exchanger, and the fins of the microchannel are formed with a louver to increase heat exchange efficiency. However, since such a louver has many shapes that are open in the direction of air flow, there is a problem in that small pieces of clothing (tints) are get caught in the louver, thereby hindering the air flow and reducing the heat exchange efficiency.

[0014] In the case of Patent Document 2 (Korean Patent Publication No. 10-2391896), it discloses a corrugated fin in which a convex line 4 and a concave line 5 are alternately arranged in parallel, but in the case of Patent Document 2 (Korean Patent Publication No. 10-2391896), there is a problem in that the optimal heat exchange efficiency cannot be achieved with a shape that simply alternately arranges the convex line and the concave line.

SUMMARY

[0015] The disclosure has been made in view of the above problems, and may provide a heat exchanger that suppresses tint from being caught in a fin of a microchannel condenser in a machine room of a clothing processing equipment and improves heat exchange efficiency.

[0016] The disclosure may further provide a heat exchanger that suppresses tint from being caught in a fin of a microchannel condenser in a machine room of a clothing processing equipment, improves the reliability of the heat exchanger, and improves the rigidity of the fin.

[0017] The disclosure may further provide a clothing processing equipment that suppresses tint from being caught in a fin of a microchannel condenser in a machine room of a clothing processing equipment and improves heat exchange efficiency.

[0018] The disclosure may further provide a clothing

processing equipment that simultaneously uses a micro-channel condenser and a fin-tube evaporator in a machine room of a clothing processing equipment, improves heat exchange performance, and reduces airflow resistance.

[0019] The problems of the present disclosure are not limited to the problems mentioned above, and other problems not mentioned can be clearly understood by those skilled in the art from the description below.

[0020] The heat exchanger according to the present disclosure includes two mountain portions in the fin, and two mountain portions are arranged symmetrically with respect to the center of the fin.

[0021] In addition, the heat exchanger according to another embodiment of the present disclosure includes three mountain portions in the fin, and two mountain portions protrude in the opposite direction to the remaining one mountain portion and are arranged symmetrically with respect to the center of the fin.

[0022] In accordance with an aspect of the present disclosure, a heat exchanger includes: a plurality of refrigerant tubes through which refrigerant flows; and a fin which is arranged between adjacent refrigerant tubes, conducts heat, and extends in a first direction, in which the fin includes: a flat portion defining a surface parallel to the first direction; a first mountain portion having a step from the flat portion; and a second mountain portion having a step from the flat portion, in which the first mountain portion and the second mountain portion are arranged symmetrically with respect to a center of the fin.

[0023] The flat portion is arranged to surround the first mountain portion and the second mountain portion.

[0024] The first mountain portion and the second mountain portion protrude in the same direction from the flat portion.

[0025] One end of the first mountain portion is connected to one end of the second mountain portion.

[0026] The first mountain portion includes a plurality of inclined surfaces having an incline with respect to the first direction.

[0027] The second mountain portion includes a plurality of inclined surfaces having an incline with respect to the first direction.

[0028] The first mountain portion includes: a first inclined surface having an incline with respect to the first direction; a second inclined surface which has an incline with respect to the first direction, and has one end connected to the first inclined surface; a third inclined surface which has an incline in the first direction, and is connected to the first inclined surface and the second inclined surface; and a fourth inclined surface which has an incline in the first direction, and is connected to the first inclined surface and the second inclined surface.

[0029] In the first direction, a length of the second inclined surface is longer than a length of the first inclined surface.

[0030] The first mountain portion further includes a first top portion having the highest height in the first mountain

portion, in which the first top portion is a portion connecting the first inclined surface and the second inclined surface, and extends in a direction intersecting with the first direction.

[0031] The first top portion is connected to the third inclined surface and the fourth inclined surface, both ends of the first top portion in the first direction are connected to the first inclined surface and the second inclined surface, respectively, and both ends of the first top portion in a second direction intersecting with the first direction are connected to the third inclined surface and the fourth inclined surface, respectively.

[0032] A length of the first top portion in the second direction is longer than a length of the first top portion in the first direction.

[0033] The second inclined surface is located closer to the second mountain portion than the first inclined surface.

[0034] A height of the first mountain portion or the second mountain portion is greater than a thickness value of the flat portion.

[0035] The length of the first top portion in the second direction is greater than a height of the first mountain portion or a height of the second mountain portion.

[0036] An inclination angle of the first inclined surface is greater than an inclination angle of the second inclined surface.

[0037] In addition, in accordance with another aspect of the present disclosure, a heat exchanger includes: a plurality of refrigerant tubes through which refrigerant flows; and a fin which is arranged between adjacent refrigerant tubes, conducts heat, and extends in a first direction, in which the fin includes: a flat portion defining a surface parallel to the first direction; a first mountain portion protruding in a second direction intersecting with the first direction from the flat portion; a second mountain portion protruding in the second direction from the flat portion; and a third mountain portion protruding in a direction opposite to the second direction from the flat portion at between the first mountain portion and the second mountain portion, in which the first mountain portion and the second mountain portion are arranged symmetrically with respect to the third mountain portion.

[0038] The flat portion is arranged to surround the first mountain portion, the second mountain portion, and the third mountain portion.

[0039] One end of the third mountain portion is connected to the first mountain portion, and the other end of the third mountain portion is connected to the second mountain portion.

[0040] The first mountain portion includes a plurality of inclined surfaces having an incline with respect to the first direction, in which the second mountain portion includes a plurality of inclined surfaces having an incline with respect to the first direction, in which a partial inclined surface of the first mountain portion and a partial inclined surface of the second mountain portion define the third mountain portion.

[0041] In addition, in accordance with another aspect of the present disclosure, a heat exchanger includes: a plurality of refrigerant tubes through which refrigerant flows; and a fin which is arranged between adjacent refrigerant tubes, conducts heat, and extends in a first direction, in which the fin includes: a flat portion defining a surface parallel to the first direction; a first top line protruding in a direction intersecting with the first direction from the flat portion; a second top line protruding in a direction intersecting with the first direction from the flat portion; and a third top line protruding in a direction from the flat portion at between the first top line and the second top line, in which the first top line and the third top line are connected to each other by an inclined surface, the second top line and the third top line are connected to each other by an inclined surface, and the third top line protrudes from the flat portion in a direction opposite to the first top line and the second top line.

BRIEF DESCRIPTION OF THE DRAWINGS

[0042] The above and other objects, features and advantages of the present disclosure will be more apparent from the following detailed description in conjunction with the accompanying drawings, in which:

FIG. 1 is a schematic diagram showing the flow of air and refrigerant in a clothing processing equipment according to an embodiment of the present disclosure;

FIG. 2 is a schematic diagram showing the configuration of a clothing processing equipment according to an embodiment of the present disclosure;

FIG. 3 is a diagram showing a machine room and an air passage portion of a clothing processing equipment according to an embodiment of the present disclosure;

FIG. 4 is a diagram showing an evaporator and a condenser shown in FIG. 3;

FIG. 5 is a perspective view showing a condenser shown in FIG. 3;

FIG. 6 is a cross-sectional view showing the refrigerant tube and fin of the condenser shown in FIG. 3;

FIG. 7 is an enlarged view of a partial area of FIG. 6;

FIG. 8 is a perspective view of FIG. 7;

FIG. 9 is a diagram viewing FIG. 8 from the air flow direction;

FIG. 10 is a plan view of the fin shown in FIG. 8;

FIG. 11 is a side view of the fin shown in FIG. 10;

FIG. 12 is a cross-sectional view taken along line 12-12' of the fin shown in FIG. 10;

FIG. 13 is a partial diagram of a condenser according to another embodiment of the present disclosure;

FIG. 14 is a plan view of the fin shown in FIG. 13;

FIG. 15 is a side view of the fin shown in FIG. 14;

FIG. 16 is a cross-sectional view taken along line 16-16' of the fin shown in FIG. 14; and

FIG. 17 is a cross-sectional view taken along line

17-17' of the fin shown in FIG. 14.

DETAILED DESCRIPTION

[0043] Advantages and features of the present invention and methods for achieving those of the present invention will become apparent upon referring to embodiments described later in detail with reference to the attached drawings. However, embodiments are not limited to the embodiments disclosed hereinafter and may be embodied in different ways. The embodiments are provided for perfection of disclosure and for informing persons skilled in this field of art of the scope of the present invention. The same reference numerals may refer to the same elements throughout the specification.

[0044] Spatially-relative terms such as "below", "beneath", "lower", "above", or "upper" may be used herein to describe one element's relationship to another element as illustrated in the Figures. It will be understood that spatially-relative terms are intended to encompass different orientations of the device in addition to the orientation depicted in the Figures. For example, if the device in one of the figures is turned over, elements described as "below" or "beneath" other elements would then be oriented "above" the other elements. The exemplary terms "below" or "beneath" can, therefore, encompass both an orientation of above and below. Since the device may be oriented in another direction, the spatially-relative terms may be interpreted in accordance with the orientation of the device.

[0045] The terminology used in the present invention is for the purpose of describing particular embodiments only and is not intended to limit the disclosure. As used in the disclosure and the appended claims, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0046] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and the present invention, and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0047] In the drawings, the thickness or size of each layer is exaggerated, omitted, or schematically illustrated for convenience of description and clarity. Also, the size or area of each constituent element does not entirely reflect the actual size thereof.

[0048] Hereinafter, exemplary embodiments of the present invention will be described with reference to the accompanying drawings.

[0049] FIG. 1 is a schematic diagram showing the flow of air and refrigerant in a clothing processing equipment according to an embodiment of the present disclosure, and FIG. 2 is a schematic diagram showing a configuration of a clothing processing equipment according to an embodiment of the present disclosure.

[0050] Referring to FIG. 1 and FIG. 2, a clothing processing equipment 100 according to the present disclosure is an example of a drum-type dryer, and may be configured to include a cabinet 110, a drum 130, a driving unit (not shown), a blower fan 170, and a heat pump 160, and the air of the drum 130 is connected to the heat pump 160 by an air path 150.

[0051] Here, the cabinet 110 may include a door 112 provided on a front side to insert clothing while forming an outer shape of a product, and a base 114 on which an internal configuration of the clothing processing equipment 100 is installed.

[0052] Meanwhile, the drum 130 may rotate around a rotation axis that is arranged horizontally or inclined at a certain angle inside the cabinet. Meanwhile, the drum 130 has a hollow cylindrical shape, and provides an accommodation space for drying clothing, which are drying target, by putting the clothing into the space.

[0053] The drum 130 is formed in a cylindrical shape having front and rear sides that are open. The drum 130 has a front support portion 132 that rotatably supports the drum 130 at a front side. In addition, the drum 130 has a rear support portion 133 that rotatably supports the drum 130 at a rear side.

[0054] In addition, a front roller 142 and a rear roller 143 in the form of roller that rotatably support the drum 130 may be additionally provided at the front and rear lower portions of the drum 130. That is, the front support portion 132 and the rear support portion 133 block the front and rear surfaces of the drum 130 to form a drying space for drying target, and at the same time, serve to support the front and rear ends of the drum 130.

[0055] Meanwhile, an inlet 132b for inserting the drying target into the drum 130 is formed in the front support portion 132, and the inlet is selectively opened and closed by the door 112. In addition, an air discharge port 132a to which an air path 150 described later is connected is located at the lower portion of the front support portion 132. A suction port 151 of air path 150 described later is provided in the air discharge port 132a to communicate.

[0056] In addition, an air inlet 133a formed with a plurality of holes is formed in the rear support portion 133 so that air is supplied to the drum 130. The air inlet 133a is provided so that an exhaust path 152 of the air path 150 described later is communicated.

[0057] Here, in order to efficiently dry the clothing, which are the objects to be dried, a lifter 131a for tumbling the clothing that is put in may be further provided on the inner surface of the drum 130.

[0058] In addition, a driving unit provides rotational power by using a motor (not shown), and the output shaft of the motor and the drum 130 are connected by a power transmission means such as a belt, and the rotational power of the motor is transmitted to the drum 130, thereby rotating the drum 130.

[0059] In addition, the air path 150 may be connected to the drum 130 to form a closed loop for air circulation. For example, the air path 150 may be formed in the form of duct. The suction path 151 for air discharge is formed at the lower portion of the front support portion 132 of the drum 130, and the exhaust path 152 for air supply is formed at the rear support portion 133 of the drum 130.

[0060] Meanwhile, the blower fan 170 may be installed inside the air path 150 extending from the suction path 151 to an evaporator 300 of the heat pump 160, or installed inside the air path 150 extending from the condenser 400 of the heat pump 160 to the exhaust path 152.

[0061] Here, the blower fan 170 may be driven by a separate fan motor, and may apply power to the air to pass it through the inside of the drum 130, and may circulate the air discharged from the drum 130 back into the drum 130.

[0062] In addition, a lint filter 162 (see FIG. 3) for filtering a lint in the circulating air is installed in the suction path 151. The lint filter 162 may capture the lint contained in the air as the air sucked from the drum 130 passes through the suction path 151.

[0063] Therefore, the clothing (also called 'cloth') evaporates moisture by a hot air supplied into the drum 130, and the air passing through the drum 130 is discharged from the drum 130 while containing the moisture evaporated from the clothing. The high-temperature and humid air discharged from the drum 130 moves along the air path 150, receives heat from the heat pump 160 to be heated, and then is circulated to the drum 130.

[0064] Meanwhile, the heat pump 160 is configured to include an evaporator 300, a compressor 163, a condenser 400, and an expansion valve 164. The heat pump 160 may use a refrigerant as a working fluid. The refrigerant moves along a refrigerant pipe 165, and the refrigerant pipe 165 forms a closed loop for the circulation of the refrigerant. The evaporator 300, the compressor 163, the condenser 400, and the expansion valve 164 are connected by the refrigerant pipe 165, so that the refrigerant passes through the evaporator 300, the compressor 163, the condenser 400, and the expansion valve 164 in sequence.

[0065] Here, the evaporator 300 is installed in the air path 150 so as to be connected to a drum outlet, and heat-exchanges the air discharged from the drum outlet with the refrigerant, thereby recovering the heat of the air discharged from the drum 130 without discharging it to the outside of a dryer.

[0066] In addition, the condenser 400 is installed in the air path 150 so as to be connected to a drum inlet, and heat-exchanges the air passing through the evaporator 300 with the refrigerant, thereby dissipating the heat of

the refrigerant absorbed in the evaporator 300 to the air to be flowed into the drum 130.

[0067] The compressor 163 compresses the refrigerant evaporated in the evaporator 300 to create a high-temperature, high-pressure refrigerant, and moves the high-temperature, high-pressure refrigerant to the condenser 400 along the refrigerant pipe 165. The compressor 163 may be an inverter-type compressor 163 capable of varying a frequency to control the discharge amount of the refrigerant.

[0068] The expansion valve 164 is installed in the refrigerant pipe 165 extending from the condenser 400 to the evaporator 300, and expands the refrigerant condensed in the condenser 400 to make a low-temperature, low-pressure refrigerant and transmits it to the evaporator 300.

[0069] Looking at the movement path of the refrigerant according to a configuration, the refrigerant is flowed into the compressor 163 in a gaseous state and becomes high-temperature, high-pressure by compression of the compressor 163, and the high-temperature, high-pressure refrigerant is flowed into the condenser 400 and changed from a gaseous state to a liquid state as the condenser 400 dissipates heat to the air.

[0070] Next, the liquid refrigerant flows into the expansion valve 164 and is changed into low-temperature, low-pressure by a wire drawing effect of the expansion valve 164 (or including a capillary tube, etc.), and the low-temperature, low-pressure liquid refrigerant flows into the evaporator 300 and absorbs heat from the air in the evaporator 300, thereby evaporating the refrigerant from the liquid state into the gas state.

[0071] As described above, the heat pump 160 repeatedly circulates the refrigerant in the order of the compressor 163, the condenser 400, the expansion valve 164, and the evaporator 300, and provides a heat source to the air circulated to the drum 130.

[0072] Meanwhile, the clothing processing equipment 100 according to the present disclosure can supply pressurized air into the inside of the drum 130 separately from the circulation supply of heated air by the heat pump 160, thereby shocking the drying target inside the drum 130 and changing the movement path of the heated air inside the drum 130 simultaneously.

[0073] That is, in the case of the drying target loaded into the drum 130, various types of moisture may be contained according to the material of the drying target, and by supplying pressurized air, relatively large moisture contained in the drying target may be removed from the drying target, or broken down into relatively small-sized moisture, thereby allowing faster drying of the moisture by the heated air.

[0074] In addition, in the case of the heated air supplied to the drum 130, while moving from the air inlet 133a at the rear of the drum 130 to the air outlet 132a at the front of the drum 130, it dries the drying target inside the drum 130, passes through the air path 150 and circulates the drum 130 and the heat pump 160. In the case of the

movement path of such heated air, the drying degree of the drying target may be improved as the heated air is in contact with the drying target over a large area and for a long time. Here, in the case of pressurized air supplied separately from the heated air, it is supplied at a higher pressure than the heated air through a different location and different path from the heated air, thereby impacting the drying target and changing the path along which the heated air moves inside the drum 130, so that the heated air can dry moisture faster.

[0075] Meanwhile, in order to supply pressurized air into the inside of the drum 130, there may be provided a pressurized air generator 200 that generates pressurized air and a pressurized air nozzle 300 that sprays the pressurized air generated from the pressurized air generator 200 into the inside of the drum 130.

[0076] Hereinafter, the arrangement of the evaporator 300 and the condenser 400 will be described in detail.

[0077] FIG. 3 is a diagram showing a machine room and an air flow path section of a clothing processing equipment according to an embodiment of the present disclosure, and FIG. 4 is a diagram showing the evaporator 300 and the condenser 400 shown in FIG. 3.

[0078] Referring to FIGS. 3 and 4, the evaporator 300 and the condenser 400 may be installed inside the air flow path 150. The evaporator 300 may be connected to the drum outlet, and the condenser 400 may be connected to the drum inlet.

[0079] Meanwhile, the present disclosure may include a machine room 161 in which a compressor 163, an expansion valve, and a refrigerant pipe 165 are located. The machine room 161 may be arranged next to the air flow path 150.

[0080] Since the high temperature and humidity air discharged from the drum 130 has a higher temperature than the refrigerant of the evaporator 300, as it passes through the evaporator 300, the heat of the air is absorbed by the refrigerant of the evaporator 300, thereby being condensed and generating condensed water. Accordingly, the moisture of the high temperature-humidity air is removed by the evaporator 300, and the condensed water can be collected into a separate condensed water tank (not shown) and drained.

[0081] Meanwhile, the heat source of the air absorbed in the evaporator 300 is moved to the condenser 400 via the refrigerant, and the compressor 163 may be located between the evaporator 300 and the condenser 400 to move the heat source from the evaporator 300 (low heat source portion) to the condenser 400 (high heat source portion).

[0082] Meanwhile, the evaporator 300 may be a fin & tube type heat exchanger. The fin & tube type is a type in which a plurality of flat fins are attached to a hollow tube, and the refrigerant flows along the inside of the tube, and the air can exchange heat with the refrigerant as it passes between the plurality of fins attached to the tube. Here, the fin is used to expand the heat exchange area between the air and the refrigerant.

[0083] For example, the evaporator 300 may include a plurality of evaporation refrigerant tubes 310 through which refrigerant flows, and an evaporation fin 320 that conducts heat of the evaporation refrigerant. The evaporator 300 may include an evaporation inlet pipe 391 that supplies refrigerant to the evaporation refrigerant tube 310, and an evaporation outlet pipe 392 through which refrigerant is discharged from the evaporation refrigerant tube 310.

[0084] The evaporation inlet pipe 391 is connected to the expansion valve 164 and the evaporation refrigerant tube 310, and the evaporation outlet pipe 392 is connected to the compressor 163 and the evaporation refrigerant tube 310. The detailed structure of the evaporator 300 is described later in FIG. 10.

[0085] The condenser 400 may include a microchannel type heat exchanger. The condenser 400 includes a condensation refrigerant tube 410 including a plurality of channels 410a through which refrigerant flows, and a condensation fin 420 for conducting heat of the condensation refrigerant tube 410.

[0086] The condenser 400 may include a condensation inlet pipe 491 for supplying refrigerant to the condensation refrigerant tube 410, and a condensation outlet pipe 492 for discharging refrigerant from the condensation refrigerant tube 410. The condensation inlet pipe 491 is connected to the compressor 163 and the condensation refrigerant tube 410, and the condensation outlet pipe 492 is connected to the expansion valve 164 and the condensation refrigerant tube 410. The detailed structure of the condenser 400 is described later in FIGS. 5 to 9.

[0087] If a micro-channel type heat exchanger is used for the condenser 400, the temperature of the air passing through the condenser 400 can be increased more than when a fin tube heat exchanger is used, and the air can be heated to a target temperature in a much shorter heat exchange time. Therefore, if a micro-channel type heat exchanger is used for the condenser 400, the drying efficiency of the clothing processing equipment can be improved.

[0088] Here, the cross-sectional area of each channel 410a of the refrigerant tube of the condenser 400 is smaller than the cross-sectional area of the refrigerant tube of the evaporator 300. In the case of the evaporator 300, a fin tube heat exchanger is used rather than a micro-channel heat exchanger because a large amount of heat exchange is not required.

[0089] The air flowing in the air flow path 150 exchanges heat with the evaporator 300 and then flows into the condenser 400. At this time, if the evaporator 300 and the condenser 400 are disposed too close together, the condensed water generated in the evaporator 300 flows into the condenser 400, thereby reducing the heat exchange efficiency of the condenser 400.

[0090] In order to prevent the condensed water generated in the evaporator 300 from flowing into the condenser 400, the separation distance D1 between the evaporator 300 and the condenser 400 may be larger

than the width W1 of the air flow direction of the evaporator 300.

[0091] The width W1 of the airflow direction of the evaporator 300 may be larger than the width W2 of the airflow direction of the condenser 400. The height H1 of the evaporator 300 may be smaller than the height H2 of the condenser 400.

[0092] Preferably, the separation distance D1 of the condenser 400 may be larger than the sum of the width W1 of the airflow direction of the evaporator 300 and the width W2 of the airflow direction of the condenser 400.

[0093] More preferably, the separation distance D1 of the condenser 400 may be 100 mm to 250 mm.

[0094] If the separation distance D1 of the condenser 400 is larger than the sum of the width W1 of the air flow direction of the evaporator 300 and the width W2 of the air flow direction of the condenser 400, the condensed water generated in the evaporator 300 by the air flow falls into a space between the condenser 400 and the evaporator 300.

[0095] The condensation inlet pipe 491 and the condensation outlet pipe 492 may be located in the same direction with respect to the condensation refrigerant tube 410. Specifically, the condensation inlet pipe 491 and the condensation outlet pipe 492 may extend from the condensation refrigerant tube 410 toward the machine room.

[0096] More specifically, if the air flow direction is defined as a front-rear direction FR, the condensation inlet pipe 491 and the condensation outlet pipe 492 extend to the right from the condensation refrigerant tube 410.

[0097] If the condensation inlet pipe 491 and the condensation outlet pipe 492 are located in the same direction with respect to the condensation refrigerant tube 410, a space for arranging the refrigerant pipe can be reduced, the length of the refrigerant pipe can be reduced, and a sufficient space for the air flow path 150 can be secured.

[0098] An evaporation inlet pipe 391 and an evaporation outlet pipe 392 can be located in the same direction with respect to an evaporation refrigerant tube 310. Specifically, the evaporation inlet pipe 391 and the evaporation outlet pipe 392 can be extended from the evaporation refrigerant tube 310 toward the machine room.

[0099] More specifically, the evaporation inlet pipe 391 and the evaporation outlet pipe 392 are extended to the right from the evaporation refrigerant tube 310.

[0100] If the evaporation inlet pipe 391 and the evaporation outlet pipe 392 are located in the same direction with respect to the evaporation refrigerant tube 310, a space for arranging the refrigerant pipe can be reduced, the length of the refrigerant pipe can be reduced, and sufficient space for the air path 150 can be secured.

[0101] Preferably, the evaporation inlet pipe 391, the evaporation outlet pipe 392, the condensation inlet pipe 491, and the condensation outlet pipe 492 can extend in the same direction from the air path 150. The evaporation inlet pipe 391, the evaporation outlet pipe 392, the con-

densation inlet pipe 491, and the condensation outlet pipe 492 extend in the right direction from the air path 150.

[0102] Hereinafter, the structure of the condenser 400 in which heat exchange efficiency is improved and tint is discharged without being caught in a protrusion even if it is introduced between fins spaced apart from each other is described in detail. The condenser 400 includes a heat exchanger. Hereinafter, the condenser 400 means a heat exchanger.

[0103] FIG. 5 is a perspective view showing the condenser 400 shown in FIG. 3.

[0104] Referring to FIG. 5, the condenser 400 is a microchannel type heat exchanger. The condenser 400 is made of aluminum material.

[0105] The condenser 400 may include a first heat exchange unit P1, a second heat exchange unit P2, and a third heat exchange unit P3. Unlike the present embodiment, the condenser 400 may have three or more heat exchange units that are stacked.

[0106] The first heat exchange unit P1, the second heat exchange unit P2, and the third heat exchange unit P3 may be arranged to overlap with each other in the front-rear direction which is the air flow direction. The first heat exchange unit P1, the second heat exchange unit P2, and the third heat exchange unit P3 may be arranged to completely overlap in the front-rear direction or may be arranged to overlap in some area.

[0107] The first heat exchange unit P1, the second heat exchange unit P2, and the third heat exchange unit P3 may be arranged along the air flow direction.

[0108] The condenser 400 includes a first heat exchange unit P1, a second heat exchange unit P2 located to overlap with the first heat exchange unit P1 in the air flow direction, a third heat exchange unit P3 located to overlap the second heat exchange unit P2 in the air flow direction, a condensation inlet pipe 491 connected to the first heat exchange unit P1 to supply refrigerant, a condensation outlet pipe 492 connected to the third heat exchange unit P3 to discharge refrigerant, a first connection pipe 493 that connects the first heat exchange unit P1 and the second heat exchange unit P2, and allows the refrigerant to flow from the first heat exchange unit P1 to the second heat exchange unit P2, and a second connection pipe 494 that connects the second heat exchange unit P2 and the third heat exchange unit P3, and allows the refrigerant to flow from the second heat exchange unit P2 to the third heat exchange unit P3.

[0109] The first heat exchange unit P1 is arranged to exchange heat with air that has been heat-exchanged with the second heat exchange unit P2, and the second heat exchange unit P2 is arranged to exchange heat with air that has been heat-exchanged with the third heat exchange unit P3. That is, air that has been heat-exchanged in the third heat exchange unit P3 is heat-exchanged in the second heat exchange unit P2, and then heat-exchanged in the first heat exchange unit P1.

[0110] Specifically, the first heat exchange unit P1, the second heat exchange unit P2, and the third heat ex-

change unit P3 are arranged on a path through which external air flows, and the external air is firstly heat-exchanged with the third heat exchange unit P3, secondly heat-exchanged with the second heat exchange unit P2, and thirdly heat-exchanged with the first heat exchange unit P1.

[0111] The third heat exchange unit P3 may be located upstream of the air flow direction than the second heat exchange unit P2, and the second heat exchange unit P2 may be located upstream of the air flow direction than the first heat exchange unit P1.

[0112] Specifically, the third heat exchange unit P3 may be located closer to the suction path 151 through which air is flowed in than the second heat exchange unit P2, and the first heat exchange unit P1 may be located closer to the exhaust path 152 through which air is discharged than the second heat exchange unit P2.

[0113] Since the heat exchange efficiency decreases when the temperature difference between the refrigerant and the air is too large, the heat exchange efficiency is improved by maintaining the temperature difference between the refrigerant and the air appropriately. The first heat exchange unit P1 through which the high-temperature refrigerant flows is disposed in an area where the temperature of the outside air is high, and the third heat exchange unit P3 through which the low-temperature refrigerant flows is disposed in an area where the temperature of the outside air is low, so that the temperature of the refrigerant in each heat exchange unit and the temperature of the outside air are appropriately different, thereby improving the heat exchange efficiency of the condenser 400.

[0114] The first heat exchange unit P1, the second heat exchange unit P2, and the third heat exchange unit P3 may include a plurality of refrigerant tubes 50 and a fin which is located between the refrigerant tubes 50 that are adjacent to each other to conduct heat.

[0115] The first heat exchange unit P1, the second heat exchange unit P2, and the third heat exchange unit P3 are manufactured by stacking a plurality of refrigerant tubes 50. Each refrigerant tube 50 extends in a horizontal direction so that the refrigerant moves horizontally.

[0116] Specifically, the refrigerant tube 50 of the first heat exchange unit P1, the second heat exchange unit P2, and the third heat exchange unit P3 are arranged long in a horizontal direction (transverse direction) when the air flow direction is front-rear direction, and a plurality of refrigerant tubes 50 can be stacked vertically. As air passes through a space between the plurality of refrigerant tubes 50 stacked in a vertical direction (longitudinal direction), heat is exchanged with the refrigerant in the refrigerant tube 50. The plurality of refrigerant tubes 50 stacked vertically define a heat exchange surface together with the fin described below.

[0117] Hereinafter, the structure of the refrigerant tube 50 and the fin of each heat exchanger will be described in detail.

[0118] FIG. 6 is a cross-sectional view of the refrigerant

tube and the fin of the condenser shown in FIG. 3.

[0119] Although FIG. 6 illustrates the first heat exchange unit P1, the structure of the refrigerant tube 50 and the fin of the second heat exchange unit P2 and the third heat exchange unit P3 are the same as that of the first heat exchange unit P1.

[0120] Referring to FIG. 6, as illustrated in FIG. 5, the cross-sectional shape of the refrigerant tube 50 may be a rectangular shape that has a left-right direction length longer than an up-down direction length, and the cross-sectional shape of the microchannel 50a may be a rectangular shape.

[0121] The microchannel 50a is usually stacked in a single row in a direction intersecting with the longitudinal direction of the refrigerant tube 50.

[0122] A fin 60 transmits heat of the refrigerant tube 50. The fin 60 increases the contact area with air to improve heat dissipation performance.

[0123] The fin 60 is arranged between adjacent refrigerant tubes 50. The fin 60 may have various shapes, but may be formed by bending a plate having the same width as the refrigerant tube 50. The fin 60 may be coated with a clad 601.

[0124] The fin 60 may conduct heat by connecting two refrigerant tubes 50 that are stacked in the up-down direction. The fin 60 may be in direct contact with the refrigerant tube 50, or may be connected to the refrigerant tube 50 by a sacrificial sheet 90.

[0125] When viewed from the direction of refrigerant flow, the contact area between the fin 60 and the sacrificial sheet 90 becomes a U-shape or V-shape. The fin 60 and the refrigerant tube 50 are alternately stacked in the up-down direction, and have an arrangement in which the refrigerant tube 50 is located at the lowermost and uppermost ends.

[0126] If the refrigerant tube 50 located at the uppermost end is defined as a first refrigerant tube 50, 51, and the refrigerant tube 50 located below the first refrigerant tube 50, 51 is defined as a second refrigerant tube 50, 52, the fin 60 between the first refrigerant tube 50, 51 and the second refrigerant tube 50, 52 may be defined as a first fin 60, 61. In this way, a n-th refrigerant tube and a n-th fin may be defined.

[0127] For example, the corrosion potential of the sacrificial sheet 90 may be lower than the corrosion potential of the refrigerant tube 50. When corrosion occurs while the two metals are in contact, the metal with the lower corrosion potential is corroded first, so that the sacrificial sheet 90 is corroded instead of the refrigerant tube 50, thereby preventing the refrigerant tube 50 from corroding and causing the refrigerant to leak out.

[0128] In addition, the corrosion potential of the sacrificial sheet 90 may be lower than the corrosion potential of the fin 60. Even when only the refrigerant tube 50 is not corroded, the refrigerant leakage is prevented, so there is no problem. However, if the fin 60 is corroded, the flow of air is impeded and the refrigerant efficiency is reduced, so it is preferable that the corrosion potential of the sacrificial

sheet 90 is lower than the corrosion potential of the fin 60.

[0129] If the corrosion potential of the sacrificial sheet 90 is lower than the corrosion potential of the fin 60, the sacrificial sheet 90 is corroded first instead of the fin 60, so that corrosion of the fin 60 can be prevented. Preferably, the corrosion potential of the fin 60 may be lower than the corrosion potential of the refrigerant tube 50. Among the fin 60 and the refrigerant tube 50, the portion that is dangerous when corroded is the refrigerant tube 50. If the fin 60 corrodes, the efficiency is slightly reduced, but if the refrigerant tube 50 corrodes, the refrigerant leaks and the air conditioner does not operate, which is a big problem.

[0130] Therefore, the present disclosure makes the corrosion potential of the fin 60 to be lower than the corrosion potential of the refrigerant tube 50, thereby corroding the fin 60 before the refrigerant tube 50, and preventing corrosion of the refrigerant tube 50.

[0131] In conclusion, the corrosion potential of the sacrificial sheet 90 may be lower than the corrosion potential of the refrigerant tube 50, the corrosion potential of the sacrificial sheet 90 may be lower than the corrosion potential of the fin 60, and the corrosion potential of the fin 60 may be lower than the corrosion potential of the refrigerant tube 50. Hereinafter, the detailed structure of the fin is described.

[0132] FIG. 7 is an enlarged view of a partial area of FIG. 6, FIG. 8 is a perspective view of FIG. 7, and FIG. 9 is a diagram viewing FIG. 8 from the air flow direction.

[0133] The fin 60 may be formed by bending a plurality of bodies. For example, the fin 60 may include a plurality of first bodies 611 extending in the up-down direction, a plurality of second bodies 613 that extend in the up-down direction (based on FIG. 8) and are located between the plurality of first bodies 611, an upper body 615 connecting the upper end of the first body 611 and the upper end of the second body 613 that are adjacent to each other, and a lower body 617 connecting the lower end of the first body 611 and the lower end of the second body 613 that are adjacent to each other.

[0134] Obviously, in some embodiment, the first body 611 and the second body 613 may have an incline with respect to the up-down direction.

[0135] The upper body 615 is connected to the lower end of the refrigerant tube 50 located at the upper portion among the adjacent refrigerant tubes 50, and the lower body 617 is connected to the upper end of the refrigerant tube 50 located at the upper portion among the adjacent refrigerant tubes 50.

[0136] The upper body 615 of the first fin 60, 61 is connected to the lower end of the first refrigerant tube 51, and the lower body 617 of the first fin 60, 61 is connected to the upper end of the second refrigerant tube 52.

[0137] The upper body 615 is located so as not to overlap the lower body 617 in the up-down direction. The upper body 615 and the lower body 617 are located alternately in the left-right direction.

[0138] A flat portion 620, a first mountain portion 630, a

second mountain portion 640, and a third mountain portion described below may be formed in the first body 611 and the second body 613.

[0139] FIG. 10 is a plan view of the fin shown in FIG. 8, FIG. 11 is a side view of the fin shown in FIG. 10, and FIG. 12 is a cross-sectional view taken along line 12-12' of the fin shown in FIG. 10.

[0140] Referring to FIGS. 10 to 12, the fin extends in a first direction (front-rear direction). Therefore, the first direction means a longitudinal direction.

[0141] For example, the fin 60 includes a flat portion 620 defining a plane parallel to the first direction, a first mountain portion 630 having a step from the flat portion 620, and a second mountain portion 640 having a step from the flat portion 620.

[0142] The flat portion 620 may be a portion having a step from the first mountain portion 630 and the second mountain portion 640. Specifically, the flat portion 620 is located lower than the first mountain portion 630 and the second mountain portion 640. The flat portion 620 may have various shapes, but may be a flat plate shape with respect to the first direction.

[0143] It is preferable that the flat portion 620 is arranged to surround the first mountain portion 630 and the second mountain portion 640. When the flat portion 620 is arranged to surround the first mountain portion 630 and the second mountain portion 640, the flat portion 620 is arranged close to the portion where the fin is bent, so that the rigidity of the fin can be improved.

[0144] That is, the flat portion 620 may be a plate shape in a longitudinal direction, and a portion of the flat portion 620 in the center of the flat portion 620 may be pressed and deformed to define a mountain portion. In this case, if the mountain portion is located at the outer edge of the fin 60, there is a risk that the bent fin portions may be deformed. Preferably, the distance D1 between the upper end of the flat portion 620 and each mountain portion may be greater than the distance D2 between the front end (or rear end) of the flat portion 620 and each mountain portion. If the distance D1 between the upper end of the flat portion 620 and each mountain portion is greater than the distance D2 between the front end (or rear end) of the flat portion 620 and each mountain portion, the bending portion of the fin is the upper end and lower end of the flat portion 620, so that the bending portion of the fin is sufficiently separated, thereby not reducing the rigidity, and improving the heat exchange efficiency.

[0145] The first mountain portion 630 and the second mountain portion 640 may be arranged symmetrically with respect to the center of the fin. The first mountain portion 630 and the second mountain portion 640 may be spaced apart from each other, or may be connected to each other.

[0146] At least one end of the first mountain portion 630 and the second mountain portion 640 may be connected to the flat portion 620. The first mountain portion 630 and the second mountain portion 640 may be arranged along the longitudinal direction of the fin. That is, the first

mountain portion 630 is located in front of the second mountain portion 640. Preferably, one end of the first mountain portion 630 may be connected to one end of the second mountain portion 640.

[0147] The first mountain portion 630 and the second mountain portion 640 may protrude in the same direction from the flat portion 620. Specifically, the first mountain portion 630 and the second mountain portion 640 protrude upward from the flat portion 620.

[0148] The cross-sectional shape of the first mountain portion 630 and the second mountain portion 640 may be a curved or linear shape.

[0149] For example, the first mountain portion 630 may include a plurality of inclined surfaces having an incline in a first direction, and the second mountain portion 640 may include a plurality of inclined surfaces having an incline in the first direction.

[0150] Specifically, the first mountain portion 630 may include a first inclined surface 631 having an incline in the first direction, a second inclined surface 632 that has an incline in the first direction and has one end connected to the first inclined surface 631, a third inclined surface 635 that has an incline in the first direction and is connected to the first inclined surface 631 and the second inclined surface 632, and a fourth inclined surface 634 that has an incline in the first direction and is connected to the first inclined surface 631 and the second inclined surface 632.

[0151] The front end of the first inclined surface 631 is connected to the flat portion 620, the first inclined surface 631 is inclined upward from the front to the rear, and the second inclined surface 632 is inclined downward from the front to the rear. The rear end of the second inclined surface 632 is connected to the second mountain portion 640.

[0152] The length D4 of the second inclined surface 632 is greater than the length D6 of the first inclined surface 631. The inclination angle of the first inclined surface 631 is greater than the inclination angle of the second inclined surface 632. The inclination angle of a fifth inclined surface 641 and the inclination angle of a sixth inclined surface 642 mean the inclination angle with respect to the flat portion 620.

[0153] The left-right width of the first inclined surface 631 may become smaller as it progresses from the front to the rear. The left-right width of the second inclined surface 632 may become larger as it progresses from the front to the rear. The left-right width of the rear end of the first inclined surface 631 may be the same as the left-right width of the front end of the second inclined surface 632.

[0154] The upper end of the third inclined surface 635 is connected to the flat portion 620, a part of the lower end of the third inclined surface 635 is connected to the first inclined surface 631, and another part of the lower end of the third inclined surface 635 is connected to the second inclined surface 632. The third inclined surface 635 is inclined upward from the right to the left.

[0155] The lower end of the fourth inclined surface 634 is connected to the flat portion 620, a part of the upper end

of the fourth inclined surface 634 is connected to the first inclined surface 631, and another part of the upper end of the fourth inclined surface 634 is connected to the second inclined surface 632. The fourth inclined surface 634 is inclined upward from the left to the right.

[0156] The first mountain portion 630 may further include a first top portion 633 having the highest height in the first mountain portion 630. The first top portion 633 may be a portion where the first inclined surface 631 and the second inclined surface 632 are connected. Specifically, the first top portion 633 may be a portion where the rear end of the first inclined surface 631 and the front end of the second inclined surface 632 meet.

[0157] The first top portion 633 may be extended in a direction intersecting with a first direction. Specifically, the first top portion 633 may be extended in the left-right direction. The first top portion 633 may have a line shape. The length D3 of the first top portion 633 in a second direction may be longer than the length of the first top portion 633 in the first direction.

[0158] The first top portion 633 may be connected to the third inclined surface 635 and the fourth inclined surface 634. Both ends of the first top portion 633 in the first direction (front-rear direction) may be connected to the first inclined surface 631 and the second inclined surface 632, respectively, and both ends of the first top portion 633 in the second direction (left-right direction) intersecting with the first direction may be connected to the third inclined surface 635 and the fourth inclined surface 634, respectively.

[0159] The second inclined surface 632 may be closer to the second mountain portion 640 than the first inclined surface 631.

[0160] The second mountain portion 640 may have the same shape as the first mountain portion 630 and may be formed symmetrically with respect to the center of the fin.

[0161] Specifically, the second mountain portion 640 may include a fifth inclined surface 641 having an incline in the first direction, a sixth inclined surface 642 that has an incline in the first direction and has one end connected to the fifth inclined surface 641, a seventh inclined surface 645 that has an incline in the first direction and is connected to the fifth inclined surface 641 and the sixth inclined surface 642, and an eighth inclined surface 644 that has an incline in the first direction and is connected to the fifth inclined surface 641 and the sixth inclined surface 642.

[0162] The front end of the fifth inclined surface 641 is connected to the first mountain portion 630, the fifth inclined surface 641 is inclined upward from the front to the rear, and the sixth inclined surface 642 is inclined downward from the front to the rear. The rear end of the sixth inclined surface 642 is connected to the flat portion 620.

[0163] The length of the sixth inclined surface 642 is smaller than the length of the fifth inclined surface 641. The inclination angle of the fifth inclined surface 641 is smaller than the inclination angle of the sixth inclined

surface 642. The inclination angle of the fifth inclined surface 641 and the inclination angle of the sixth inclined surface 642 mean the inclination angle with respect to the flat portion 620.

[0164] The left-right width of the fifth inclined surface 641 may become smaller as it goes from the front to the rear. The left-right width of the sixth inclined surface 642 may become larger as it goes from the front to the rear. The left-right width of the rear end of the fifth inclined surface 641 may be the same as the left-right width of the front end of the sixth inclined surface 642.

[0165] The upper end of the seventh inclined surface 645 is connected to the flat portion 620, a part of the lower end of the seventh inclined surface 645 is connected to the fifth inclined surface 641, and another part of the lower end of the seventh inclined surface 645 is connected to the sixth inclined surface 642. The seventh inclined surface 645 is inclined upward from the right to the left.

[0166] The eighth inclined surface 644 has a lower end connected to the flat portion 620, a part of the upper end of the eighth inclined surface 644 is connected to the fifth inclined surface 641, and another part of the upper end of the eighth inclined surface 644 is connected to the sixth inclined surface 642. The eighth inclined surface 644 is inclined upward from the left to the right.

[0167] The second mountain portion 640 may further include a second top portion 643 having the highest height in the second mountain portion 640. The second top portion 643 may be a portion where the fifth inclined surface 641 and the sixth inclined surface 642 are connected. Specifically, the second top portion 643 may be a portion where the rear end of the fifth inclined surface 641 and the front end of the sixth inclined surface 642 meet.

[0168] The second top portion 643 may be extended in a direction intersecting with the first direction. Specifically, the second top portion 643 may be extended in the left-right direction. The second top portion 643 may have a line shape. The length D3 of the second top portion 643 in the second direction may be longer than the length of the second top portion 643 in the first direction.

[0169] The second top portion 643 may be connected to the seventh inclined surface 645 and the eighth inclined surface 644. Both ends of the second top portion 643 in the first direction (front-rear direction) may be connected to the fifth inclined surface 641 and the sixth inclined surface 642, respectively, and both ends of the second top portion 643 in the second direction (left-right direction) intersecting with the first direction may be connected to the seventh inclined surface 645 and the eighth inclined surface 644, respectively.

[0170] The fifth inclined surface 641 may be closer to the first mountain portion 630 than the sixth inclined surface 642.

[0171] A bottom portion may be located between the first top portion 633 and the second top portion 643. The bottom portion may be a portion where the rear end of the second inclined surface 632 and the front end of the fifth

inclined surface 641 meet. The bottom portion may extend in a left-right direction in a line shape. The bottom portion may be located at the same height as the flat portion 620 or at a higher height than the flat portion 620. The bottom portion may be the lowermost portion among the first mountain portion 630 and the second mountain portion 640.

[0172] The height H1 of the first mountain portion 630 or the second mountain portion 640 may be greater than the thickness T1 of the flat portion 620. The length D3 of the first top portion 633 in the second direction may be greater than the height H1 of the first mountain portion 630 or the height H1 of the second mountain portion 640.

[0173] The length L of the first body 611 (or fin) may be 1.7 to 2.5 times the width W of the first body 611 (or fin). The width D7 of the mountain portion may be 0.6 to 0.9 times the width W of the first body 611 (or fin).

[0174] For example, the first mountain portion 630 may include various shapes having a vertex protruding in a direction intersecting with the first direction, and the second mountain portion 640 may include various shapes having a vertex protruding in an intersecting direction. Specifically, although not shown in the drawing, the first mountain portion 630 may have a hemispherical shape that protrudes in a direction intersecting with the first direction.

[0175] FIG. 13 is a partial diagram of a condenser according to another embodiment of the present disclosure, FIG. 14 is a plan view of the fin shown in FIG. 13, FIG. 15 is a side view of the fin shown in FIG. 14, FIG. 16 is a cross-sectional view taken along line 16-16' of the fin shown in FIG. 14, and FIG. 17 is a cross-sectional view taken along line 17-17' of the fin shown in FIG. 14.

[0176] Referring to FIGS. 13 to 17, the heat exchanger according to another embodiment has a difference in the structure of the flat portion 720 and the mountain portion formed in the fin, in comparison with the embodiment of FIGS. 10 to 12.

[0177] Hereinafter, the difference from the embodiment of FIGS. 10 to 12 will be mainly described, and the configurations that are not specifically mentioned are considered to be the same as the embodiment of FIGS. 10 to 12.

[0178] Another fin according to another embodiment includes a flat portion 720, a first mountain portion 730 protruding than the flat portion 720 in a second direction intersecting with a first direction, a second mountain portion 740 protruding than the flat portion 720 in the second direction, and a third mountain portion 750 protruding than the flat portion 720 in a direction opposite to the second direction between the first mountain portion 730 and the second mountain portion 740.

[0179] The first mountain portion 730 and the second mountain portion 740 may be arranged symmetrically with respect to the third mountain portion 750.

[0180] The flat portion 720 may be arranged to surround the first mountain portion 730, the second mountain portion 740, and the third mountain portion 750.

[0181] One end of the third mountain portion 750 may be connected to the first mountain portion 730, and the other end of the third mountain portion 750 may be connected to the second mountain portion 740.

[0182] The first mountain portion 730 may include a plurality of inclined surfaces having an incline with respect to the first direction, the second mountain portion 740 may include a plurality of inclined surfaces having an incline with respect to the first direction, and partial inclined surface of the first mountain portion 730 and partial inclined surface of the second mountain portion 740 may define the third mountain portion 750. At this time, a part of the inclined surface may be located at the same height as the flat portion 720.

[0183] Obviously, depending on the embodiment, the first mountain portion 730, the second mountain portion 740, and the third mountain portion 750 can be formed separately.

[0184] In order to form three mountain portions on one plate, it is preferable that a part of the inclined surface of the first mountain portion 730 and a part of the inclined surface of the second mountain portion 740 define the third mountain portion 750.

[0185] Specifically, the fin 60A may include a first inclined surface 731 having an incline in the first direction, a second inclined surface 732 that has an incline in the first direction and has one end connected to the first inclined surface 731, a third inclined surface 735 that has an incline in the first direction and is connected to the first inclined surface 731 and the second inclined surface 732, a fourth inclined surface 734 that has an incline in the first direction and is connected to the first inclined surface 731 and the second inclined surface 732, a fifth inclined surface 741 that has one end having an incline in the first direction connected to the second inclined surface 732, a sixth inclined surface 742 that has an incline in the first direction and has one end connected to the fifth inclined surface 741, a seventh inclined surface 745 that has an incline in the first direction and is connected to the fifth inclined surface 741 and the sixth inclined surface 742, an eighth inclined surface 744 that has an incline in the first direction and is connected to the fifth inclined surface 741 and the sixth inclined surface 742, a ninth inclined surface 752 connected to the third inclined surface 735 and the seventh inclined surface 745, and a tenth inclined surface 751 connected to the fourth inclined surface 734 and the eighth inclined surface 744.

[0186] The front end of the first inclined surface 731 is connected to the flat portion 720, the first inclined surface 731 is inclined upward from the front to the rear, and the second inclined surface 732 is inclined downward from the front to the rear. The second inclined surface 732 has a rear end connected to the fifth inclined surface 741.

[0187] The length of the second inclined surface 732 in the front-rear direction is greater than the length of the first inclined surface 731 in the front-rear direction. The inclination angle of the first inclined surface 731 is greater than the inclination angle of the second inclined surface

732.

[0188] The second inclined surface 732 may have a front end that is the first top portion 733 of the first mountain portion 730, and a rear end of the second inclined surface 732 may be located below the flat portion 720. That is, the rear end of the second inclined surface 732 is the lowermost location in the fin, and is defined as the third top portion 755 of the third mountain portion 750.

[0189] The left-right width of the first inclined surface 731 may become smaller as it goes from the front to the rear. The left-right width of the second inclined surface 732 may become larger as it goes from the front to the rear. The left-right width of the rear end of the first inclined surface 731 may be the same as the left-right width of the front end of the second inclined surface 732.

[0190] A part of the upper end of the third inclined surface 735 is connected to the flat portion 720, and another part of the upper end of the third inclined surface 735 is connected to the ninth inclined surface 752. The front end of the upper end of the third inclined surface 735 is connected to the flat portion 720, and the rear end of the upper end of the third inclined surface 735 is connected to the ninth inclined surface 752.

[0191] A part of the lower end of the third inclined surface 735 is connected to the first inclined surface 731, and another part of the lower end of the third inclined surface 735 is connected to the second inclined surface 732. The third inclined surface 735 is inclined upward from the right to the left.

[0192] A part of the lower end of the fourth inclined surface 734 is connected to the flat portion 720, and another part of the lower end of the fourth inclined surface 734 is connected to the tenth inclined surface 751.

[0193] A part of the upper end of the fourth inclined surface 734 is connected to the first inclined surface 731, and another part of the upper end of the fourth inclined surface 734 is connected to the second inclined surface 732. The fourth inclined surface 734 is inclined upward from the left to the right.

[0194] The front end of the fifth inclined surface 741 is connected to the second inclined surface 732, the fifth inclined surface 741 is inclined upward from the front to the rear, and the sixth inclined surface 742 is inclined downward from the front to the rear. The rear end of the sixth inclined surface 742 is connected to the flat portion 720.

[0195] The length of the sixth inclined surface 742 is smaller than the length of the fifth inclined surface 741. The inclination angle of the fifth inclined surface 741 is smaller than the inclination angle of the sixth inclined surface 742.

[0196] The left-right width of the fifth inclined surface 741 may become smaller as it goes from the front to the rear. The left-right width of the sixth inclined surface 742 may become larger as it goes from the front to the rear. The left-right width of the rear end of the fifth inclined surface 741 may be the same as the left-right width of the front end of the sixth inclined surface 742.

[0197] A part of the upper end of the seventh inclined surface 745 is connected to the flat portion 720, another part of the upper end of the seventh inclined surface 745 is connected to the ninth inclined surface 752, a part of the lower end of the seventh inclined surface 745 is connected to the fifth inclined surface 741, and another part of the lower end of the seventh inclined surface 745 is connected to the sixth inclined surface 742. The seventh inclined surface 745 is inclined upward from the right to the left.

[0198] A part of the lower end of the eighth inclined surface 744 is connected to the flat portion 720, another part of the lower end of the eighth inclined surface 744 is connected to the tenth inclined surface 751, another part of the upper end of the eighth inclined surface 744 is connected to the fifth inclined surface 741, and another part of the upper end of the eighth inclined surface 744 is connected to the sixth inclined surface 742. The eighth inclined surface 744 is inclined upward from the left to the right.

[0199] The upper end of the ninth inclined surface 752 is connected to the flat portion 720, the front portion of the lower end of the ninth inclined surface 752 is connected to the third inclined surface 735, and the rear portion of the lower end of the ninth inclined surface 752 is connected to the seventh inclined surface 745. Obviously, in some embodiment, the center of the lower end of the ninth inclined surface 752 may be connected to the boundary (the third top portion 755) between the second inclined surface 732 and the fifth inclined surface 741. The ninth inclined surface 752 may be inclined downward as it goes toward the left.

[0200] The lower end of the tenth inclined surface 751 is connected to the flat portion 720, the front portion of the upper end of the tenth inclined surface 751 is connected to the fourth inclined surface 734, and the rear portion of the upper end of the tenth inclined surface 751 is connected to the eighth inclined surface 744. Obviously, in some embodiment, the center of the upper end of the tenth inclined surface 751 may be connected to the boundary (the third top portion 755) between the second inclined surface 732 and the fifth inclined surface 741. The tenth inclined surface 751 may be inclined downward as it goes toward the right.

[0201] The inclination angle of the third inclined surface 735 and the fourth inclined surface 734 may be the same. The inclination angle O1 of the third inclined surface 735 and the fourth inclined surface 734 may be smaller than the inclination angle O2 of the ninth inclined surface 752 and the tenth inclined surface 751. The inclination angle of the ninth inclined surface 752 and the inclination angle of the tenth inclined surface 751 may be the same.

[0202] Here, the inclination angle refers to the angle formed by the flat portion 720 and the inclined surface.

[0203] The first top portion 733 may be a portion where the first inclined surface 731 and the second inclined surface 732 are connected. Specifically, the first top

portion 733 may be a portion where the rear end of the first inclined surface 731 and the front end of the second inclined surface 732 meet.

[0204] The first top portion 733 may be extended in a direction intersecting with the first direction. Specifically, the first top portion 733 may be extended in the left-right direction. The first top portion 733 may have a line shape. The length of the first top portion 733 in the second direction may be longer than the length of the first top portion 733 in the first direction.

[0205] The first top portion 733 may be connected to the third inclined surface 735 and the fourth inclined surface 734. Both ends of the first top portion 733 in the first direction (front-rear direction) may be connected to the first inclined surface 731 and the second inclined surface 732, respectively, and both ends of the first top portion 733 in the second direction (left-right direction) intersecting with the first direction may be connected to the third inclined surface 735 and the fourth inclined surface 734, respectively.

[0206] The second inclined surface 732 may be closer to the second mountain portion 740 than the first inclined surface 731.

[0207] The second mountain portion 740 may have the same shape as the first mountain portion 730 and may be formed symmetrically with respect to the center of the fin.

[0208] The second mountain portion 740 may further include a second top portion 743 having the highest height in the second mountain portion 740. The second top portion 743 may be a portion where the fifth inclined surface 741 and the sixth inclined surface 742 are connected. Specifically, the second top portion 743 may be a portion where the rear end of the fifth inclined surface 741 and the front end of the sixth inclined surface 742 meet.

[0209] The second top portion 743 may extend in a direction intersecting with the first direction. Specifically, the second top portion 743 may extend in the left-right direction. The second top portion 743 may have a line shape. The length D3 of the second top portion 743 in the second direction may be longer than the length of the second top portion 743 in the first direction.

[0210] The second top portion 743 may be connected to the seventh inclined surface 745 and the eighth inclined surface 744. Both ends of the second top portion 743 in the first direction (front-rear direction) may be connected to the fifth inclined surface 741 and the sixth inclined surface 742, respectively, and both ends of the second top portion 743 in the second direction (left-right direction) intersecting with the first direction may be connected to the seventh inclined surface 745 and the eighth inclined surface 744, respectively.

[0211] The third mountain portion 750 may include a third top portion 755. The third top portion 755 may be located between the first top portion 733 and the second top portion 743.

[0212] The third mountain portion 750 may be defined as an inclined surface located at a lower height than the flat portion 720 among the inclined surfaces, the first

mountain portion 730 may be an inclined surface located in the front among the inclined surfaces located at a higher height than the flat portion 720 among the inclined surfaces, and the second mountain portion 740 may be an inclined surface located in the rear among the inclined surfaces located at a higher height than the flat portion 720 among the inclined surfaces.

[0213] The third mountain portion 750 is defined as the rear end of the second inclined surface 732, the rear end of the third inclined surface 735, the rear end of the fourth inclined surface 734, the front end of the fifth inclined surface 741, the front end of the sixth inclined surface 742, the front end of the eighth inclined surface 744, a part of the ninth inclined surface 752, and a part of the tenth inclined surface 751.

[0214] The first mountain portion 730 is defined as the first inclined surface 731, the front end of the second inclined surface 732, a part of the third inclined surface 735, and a part of the fourth inclined surface 734.

[0215] The first mountain portion 730 is defined as the sixth inclined surface 742, the rear end of the fifth inclined surface 741, a part of the seventh inclined surface 745, and a part of the eighth inclined surface 744.

[0216] The third top portion 755 may be a portion where the rear end of the second inclined surface 732 and the front end of the fifth inclined surface 741 meet. The third top portion 755 may extend in a line shape in the left-right direction. The third top portion 755 is located at a lower height than the flat portion 720.

[0217] The height H2 of the first mountain portion 730 or the second mountain portion 740 may be greater than the thickness T1 of the flat portion 720. The length of the first top portion 733 in the second direction may be greater than the height H2 of the first mountain portion 730 or the height H2 of the second mountain portion 740.

[0218] The height H2 of the first mountain portion 730 or the second mountain portion 740 may be smaller than the height H3 of the third mountain portion 750. The height H3 of the third mountain portion 750 may be 1.8 to 2.2 times greater than the height H2 of the first mountain portion 730 or the second mountain portion 740.

[0219] The first top portion 733 may be referred to as a first top line, the second top portion 743 as a second top line, and the third top portion 755 as a third top line.

[0220] The first top line protrudes upwardly than the flat portion 720, the second top line protrudes upwardly from the flat portion 720, and the third top line protrudes downwardly from the flat portion 720 at between the first top line and the second top line.

[0221] The first top line and the third top line may be connected to each other by an inclined surface, and the second top line and the third top line may be connected to each other by an inclined surface.

[0222] For another example, the first mountain portion 730 and the second mountain portion 740 may have various shapes having a peak higher than the flat portion 720, and the third mountain portion 750 may have various shapes having a peak lower than the flat portion 720.

[0223] Specifically, although not shown in the drawing, the first mountain portion 730 and the second mountain portion 740 may have a hemispherical shape protruding higher from the flat portion 720, and the third mountain portion 750 may have a hemispherical shape protruding lower from the flat portion 720.

[0224] The clothing processing equipment and heat exchanger of the present disclosure have one or more of the following effects.

[0225] First, the present disclosure provides an advantage in that the fin of a micro heat exchanger used in the clothing processing equipment include two protrusions protruding from the fin, and the two protrusions are arranged along the air flow direction, so that the flow path of air flowing between the fins becomes longer, and the contact time between the air and the fin increases. Accordingly, the heat exchange efficiency is improved, and even if tint is flowed in between the fins spaced apart from each other, it is discharged without being caught by the protrusions.

[0226] Second, the present disclosure provides an advantage in that the fin of a micro heat exchanger used in the clothing processing equipment include two protrusions protruding from the fin and one protrusion protruding in the opposite direction to the two protrusions at between the two protrusions, and the three protrusions are arranged along the air flow direction, so that the flow path of air flowing between the fins becomes longer. Accordingly, the contact time between the air and the fins increases, so that the heat exchange efficiency is improved, and even if tint is flowed in between the fins spaced apart from each other, it is discharged without being caught by the protrusions, and even if it is protruded to only one side, it prevents the rigidity of the fins from being reduced.

[0227] Third, the present disclosure includes aluminum in the fins of the heat exchanger, thereby being resistant to corrosion.

[0228] Fourth, the present disclosure provides an advantage in that a microchannel heat exchanger is used as a condenser and a fin-tube heat exchanger is used as an evaporator in the machine room of the clothing processing equipment, so that a fin-tube heat exchanger having a low manufacturing cost is used for the evaporator as the evaporator requires relatively little energy, and a microchannel heat exchanger is used for the condenser which requires a large amount of heat to reheat the air in the air flow path and supply it to a tub, thereby improving heat exchange performance, reducing airflow resistance, and lowering the manufacturing cost.

[0229] The above described features, configurations, effects, and the like are included in at least one of the embodiments of the present invention, and should not be limited to only one embodiment. In addition, the features, configurations, effects, and the like as illustrated in each embodiment may be implemented with regard to other embodiments as they are combined with one another or modified by those skilled in the art. Thus, content related

to these combinations and modifications should be construed as including in the scope and spirit of the invention as disclosed in the accompanying claims.

[0230] The above described features, configurations, effects, and the like are included in at least one of the embodiments of the present invention, and should not be limited to only one embodiment. In addition, the features, configurations, effects, and the like as illustrated in each embodiment may be implemented with regard to other embodiments as they are combined with one another or modified by those skilled in the art. Thus, content related to these combinations and modifications should be construed as including in the scope and spirit of the invention as disclosed in the accompanying claims.

Claims

1. A heat exchanger comprising:

a plurality of refrigerant tubes (50, 51) through which refrigerant flows; and
a fin (60, 60A) which is arranged between adjacent refrigerant tubes (50, 51), conducts heat, and extends in a first direction,
wherein the fin (60, 60A) comprises:

a flat portion (620, 720) defining a surface parallel to the first direction;
a first mountain portion (630, 730) having a step from the flat portion (620, 720); and
a second mountain portion (640, 740) having a step from the flat portion (620, 720),
wherein the first mountain portion (630, 730) and the second mountain portion (640, 740) are arranged symmetrically with respect to a center of the fin (60, 60A), and
wherein the flat portion (620, 720) is arranged to surround the first mountain portion (630, 730) and the second mountain portion (640, 740).

2. The heat exchanger of claim 1, wherein the first mountain portion (630, 730) and the second mountain portion (640, 740) protrude in the same direction from the flat portion (620, 720).

3. The heat exchanger of claim 1 or 2, wherein one end of the first mountain portion (630, 730) is connected to one end of the second mountain portion (640, 740).

4. The heat exchanger of any one of the preceding claims, wherein the first mountain portion (630, 730) comprises a plurality of inclined surfaces (631, 632, 635, 634, 731, 732, 734, 735) having an incline with respect to the first direction, and wherein the second mountain portion (640, 740)

comprises a plurality of inclined surfaces (641, 642, 644, 645, 741, 742, 744, 745) having an incline with respect to the first direction.

5. The heat exchanger of any one of the preceding claims, wherein the first mountain portion (630, 730) comprises:

a first inclined surface (631, 731) having an incline with respect to the first direction;
a second inclined surface (632, 732) which has an incline with respect to the first direction, and has one end connected to the first inclined surface (631, 731);
a third inclined surface (635, 735) which has an incline in the first direction, and is connected to the first inclined surface (631, 731) and the second inclined surface (632, 732); and
a fourth inclined surface (634, 734) which has an incline in the first direction, and is connected to the first inclined surface (631, 731) and the second inclined surface (632, 732).

6. The heat exchanger of claim 5, wherein, in the first direction, a length of the second inclined surface (632, 732) is longer than a length of the first inclined surface (631, 731).

7. The heat exchanger of claim 5 or 6, wherein the first mountain portion (630, 730) further comprises a first top portion (633, 733) having the highest height in the first mountain portion (630, 730), wherein the first top portion (633, 733) is a portion connecting the first inclined surface (631, 731) and the second inclined surface (632, 732), and extends in a direction intersecting with the first direction.

8. The heat exchanger of claim 7, wherein the first top portion (633, 733) is connected to the third inclined surface (635, 735) and the fourth inclined surface (634, 734),

both ends of the first top portion (633, 733) in the first direction are connected to the first inclined surface (631, 731) and the second inclined surface (632, 732), respectively, and
both ends of the first top portion (633, 733) in a second direction intersecting with the first direction are connected to the third inclined surface (635, 735) and the fourth inclined surface (634, 734), respectively.

9. The heat exchanger of claim 7 or 8, wherein a length of the first top portion (633, 733) in the second direction is longer than a length of the first top portion (633, 733) in the first direction.

10. The heat exchanger of claim 7, 8 or 9, wherein the

second inclined surface (632, 732) is located closer to the second mountain portion (640, 740) than the first inclined surface (631, 731).

11. The heat exchanger according to any one of claims 8 to 10, wherein a height of the first mountain portion (630, 730) or the second mountain portion (640, 740) is greater than a thickness value of the flat portion (620, 720).

12. The heat exchanger according to any one of claims 9 to 11, wherein the length of the first top portion (633, 733) in the second direction is greater than a height of the first mountain portion (630, 730) or a height of the second mountain portion (640, 740).

13. The heat exchanger according to any one of claims 5 to 12, wherein an inclination angle of the first inclined surface (631, 731) is greater than an inclination angle of the second inclined surface (632, 732).

14. The heat exchanger any one of the preceding claims, further comprising:

a third mountain portion (650, 750) protruding in a direction opposite to the second direction from the flat portion (620, 720) at between the first mountain portion (630, 730) and the second mountain portion (640, 740), wherein the first mountain portion (630, 730) and the second mountain portion (640, 740) are arranged symmetrically with respect to the third mountain portion (650, 750), and wherein the first mountain portion (630, 730) and the second mountain portion (640, 740) protrude in the second direction.

15. The heat exchanger of claim 14, wherein one end of the third mountain portion (650, 750) is connected to the first mountain portion (630, 730), and the other end of the third mountain portion (650, 750) is connected to the second mountain portion (640, 740).

Fig. 1

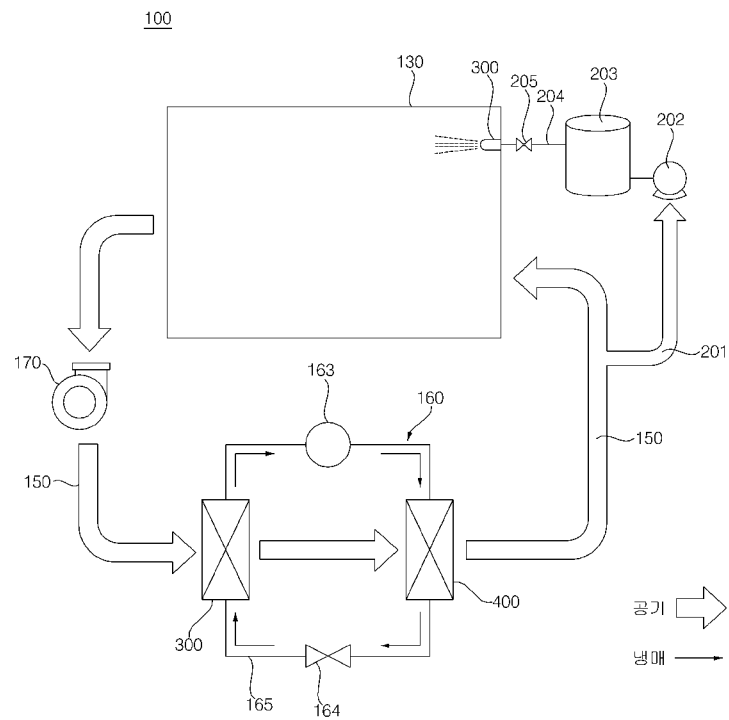


Fig. 2

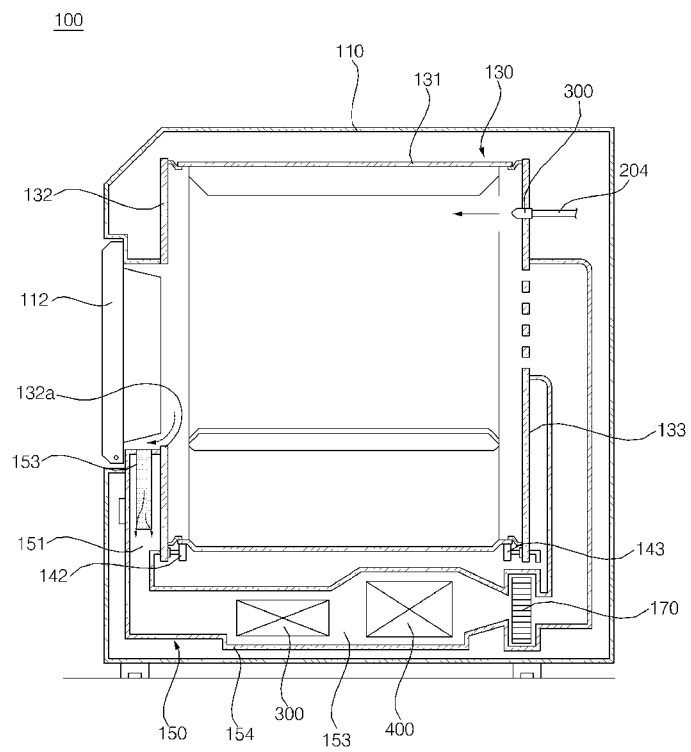


Fig. 3

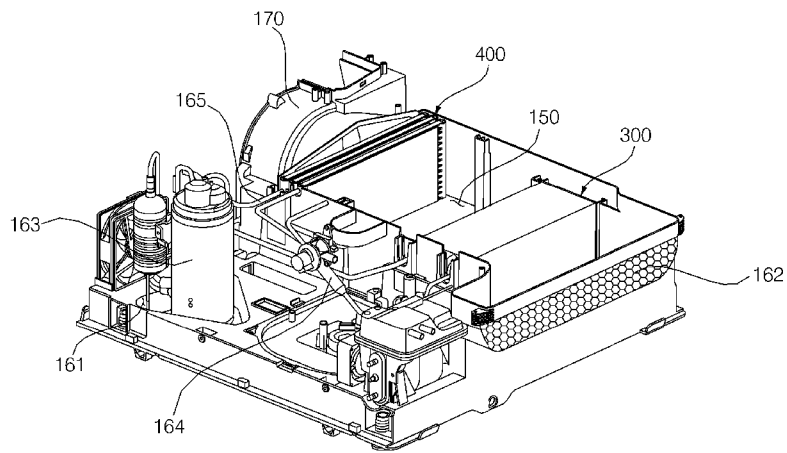


Fig. 4

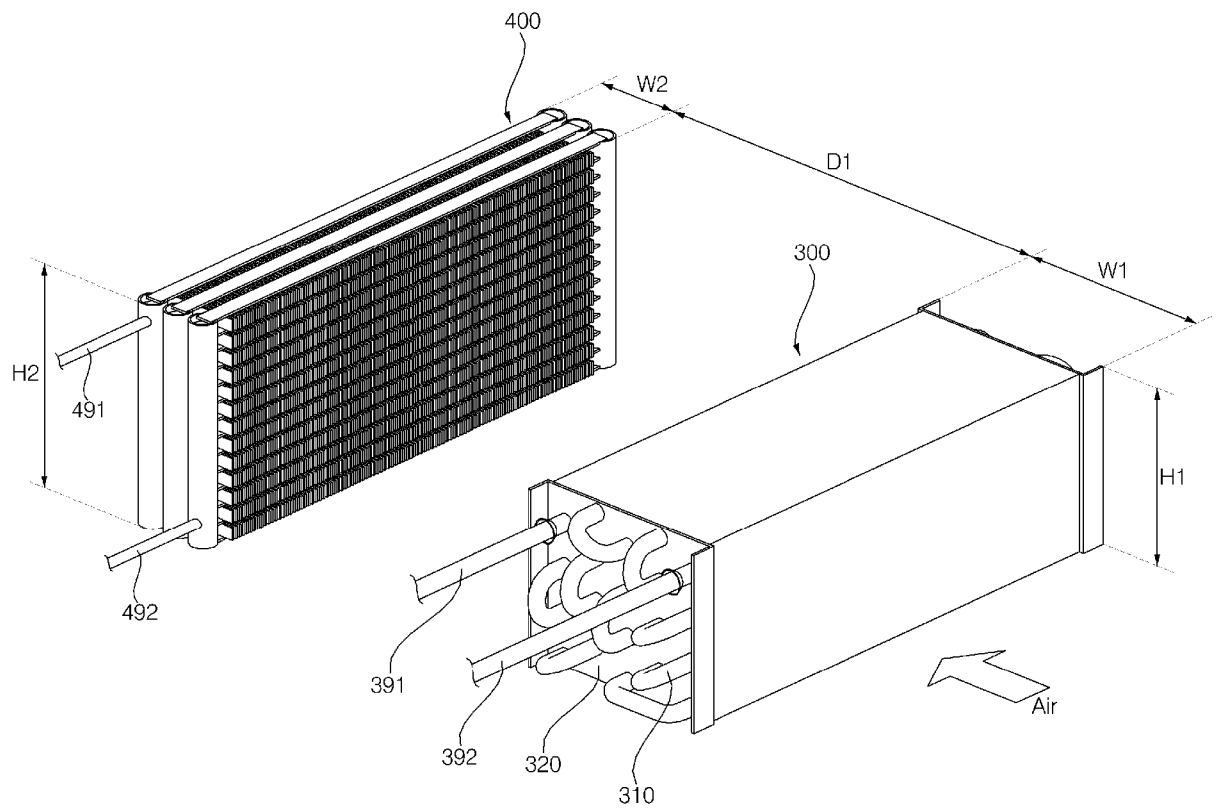


Fig. 5

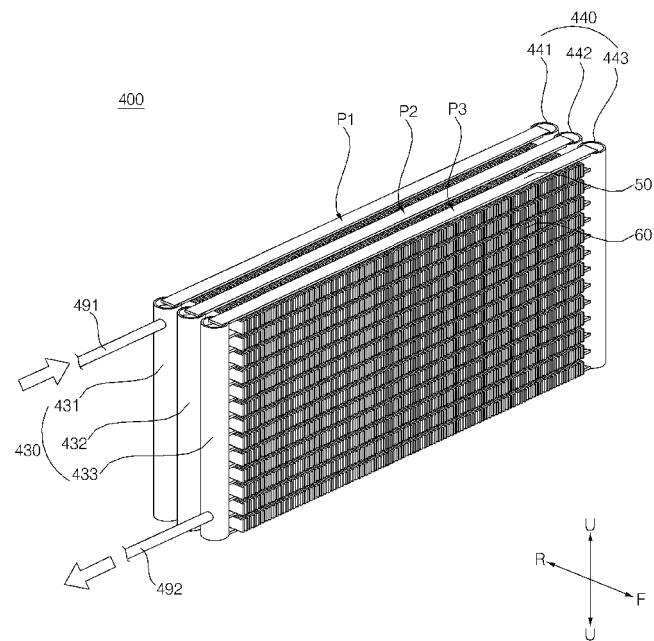


Fig. 6

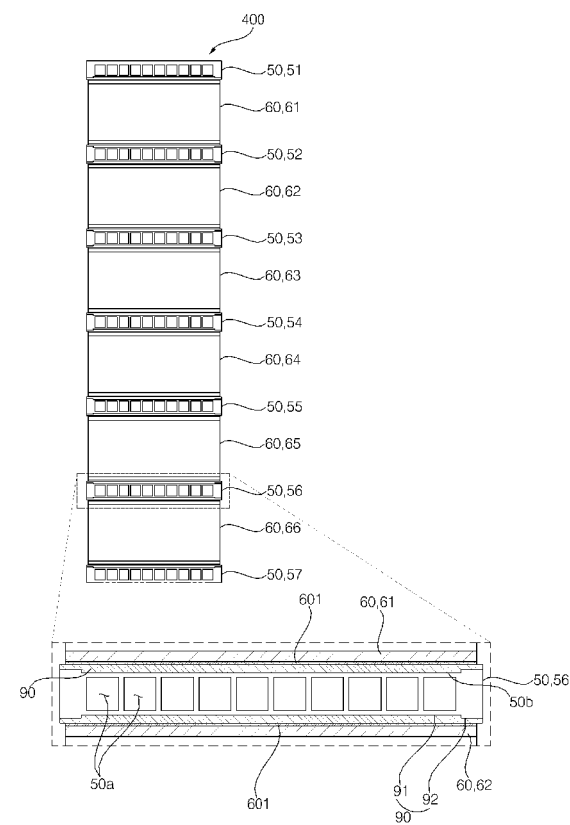


Fig. 7

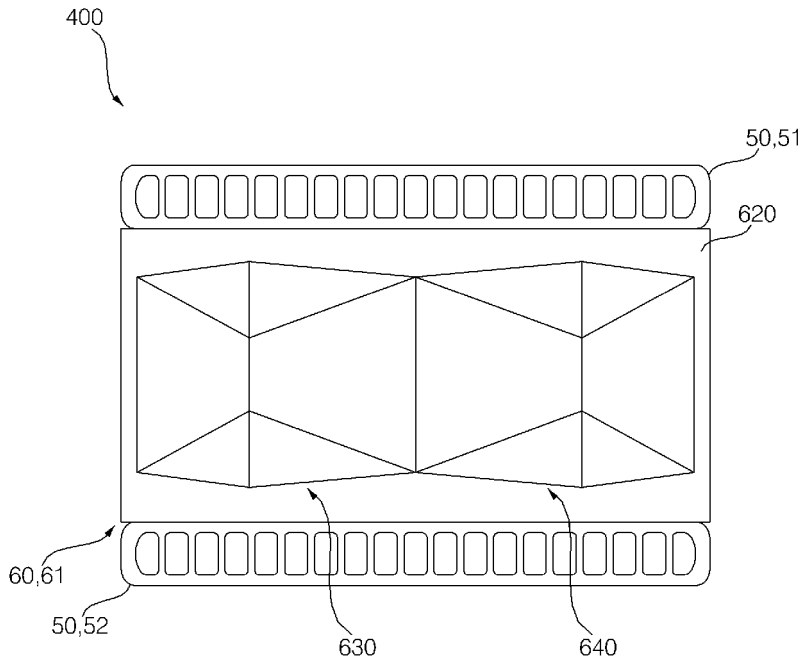


Fig. 8

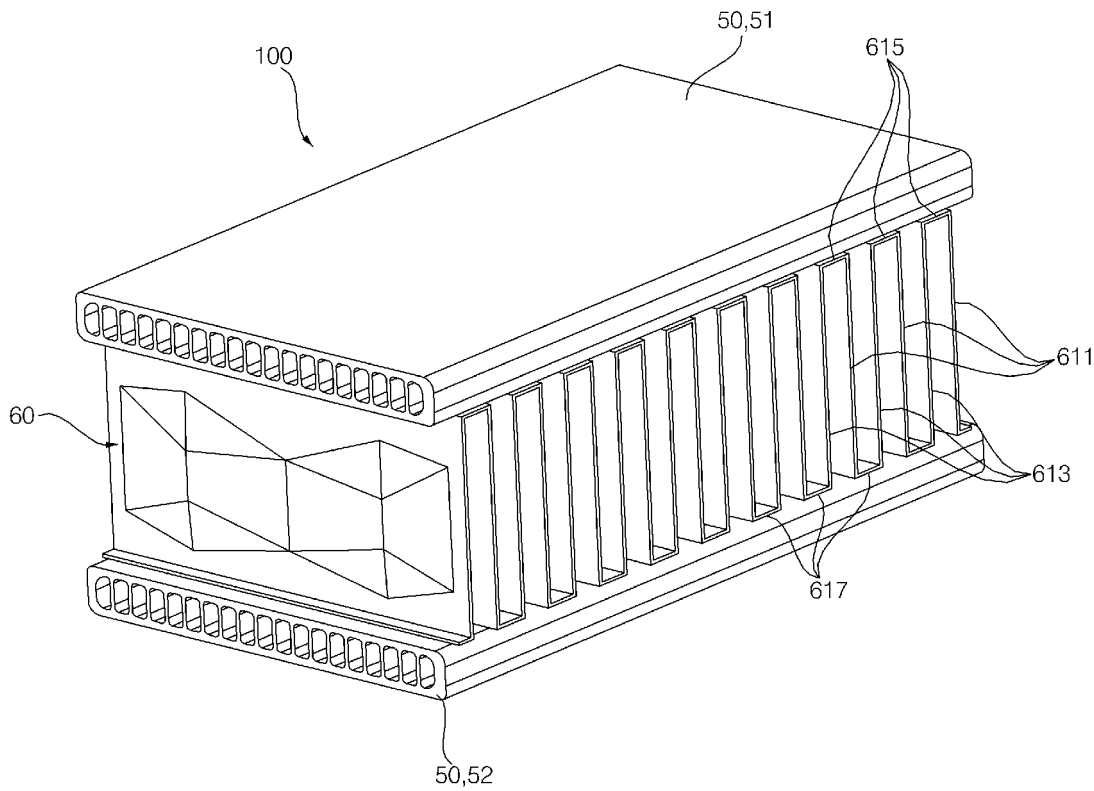


Fig. 9

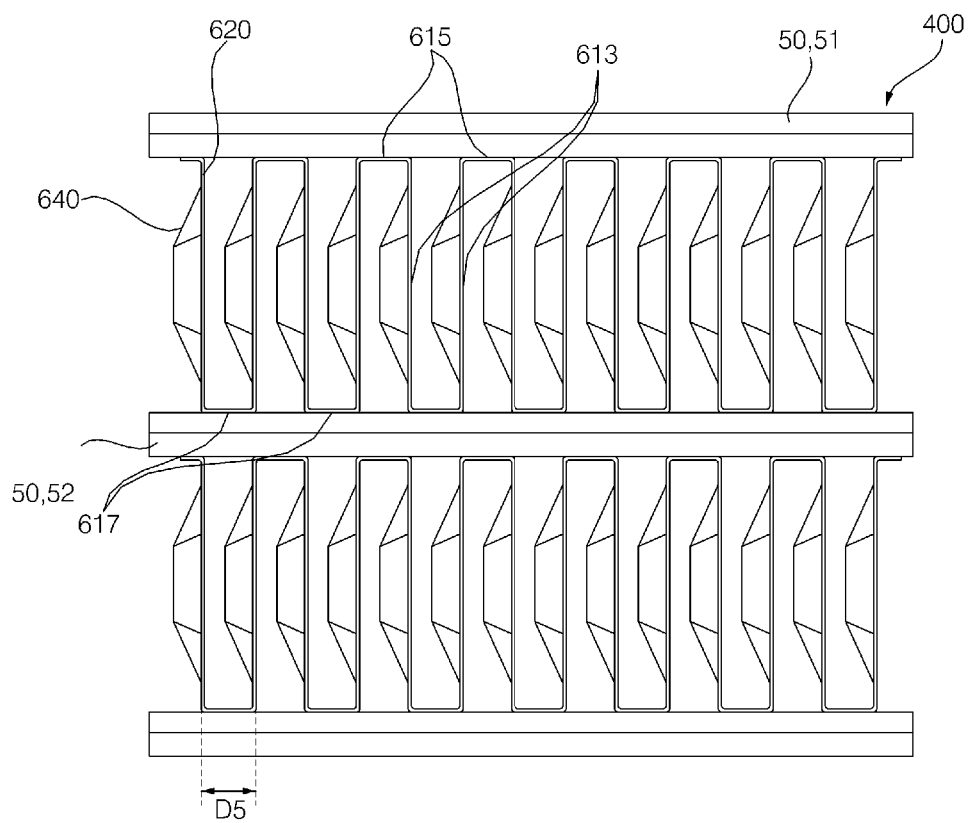


Fig. 10

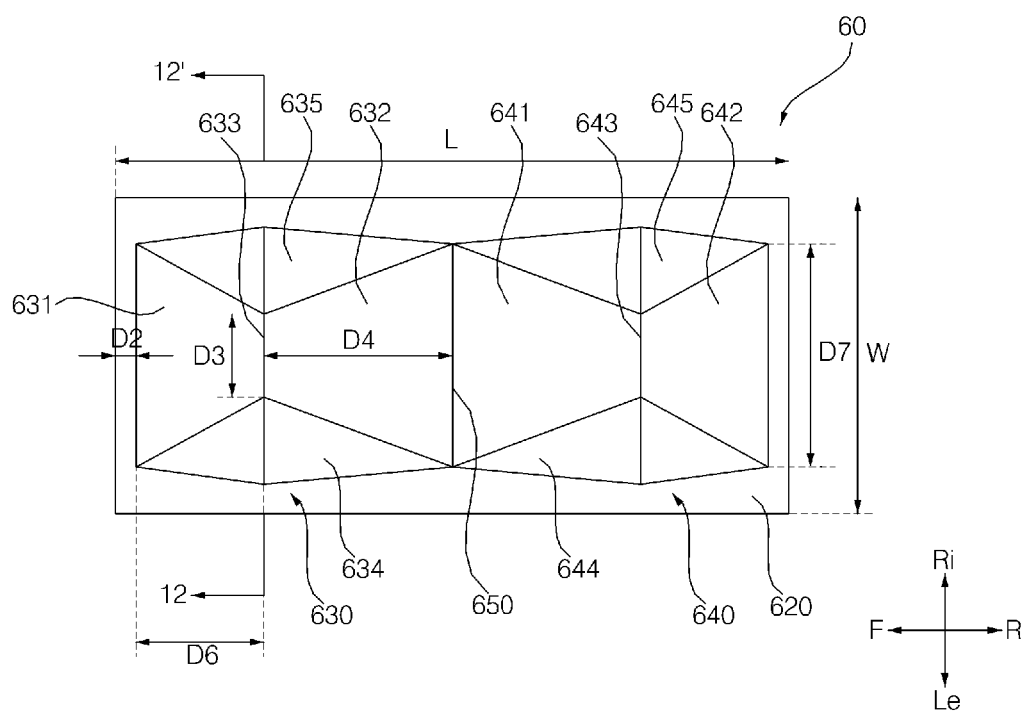


Fig. 11

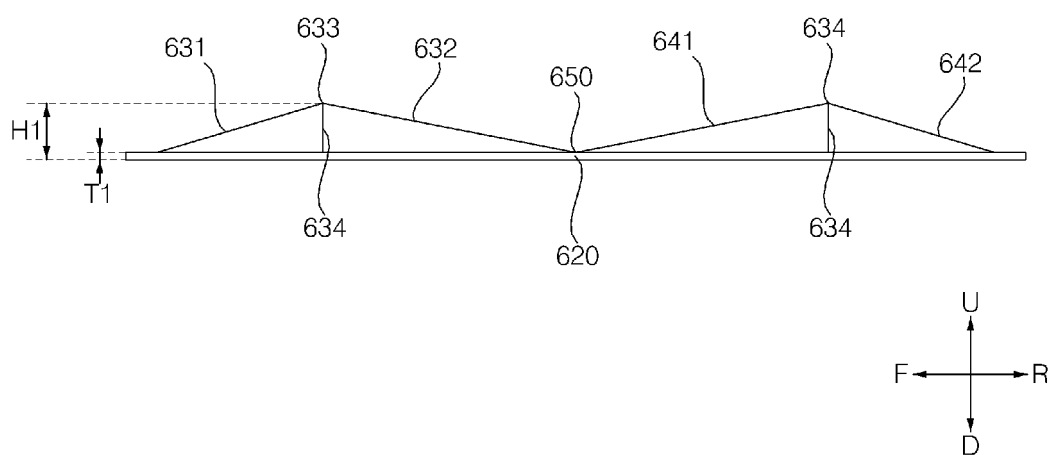


Fig. 12

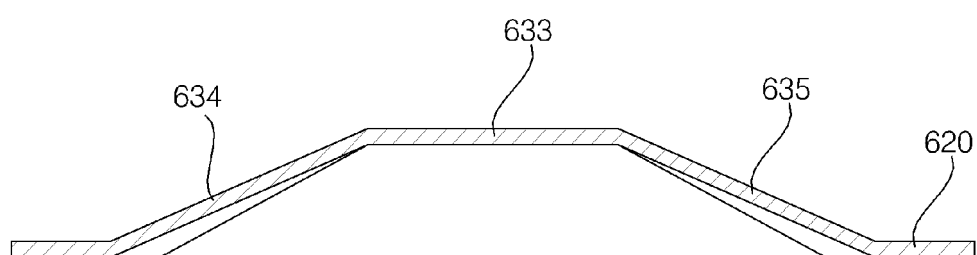


Fig. 13

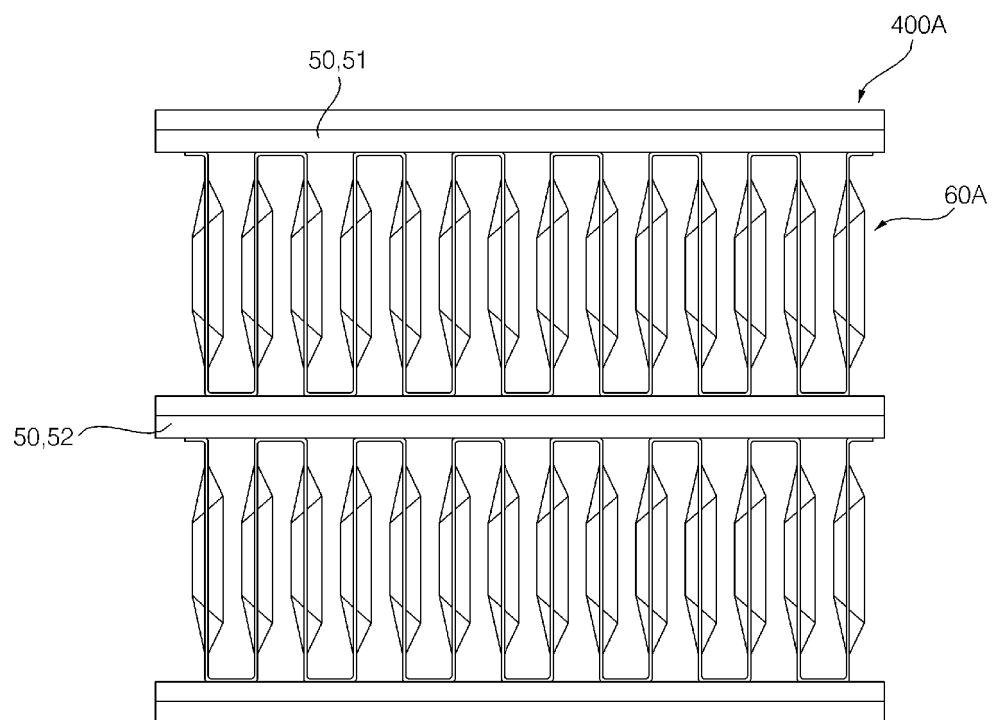


Fig. 14

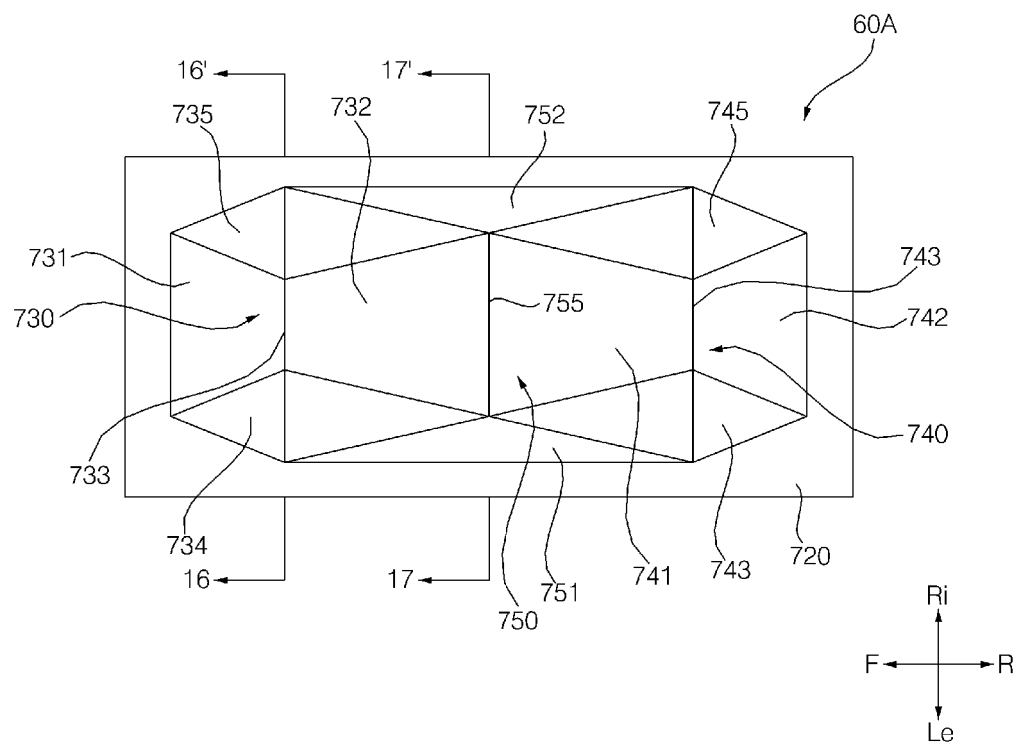


Fig. 15

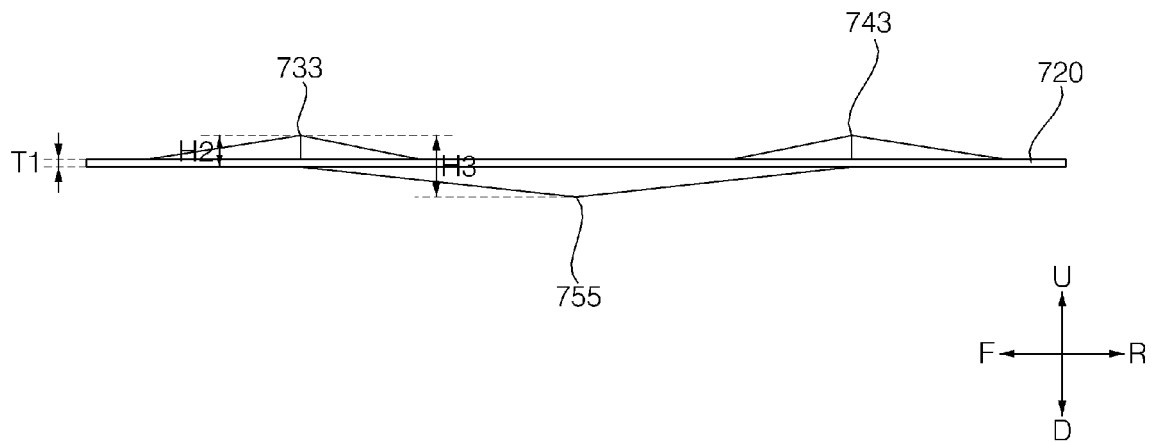


Fig. 16

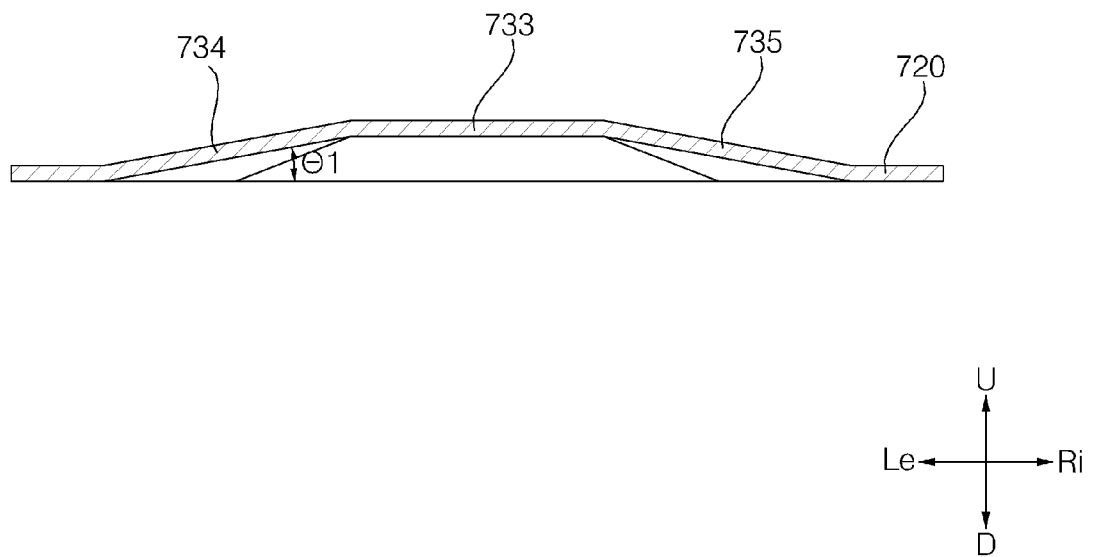
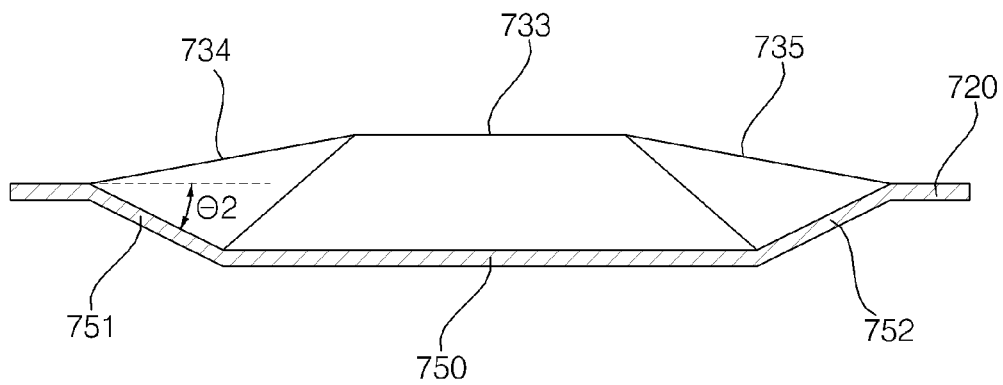


Fig. 17





EUROPEAN SEARCH REPORT

Application Number

EP 24 21 5900

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 4 130 634 A1 (MITSUBISHI ELECTRIC CORP [JP]) 8 February 2023 (2023-02-08)	1,2,4-13	INV.
A	* figures 1,5,6,9,10,12,13,15,16 *	14,15	F28D1/053 F28F1/12
X	CN 111 059 953 A (GREE ELECTRIC APPLIANCES INC ZHUHAI) 24 April 2020 (2020-04-24) * figure 3b *	1-5	
X	WO 2015/058452 A1 (MIDEA GROUP CO,LTD [CN]; CHENG ZHIMING [CN] ET AL.) 30 April 2015 (2015-04-30) * figures 1,5 *	1,2,4,5	
A	US 2005/056407 A1 (OH SAI KEE [KR] ET AL) 17 March 2005 (2005-03-17) * figures 6,7,9 *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			F28D F28F
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		1 April 2025	Delaitre, Maxime
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 24 21 5900

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-04-2025

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 4130634 A1	08-02-2023	EP 4130634 A1	08-02-2023
		ES 2987256 T3	14-11-2024
		JP 7309041 B2	14-07-2023
		JP WO2021199121 A1	07-10-2021
		WO 2021199121 A1	07-10-2021

CN 111059953 A	24-04-2020	NONE	

WO 2015058452 A1	30-04-2015	NONE	

US 2005056407 A1	17-03-2005	CN 1598434 A	23-03-2005
		EP 1515107 A1	16-03-2005
		JP 2005090939 A	07-04-2005
		KR 20050027407 A	21-03-2005
		US 2005056407 A1	17-03-2005

30

35

40

45

50

55

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- KR 20160069333 [0010]
- KR 102391896 [0014]