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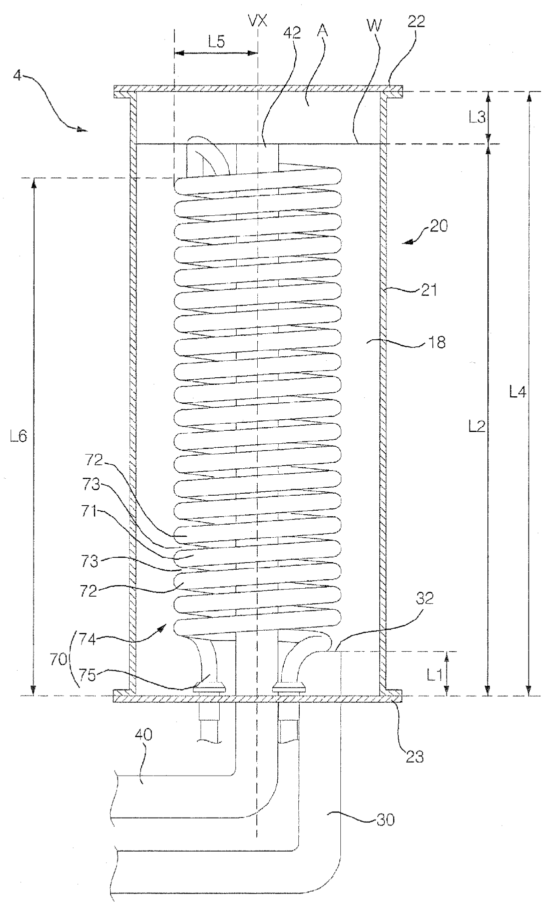
(54) Heat exchanger

(57) A heat exchanger of the present invention includes: a case in which a space is formed; a tope cover coupled to the top of the case; a lower cover coupled to the bottom of the case; a cooling water inflow pipe guiding cooling water flowing into the space and having an exit end through which cooling water comes out into the space; a tube through which a refrigerant that exchanges heat with the cooling water passes; and a cooling water discharge pipe guiding the cooling water discharged from the space and having an inlet end that the cooling water enters, in which the tube has a spiral pipe portion positioned in the space and spirally wound, the inlet end is positioned to be spaced from the top cover under the top cover, the height of the inlet end is larger than the height of the upper end of the spiral pipe portion, and the height between the exit end and the lower cover is smaller than the height between the inlet end and the lower cover; therefore, it is possible to achieve a compact heat exchanger while minimizing the installation space and the cooling water can exchange heat with the spiral pipe portion of the tube as much as possible.

Fig. 3



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Description

[0001] The present invention relates to a heat exchanger equipped with a tube on the shell, particularly a heat exchanger having a spiral pipe portion formed by spirally winding a tube several times.

[0002] Heat exchangers are apparatuses that allow heat to transfer between two fluids and used for various purposes such as cooling, heating, and supplying hot water.

[0003] Heat exchangers can function as a waste heat recovery heat exchanger that recovers waste heat, a cooler that cools the fluid at a high-temperature side, a heater that heats the fluid at a low-temperature side, a condenser that condenses vapor, or an evaporator that evaporates the fluid at a low-temperature side.

[0004] Various kinds of heat exchangers may be used, and there are a fin-tube type heat exchanger having a tube through which the first fluid flows and fins formed on the tube, a shell-tube type air conditioner having a shell through which the first fluid flows and a tube through which the second fluid that exchanges heat with the first fluid flows, a double tube type heat exchanger having an inner tube through which the first fluid flows and an outer tube through which the second fluid that exchanges heat with the first fluid and which covers the inner tube, and a plate type heat exchanger in which the first fluid and the second fluid flows with a heat transfer plate therebetween.

[0005] In the heat exchangers, a shell may be disposed to be horizontally long in a shell-tube type heat exchanger, a plurality of tubes may be disposed to be longitudinally long in the shell, first fluid that is a cooling water may flow into the shell and be discharged outside the shell, and second fluid that is a refrigerant may be cooled by the cooling water while passing through a tube. A cooling water inlet through which cooling water flows into the shell may protrude outward at one side of the shell and a cooling water inflow channel that guides the cooling water to the cooling water inlet may be connected to the cooling water inlet. A cooling water outlet through which cooling water is discharged outside the shell may protrude outward at the other side of the shell and a cooling water discharge channel that guides the cooling water discharged from the cooling water outlet may be connected to the cooling water outlet.

[Prior Art Document]

[Patent Document]

[0006] KR 10-2011-0128709 A (2011.11.30)

[0007] The heat exchangers according to the related art has a problem in that a large installation space is required because the heat exchangers are disposed to be horizontally long and a plurality of straight pipe-shaped tubes is disposed, so that the number of tubes is large and a specific tube seat is required to fix the tubes, thus the structure is complicated without being in a compact size.

[0008] The present invention aims to solve the above problem of the prior art. The object is achieved by the features of the claims.

[0009] The present invention provides a heat exchanger including: a case in which a space is formed; a top cover coupled to the top of the case; a lower cover coupled to the bottom of the case; a cooling water inflow pipe guiding cooling water flowing into the space and having an exit end through which cooling water comes out into the space; a tube through which a refrigerant that exchanges heat with the cooling water passes; and a cooling water discharge pipe guiding the cooling water discharged from the space and having an inlet end that the cooling water enters, in which the tube has a spiral pipe portion positioned in the space and spirally wound, the inlet end is positioned to be spaced from the top cover under the top cover, the height of the inlet end is larger than the height of the upper end of the spiral pipe portion, and the height between the exit end and the lower cover is smaller than the height between the inlet end and the lower cover.

[0010] A heat exchanger comprises: a shell having a case in which a space is formed, a top cover coupled to the top of the case, and a lower cover coupled to the bottom of the case; a cooling water inflow pipe having an exit end through which cooling water exits into the space; a tube through which a refrigerant that exchanges heat with the cooling water passes; and a cooling water discharge pipe having an inlet end through which the cooling water discharged from the space enters the cooling water discharge pipe, wherein the tube has a spiral pipe portion positioned in the space and spirally wound, the inlet end is positioned to be spaced from the top cover under the top cover, the height of the inlet end is larger than the height of the upper end of the spiral pipe portion, and the height between the exit end and the lower cover is smaller than the height between the inlet end and the lower cover. The height between the inlet end and the top cover may be 0.1 to 0.2 times the height of the case.

[0011] The height between the inlet end and the top cover may be 0.1 to 0.15 times the height of the case.

[0012] The cooling water inflow pipe, the cooling water discharge pipe, and the tube may extend under the lower cover through the lower cover.

[0013] The spiral pipe portion may be positioned between the cooling water discharge pipe and the shell and may have a vertical central axis.

[0014] The vertical central axis may be positioned at a portion where a portion of the cooling water discharge pipe is positioned in the shell.

[0015] For the tube, a plurality of tubes may be disposed in the shell and the plurality of tubes may have different distances from the vertical central axis to the spiral pipe portion.

[0016] The spiral pipe portion of one of the plurality of tubes may be in contact with the cooling water discharge pipe.

[0017] The height of the exit end may be smaller than the height of the lower end of the spiral pipe portion.

[0018] The case may be vertically long.

[0019] The present invention has the advantage that it is possible to achieve a compact heat exchanger while minimizing the installation space and the cooling water can exchange heat with the spiral pipe portion of the tube as much as possible.

[0020] Further, the present invention has the advantage that it is possible to minimize rupture due to freezing of the cooling water and increase the heat transfer amount between the cooling water and the refrigerant.

[0021] Further, the present invention has the advantage that it is possible to clean the tube after separating the top cover and the case, and simply clean the tube without separating the cooling water inflow pipe, the cooling water discharge pipe, and the tube.

[0022] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

FIG. 1 is a diagram illustrating the configuration of an air conditioner equipped with a heat exchanger according to an exemplary embodiment of the present invention;

FIG. 2 is a side view showing the external appearance of a heat exchanger according to an exemplary embodiment of the present invention;

FIG. 3 is a view showing the inside of the heat exchanger according to an exemplary embodiment of the present invention;

FIG. 4 is a bottom view of the shell shown in FIG. 2;

FIG. 5 is a perspective view of the base shown in FIG. 2;

FIG. 6 is a plan view showing the inside of the heat exchanger according to an exemplary embodiment of the present invention; and

FIG. 7 is a graph showing the heat transfer amount according to the ratio of the height between the inlet and the top cover shown in FIG. 3 and the height of a case.

[0023] Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[0024] FIG. 1 is a diagram illustrating the configuration of an air conditioner equipped with a heat exchanger according to an exemplary embodiment of the present invention.

[0025] The air conditioner shown in FIG. 1 may include a condenser 2, a first heat exchanger 4, an expansion device 6, and a second heat exchanger 8. The first heat exchanger 4 may allow heat exchange between cooling water and a refrigerant. The cooling water may function as cooling fluid that absorbs heat of a refrigerant. The air conditioner may include a compressor 2 that compresses a refrigerant, the first heat exchanger 4 that allows heat exchange between a refrigerant and cooling water, an expansion device 6 that expands a refrigerant, and a second heat exchanger 8 that allows heat exchange between a refrigerant and the air.

[0026] The refrigerant may sequentially pass through the compressor 2, the first heat exchanger 4, the expansion device 6, and the second heat exchanger 8. That is, the refrigerant compressed by the compressor 2 may return to the compressor 2 after sequentially passing through the first heat exchanger 4, the expansion device 6, and the second heat exchanger 8. In this case, the first heat exchanger 4 may function as a condenser that condenses the refrigerant, the second heat exchanger 8 may function as an evaporator that evaporates the refrigerant, and the cooling water may absorb heat of the refrigerant compressed by the compressor 2.

[0027] The air conditioner may further include a flow path selector valve (not shown) that sends the refrigerant compressed by the compressor 2 to the first heat exchanger 4 or the second heat exchanger 8. The air conditioner may include a first circuit through which the refrigerant compressed by the compressor 2 returns to the compressor 2 after sequentially passing through the flow path selector valve, the first heat exchanger 4, the expansion device 6, the second heat exchanger 8, and the flow path selector valve. The air conditioner may include a second circuit through which the refrigerant compressed by the compressor 2 returns to the compressor 2 after sequentially passing through the flow path selector valve (not shown), the second heat exchanger 8, the expansion device 6, the first heat exchanger 4, and the flow path selector valve. The first circuit may be a circuit for a cooling operation in which the room is cooled by the second heat exchanger 8, the first heat exchanger 4 may function as a condenser that condenses the refrigerant, and the second heat exchanger 8 may function as an evaporator that evaporates the refrigerant. The second circuit may be a circuit for a heating operation in which the room is heated by the second heat exchanger 8, the second heat exchanger 8 may function as a condenser that condenses the refrigerant, and the first heat exchanger 4 may function as an evaporator that evaporates the refrigerant.

[0028] The cooling water may be liquid-state fluid such as water or antifreeze and the refrigerant may be various kinds of refrigerants such as the Freon-based refrigerant or carbon dioxide refrigerant that is generally used for air conditioners.

[0029] The compressor may be a compressor that compresses a refrigerant, such as rotary compressor, a scroll compressor, and a screw compressor. The compressor 2 may be connected with the first heat exchanger 4 through a compressor outlet channel 3.

[0030] The first heat exchanger 4 may be a shell-tube type heat exchanger. The first heat exchanger 4 may include a shell through which cooling water such as water or an antifreeze passes, and a tube through which a refrigerant passes. The first heat exchanger 4 may be connected with the expansion device 6 through a first heat exchanger-expansion device connection channel 5. The first heat exchanger 4 will be described in detail below.

[0031] The expansion device may be a capillary tube or an electronic expansion valve through which a refrigerant expands. The expansion device 6 may be connected with the second heat exchanger 8 through an expansion device-second heat exchanger connection channel 7.

[0032] The second heat exchanger 8 may be a fin-tube type heat exchanger or a coil type heat exchanger through which a refrigerant passes. The second heat exchanger 8 may include a tube through which a refrigerant exchanges heat with the indoor air. The second heat exchanger 8 may further include fins that are heat transfer members coupled to the tube. The second heat exchanger 8 may be connected with the compressor through a compressor intake channel 9.

[0033] The air conditioner may include a heat treatment unit 10 connected with the first heat exchanger 4. The heat treatment unit 10 may function as a cooler that cools cooling water, when the first heat exchanger 4 functions as a condenser that condenses a refrigerant. When being a cooler, the heat treatment unit 10 may include a cooling tower that cools cooling water. The heat treatment unit 10 may be connected with the first heat exchanger 4 through water pipes 12 and 14. The first heat exchanger 4 may be connected with the heat treatment unit 10 through the water discharge pipe 12 and the cooling water in the first heat exchanger 4 may be discharged to the heat treatment unit 10 through the water discharge pipe 12. The first heat exchanger 4 may be connected with the heat treatment unit 10 through the water intake pipe 14 and the cooling water in the heat treatment unit 10 may enter the first heat exchanger 4 through the water intake pipe 14. A circulating mechanism, such as a pump, which circulates the cooling water to the heat treatment unit 10 and the first heat exchanger 4 may be disposed in at least one of the heat treatment unit 10, the water discharge pipe 12, and the water intake pipe 14.

[0034] The air conditioner may further include an indoor fan 16 that returns the indoor air to the room through the second heat exchanger 8.

[0035] The compressor, the first heat exchanger 4, the expansion device 6, the second heat exchanger 8, and the indoor fan 16 may be disposed in one air-conditioning unit, and the air in the room may be discharged again to the room through a duct after flowing to the second heat exchanger 8 through a duct. The heat treatment unit 10 may be disposed outside one air-conditioning unit and connected with one air-conditioning unit through the water pipes 12 and 14.

[0036] The compressor 2, the first heat exchanger 4, the expansion device 6, the second heat exchanger 8, and the indoor fan 16 may be distributed in a plurality of air-conditioning units I and O. The first heat exchanger 4 and the indoor fan 16 may be disposed together in the indoor unit I, and the compressor 2 and the first heat exchanger 4 may be disposed together in the compression unit O (or outdoor unit). The expansion device 6 may be disposed in at least one of the indoor unit I and the compression unit O. For the expansion device 6, one expansion device may be disposed in the indoor unit I or the compression unit O. A plurality of expansion devices 6 may be disposed, where the first expansion device may be disposed in the indoor unit I and the second expansion device may be disposed in the compression unit O. The first expansion device may function as an outdoor expansion device that is disposed closer to the first heat exchanger 4 than the second heat exchanger 8. The second expansion device may function as an indoor expansion device that is disposed closer to the second heat exchanger 8 than the first heat exchanger 4. The indoor unit I may be installed in the room. The compression unit O may be installed at the machine room, the basement, or the roof of a building. The compression unit O may be connected with the heat treatment unit 10 through the water pipes 12 and 14.

[0037] The first heat exchanger 4 is referred to as a heat exchanger in the following description.

[0038] FIG. 2 is a side view showing the external appearance of a heat exchanger according to an exemplary embodiment of the present invention, FIG. 3 is a view showing the inside of the heat exchanger according to an exemplary embodiment of the present invention, and FIG. 4 is a bottom view of the shell shown in FIG. 2, and FIG. 5 is a perspective view of the base shown in FIG. 2.

[0039] The heat exchanger 4 may include the shell 20, a cooling water inflow pipe 30 that guides cooling water W into the shell 20, a cooling water discharge pipe 40 that guides the cooling water W to the outside of the shell 20, and a tube 70 through which a refrigerant that exchanges heat with the cooling water W passes.

[0040] A space 18 may be defined in the shell 20. The space 18 may be filled up with the cooling water W and may receive the tube 70.

[0041] The shell may include a case 21 in which the space 18 is formed, and a top cover 22 coupled to the top of the case 21. The shell 20 may include a lower cover 23 coupled to the bottom of the case 21.

[0042] The case 21 may be disposed to be vertically long. The case 21 may be manufactured separately from the to cover 22 and the lower cover 23 and then combined with the top cover 22 and the lower cover 23, without being integrally formed with at least one of the top cover 22 and the lower cover 23. When the case 21, the top cover 22, and the lower cover 23 are separately manufactured and then combined, the inner circumferential surface of the case 21, the underside of the top cover 22, and the top of the lower cover 23 can be easily coated. When the inside of the shell 20 is coated, with the case 21 integrally formed with one of the to cover 22 and the lower cover 23, the coating fluid may not be uniformly spread throughout the inner wall of the case 21. On the contrary, when the case 21, the top cover 22, and the lower cover 23 are separately manufactured, the coating fluid can be uniformly spread throughout the inner wall of the case 21. In the shell 20, the case 21, the top cover 22, and the lower cover 23 may be combined, after the inner circumferential surface of the case 21, the underside of the top case 22, and the top of the lower cover 23 are coated.

[0043] The case 21 may have a hollow body 21a with the space 18 therein, a first connecting portion 21b coupled with the top cover 22, and a second connecting portion 21c coupled with the lower cover 23.

[0044] The hollow body 21a may be formed in a hollow cylindrical shape.

[0045] The first connecting portion 21b may protrude in a flange shape from the upper end of the hollow body 21a. The first connecting portion 21b may have fastening holes for fastening to the top cover 22 by fasteners 22a such as bolts.

[0046] The second connecting portion 21c may protrude in a flange shape from the lower end of the hollow body 21a. The second connecting portion 21c may have fastening holes for fastening to the lower cover 23 by fasteners 23a such as bolts.

[0047] The top cover 22 may be a plate. The top cover 22 may be formed in a circular plate shape. A fastening hole corresponding to the first connecting portion 21b may be formed through the top cover 22 and the top cover 22 may be coupled to the first connecting portion 21b by the fasteners 22a such as bolts. The top cover 22 may close an upper open surface of the case 21.

[0048] The lower cover 23 may be a plate. The lower cover 23 may be formed in a circular plate shape. A fastening hole corresponding to the second connecting portion 21b may be formed through the lower cover 23 and the lower cover 23 may be coupled to the second connecting portion 21c by the fasteners 23a such as bolts. The top cover 22 may close a lower open surface of the case 21.

[0049] The shell 20 may has a space defined among the case 21, the top cover 22, and the lower cover 23 and the cooling water W may flow into the space 18 through the cooling water inflow pipe 30. The cooling water W may exchange heat with the tube 70 while flowing through the space 18.

[0050] A cooling water inflow pipe-through hole 24 through which the cooling water inflow pipe 30 passes may be formed in the shell 20. A cooling water discharge pipe-through hole 25 through which the cooling water discharge pipe 40 passes may be formed in the shell 20. Tube through-holes 26 through which the tube 70 passes may be formed in the shell 20. The number of the tube through-holes 26 may be the same as the number of the tubes 70.

[0051] The cooling water inflow pipe 30 guides the cooling water W that flows into the space 18 and an exit end 3 through which the cooling water comes out into the space 18 may be formed at the cooling water inflow pipe 30. The cooling water inflow pipe 30 may pass through the shell 20 such that the exit end 32 is positioned in the shell 20. In the cooling water inflow pipe 30, the height L1 between the exit end 32 and the lower cover 23 may be smaller than the height L2 between an inlet end 42 and a lower cover 23, which are described below, of the cooling water discharge pipe 40. The cooling water W flowing in the shell 20 through the cooling water inflow pipe 30 may fill up from the lower portion in the shell 20. The cooling water inflow pipe 30 may be disposed such that the exit end 32 is positioned at the lower portion in the shell 20. The portion, which is positioned outside the shell 20, of the cooling water inflow pipe 30 may be connected to the water intake pipe 14 shown in FIG. 1.

[0052] The cooling water discharge pipe 40 guides the cooling water W discharged from the space 18 and may have the inlet end 42 that the cooling water W in the space 18 enters. The cooling water discharge pipe 40 may pass through the shell 20 such that the inlet end 42 is positioned in the shell 20. The cooling water discharge pipe 40 may be disposed such that the cooling water W at the lower portion in the shell 20 is not discharged through the cooling water discharge pipe 40 but the cooling water W at the upper portion in the shell 20 is discharged through the cooling water discharge pipe 40. The inlet end 42 may be positioned at the upper portion in the shell 20. The portion, which is positioned outside the shell 20, of the cooling water discharge pipe 40 may be connected to the water discharge pipe 12 shown in FIG. 1. The inlet end 42 may be positioned under the top cover 22. The inlet end 42 may be spaced from the top cover 22. The inlet end 42 may be vertically spaced from the top cover 22. When the water level in the shell 20 is higher than the inlet end 42, the cooling water W may enter the cooling water discharge pipe 40 through the inlet end 42 and an air layer A that is a space for receiving air may be formed between the inlet end 42 and the top cover 22. The heat exchanger 4 is not provided with a specific air vent for discharging the air in the air layer A and the top cover 22 may cover the entire upper opening of the space 18. In the heat exchanger 4, the larger the height L3 between the inlet end 42 and the top cover 22, the larger the height of the air layer A between the cooling water W and the shell 20, and the less the height L3 between the inlet end 42 and the top cover 22, the larger the height of the air layer A between the cooling water W and the shell 20. When the height of the air layer A is smaller than an appropriate range, it is difficult to ensure a sufficient space, the internal pressure of the shell 20 may increase, and the shell may be frozen to burst, due to freezing of the cooling water W. Meanwhile, when the height of the air layer A is larger than an appropriate range, the material cost may increase due to the increase in height of the shell 20. Further, the cooling water W may leak from between the case 21 and the top cover 22 due to vibration or the like of the heat exchanger 4. In the heat exchanger 4, the height L3 between the inlet end 42 and the top cover 22 may be the height of the air layer A.

[0053] The cooling water intake pipe 30, the cooling water discharge pipe 40, and the tube 70 may be disposed through one of the case 21, the top cover 22, and the lower cover 23. When the cooling water intake pipe 30, the cooling water discharge pipe 40, and the tube 70 are disposed through the lower cover 23, it is possible to easily clean the heat exchanger 4. In the heat exchanger 4, the upper cover 22 may be separated from the case 21 and the case 21 may be separated from the lower cover 23, with the cooling water intake pipe 30, the cooling water discharge pipe 40, and the tube 70 fixed to the lower cover 23. The worker can easily clean the heat exchanger 4, with the upper cover 2 and the case 21 separated and the cooling water intake pipe 30, the cooling water discharge pipe 40, and the tube 70 fixed to the lower cover 23. Considering easiness of cleaning the heat exchanger 4, it is preferable that cooling water intake pipe 30, the cooling water discharge pipe 40, and the tube 70 are disposed through the lower cover 23.

[0054] The heat exchanger 4 may include a base 50 that supports the shell 20. The base may have a fastening portion 52 where the shell 20 is fastened. The fastening portion 52 may be formed in a plate shape. The fastening portion 52 may be horizontally disposed under the shell 20. The shell 20 may be placed on the fastening portion 52 or fastened to the fastening portion 52.

[0055] Fastening holes 54 for fastening the shell 20 with fasteners 23a such as bolts may be formed through the fastening portion 52. A through-hole 55 through which at least one of the cooling water intake pipe 30 and the cooling water discharge pipe 40 passes may be formed through the fastening portion 52. The through-hole 55 of the fastening portion 52 may be composed of a cooling water inflow pipe-through hole through which the cooling water inflow pipe 30 passes and a cooling water discharge pipe-through hole through which the cooling water discharge pipe 40 passes. One through-hole 55 is formed at the fastening portion 52, and the cooling water inflow pipe 30 and the cooling water discharge pipe 40 may pass together through one through-hole 55. When one through-hole 55 is formed at the fastening portion 52, the through-hole 55 may be formed to be horizontally long. The through-hole 55 may be formed to be open at one side of the fastening portion 52. The through-hole 55 may be formed such that the lower portion of the cooling water inflow pipe through-hole 24 of the shell 20 and the lower portion of the cooling water discharge pipe through-hole 25 of the shell 20 are open. Tube holes 56 through which the tube 70 passes may be formed in the fastening portion 52. The base 50 may have a support portion that supports the fastening portion 52. The support portion may include a plurality of legs 57, 58, 59, and 60 supporting the fastening portion 52. In the heat exchanger 4, when the shell 20 is placed on the fastening portion 52, a portion of the cooling water inflow pipe 30, a portion of the cooling water discharge pipe 40, and a portion of the tube 70 may be positioned under the fastening portion 52. In the heat exchanger 4, all of the cooling water inflow pipe 30, cooling water discharge pipe 40, and tube 70 may extend under the shell 20.

[0056] The tube 70 may have a spiral pipe portion 74 that is positioned in the space 18 and spirally wound. A gap 73 may be defined between turns 71 and 72 of the spiral pipe portion 74. The entire shape of the spiral pipe portion 74 may be formed in a coil shape. The spiral pipe portion 74 may be positioned between the cooling water discharge pipe 40 and the shell 20 and may have a vertical central axis VX. The vertical central axis VX may be positioned at the portion where the portion of the cooling water discharge pipe 40 is positioned in the shell 20. The vertical central axis VX may coincide with the central axis of the portion where the portion of the cooling water discharge pipe 40 is positioned in the shell 20. The turns 71 and 72 may be wound such that the distances L5 from the vertical central axis VX are the same. The spiral portion 74 may have at least ten or more turns. The spiral portion 74 may be wound continuously clockwise or continuously counterclockwise. The turns 71 and 72 may be vertically spaced from each other and a gap 73 may be defined between the turns 71 and 72. The cooling water W may flow into the space in the spiral portion 74 from the space between the shell 20 and the spiral portion 74 through the gap 73, or may flow into the space between the shell 20 and the spiral portion 74 from the space in the spiral portion 74 through the gap 73.

[0057] The upper end of the spiral pipe portion 74 is higher than the inlet end 42 of the cooling water discharge pipe 40, it is preferable to minimize the cooling water W that enters the inlet end 42 without exchanging heat with the spiral pipe portion 74, and it is preferable that the height L5 between the upper end of the spiral pipe portion 74 and the lower cover 23 is smaller than the height L2 between the inlet end 42 and the lower cover 23. The height of the inlet end 42 may be larger than the upper end of the spiral pipe portion 74. The spiral pipe portion 74 may be disposed such that a portion is positioned above the outlet end 32 of the cooling water inflow pipe 30. The exit end 32 may be positioned under the spiral pipe portion 74. The height of the exit end 32 may be smaller than the height of the lower end of the spiral pipe portion 74.

[0058] The tube 70 may have a straight pipe portion 75 that extends from the spiral portion 74 in a straight pipe shape. The straight pipe portion 75 may be bent at the lowermost turn of the spiral portion 74. The straight pipe portion 75 may be bent at the uppermost turn of the spiral portion 74. The straight pipe portion 74 may be disposed in parallel with the vertical central axis VX.

[0059] FIG. 6 is a plan view showing the inside of the heat exchanger according to an exemplary embodiment of the present invention.

[0060] For the tube 70, a plurality of tubes 70A and 70B may be disposed in the shell 20. The tubes 70A and 70B may have different distances from the vertical central axis VX to the spiral pipe portion 74. For the tube 70, a pair of tubes 70A and 70B having different distances from the vertical central axis VX may be connected in series. For the tube 70, a pair of tubes 70A and 70B having different distances from the vertical central axis VX may be connected by a connection tube 70C. The connection tube 70C may be formed in a U-shape. The connection tube 70C may be disposed such that at least a portion is sunk in the cooling water W. The pair of tubes 70A and 70B and the connection tube 70C may constitute one heat transfer tube P. The refrigerant flows to the connection tube 70C after sequentially passing through the straight pipe portion 75 and the spiral portion 74 of any one 70A of the pair of tubes 70A and 70B, and then, may flow to the outside of the shell 20 after sequentially passing through the spiral portion 74 and the straight pipe portion 75 of the other one 70B of the pair of tubes 70A and 70B. The refrigerant may exchange heat with the cooling water W while passing through any one 70A of the pair of tubes 70A and 70B, exchange heat with the cooling water W while passing through the connection tube 70C, and then exchange heat with the cooling water W while passing through the other one 70B of the pair of tubes 70A and 70B. For the tube 70, a plurality of pairs of tubes 70A and 70B having different distances from the vertical central axis VX and connected in series may be disposed.

[0061] The spiral pipe portion 74 of one 70A of the tubes 70A and 70B may be fixed with the cooling water discharge pipe 40. The tubes 70A and 70B may be fixed with the cooling water discharge pipe 40, with the tube closest to the cooling water discharge pipe 40 in contact with the cooling water discharge pipe 40. The tube closest to the cooling water discharge pipe 40 may be disposed, like surrounding the cooling water discharge pipe 40. The tube closest to the shell 20 in the tubes 70A and 70B may be not in contact with the inner surface of the shell 20.

FIG. 7 is a graph showing the heat transfer amount according to the ratio of the height between the inlet and the top cover shown in FIG. 3 and the height of a case.

FIG. 7 is a dimensionless graph showing heat transfer performance according to a change of a height ratio, with respect to a height ratio where the heat exchanger has the optimum heat transfer performance.

[0062] In the heat exchanger 4, the heat transfer amount of the cooling water and the refrigerant may be measured while only the height ratio X changes, under the conditions that the speed of current of water in the cooling water inflow pipe 30 is 2.7m/sec, the mass flow rate of the water is 1.6kg/sec, and the volume flow rate of the water is 96LPM, in which when the height ratio X is about 0.13, the heat transfer performance is the highest and the dimensionless heat transfer amount according to the height ratio X when the height ratio of 0.13 is 100% may be shown as in FIG. 7.

[0063] In the heat exchanger 4, the height L3 between the inlet end 42 and the top cover 22 may be 0.1 to 0.2 times the height L4 of the case 21. That is, in the heat exchanger 4, the ratio (X= L3/L4) of the height L3 between the inlet end 42 and the top cover 22 and the height of the case 21 may be 0.1 to 0.2.

[0064] When the height L3 between the inlet end 42 and the top cover 22 is less than 0.1 times the height L4 of the case 21, the lower the height ratio, the less the heat transfer amount, and the area where the height ratio X is 0.8 or less may be a rupture area A where the height of the air area is too small. When the height L3 between the inlet end 42 and the top cover 22 is above 0.2 times the height L4 of the case 21, the heat transfer amount may reduce 90% or less of the maximum heat transfer amount, and it is preferable that the height L3 between the inlet end 42 and the top cover 22 is 0.1 to 0.2 times the height L4 of the case 21.

[0065] When the height L3 between the inlet end 42 and the top cover 22 is 0.1 to 0.15 times the height L4 of the case 21, the heat transfer amount may be maintained at 90% or more of the maximum heat transfer amount, and it is preferable that the height L3 between the inlet end 42 and the top cover 22 is set between 0.1 to 0.15 times the height L4 of the case 21.

[0066] Hereinafter, the operation of the present invention having the configuration is described.

[0067] First, the refrigerant may pass through the tube 70 and exchange heat with the cooling water while passing through the tube 70. The refrigerant may be discharged to the outside of the heat exchanger 4 after sequentially passing through the tubes 70A and 70B.

[0068] The cooling water may flow to the lower portion in the shell 20 through the cooling water inflow pipe 30 and may flow up in the shell 20. The cooling water flowing in the space 18 through the exit end 32 of the cooling water inflow pipe 30 may pass through the gap 73 between the turns 71 and 72 of the spiral pipe portion 74 while rising in the shell 20, and may exchange heat with the tube 70. The cooling water exchanges heat with the entire spiral pipe portion 74 while rising to a water level higher than the upper end of the spiral pipe portion 74, and then may flow into the inlet end 42 of the cooling water discharge pipe 40 at apposition higher than the spiral pipe portion 74, and may be discharged to the outside of the heat exchanger 4 through the cooling water discharge pipe 40. The cooling water passing through the cooling water discharge pipe 40 may exchanges heat with the tube that is in contact with the cooling water discharge pipe 40, in contact with the tube that is in contact with the cooling water discharge pipe 40.

[0069] The heat exchanger allows heat exchange between the cooling water and the refrigerant while keeping the optimum heat transfer amount and may be prevented from frozen to burst by an appropriate height of the air layer A even if the cooling water freezes due to too low air temperature.

[0070] In the heat exchanger 4, the case 21 may be separated from the lower cover 23 to clean the tube 70. A worker can clean the tube 70 with cleaning tools such as a cleaning brush, without separating the cooling water inflow pipe 30, the cooling water discharge pipe 40, and the tube 70 from the lower cover 23.

Claims

1. A heat exchanger comprising:

a shell (20) having:

a case (21) in which a space (18) is formed;
a top cover (22) coupled to the top of the case; and
a lower cover (23) coupled to the bottom of the case;

a cooling water inflow pipe (30) having an exit end (32) through which cooling water exits into the space (18);
a tube (70) through which a refrigerant that exchanges heat with the cooling water passes; and
a cooling water discharge pipe (40) having an inlet end (42) through which the cooling water discharged from the space (18) enters the cooling water discharge pipe,
wherein the tube (70) has a spiral pipe portion (74) positioned in the space (18) and spirally wound,
the inlet end (42) is positioned to be spaced from the top cover (22) under the top cover,
the height of the inlet end (42) is larger than the height of the upper end of the spiral pipe portion (74), and
the height between the exit end (32) and the lower cover (23) is smaller than the height between the inlet end (42) and the lower cover (23).

2. The heat exchanger of claim 1, wherein the height between the inlet end (42) and the top cover (22) is 0.1 to 0.2 times the height of the case (21).

3. The heat exchanger of claim 1, wherein the height between the inlet end (42) and the top cover (22) is 0.1 to 0.15 times the height of the case (21).

4. The heat exchanger of any of preceding claims, wherein the cooling water inflow pipe (30), the cooling water discharge pipe (40), and the tube (70) extend under the lower cover (23) through the lower cover.

5. The heat exchanger of any of preceding claims, wherein the spiral pipe portion (74) is positioned between the cooling water discharge pipe (40) and the shell (20) and has a vertical central axis (VX).

6. The heat exchanger of claim 5, wherein the vertical central axis (VX) is positioned at a portion where a portion of the cooling water discharge pipe (40) is positioned in the shell (20).

7. The heat exchanger of claim 5 or 6, wherein for the tube (70), a plurality of tubes (70A, 70B) is disposed in the shell (20) and the plurality of tubes have different distances from the vertical central axis (VX) to the spiral pipe portion (74).

8. The heat exchanger of claim 7, wherein the spiral pipe portion (74) of one of the plurality of tubes (70A, 70B) is in contact with the cooling water discharge pipe (40).

9. The heat exchanger of any of preceding claims, wherein the height of the exit end (42) is smaller than the height of the lower end of the spiral pipe portion (74).

10. The heat exchanger of any of preceding claims, wherein the case (21) is vertically long.

Fig. 1

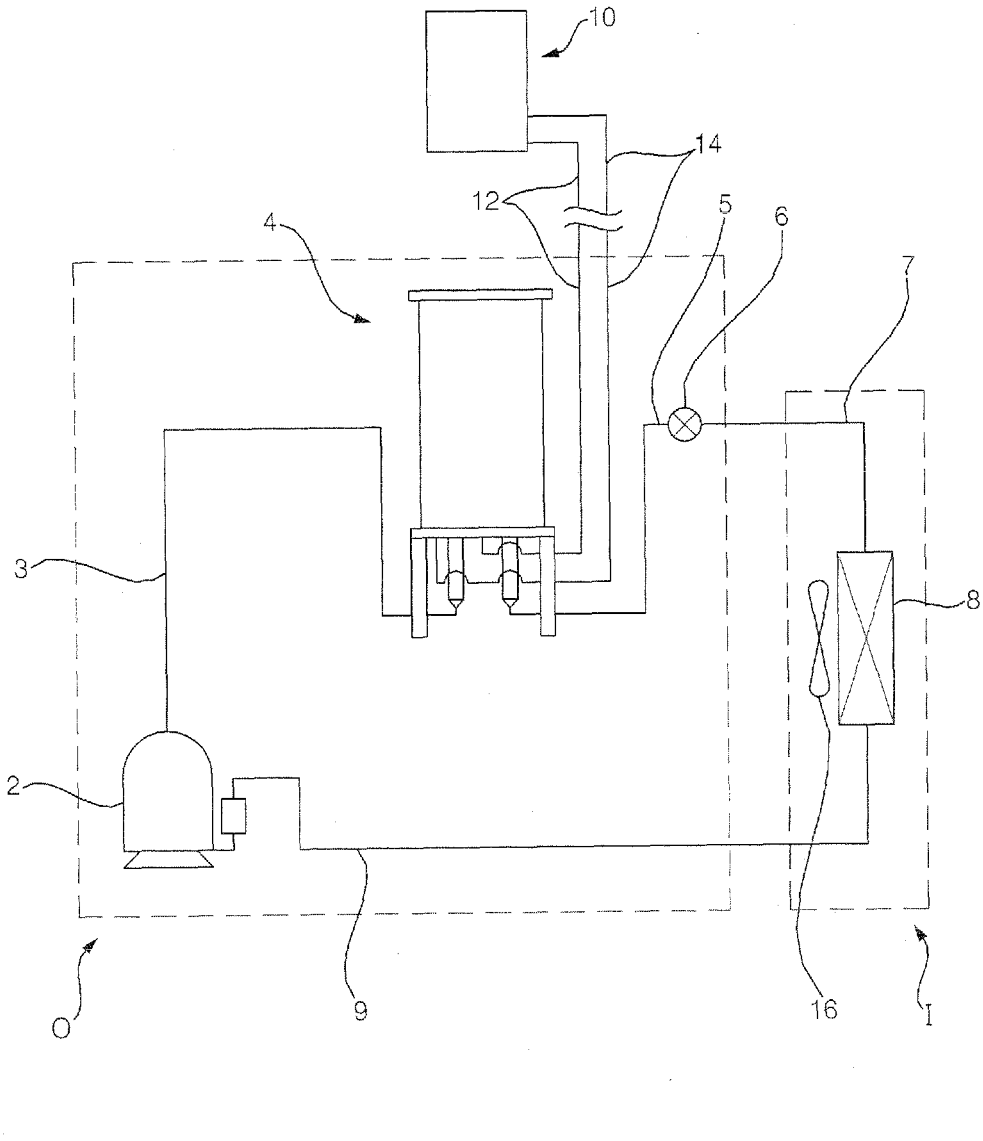


Fig. 2

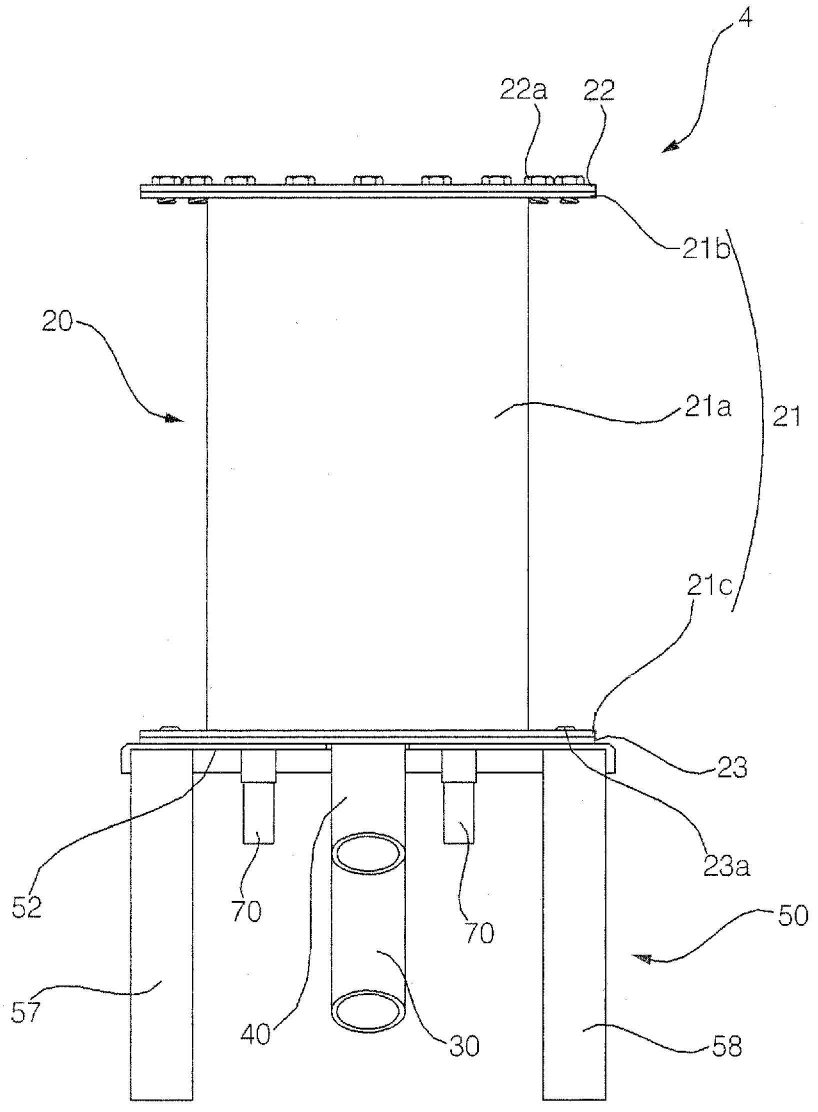
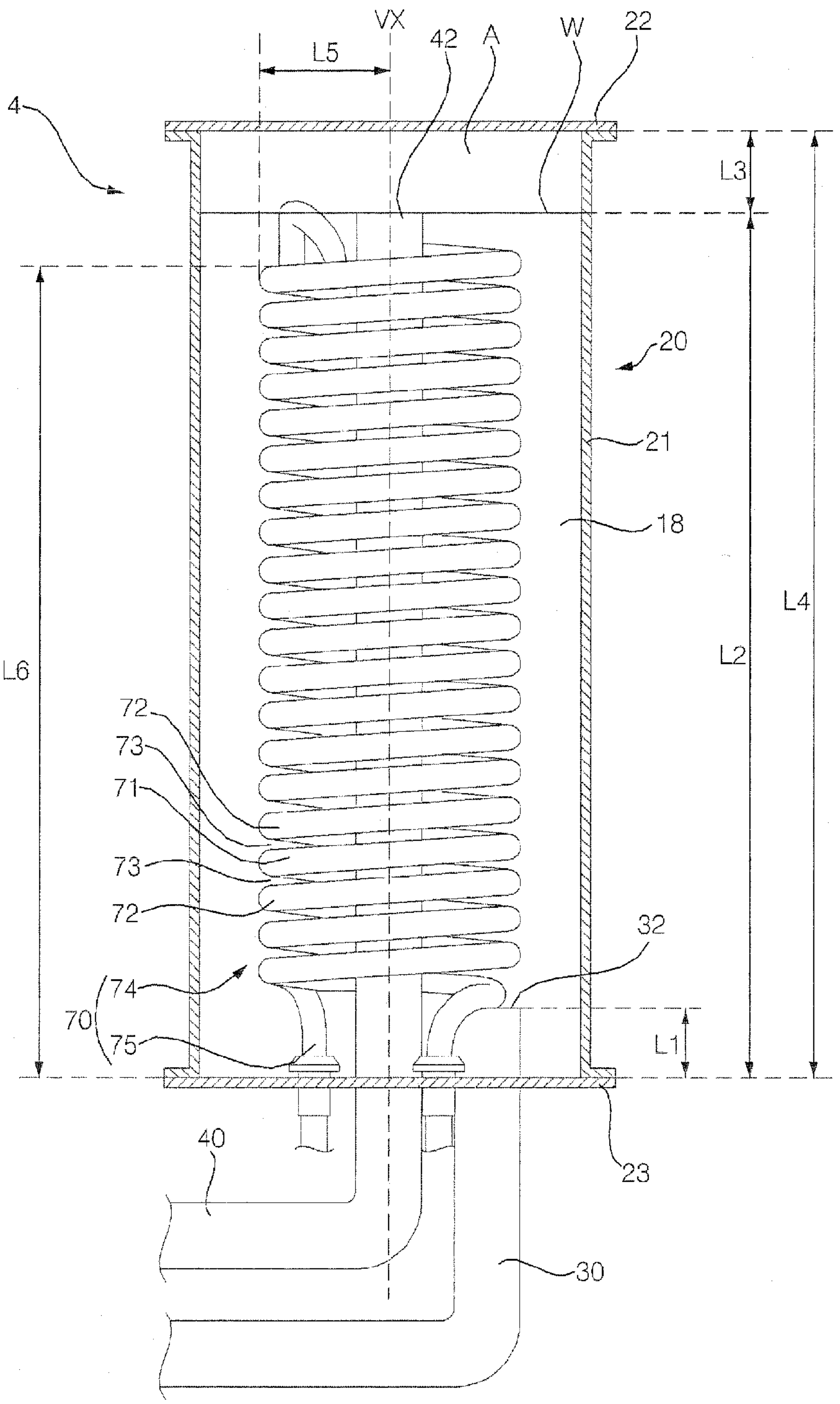


Fig. 3



VX
L5
42
A
W
22
4
L3
20
21
18
L4
L2
L6
72
73
71
73
72
32
74
70
75
L1
40
23
30

Fig. 4

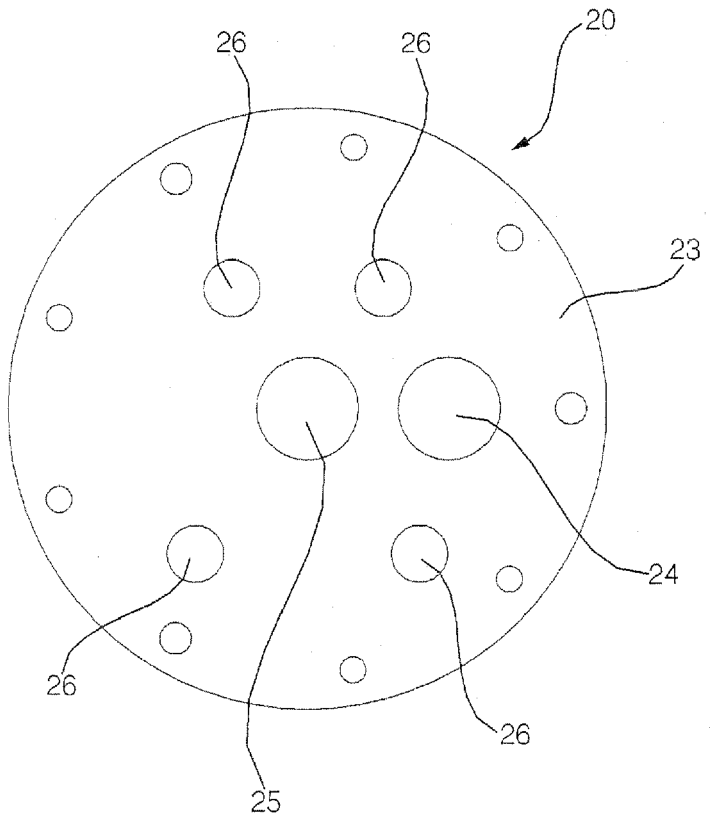


Fig. 5

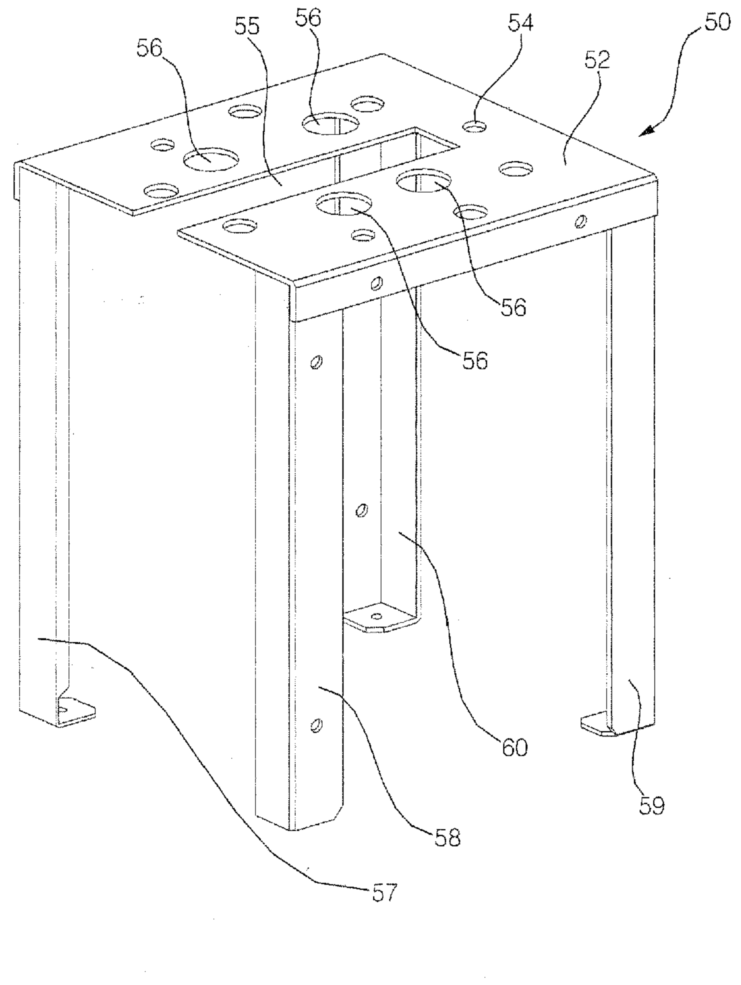


Fig. 6

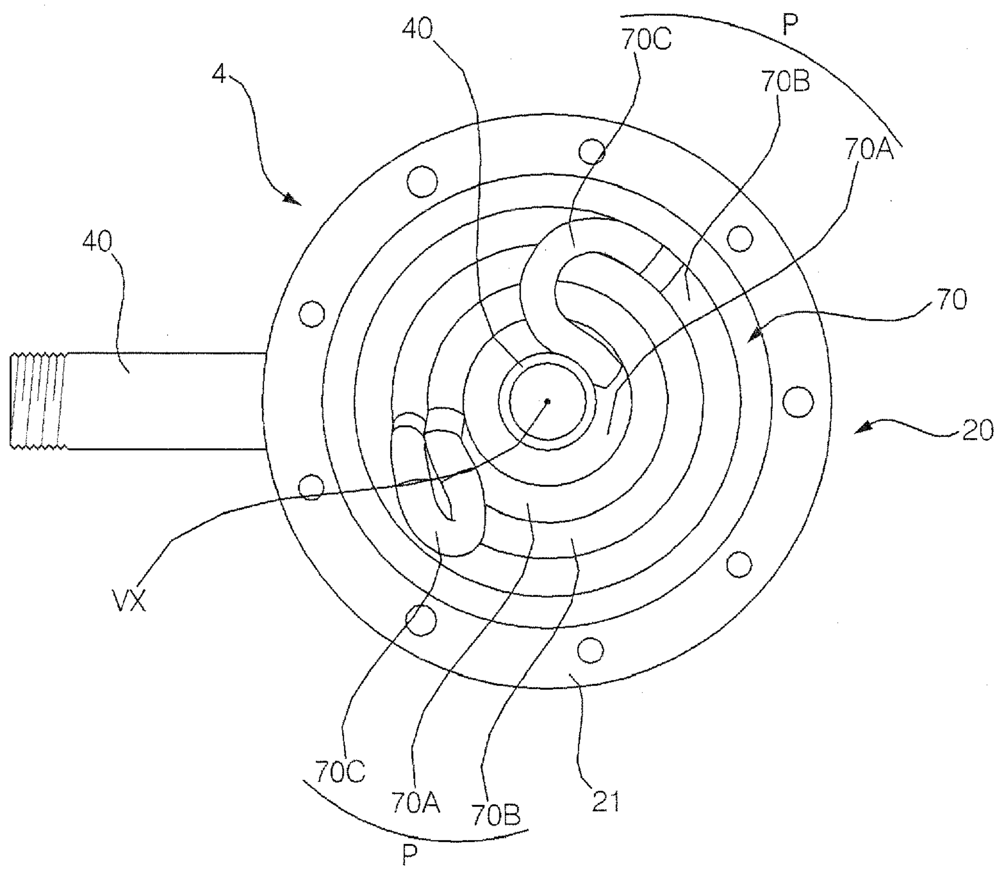
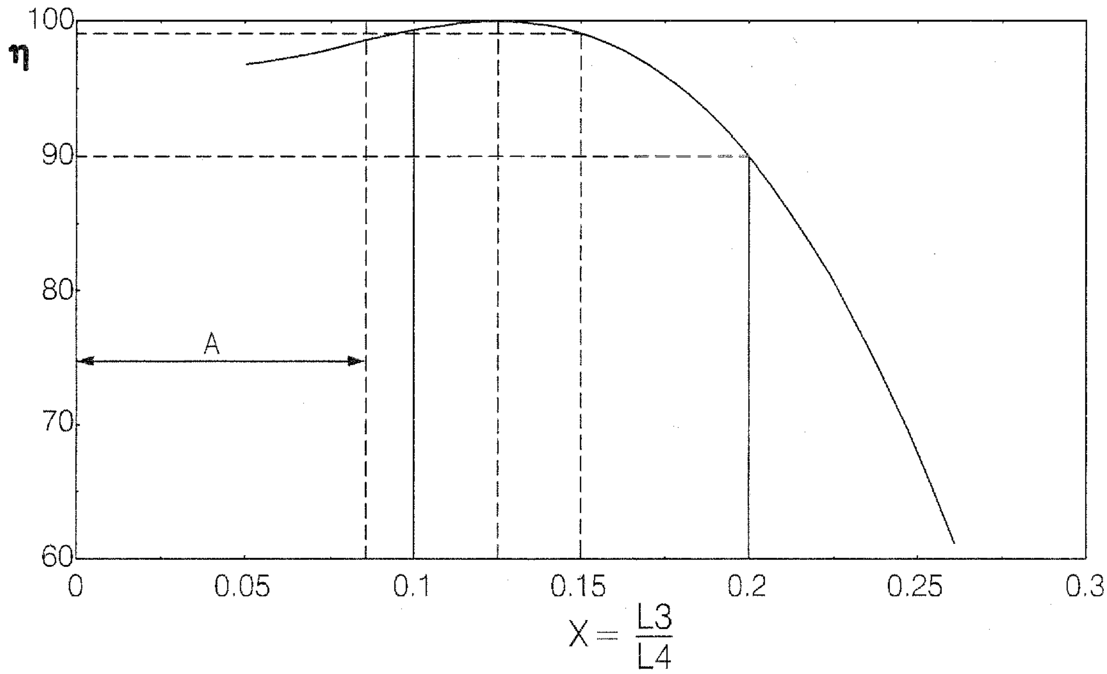


Fig. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 13 16 4718

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 03/087677 A2 (S S RUSTFRI AS [DK]; SOERENSEN POVL KONGSGAARD [DK]; NIELSEN ELO [DK]) 23 October 2003 (2003-10-23) * figures * -----	1-10	INV. F28D7/02
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	16 September 2013	Mellado Ramirez, J

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