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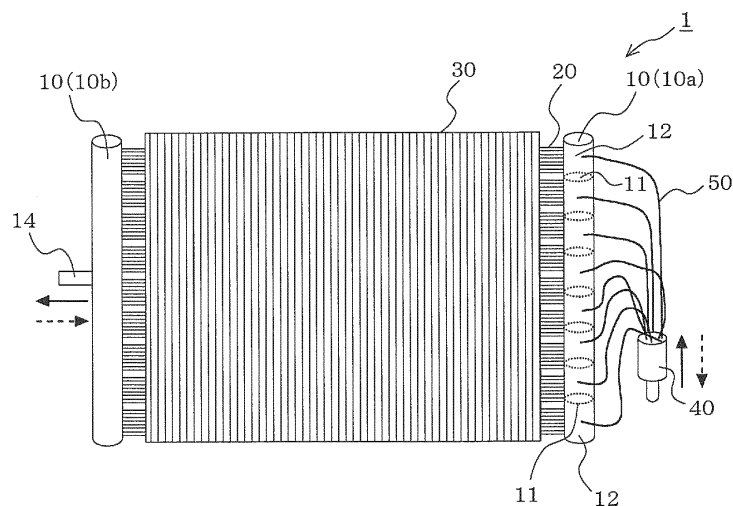
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(54) **COOLANT DISTRIBUTOR, AND HEAT EXCHANGER EQUIPPED WITH COOLANT DISTRIBUTOR**

(57) A header 10a that has a configuration in which the header 10a is connected to one end of each of a plurality of flattened pipes 20 of a heat exchanger 1 that flows a refrigerant in parallel to the plurality of flattened pipes 20 disposed in parallel and an interior of the header 10a is divided by one or more division plates 11 in a

parallel direction in which the plurality of heat-transfer pipes 20 are disposed in parallel, the header 10a being mounted so as to stand in an up-down direction, and a distributor 40 configured to distribute the refrigerant to each chamber within the header 10a divided by the division plates 11, are provided.

F I G . 1



Description

Technical Field

[0001] The present invention relates to a refrigerant distributing device that is mounted to a heat exchanger used in a refrigeration cycle apparatus such as an air-conditioning apparatus and distributes a refrigerant, and a heat exchanger including the refrigerant distributing device.

Background Art

[0002] Conventionally, there is a heat exchanger in which a pair of headers extends in an up-down direction so as to be spaced apart from each other in a right-left direction, a plurality of flattened pipes are disposed in parallel between the pair of headers, and both end portions of each of a plurality of heat exchange pipes communicate with the pair of headers. In the case where such a heat exchanger is used as an evaporator, a refrigerant flows thereinto as a two-phase gas-liquid flow, and thus liquid stays in the gravitational direction within the header at an inlet side, while gas stays in an upper portion within the header. Thus, it is not possible to uniformly distribute the refrigerant to each flattened pipe, resulting in deterioration of the performance of the heat exchanger.

[0003] Therefore, in the case where the heat exchanger is used as an evaporator, the header at the inlet side is required to have a function to uniformly distribute the refrigerant. As such a refrigerant distributing device, conventionally, there is a refrigerant distributing device in which a loop-shaped flow path is formed within a header so as to be turned in an up-down direction, a flow of a two-phase refrigerant having flowed therein is circulated within the header to be made uniform, whereby the refrigerant is distributed to each of a plurality of heat-transfer pipes (see, e.g., Patent Literature 1).

[0004] In addition, as an evaporator that allows uniform distribution of a refrigerant, there is an evaporator that has a configuration in which a pair of headers extends in a right-left direction (the horizontal direction) so as to be spaced apart from each other and a plurality of flattened pipes are disposed in parallel between the pair of headers, and in which a plurality of refrigerant inlets are provided in the header at an inlet side so as to be spaced apart from each other in the right-left direction, and a refrigerant is jetted and flowed from each refrigerant inlet into the header via an orifice (see, e.g., Patent Literature 2).

Citation List

Patent Literature

[0005]

Patent Literature 1: Japanese Unexamined Patent

Application Publication No. 2011-85324 (Abstract, Fig. 1)

Patent Literature 2: Japanese Unexamined Patent Application Publication No. 2000-249428 (Abstract, Fig. 4)

Summary of Invention

Technical Problem

[0006] With the structure of Patent Literature 1, although an effect of refrigerant uniform distribution is observed at a certain level, all of the plurality of heat-transfer pipes communicate with each other in the interior of the header and thus are influenced in the interior of the header by a head difference. Therefore, the refrigerant distribution effect cannot be sufficient and further improvement thereof is desired.

[0007] In Patent Literature 2, since the header is horizontally mounted, the header is not influenced by a head difference. However, in the case where the header is mounted so as to stand in the up-down direction, a liquid is likely to stay in a lower portion under influence of the head difference.

[0008] The present invention has been made in view of such points, and an object of the present invention is to provide a refrigerant distributing device that is able to uniformly distribute a refrigerant by suppressing the influence of a head difference, and a heat exchanger including the refrigerant distributing device. Solution to Problem

[0009] A refrigerant distributing device according to the present invention includes: a header having a configuration in which the header is connected to one end of each of a plurality of heat-transfer pipes of a heat exchanger that flows a refrigerant in parallel to the plurality of heat-transfer pipes disposed in parallel and an interior of the header is divided, by one or more division plates, in a parallel direction in which the plurality of heat-transfer pipes are disposed, the header being mounted so as to stand in an up-down direction; and a distributor configured to distribute the refrigerant to each chamber within the header divided by the division plates and flow the refrigerant into each chamber.

Advantageous Effects of Invention

[0010] According to the present invention, it is possible to obtain a refrigerant distributing device that is able to uniformly distribute a refrigerant by suppressing the influence of a head difference. It is possible to obtain an effective effect particularly when the header is mounted so as to stand in the up-down direction. Brief Description of Drawings

[0011]

[Fig. 1] Fig. 1 is a schematic perspective view of a heat exchanger including a refrigerant distributing

device according to one embodiment of the present invention.

[Fig. 2] Fig. 2 is a schematic cross-sectional view of a portion of the refrigerant distributing device in Fig. 1.

[Fig. 3] Fig. 3 is a perspective view showing a flattened pipe in Fig. 1.

[Fig. 4] Fig. 4 is a diagram showing a refrigerant circuit of a refrigeration cycle apparatus to which the heat exchanger in Fig. 1 is applied.

[Fig. 5] Fig. 5 is a diagram showing another configuration example of the refrigerant distributing device.

[Fig. 6] Fig. 6 is a diagram illustrating the principle of determining the height of each chamber in accordance with a wind speed distribution.

Description of Embodiments

[0012] Fig. 1 is a schematic perspective view of a heat exchanger including a refrigerant distributing device according to one embodiment of the present invention. Fig. 2 is a schematic cross-sectional view of a portion of the refrigerant distributing device in Fig. 1. In Figs. 1 and 2 and the figures described below, portions designated by the same reference signs are the same or equivalent portions, and the same applies to the entire specification. In addition, the forms of constituent elements described in the entire specification are merely illustrative and not limited to these descriptions.

[0013] A heat exchanger 1 is a parallel-flow type heat exchanger which flows a refrigerant in parallel, and includes a pair of headers 10 (10a, 10b) each header is spaced apart from each other in a right-left direction and stands in an up-down direction; and a plurality of flattened pipes (heat-transfer pipes) 20 that are disposed in parallel in the up-down direction between the pair of headers 10 and both ends of each of which are connected to the pair of headers 10. The heat exchanger 1 further includes a plurality of fins 30 and a distributor 40. The pair of headers 10, the flattened pipes 20, and the fins 30 is formed of aluminum or an aluminum alloy. The distributor 40 is connected to the header 10a via capillary tubes 50 and forms a refrigerant distributing device with the header 10a.

[0014] The fins 30 are plate-shaped fins that are stacked between the pair of headers 10 so as to be spaced apart from each other and between which air passes. The plurality of flattened pipes 20 extend through the fins 30. The fins 30 may not necessarily be plate-shaped fins. For example, the fins 30 may be, for example, wave-shaped fins that are stacked in the up-down direction alternately with the flattened pipes 20, and in short, may be fins that are disposed so as to allow air to pass therethrough in an air passing direction.

[0015] As shown in Fig. 3, each flattened pipe 20 has a plurality of through holes 20a serving as refrigerant flow paths.

[0016] The interior of the header 10a is divided by one

or more division plates 11 in the up-down direction into a plurality of chambers 12. Here, eight chambers 12 are formed by seven division plates 11. At each chamber 12, a plurality of through holes 13 are formed so as to be aligned in the up-down direction. The flattened pipe 20 is connected to each through hole 13. In addition, each chamber 12 is connected to the distributor 40 via the capillary tube 50.

[0017] The distributor 40 includes therein an orifice (not shown) that reduces a flow of the refrigerant. In the case where the heat exchanger 1 is used as an evaporator, the distributor 40 causes a two-phase gas-liquid flow entering thereinto to be a spray flow (uniform flow) by passing the refrigerant through the orifice, thereby making the refrigerant into a state where uniform distribution of the refrigerant is easy. The refrigerant made into a spray flow is uniformly distributed to the respective capillary tubes 50 and flows thereinto, and flows into the respective chambers 12 through the capillary tubes 50.

[0018] Each capillary tube 50 adjusts the pressure loss therein with its specifications (length, inner diameter), thereby adjusting a distribution ratio to each chamber 12 of the header 10a. Here, the specifications of all of the capillary tubes 50 are the same, and thus the refrigerant is flowed into each chamber 12 in the same amount.

[0019] In manufacturing the heat exchanger 1 configured as described above, the flattened pipes 20, the fins 30, and the pair of headers 10 are simultaneously joined by means of brazing in a furnace in an assembled state, and then the distributor 40 and each respective capillary tube 50 are connected to each other.

[0020] Fig. 4 is a diagram showing a refrigerant circuit of a refrigeration cycle apparatus to which the heat exchanger in Fig. 1 is applied.

[0021] A refrigeration cycle apparatus 60 includes a compressor 61, a condenser 62, an expansion valve 63 as a pressure reducing device, and an evaporator 64. The heat exchanger 1 is used in at least one of the condenser 62 and the evaporator 64. A gas refrigerant discharged from the compressor 61 flows into the condenser 62, exchanges heat with air passing through the condenser 62, to become a high-pressure liquid refrigerant, and flows out therefrom. The high-pressure liquid refrigerant having flowed out of the condenser 62 is reduced in pressure by the expansion valve 63 to become a low-pressure two-phase gas-liquid refrigerant, and flows into the evaporator 64. The low-pressure two-phase gas-liquid refrigerant having flowed into the evaporator 64 exchanges heat with air passing through the evaporator 64, to become a low-pressure gas refrigerant, and is sucked into the compressor 61 again.

[0022] Hereinafter, a flow of the refrigerant in the case where the heat exchanger 1 is used as an evaporator will be described with reference to Figs. 1 to 4. In Fig. 1, a solid arrow indicates the flow of the refrigerant in the case where the heat exchanger 1 is used as an evaporator.

[0023] The flow of the two-phase gas-liquid refrigerant

having flowed out of the expansion valve 63 first enters into the distributor 40 and is made into a spray flow. The refrigerant made into a spray flow is uniformly distributed to the respective capillary tubes 50 and flows thereinto. The refrigerant having passed through the respective capillary tubes 50 flows into the respective chambers 12 of the header 10a.

[0024] Here, in the case with a configuration of the related art in which no division plate is provided in a header, since the entire interior of the header is a single space, a head difference due to the gravity is great, and thus a drift is likely to occur. However, in the present embodiment, the division plates 11 are provided to divide the interior of the header 10a, and the refrigerant is flowed into each chamber 12 at which the head difference is small. Thus, the effect of the head difference on the refrigerant having flowed into each chamber 12 is reduced, and the refrigerant in each chamber 12 is uniformly distributed to each flattened pipe 20 connected to the chamber 12 and flows thereinto.

[0025] The refrigerant having flowed into each flattened pipe 20 flows through the through holes 20a of the flattened pipe 20 toward the header 10b, joins each other in the header 10b, and flows out of the heat exchanger 1 through an external connection pipe 14.

[0026] Hereinafter, a flow of the refrigerant in the case where the heat exchanger 1 is used as a condenser will be described with reference to Figs. 1 and 4. In Fig. 1, a dotted arrow indicates the flow of the refrigerant in the case where the heat exchanger 1 is used as a condenser.

[0027] The flow of the gas refrigerant having flowed out of the compressor 61 enters into the header 10b, is uniformly distributed therein, and flows into each flattened pipe 20. When the refrigerant is in a gas state, uniform distribution of the refrigerant is easy. Thus, a refrigerant distributing device such as a distributor is unnecessary, and a configuration is provided in which the flow of the gas refrigerant having flowed out of the compressor 61 is directly flowed into the header 10b.

[0028] Then, the refrigerant having flowed into each flattened pipe 20 flows through the through holes 20a of the flattened pipe 20 toward the header 10a and flows into each chamber 12 of the header 10a. The refrigerant having flowed into each chamber 12 flows into the distributor 40 via each capillary tube 50, joins each other therein, and flows out of the heat exchanger 1.

[0029] According to the embodiment described above, in the case where the heat exchanger 1 is used as an evaporator, a two-phase refrigerant flow having entered thereinto is uniformly distributed by the distributor 40, and the uniformly distributed refrigerant is flowed into each chamber 12 at which the head difference is reduced. Thus, the effect of the head difference on the refrigerant having flowed into each chamber 12 is reduced, thereby allowing the refrigerant to be uniformly distributed and flowed into each flattened pipe 20 to suppress a drift. Therefore, use of the refrigerant distributing device including the distributor 40 and the header 10a allows the

capacity of the evaporator to be maximized to increase the heat exchange efficiency of the heat exchanger 1 as an evaporator.

[0030] The position of each division plate 11 may be determined in consideration of the head difference that allows uniform distribution. Provision of only a minimum necessary number of division plates 11 allows cost reduction.

[0031] In addition, the refrigerant distributing device and the heat exchanger according to the present invention are not limited to the structure shown in Fig. 1, and various changes such as (1) to (3) below may be made without departing from the scope of the present invention.

[0032]

(1) A drift suppression member for suppressing a distribution drift may further be provided at a refrigerant inflow portion of each chamber 12.

Any member that is able to suppress a distribution drift may be used as the drift suppression member, and, for example, an orifice 70 may be provided as shown in Fig. 5. The orifice 70 is provided at a connection port, at each chamber 12, connected to the capillary tube 50 and has a through hole 71 with a smaller inner diameter than that of the capillary tube 50. The orifice 70 further reduces the flow of the refrigerant having flowed thereinto from the capillary tube 50, by means of the through hole 71, thereby promoting making the refrigerant into a spray flow. The promotion of making the refrigerant into a spray flow makes distribution of the refrigerant to each flattened pipe 20 in the chamber 12 to be more uniform, thereby allowing a distribution drift to be further suppressed.

(2) The height (the length in a direction in which the plurality of flattened pipes 20 are disposed in parallel) of each chamber 12 may be determined in accordance with a wind speed distribution at the heat exchanger 1.

[0033] The wind speed of air blown from a fan to the heat exchanger 1 is not necessarily uniform over the entire surface of the heat exchanger 1, and a wind speed distribution exists therein. For example, in the case of a multi-air-conditioning apparatus for a building, since a fan is provided at an upper portion of the heat exchanger 1, the wind speed is higher at the upper portion of the heat exchanger 1 than at a lower portion thereof. In the case where the heat exchanger 1 is used as an evaporator, the refrigerant passing through a portion where the wind speed is high progresses in gasification further than the refrigerant passing through a portion where the wind speed is low, and is easily dried. Thus, in the case where the amount of the refrigerant flowing into each chamber 12 is the same, the refrigerant having passed through the portion where the wind speed is high has higher quality than that of the refrigerant having passed through the portion where the wind speed is low, and the state of the

refrigerant flowing into the header 10b is varied.

[0034] When the state of the refrigerant is varied as described above, the state of the refrigerant flowing out of the external connection pipe 14 is not stable. Thus, for a portion of the header 10a to which the flattened pipes 20 located at the portion where the wind speed is high are connected, the heights of the chambers 12 are decreased such that a heat-exchange region per chamber is reduced in size, whereby the number of flattened pipes connected to the chamber 12 is decreased. This will be specifically described below with reference to Fig. 6.

[0035] Fig. 6 is a diagram illustrating the principle of determining the height of each chamber in accordance with a wind speed distribution and shows here a case where a wind speed at the upper side is high and a wind speed at the lower side is low.

[0036] As shown in Fig. 6, the height of each chamber 12A at the upper side at which the wind speed is high is made smaller than the height of each chamber 12B at the lower side at which the wind speed is low, so that the number of the flattened pipes connected to each chamber 12A is made smaller than the number of the flattened pipes connected to each chamber 12B. Thus, a heat-exchange region A at the chamber 12A side is smaller than a heat-exchange region B at the chamber 12B side, and the heat transfer area is small, so to speak. Therefore, the substantial heat exchange amount is substantially the same in the heat-exchange region A and the heat-exchange region B, and it is possible to make the refrigerant state at an outlet to be uniform.

[0037] The case has been described in which the amount of the refrigerant flowing into each chamber 12 is the same and the refrigerant state at the outlet is made uniform by changing the heights of the chambers 12. However, the following case may be employed. Specifically, the height of each chamber 12 is made the same, and the distribution amount of the refrigerant flowing into each chamber 12 is changed. In this case, the distribution amount of the refrigerant flowing into each chamber 12 may be determined in accordance with a wind speed distribution, and the specifications (length, inner diameter) of each capillary tube 50 may be determined such that the determined distribution amount is achieved. Specifically, the capillary tubes 50 are selected such that the distribution amount for each chamber 12 to which the flattened pipes 20 located at the portion where the wind speed is high are connected is large and the distribution amount for each chamber 12 to which the flattened pipes 20 at the portion where the wind speed is low are connected is small.

(3) In the present embodiment, the case has been described in which the entire heat exchanger 1 has substantially an I shape. However, the entire heat exchanger 1 may have substantially an L shape, substantially a U shape, or substantially a rectangular shape. Which shape the heat exchanger 1 has may be determined in accordance with a mounting space,

within a housing, for the heat exchanger 1 in which the heat exchanger 1 is mounted. The heat exchanger 1 may have a shape that maximizes use of the mounting space to allow the heat exchanger 1 to be densely mounted.

(4) In the present embodiment, each heat-transfer pipe is a flattened pipe, but may not necessarily be a flattened pipe and may be a circular pipe. Reference Signs List

[0038] 1 heat exchanger 10 header 10a header 10b header 11 division plate 12 chamber 12A chamber 12B chamber 13 through hole 14 external connection pipe 20 flattened pipe (heat-transfer pipe) 30 fin 40 distributor 50 capillary tube 60 refrigeration cycle apparatus 61 compressor 62 condenser 63 expansion valve 64 evaporator 70 orifice 71 through hole A heat-exchange region B heat-exchange region

Claims

1. A refrigerant distributing device comprising:

a header having a configuration in which the header is connected to one end of each of a plurality of heat-transfer pipes of a heat exchanger that flows a refrigerant in parallel to the plurality of heat-transfer pipes disposed in parallel and an interior of the header is divided, by one or more division plates, in a parallel direction in which the plurality of heat-transfer pipes are disposed, the header being mounted so as to stand in an up-down direction; and a distributor configured to distribute the refrigerant to each chamber within the header divided by the division plates and flow the refrigerant into each chamber.

2. The refrigerant distributing device of claim 1, wherein a drift suppression member is provided at a refrigerant inflow portion of each chamber so as to suppress a drift of the refrigerant.

3. The refrigerant distributing device of claim 2, wherein the drift suppression member is an orifice configured to reduce a flow of the refrigerant.

4. The refrigerant distributing device of any one of claims 1 to 3, wherein a position of the division plates is set in accordance with a wind speed distribution at the heat exchanger, and the position of the division plate is set such that a length, in the parallel direction, of the chamber to which the heat-transfer pipes passing through a portion where a wind speed is high are connected is shorter than a length, in the parallel direction, of the chamber to which the heat-transfer pipes passing through a portion where the wind

speed is low are connected.

5. The refrigerant distributing device of any one of claims 1 to 3, wherein the distributor is connected to each of the respective chambers via each of a plurality of capillary tubes that allow a flow rate of the refrigerant to be adjusted, a distribution amount of the refrigerant flowed into each chamber is set in accordance with a wind speed distribution at the heat exchanger, the plurality of capillary tubes are selected such that a distribution amount for the chamber to which the heat-transfer pipes located at a portion where a wind speed is high are connected is larger than a distribution amount for the chamber to which the heat-transfer pipes located at the portion where the wind speed is low are connected.
6. A heat exchanger comprising the refrigerant distributing device of any one of claims 1 to 5.
7. The heat exchanger of claim 6, wherein the parallel direction in which the plurality of heat-transfer pipes are disposed is the up-down direction, the header is mounted so as to stand in the up-down direction, and each heat-transfer pipe is a flattened pipe having a plurality of through holes that are refrigerant flow paths.

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FIG. 1

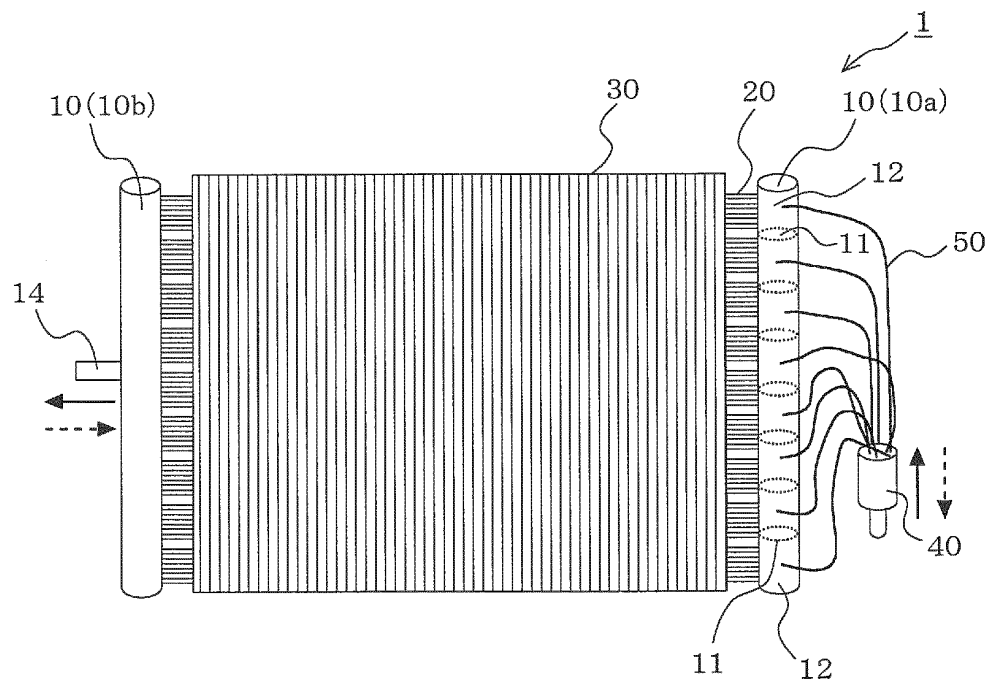


FIG. 2

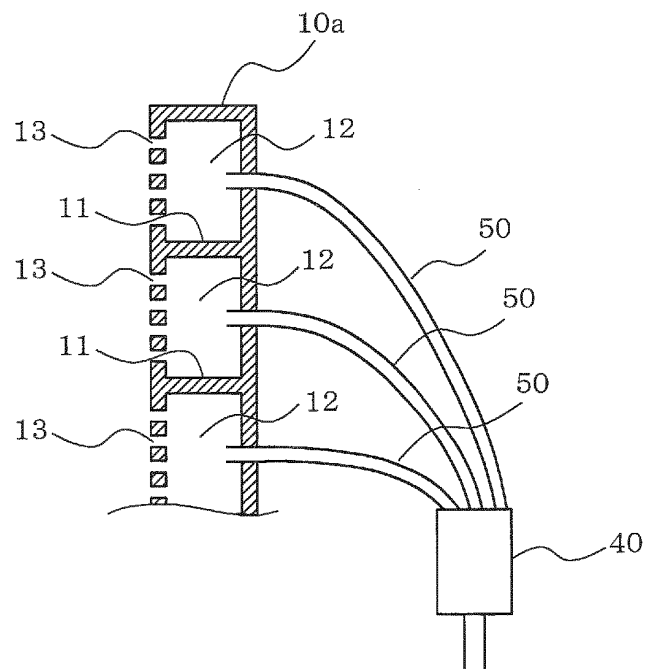


FIG. 3

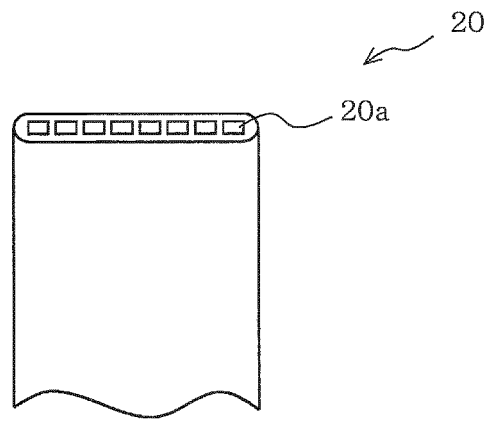


FIG. 4

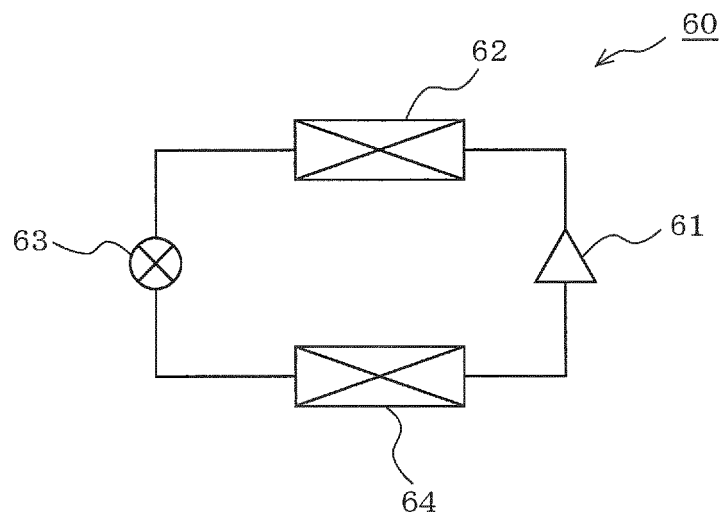


FIG. 5

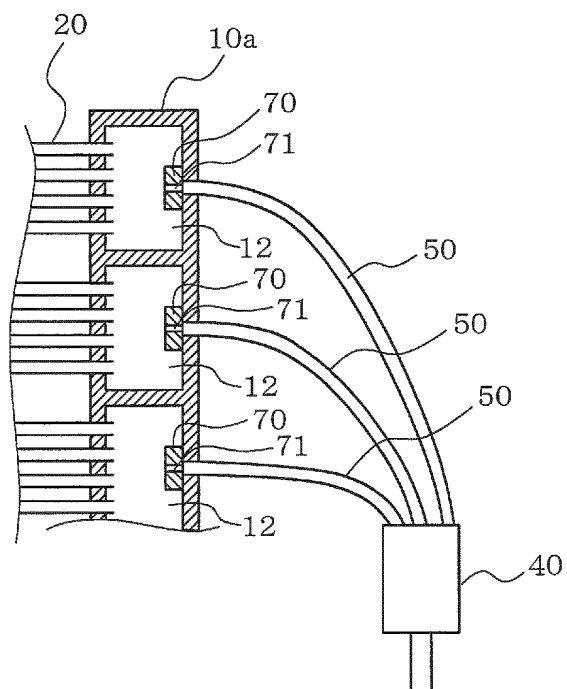
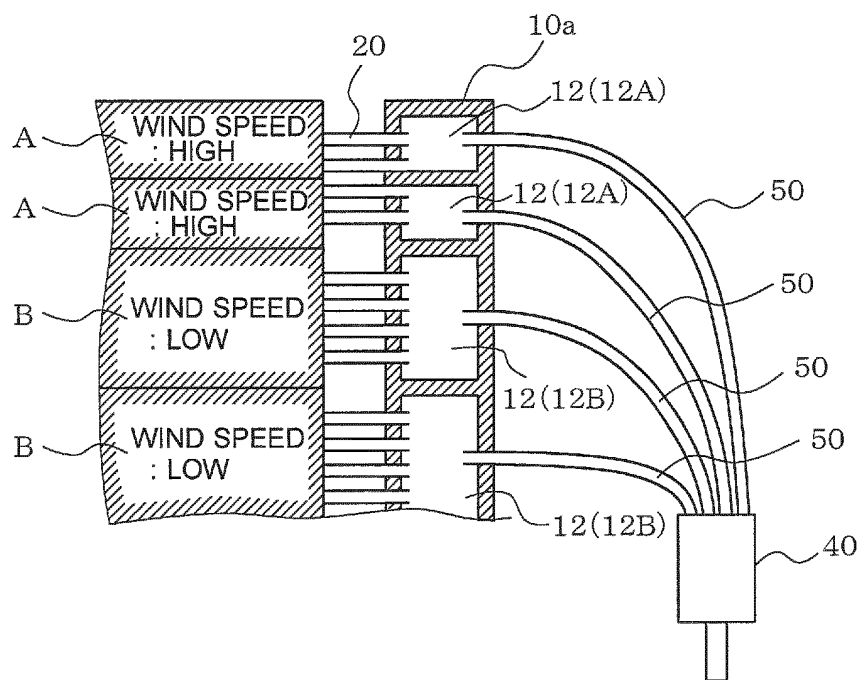


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/002860

A. CLASSIFICATION OF SUBJECT MATTER

F25B41/00 (2006.01) i, F28F9/02 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F25B41/00, F28F9/02

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012

Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y A	JP 2006-336936 A (Kobe Steel, Ltd.), 14 December 2006 (14.12.2006), paragraphs [0022], [0023]; fig. 3 (Family: none)	1-3, 5-7 4
Y A	JP 2003-214726 A (Mitsubishi Heavy Industries, Ltd.), 30 July 2003 (30.07.2003), paragraphs [0027] to [0033], [0048]; fig. 2 (Family: none)	2, 3, 5-7 4

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

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Date of the actual completion of the international search

29 May, 2012 (29.05.12)

Date of mailing of the international search report

12 June, 2012 (12.06.12)

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/002860

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	JP 9-145187 A (Hitachi, Ltd.), 06 June 1997 (06.06.1997), entire text; all drawings (Family: none)	4
A	JP 2009-222366 A (Hitachi Appliances, Inc.), 01 October 2009 (01.10.2009), entire text; all drawings (Family: none)	1-7
A	JP 2010-133644 A (Hitachi Appliances, Inc.), 17 June 2010 (17.06.2010), entire text; all drawings (Family: none)	1-7
A	JP 10-132423 A (Daikin Industries, Ltd.), 22 May 1998 (22.05.1998), entire text; all drawings (Family: none)	1-7

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REFERENCES CITED IN THE DESCRIPTION

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