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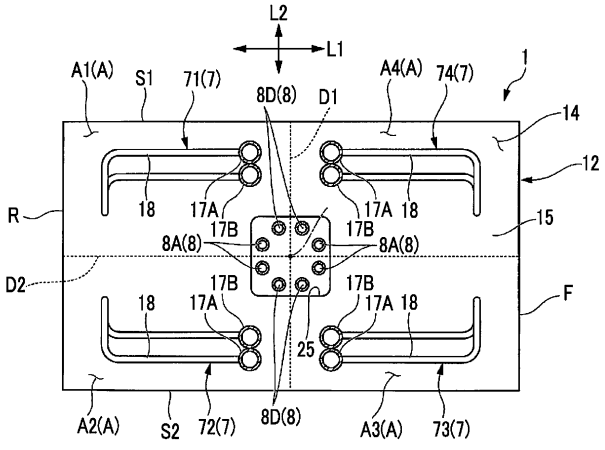
(54) **AIR CHILLER**

(57) Provided is an air cooled chiller (1) that comprises a machine chamber, a heat exchanger chamber (14) provided on a top plate (15) of the machine chamber, and three or more independent systems of refrigerant circuits that have an air heat exchanger (7), a water heat exchanger, an expansion unit, and a compressor, wherein the air heat exchangers (7) in each refrigerant circuit are provided sequentially in the circumferential direction of a reference axis (c) that extends in the vertical direction in the heat exchanger chamber (14) so as to surround the reference axis (C), and the compressors in each refrigerant circuit are disposed so that the relative positions among same in the machine chamber in the plan view correspond to the relative positions of the air heat exchangers (7) in the heat exchanger chamber (14) in the plan view.

FIG. 3



EP 3 441 685 A1

Description

Technical Field

[0001] The present invention relates to an air cooled chiller.

[0002] Priority is claimed on Japanese Patent Application No. 2016-202648, filed October 14, 2016, the content of which is incorporated herein by reference.

Background Art

[0003] PTL 1 discloses an air cooled chiller (chilling unit) having a refrigerant circuit including a plurality of systems, in which a plurality of air heat exchangers are disposed on an upper portion and a plurality of refrigerant circuits except for the air heat exchangers are disposed in a machine chamber positioned on a lower portion.

[0004] In this air cooled chiller, by setting a position of a control device disposed in the machine chamber to an optimum position, a maintenance work with respect to the control device is easily performed.

Citation List

Patent Literature

[0005] [PTL 1] International Publication No. WO2011/099629

Summary of Invention

Technical Problem

[0006] Meanwhile, in the air cooled chiller of the related art, the maintenance work of the control device is easily performed. However, a disposition of a refrigerant pipe extending in a vertical direction of the air cooled chiller is still complicated. Accordingly, it is difficult to understand a connection relationship between the compressor and the air heat exchanger, and there is a problem that the maintenance work is not easily performed.

[0007] An object of the present invention is to provide an air cooled chiller capable of improving maintenance. Solution to Problem

[0008] According to a first aspect of the present invention, there is provided an air cooled chiller including: a machine chamber; an heat exchange chamber which is provided on a top plate of the machine chamber; independent refrigerant circuits having three or more systems each including an air heat exchanger, a water heat exchanger, an expansion unit, and a compression unit, in which the air heat exchangers of the refrigerant circuits are sequentially provided in a circumferential direction of a reference axis so as to surround the reference axis extending in a vertical direction in the heat exchange chamber, and the compression units of the refrigerant circuits are disposed such that a relative positional relationship of the compression units in the machine chamber in a plan view corresponds to a relative positional relationship of the air heat exchangers in the heat exchange chamber in a plan view.

[0009] According to this configuration, the positions of the air heat exchangers in a plan view correspond to the positions of the compression units in a plan view, and thus, it is possible to prevent dispositions of the refrigerant pipes positioned between the air heat exchangers and the compression units from being complicated. Accordingly, it is possible to improve maintenance of the air cooled chiller.

[0010] In the above-described air cooled chiller, the refrigerant circuit includes a refrigerant pipe which connects the air heat exchanger and the compression unit to each other, and a pipe insertion hole through which a plurality of the refrigerant pipes are collected and inserted is provided on the top plate.

[0011] According to this configuration, the plurality of refrigerant pipes are collected in the pipe insertion hole, and thus, it is possible to further improve the maintenance.

[0012] In the above-described air cooled chiller, the pipe insertion hole is formed at a center of the top plate in a plan view.

[0013] According to this configuration, lengths of the plurality of refrigerant pipes can be reduced, and it is possible to decrease a manufacturing cost of the air cooled chiller.

[0014] The above-described air cooled chiller further includes a plurality of control devices which are provided to correspond to the refrigerant circuits and control the corresponding refrigerant circuits, in which the control devices are disposed in the vicinities of the compression units such that a relative positional relationship of the control devices in the machine chamber in a plan view corresponds to a relative positional relationship of the air heat exchangers in the heat exchange chamber in a plan view.

[0015] According to this configuration, it is possible to prevent wires between the control devices and the refrigerant

circuits from being complicated.

Advantageous Effects of Invention

[0016] According to the present invention, it is possible to improve the maintenance of the air cooled chiller. Brief Description of Drawings

[0017]

Fig. 1 is a refrigerant circuit diagram of an air cooled chiller of a first embodiment of the present invention.
Fig. 2 is a perspective view of the air cooled chiller of the first embodiment of the present invention.
Fig. 3 is a sectional view taken along line III-III of Fig. 2 and is a view for explaining a disposition of an air heat exchanger of the air cooled chiller of the first embodiment of the present invention.
Fig. 4 is a sectional view taken along line IV-IV of Fig. 2 and is a view for explaining a disposition of a compressor of the air cooled chiller of the first embodiment of the present invention.
Fig. 5 is a view corresponding to Fig. 4 and is a view for explaining a disposition of a compressor of an air cooled chiller of a second embodiment of the present invention.

Description of Embodiments

[First Embodiment]

[0018] Hereinafter, an air cooled chiller (chilling unit) of a first embodiment of the present invention will be described in detail with reference to the drawings. The air cooled chiller of the present embodiment is used as a heat source of an air conditioner.

[0019] First, a refrigerant circuit diagram of the air cooled chiller will be described.

[0020] As shown in Fig. 1, the air cooled chiller 1 includes refrigerant circuits 2 having four independent systems and a control device 19 (refer to Fig. 4). Each refrigerant circuit 2 includes a machine section 20 and an air heat exchanger 7. The machine section 20 includes a compressor 3 (compression unit), a four-way switching valve 4, a water heat exchanger 5, and an expansion valve 6 (expansion unit). The machine section 20 is a section of the refrigerant circuit 2 excluding the air heat exchanger 7.

[0021] The compressor 3, the four-way switching valve 4, the water heat exchanger 5, the expansion valve 6, and the air heat exchanger 7 are sequentially connected to each other via the refrigerant pipe 8. By switching a flow path of a refrigerant using the four-way switching valve 4, the air cooled chiller 1 can cope with either a cooling operation or a heating operation.

[0022] The air cooled chiller 1 of the present embodiment shares one water heat exchanger 5 by the refrigerant circuits 2 having two systems. That is, in the refrigerant circuit 2, a first refrigerant circuit 21 and a second refrigerant circuit 22 share a first water heat exchanger 51, and a third refrigerant circuit 23 and a fourth refrigerant circuit 24 share a second water heat exchanger 52.

[0023] The compressor 3 includes a motor (not shown) which is driven by an inverter. A rotating speed of the motor is adjusted by an output frequency of the inverter. By adjusting the rotating speed of the motor, a discharge amount of the refrigerant is adjusted.

[0024] The water heat exchanger 5 includes a water piping 9, a water circulation pump 10, two refrigerant flow paths 53 and 54, and one water flow path 55. The water heat exchanger 5 performs heat exchange between water supplied to the water flow path 55 via the water piping 9 by the water circulation pump 10 and the refrigerant supplied to the refrigerant flow paths 53 and 54 through the refrigerant pipe 8 between the four-way switching valve 4 and the expansion valve 6. The water piping 9 includes a first water piping 91 through which the water is supplied to the water heat exchanger 5 and a second water piping 92 through which the water is discharged from the water heat exchanger 5.

[0025] The expansion valve 6 is provided between the water heat exchanger 5 and the air heat exchanger 7. In addition, two expansion valves may be used such that the refrigerant expands in two steps. In addition, a capillary tube may be used instead of the expansion valve 6.

[0026] The air heat exchanger 7 is provided between the four-way switching valve 4 and the expansion valve 6. The air heat exchanger 7 performs heat exchange between outside air and the refrigerant. Each air heat exchanger 7 and each machine section 20 are connected to each other by two refrigerant pipes 8.

[0027] The refrigerant pipe 8 includes a first refrigerant pipe 8A which connects the air heat exchanger 7 and the expansion valve 6 to each other, a second refrigerant pipe 8B which connects the expansion valve 6 and the water heat exchanger 5, a third refrigerant pipe 8C which connects the water heat exchanger 5 and a third port 43 of the four-way switching valve 4, a fourth refrigerant pipe 8D which connects a second port 42 of the four-way switching valve 4 and the air heat exchanger 7, a fifth refrigerant pipe 8E which connects a discharge-side refrigerant pipe of the compressor

2 and a first port 41 of the four-way switching valve 4, and a sixth refrigerant pipe 8F which connects a suction portion of the compressor 2 and a fourth port 44 of the four-way switching valve 4.

[0028] Hereinafter the first refrigerant pipe 8A which connects the air heat exchanger 7 and the expansion valve 6 is referred to as an air heat exchanger pipe 8A. In addition, the fourth refrigerant pipe 8D which connects the second port 42 of the four-way switching valve 4 and the air heat exchanger 7 is referred to as an air heat exchanger pipe 8D. The air cooled chiller 1 of the present embodiment includes the refrigerant circuits 2 having four systems, and thus, eight air heat exchanger pipes 8A and 8D are provided.

[0029] The first air heat exchanger 71 of the first refrigerant circuit 21 is connected to a first compressor 31 via the second air heat exchanger pipe 8D and the four-way switching valve 4. Similarly, the second air heat exchanger 72 is connected to a second compressor 32 via the second air heat exchanger pipe 8D and the four-way switching valve 4. The third air heat exchanger 73 is connected to a third compressor 33 via the second air heat exchanger pipe 8D and the four-way switching valve 4. The fourth air heat exchanger 74 is connected to a fourth compressor 34 via the second air heat exchanger pipe 8D and the four-way switching valve 4.

[0030] An accumulator may be provided between the suction portion of the compressor 3 and the four-way switching valve 4. The accumulator prevents the refrigerant which could not be gasified by an evaporator (the water heat exchanger 5 or the air heat exchanger 7) from being sucked into the compressor 3 in a liquid state.

[0031] The refrigerant circuits 2 having four systems are unified so as to constitute the air cooled chiller 1 of the present embodiment. As shown in Fig. 2, the air cooled chiller 1 includes a rectangular parallelepiped casing 12. The refrigerant circuits 2 having four systems of the air cooled chiller 1 are accommodated in the casing 12. The casing 12 has a substantially rectangular shape when viewed from above. Hereinafter, in a plan view, a direction along a long side of an upper surface of the casing 12 is referred to as a longitudinal direction L1, and a direction along a short side of the upper surface of the casing 12 is referred to as a lateral direction L2.

[0032] In surfaces constituting the casing 12, one surface facing the longitudinal direction L1 is defined as a front surface F, a surface which is positioned on a side opposite to the front surface F and is parallel to the front surface F is defined as a rear surface R, and surfaces which connect the front surface F and the rear surface R to each other are defined as side surfaces S1 and S2. The side surfaces S1 and S2 are surfaces facing the lateral direction L2 and are surfaces which are wider than the front surface F and the rear surface R. In the pair of side surfaces S1 and S2, a right surface when viewed from the front surface side is defined as a first side surface S1, and a left surface when viewed from the front surface side is defined as a second side surface S2.

[0033] The shape of the casing 12 is not limited to the shape shown in Fig. 2, and for example, may be a square shape, a circular shape, or a polygonal shape in a plan view.

[0034] The air cooled chiller 1 includes a machine chamber 13 which is provided below the casing 12 and a heat exchange chamber 14 which is provided on a top plate 15 of the machine chamber 13. In other words, an internal space of the casing 12 is partitioned into the upper heat exchange chamber 14 and the lower machine chamber 13 by the top plate 15.

[0035] The first water piping 91 which is a pipe through which water is supplied to the water heat exchanger 5 of the machine chamber 13 and a second water piping 92 which is a pipe through which the water is discharged from the water heat exchanger 5 of the machine chamber 13 are connected to the front surface F of the casing 12.

[0036] A plurality of fans 16 are provided on the upper surface of the casing 12. The fans 16 are arranged at equal intervals in the longitudinal direction L1 of the casing 12.

[0037] In the refrigerant circuit 2, the air heat exchanger 7 is disposed in the heat exchange chamber 14. In the refrigerant circuit 2, the machine section 20 (the refrigerant circuit 2 and the control device 19 except for the air heat exchanger 7) is disposed in the machine chamber 13. The top plate 15 is disposed between the air heat exchanger 7 and the machine section 20. The eight air heat exchanger pipes 8A and 8D extend over a portion above the top plate 15 and a portion below the top plate 15.

[0038] The air heat exchanger 7 includes first headers 17A and second headers 17B which extend in a vertical direction, and a plurality of heat transfer tubes 18 which are connected to the first headers 17A and the second headers 17B and extend in a horizontal direction. The air heat exchanger pipes 8A extending from the machine section 20 are connected to the first headers, and the air heat exchanger pipes 8D extending from the machine section 20 are connected to the second headers 17B. One end of each heat transfer tube 18 is connected to the first header 17A and the other end of each heat transfer tube 18 is connected to the second header 17B.

[0039] As shown in Fig. 3, in a case where the heat exchange chamber 14 is divided into four accommodation spaces A in a plan view, each air heat exchanger 7 is disposed in each accommodation space A.

[0040] The four accommodation spaces A are partitioned by a first division surface D1 by which the heat exchange chamber 14 is divided into two portions in the longitudinal direction L1 and a second division surface D2 by which the heat exchange chamber 14 is divided into two portions in the lateral direction L2.

[0041] In the plurality of accommodation spaces A, the accommodation space A which is positioned on the rear surface R side and the first side surface S1 side is defined as a first accommodation space A1, the accommodation space A

which is positioned on the rear surface R side and the second side surface S2 side is defined as a second accommodation space A2, the accommodation space A which is positioned on the front surface F side and the second side surface S2 side is defined as a third accommodation space A3, and the accommodation space A which is positioned on the front surface F side and the first side surface S1 side is defined as a fourth accommodation space A4.

[0042] In addition, the division surfaces D1 and D2 are virtual division surfaces, and for example, it is not necessary to physically partition the division surfaces by plates.

[0043] In other words, four air heat exchangers 7 are sequentially provided in a circumferential direction of a reference axis C so as to surround the reference axis C extending in the vertical direction in the heat exchange chamber 14. The reference axis C of the present embodiment is disposed at a center of the casing 12 in a plan view. The reference axis C is an intersection line between the first division surface D1 and the second division surface D2.

[0044] The reference axis C is not required to be disposed at the center of the casing 12 in a plan view. In addition, the first division surface D1 and the second division surface D2 do not need to equally divide an area of each accommodation space A.

[0045] The first headers 17A and the second headers 17B are positioned in the vicinities of the side surfaces S1 and S2 in a plan view, and are disposed in the vicinity of a center in the longitudinal direction L1.

[0046] The heat transfer tubes 18 extend from the first headers 17A and the second headers 17B toward the front surface F or the rear surface R and are formed to be bent inward in the lateral direction L2 in the vicinity of the front surface F or the rear surface R. In other words, the heat transfer tubes 18 extend along inner surfaces of the casing 12 from the first header 17A and the second header 17B.

[0047] One pipe insertion hole 25 is formed on the top plate 15. The pipe insertion hole 25 is disposed at the center of the top plate 15 in the vicinity of an intersection between the top plate 15 and the reference axis C. The eight air heat exchanger pipes 8A and 8D are inserted into the pipe insertion hole 25. In addition, the pipe insertion hole 25 is not required to be formed at the center of the top plate 15, and the position of the pipe insertion hole 25 can be changed according to the dispositions of the compressors 3.

[0048] In a plan view of the present embodiment, the dispositions of the four compressors 3 correspond to the dispositions of the four air heat exchangers 7 in a plan view.

[0049] Specifically, the respective compressors 3 of the machine section 20 are disposed such that a relative positional relationship of the compressors 3 in a plan view in the machine chamber 13 corresponds to a relative positional relationship of the air heat exchangers 7 in a plan view in the heat exchange chamber 14.

[0050] Here, the relative positional relationship means a relative positional relationship of three or more objects. Specifically, the relative positional relationship is a relative positional relationship of three or more objects when three or more objects are disposed on a predetermined plane, and includes an approximate shape of the shape formed by the three or more objects and an order in which the three or more objects are disposed.

[0051] In the case of the air cooled chiller 1 of the present embodiment, the four air heat exchangers 7 are disposed to form a rectangular shape. In addition, the four air heat exchangers 7 are sequentially disposed in the accommodation spaces A in the counterclockwise direction from the first air heat exchanger 71 to the fourth air heat exchanger 74 with the first accommodation space A1 as a starting point.

[0052] The four compressors 3 are disposed such that the four compressors 3 form a rectangular shape. The four compressors 3 are disposed in the counterclockwise direction from the first compressor 31 to the fourth compressor 34.

[0053] In addition, the position of the first compressor 31 corresponds to the position of the first air heat exchanger 71, and similarly, the position of the second compressor 32 corresponds to the position of the second air heat exchanger 72, the position of the third compressor 33 corresponds to the position of the third air heat exchanger 73, and the position of the fourth compressor 34 corresponds to the position of the fourth air heat exchanger 74.

[0054] That is, in the four compressors 3, the first compressor 31 is disposed at a position closest to the first air heat exchanger 71. Similarly, the second compressor 32 is disposed at a position closest to the second air heat exchanger 72, the third compressor 33 is disposed at a position closest to the third air heat exchanger 73, and the fourth compressor 34 is disposed at a position closest to the fourth air heat exchanger 74.

[0055] The control device 19 is disposed between the rear surface R of the machine chamber 13 and four compressors 3.

[0056] The water heat exchanger 5 is disposed between the front surface F and the four compressors 3.

[0057] According to the above-described embodiment, the positions of the air heat exchangers 7 in a plan view correspond to the positions of the compression units 3 in a plan view, and thus, it is possible to prevent dispositions of the refrigerant pipes 8 (air heat exchanger pipes 8A and 8D) positioned between the air heat exchangers 7 and the compressors 3 from being complicated. Accordingly, it is possible to improve maintenance of the air cooled chiller 1. In addition, the dispositions of the refrigerant pipes 8 are not complicated, and thus, it is possible to improve assembling properties.

[0058] In addition, the pipe insertion hole 25 is formed on the top plate 15, and thus, the plurality of refrigerant pipes 8 can be collected in the pipe insertion hole 25. Accordingly, it is possible to further improve the maintenance of the air cooled chiller 1.

[0059] In addition, in a plan view, the pipe insertion hole 25 is formed at the center of the top plate 15, and thus, lengths of the plurality of refrigerant pipes 8 can be reduced, and it is possible to decrease a manufacturing cost of the air cooled chiller 1.

[Second Embodiment]

[0060] Hereinafter, an air cooled chiller 1B of a second embodiment of the present invention will be described with reference to the drawings. In addition, in the present embodiment, differences between the present embodiment and the above-described first embodiment will be mainly described, and descriptions of similar portions will be omitted.

[0061] As shown in Fig. 5, a plurality of control devices 19B of the air cooled chiller 1B of the present embodiment are provided to correspond to the respective refrigerant circuits 2. The control devices 19B control the refrigerant circuits 2 respectively corresponding to the control devices 19B.

[0062] The respective control devices 19B are disposed in the vicinities of the compressors 3 such that a relative positional relationship of the respective control devices 19B in the machine chamber 13 in a plan view correspond to a relative positional relationship of the air heat exchangers 7 in a plan view in the heat exchange chamber 14 .

[0063] In addition, the pipe insertion hole 25 of the present embodiment is not disposed at the center of the top plate 15, and is deviated in the longitudinal direction L1 according to the positions of the compressors 3. Specifically, the compressors 3 of the present embodiment are disposed to be close to the rear surface R, and the pipe insertion hole 25 is also disposed to be close to the rear surface R according to the dispositions of the compressors 3.

[0064] According to this configuration, it is possible to prevent wires between the control device 19B and the refrigerant circuit 2 from being complicated.

[0065] In addition, the pipe insertion hole 25 is positioned at the positions corresponding to the compressors 3, and thus, a length of the refrigerant pipe 8 can be optimized.

[0066] Hereinbefore, the embodiments of the present invention are described. However, various modifications can be applied to the present invention within a scope which does not depart from a technical idea of the present invention.

[0067] For example, the above-described embodiments, the configuration in which the air cooled chiller includes the refrigerant circuits having four systems. However, the present invention is not limited to this and can be applied to an air cooled chiller having refrigerant circuits including three or more systems.

[0068] In addition, in the above-described embodiments, the configuration in which the water heat exchangers are shared by the refrigerant circuits having two systems. However, the present invention is not limited to this, and the water heat exchanger may be provided in each refrigerant circuit. In addition, one water heat exchanger may be shared by the refrigerant circuits having four systems.

[0069] In addition, a plurality of pipe insertion holes 25 may be provided according to the dispositions of the compressors 3.

[0070] In addition, the structure of the air heat exchanger is not limited to the above-described structure. For example, a heat transfer plate (fin) may be attached to the heat transfer tube, and a plate-type heat exchanger may be adopted.

Industrial Applicability

[0071] According to the present invention, it is possible to improve maintenance of the air cooled chiller. Reference Signs List

[0072]

1, 1B:	air cooled chiller
2 (21, 22, 23, 24)	refrigerant circuit
3 (31, 32, 33, 34)	compressor
4:	four-way switching valve
5 (51, 52):	water heat exchanger
6:	expansion valve
7 (71, 72, 73, 74):	air heat exchanger
8 (8A, 8B, 8C, 8D, 8E, 8F):	refrigerant pipe
8A, 8D:	air heat exchanger pipe
9:	water piping
10:	water circulation pump
12:	casing
13:	machine chamber
14:	heat exchange chamber
15:	top plate

16:	fan
17A:	first header
17B:	second header
18:	heat transfer tube
19, 19B:	control device
20:	machine section
25:	pipe insertion hole
91:	first water piping
92:	second water piping
A (A1, A2, A3, A4):	accommodation space
C:	reference axis
D1:	first division surface
D2:	second division surface
F:	front surface
L1:	longitudinal direction
L2:	lateral direction
R:	rear surface
S1:	first side surface
S2:	second side surface

Claims

1. An air cooled chiller comprising:

a machine chamber;
a heat exchange chamber which is provided on a top plate of the machine chamber;
independent refrigerant circuits having three or more systems each including an air heat exchanger, a water heat exchanger, an expansion unit, and a compression unit,
wherein the air heat exchangers of the refrigerant circuits are sequentially provided in a circumferential direction of a reference axis so as to surround the reference axis extending in a vertical direction in the heat exchange chamber, and
wherein the compression units of the refrigerant circuits are disposed such that a relative positional relationship of the compression units in the machine chamber in a plan view corresponds to a relative positional relationship of the air heat exchangers in the heat exchange chamber in a plan view.

2. The air cooled chiller according to claim 1,
wherein the refrigerant circuit includes a refrigerant pipe which connects the air heat exchanger and the compression unit to each other, and
wherein a pipe insertion hole through which a plurality of the refrigerant pipes are collected and inserted is provided on the top plate.

3. The air cooled chiller according to claim 2,
wherein the pipe insertion hole is formed at a center of the top plate in a plan view.

4. The air cooled chiller according to any one of claims 1 to 3, further comprising:

a plurality of control devices which are provided to correspond to the refrigerant circuits and control the corresponding refrigerant circuits,
wherein the control devices are disposed in the vicinities of the compression units such that a relative positional relationship of the control devices in the machine chamber in a plan view corresponds to a relative positional relationship of the air heat exchangers in the heat exchange chamber in a plan view.

Amended claims under Art. 19.1 PCT

1. (Amended) An air cooled chiller comprising:

a machine chamber;
a heat exchange chamber which is provided on a top plate of the machine chamber;
independent refrigerant circuits having three or more systems each including an air heat exchanger, a water heat exchanger, an expansion unit, and a compression unit,
wherein the air heat exchangers of the refrigerant circuits are sequentially provided in a circumferential direction of a reference axis so as to surround the reference axis extending in a vertical direction in the heat exchange chamber,
wherein the compression units of the refrigerant circuits are disposed such that a relative positional relationship of the compression units in the machine chamber in a plan view corresponds to a relative positional relationship of the air heat exchangers in the heat exchange chamber in a plan view,
wherein the refrigerant circuit includes a refrigerant pipe which connects the air heat exchanger and the compression unit to each other,
wherein a pipe insertion hole through which a plurality of the refrigerant pipes are collected and inserted is provided on the top plate,
wherein the pipe insertion hole is formed at a center of the top plate in a plan view, and
wherein the air heat exchanger and the compression unit are disposed around the pipe insertion hole.

2. (Deleted)

3. (Deleted)

4. (Amended) The air cooled chiller according to claim 1, further comprising:

a plurality of control devices which are provided to correspond to the refrigerant circuits and control the corresponding refrigerant circuits,
wherein the control devices are disposed in the vicinities of the compression units such that a relative positional relationship of the control devices in the machine chamber in a plan view corresponds to a relative positional relationship of the air heat exchangers in the heat exchange chamber in a plan view.

FIG. 1

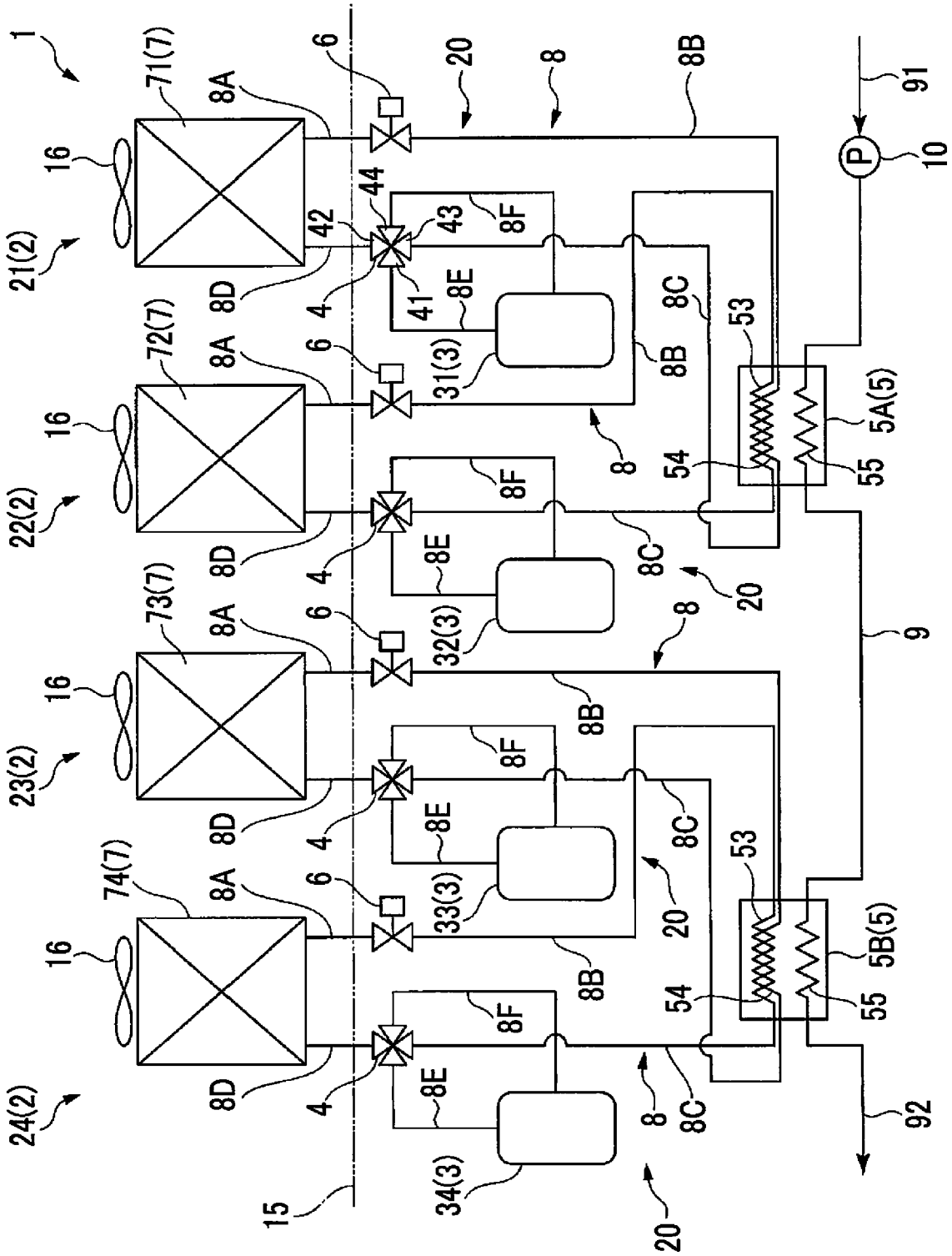

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FIG. 2

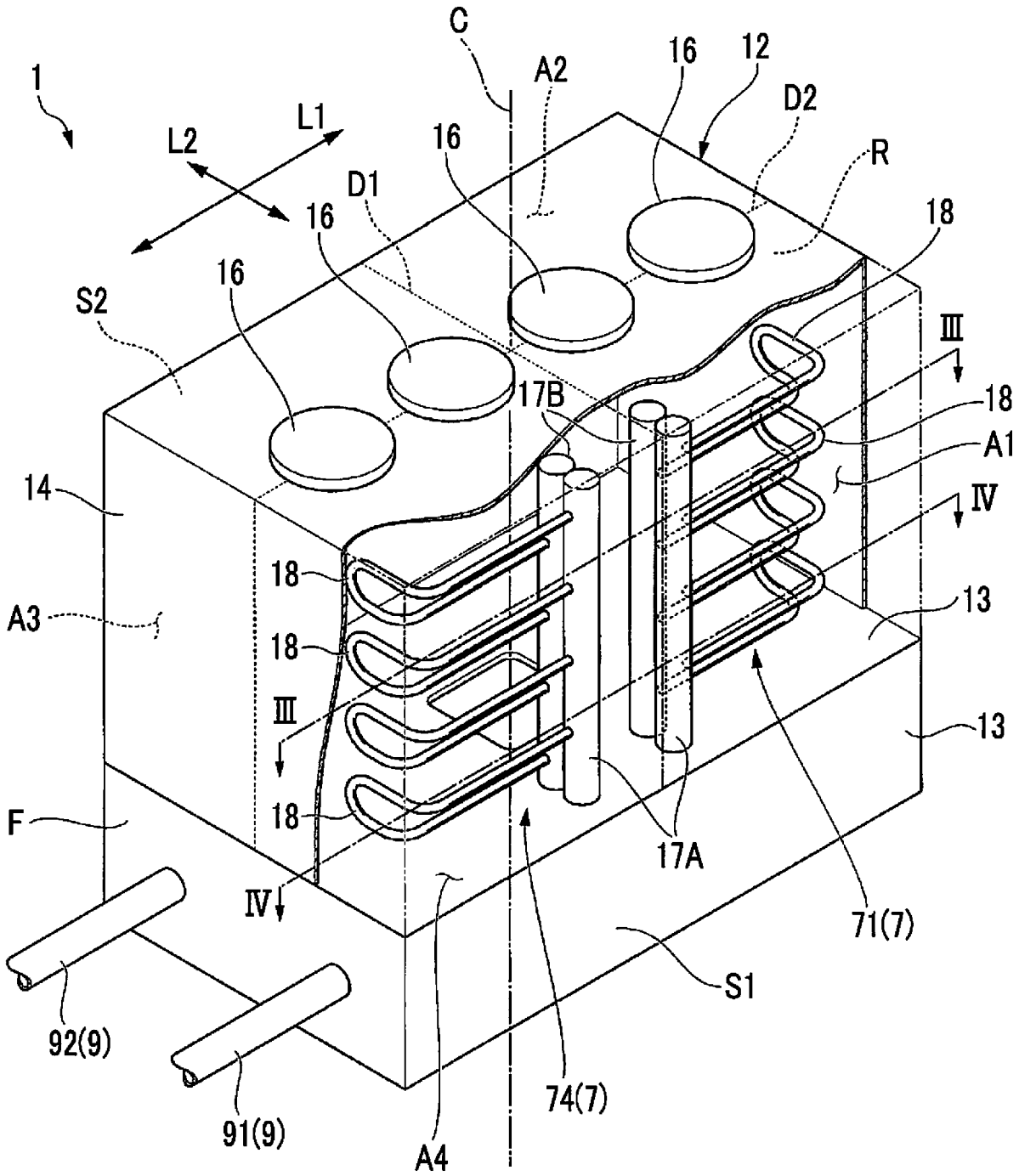
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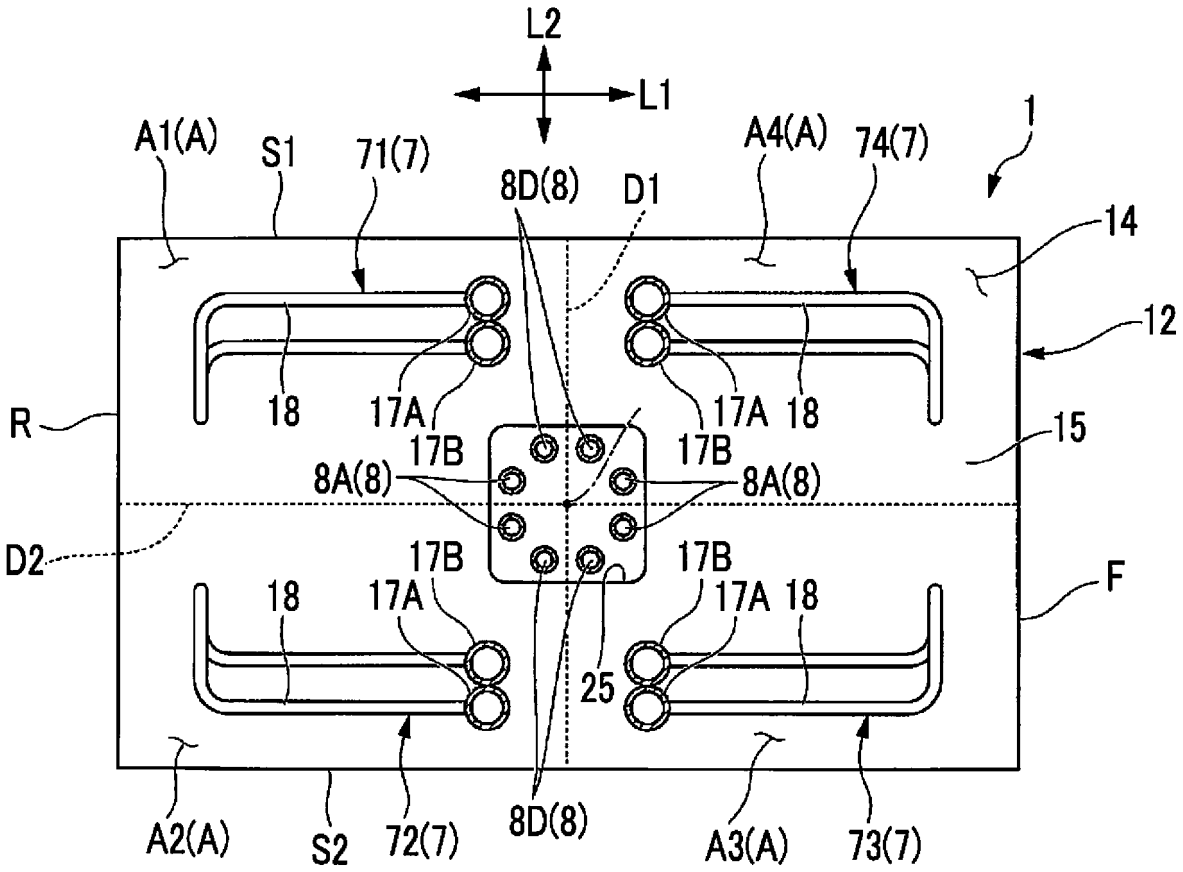
FIG. 3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17A
17B
8A(8)
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D2
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S2
72(7)
A3(A)
73(7)

FIG. 4

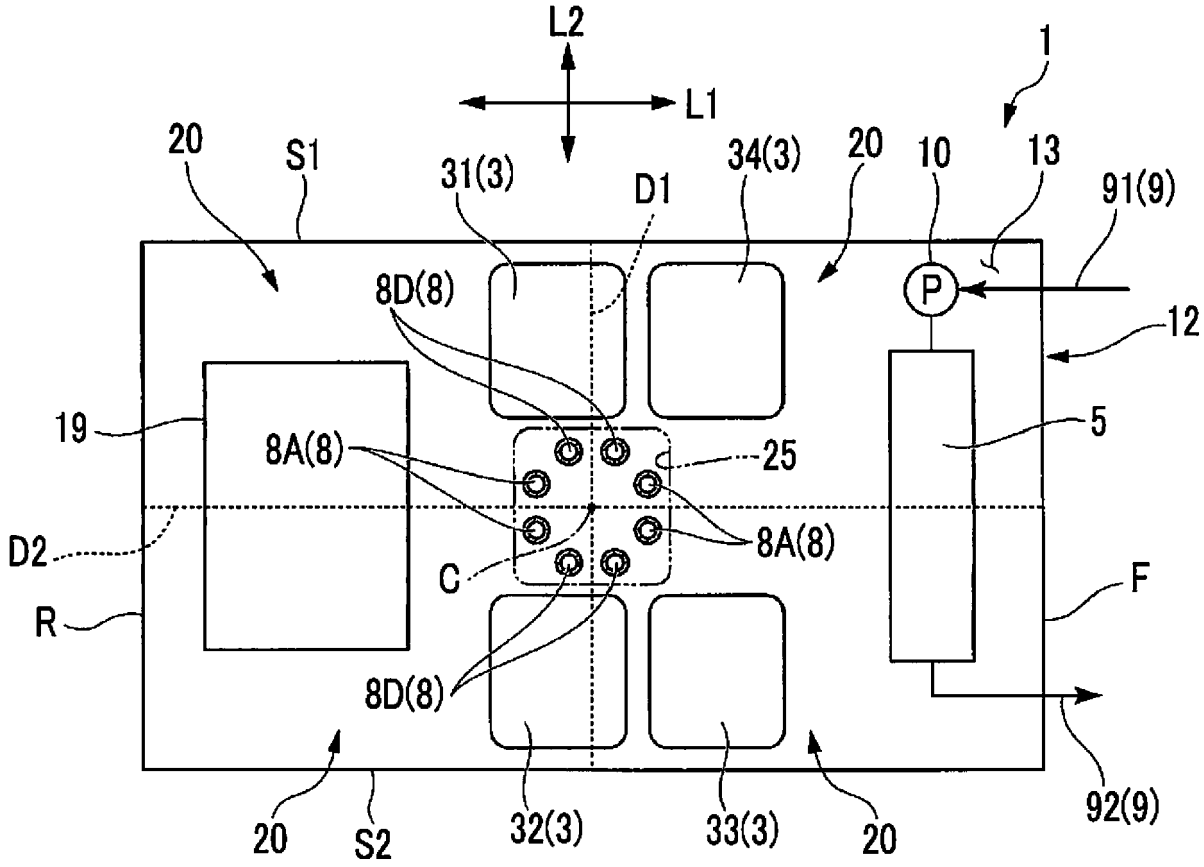
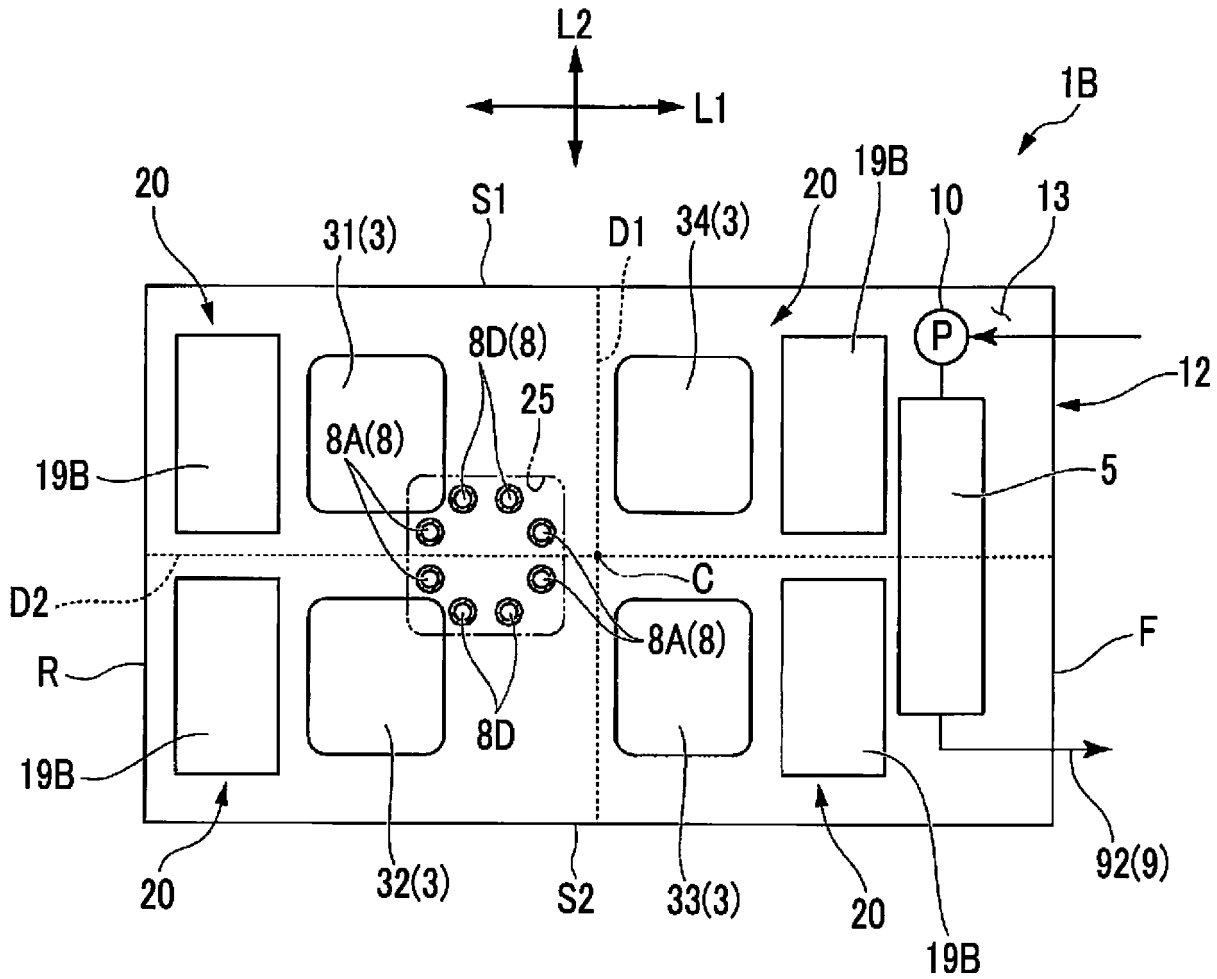

L2
L1
1
20
S1
31(3)
D1
34(3)
20
10
13
91(9)
8D(8)
P
12
19
8A(8)
25
5
D2
C
8A(8)
F
R
8D(8)
20
S2
32(3)
33(3)
20
92(9)

FIG. 5


L2
L1
1B
20
S1
31(3)
D1
34(3)
20
19B
10
13
P
12
8D(8)
25
8A(8)
19B
5
C
D2
8A(8)
F
R
8D
19B
20
32(3)
S2
33(3)
20
19B
92(9)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/036811

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F24F1/16(2011.01)i, F24F1/10(2011.01)i, F24F1/24(2011.01)i, F24F1/26(2011.01)i, F24F5/00(2006.01)i, F25B1/00(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)
Int.Cl. F24F1/16, F24F1/10, F24F1/24, F24F1/26, F24F5/00, F25B1/00

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

Published examined utility model applications of Japan	1922–1996
Published unexamined utility model applications of Japan	1971–2017
Registered utility model specifications of Japan	1996–2017
Published registered utility model specifications of Japan	1994–2017

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.
Y	JP 2010-266126 A (HITACHI APPLIANCES, INC.) 25 November 2010, paragraphs [0011], [0032]-[0035], fig. 6-8 (Family: none)	1-4
Y	WO 2011/099629 A1 (TOSHIBA CARRIER CORPORATION) 18 August 2011, paragraphs [0033]-[0036], [0055]-[0063], fig. 1-3, 8 & JP 2011/099629 A1 & CN 102753895 A & KR 10-2012-0116973 A & CN 105004027 A	1-4

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 November 2017 (21.11.2017)	28 November 2017 (28.11.2017)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/036811

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2010-216798 A (DAIKIN INDUSTRIES, LTD.) 30 September 2010, entire text, all drawings & US 2011/0303396 A1, entire text, all drawings & WO 2010/095470 A1 & EP 2402665 A1 & TW 201042217 A & CN 102317701 A	1-4

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REFERENCES CITED IN THE DESCRIPTION

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- JP 2016202648 A **[0002]**
- WO 2011099629 A **[0005]**