



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
07.02.2018 Bulletin 2018/06

(51) Int Cl.:
F28F 9/00 (2006.01) F25B 39/00 (2006.01)

(21) Application number: **15887317.4**

(86) International application number:
PCT/CN2015/098131

(22) Date of filing: **21.12.2015**

(87) International publication number:
WO 2016/155367 (06.10.2016 Gazette 2016/40)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

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(30) Priority: **31.03.2015 CN 201510149788**

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(54) **HEAT EXCHANGER AND MULTI-SPLIT SYSTEM HAVING SAME**

(57) Provided are a heat exchanger (100) and a multi-split system having the same. The heat exchanger (100) comprises a branch pipe (1) and a collecting pipe (2). The branch pipe (1) comprises a body (11), an inlet (12), and multiple flow separation holes. The inlet (12) is formed in the bottom of the body (11). The multiple flow separation holes are distributed in the side wall of the body (11) in the length direction of the body (11). In the direction from the bottom to the top, the body (11) comprises multiple segments of pipe bodies. In every two adjacent segments of pipe bodies, the flow area of a downstream pipe body is smaller than the flow area of an upstream pipe body, the height of each segment of pipe body is not greater than 0.5 meters, and the number N of the pipe bodies is greater than or equal to 2 and less than or equal to 3. The collecting pipe (2) and the branch pipe (1) are communicated by means of multiple heat exchange pipes, the multiple heat exchange pipes are distributed at intervals in the vertical direction, and the collecting pipe (2) has a refrigerant outlet (21).

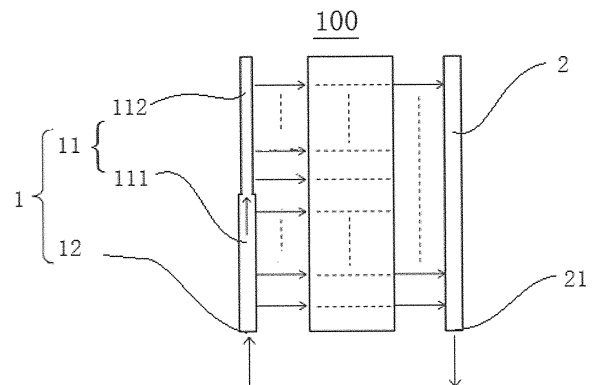


Fig. 1

Description

FIELD

[0001] The present disclosure relates to a field of heat exchanger equipment, especially to a heat exchanger and a multi-split system having the same.

BACKGROUND

[0002] A multi-split system in the related art includes an outdoor unit, an indoor unit and a refrigerant flow direction switching device and is divided to a triple-pipe (i.e. three refrigerant pipes are provided) multi-split system and a double-pipe (i.e. two refrigerant pipes are provided) multi-split system according to different amounts of refrigerant pipes between the outdoor unit and the refrigerant flow direction switching device. Although the outdoor unit in the double-pipe multi-split system has a relatively complicated refrigerant circuit, the double-pipe multi-split system has aroused widespread concern due to a relatively simple construction and a low cost thereof.

[0003] For the double-pipe multi-split system, the heat exchanger in the outdoor unit has to be designed to have a fixed refrigerant flow direction, i.e. the refrigerant flow direction has no business with refrigerating or heating. In order to reduce a flow resistance of the refrigerant when the outdoor unit refrigerates, a capillary in a traditional heat pump machine is usually replaced with a flute-like pipe, which usually results in a bias flow of a two-phase refrigerant when the outdoor unit heats, thus reducing a low heating performance of the system.

SUMMARY

[0004] The present disclosure aims to solve at least one of the technical problems in the related art. Thus, the present disclosure provides a heat exchanger which can distribute a two-phase refrigerant without a split-flow capillary better.

[0005] A multi-split system having the heat exchanger mentioned above is also provided in the present disclosure.

[0006] The heat exchanger according to embodiments of the present disclosure includes: a manifold including a main body, an inlet disposed in a bottom portion of the main body, and a plurality of split-flow ports distributed in a side wall of the main body along a length direction of the main body, in which the main body includes a plurality of pipes along from bottom to top, the pipe located downstream has a smaller flow area than the pipe located upstream in each two adjacent pipes, each pipe has a height no greater than 0.5m, and a number of the plurality of pipes is $2 \leq N \leq 3$; a header communicated with the manifold via a plurality of heat exchange tubes, in which the plurality of heat exchange tubes are spaced apart from one another along an up and down direction and the header has an outlet for discharging a refrigerant.

[0007] The heat exchanger according to embodiments of the present disclosure can distribute a two-phase refrigerant without a split-flow capillary better.

[0008] Specifically, the main body is configured in such a manner that a flow speed of a liquid refrigerant flowing through a transition portion of each two adjacent pipes is substantially equal to a flow speed of the liquid refrigerant at the inlet.

[0009] Further, the flow speed of the liquid refrigerant flowing through the transition portion of each two adjacent pipes and the flow speed of the liquid refrigerant at the inlet both a value range of 0.4~0.6m/s.

[0010] Specifically, the header is a straight pipe.

[0011] Specifically, the heat exchange tube is a flat tube.

[0012] In addition, the multi-split system is also provided in the present disclosure, which includes the heat exchanger described above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Fig. 1 is a schematic view of a heat exchanger according to an embodiment of the present disclosure; Fig. 2 is a schematic view of a heat exchanger according to another embodiment of the present disclosure.

Reference numbers:

[0014]

heat exchanger 100;
manifold 1; main body 11 ;first pipe 111 ;second pipe 112;third pipe 113;
inlet 12;
header 2; outlet 21.

DETAILED DESCRIPTION

[0015] Embodiments of the present disclosure will be described in detail in the following. Examples of the embodiments are shown in the drawings. The embodiments described herein with reference to drawings are explanatory, and used to generally understand the present disclosure, and shall not be construed to limit the present disclosure.

[0016] In the specification, it is to be understood that terms such as "central," "longitudinal," "lateral," "length," "width," "thickness," "upper," "lower," "front," "rear," "left," "right," "vertical," "horizontal," "top," "bottom," "inner," "outer," "clockwise," "counterclockwise," "axial direction," "radial direction," and "circumferential direction" should be construed to refer to the orientation as then described or as shown in the drawings under discussion. These relative terms are for convenience of description and do not indicate or imply that the device or element

be constructed or operated in a particular orientation, thus cannot be construed to limit the present disclosure.

[0017] In addition, terms such as "first" and "second" are used herein for purposes of description and are not intended to indicate or imply relative importance or significance or to imply the number of indicated technical features. Thus, the feature defined with "first" and "second" may comprise one or more of this feature expressly or implicitly. In the description of the present disclosure, "a plurality of" means at least two, such as two or three, unless specified otherwise. In the present disclosure, unless specified or limited otherwise, the terms "mounted," "connected," "communicated", "fixed" are used broadly, and may be, for example, fixed connections, detachable connections, or integral connections; may also be mechanical or electrical connections or be communicated with each other; may also be direct connections or indirect connections via intermediations; may also be inner communications of two elements or interact relationships of two elements, which can be understood by those skilled in the art according to specific situations, unless specified or limited otherwise.

[0018] A heat exchanger 100 according to embodiments of the present disclosure will be described with reference to Fig. 1 to Fig. 2, in which the heat exchanger 100 may be applied to refrigerating devices such as a single refrigerating machine, a refrigerating and heating machine or a multi-split system.

[0019] As shown in Fig. 1 and Fig. 2, the heat exchanger 100 according to embodiments of the present disclosure includes a manifold 1, a heat exchange tube (not shown in the drawings) and a header 2.

[0020] Specifically, as shown in Fig. 1, the manifold 1 includes a main body 11, an inlet 12 and a plurality of split-flow ports (not shown in the drawings). The inlet 12 is disposed in a bottom portion of the main body 11 and the plurality of split-flow ports is distributed in a side wall of the main body 11 along a length direction of the main body 11.

[0021] The header 2 is communicated with the manifold 1 via a plurality of heat exchange tubes, in which the plurality of heat exchange tubes are spaced apart from one another along an up and down direction, and the header 2 has an outlet 21 for discharging a refrigerant. As shown in Fig. 1 and Fig. 2, the refrigerant from the manifold 1 enters the heat exchange tubes through the plurality of split-flow ports and releases or absorbs heat in the heat exchange tubes, and lastly the refrigerant after the heat release or absorption enters the header 2 and further enters other flow paths via the outlet 21.

[0022] That is, the refrigerant flows by every split-flow port from bottom to top from the inlet 12 in the bottom portion of the main body 11, and the refrigerant passing through each split-flow port enters the header 2 via the heat exchange tubes.

[0023] In a direction from bottom to top, the main body 11 includes a plurality of pipes, the pipe located downstream has a smaller flow area than the pipe located up-

stream in each two adjacent pipes, and a number of the plurality of pipes is $2 \leq N \leq 3$. That is, the number of the pipes is two or three.

[0024] As shown in Fig. 1, for example in an embodiment of the present disclosure, the main body 11 includes a first pipe 111 and a second pipe 112, the inlet 12 is provided in the first pipe 111, and the second pipe 112 has a smaller cross-sectional area than the first pipe 111. In other words, the second pipe 112 has a smaller flow area than the first pipe 111. Thus, the refrigerant enters the first pipe 111 through the inlet 12 at a certain speed firstly and flows from bottom to top in the first pipe 111, and a part of the refrigerant flows through the split-flow ports into the heat exchange tubes when passing by the split-flow ports, and further enters the header 2. The liquid refrigerant in the first pipe 111 becomes less and less while flowing upwards and a speed of the refrigerant trends to decrease, and then the refrigerant enters the second pipe 112. Since the second pipe 112 has the smaller flow area than the first pipe 111, the refrigerant can be accelerated to some extent, such that the speed of the refrigerant in the second pipe 112 will not be decreased significantly and also enough refrigerant in the second pipe 112 can flow into the heat exchange tubes through the split-flow ports, thus improving a working efficiency of the heat exchanger 100 effectively.

[0025] Certainly, the present disclosure is not limited to this. As shown in Fig. 2, in another embodiment of the present disclosure, the main body 11 may also include a first pipe 111, a second pipe 112 and a third pipe 113, the inlet 12 is provided in the first pipe 111, the second pipe 112 has a smaller flow area than the first pipe 111, and the third pipe 113 has a smaller flow area than the second pipe 112. Based on a same principle, by setting lengths and flow areas of the first pipe 111, the second pipe 112 and the third pipe 113 reasonably, the refrigerant can flow through the split-flow ports in a top portion of the main body 11 so as to improve a use ratio of the heat exchange tubes corresponding to the third pipe 113 effectively, thus further improving the working efficiency of the heat exchanger 100 effectively.

[0026] Each pipe has a height no greater than 0.5m, which ensures that the refrigerant can flow to the top portion of the main body 11, thus improving a working efficiency of an upper region of the heat exchanger 100 effectively.

[0027] In the heat exchanger according to embodiments of the present disclosure 100, the main body 11 includes a plurality of pipes and the pipe located downstream has the smaller flow area than the pipe located upstream in each two adjacent pipes, such that the flow speed of the liquid refrigerant can be increased when the refrigerant flows through the transition portion of each two adjacent pipes, which has a function of speeding up the refrigerant on its way and ensures that enough liquid refrigerant can be provided to the upper region of the manifold 1 so as to allow the heat exchanger 100 to be used efficiently, so the heat exchanger 100 can distribute

the two-phase refrigerant without a split-flow capillary better.

[0028] Specifically, the main body 11 is configured in such a manner that a flow speed of the liquid refrigerant flowing through the transition portion of each two adjacent pipes is substantially equal to a flow speed of the liquid refrigerant at the inlet 12. That is, a difference between the flow areas of each two adjacent pipes is designed to improve the flow speed of the liquid refrigerant flowing through the transition portion to be substantially equal to the flow speed of the liquid refrigerant at the inlet, so as to further ensure the function of accelerating the liquid refrigerant on its way, such that the speed of the liquid refrigerant flowing from the pipe upstream to the pipe downstream will not be decreased significantly and the liquid refrigerant can enter the heat exchange tubes in an upper region of the heat exchanger 100, thus further improving the working efficiency of the heat exchanger 100 effectively.

[0029] Specifically, the flow speed of the liquid refrigerant flowing through the transition portion of each two adjacent pipes and the flow speed of the liquid refrigerant at the inlet 12 both have a value range of 0.4~0.6m/s. Thus, the flow speed of the liquid refrigerant is controlled in a certain range, which allows the liquid refrigerant to substantially uniformly enter the heat exchange tubes through the split-flow ports effectively, thus improving the working efficiency of the whole heat exchanger 100.

[0030] In examples shown in Fig. 1 and Fig. 2, the header 2 is a straight pipe. The refrigerant flowing out from the heat exchange tubes enters the header 2 and flows from top to bottom in the header 2, and it is advantageous for a circulation of the refrigerant by configuring the header 2 as the straight pipe, thus improving the working efficiency of the heat exchanger 100.

[0031] In an example of the present disclosure, the heat exchange tube is a flat tube, which can increase a heat exchange area of the refrigerant and the air, so that the refrigerant can absorb heat or release heat better, thus further improving the working efficiency of the heat exchanger 100 effectively. Meanwhile, a fin may be disposed between each two adjacent heat exchange tubes in the up and down direction, so as to increase a heat exchange area of the whole heat exchanger 100 and the air, thus further improving a heat exchange effect of the heat exchanger 100.

[0032] In addition, the present disclosure further provides a multi-split system, which includes the heat exchanger 100 described above.

[0033] In the present disclosure, unless specified or limited otherwise, a structure in which a first feature is "on" or "below" a second feature may include an embodiment in which the first feature is in direct contact with the second feature, and may also include an embodiment in which the first feature and the second feature are not in direct contact with each other, but are contacted via an additional feature formed therebetween. Furthermore, a first feature "on," "above," or "on top of" a second feature

may include an embodiment in which the first feature is right or obliquely "on," "above," or "on top of" the second feature, or just means that the first feature is at a height higher than that of the second feature; while a first feature "below," "under," or "on bottom of" a second feature may include an embodiment in which the first feature is right or obliquely "below," "under," or "on bottom of" the second feature, or just means that the first feature is at a height lower than that of the second feature.

[0034] Reference throughout this specification to "an embodiment," "some embodiments," "an example," "a specific example," or "some examples," means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the present disclosure. Thus, the appearances of the phrases above in various places throughout this specification are not necessarily referring to the same embodiment or example of the present disclosure. Furthermore, the particular features, structures, materials, or characteristics may be combined in any suitable manner in one or more embodiments or examples. In addition, different embodiments or examples and features of different embodiments or examples can be united or combined without conflicting premise by those skilled in the related art. Although embodiments of the present disclosure have been shown and described, it would be appreciated that the embodiments above are illustrative and cannot be construed to limit the present disclosure, and changes, variations, alternatives, and modifications can be made in the embodiments without departing from scope of the present disclosure by those skilled in the related art.

Claims

1. A heat exchanger, comprising:

a manifold comprising a main body, an inlet disposed in a bottom portion of the main body, and a plurality of split-flow ports distributed in a side wall of the main body along a length direction of the main body, wherein the main body comprises a plurality of pipes from bottom to top, the pipe located downstream has a smaller flow area than the pipe located upstream in each two adjacent pipes, each pipe has a height no greater than 0.5m, and a number of the plurality of pipes is $2 \leq N \leq 3$;

a header communicated with the manifold via a plurality of heat exchange tubes, wherein the plurality of heat exchange tubes are spaced apart from one another along an up and down direction and the header has an outlet for discharging a refrigerant.

2. The heat exchanger according to claim 1, wherein the main body is configured in such a manner that a

flow speed of a liquid refrigerant flowing through a transition portion of each two adjacent pipes is substantially equal to a flow speed of the liquid refrigerant at the inlet.

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3. The heat exchanger according to claim 2, wherein the flow speed of the liquid refrigerant flowing through the transition portion of each two adjacent pipes and the flow speed of the liquid refrigerant at the inlet both have a value range of 0.4~0.6m/s. 10
4. The heat exchanger according to any one of claims 1-3, wherein the header is a straight pipe.
5. The heat exchanger according to any one of claims 1-4, wherein the heat exchange tube is a flat tube. 15
6. A multi-split system, comprising a heat exchanger according to any one of claims 1-5. 20

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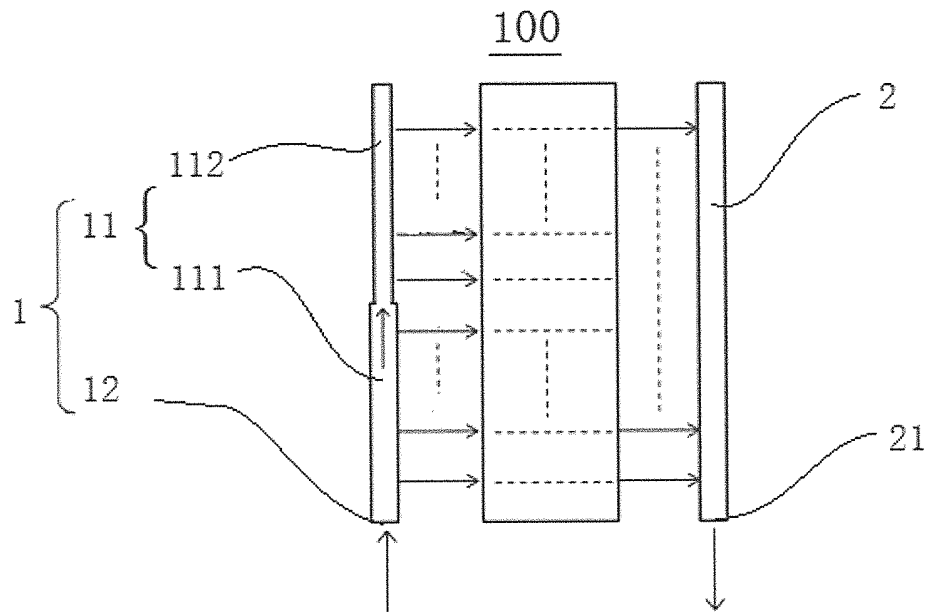


Fig. 1

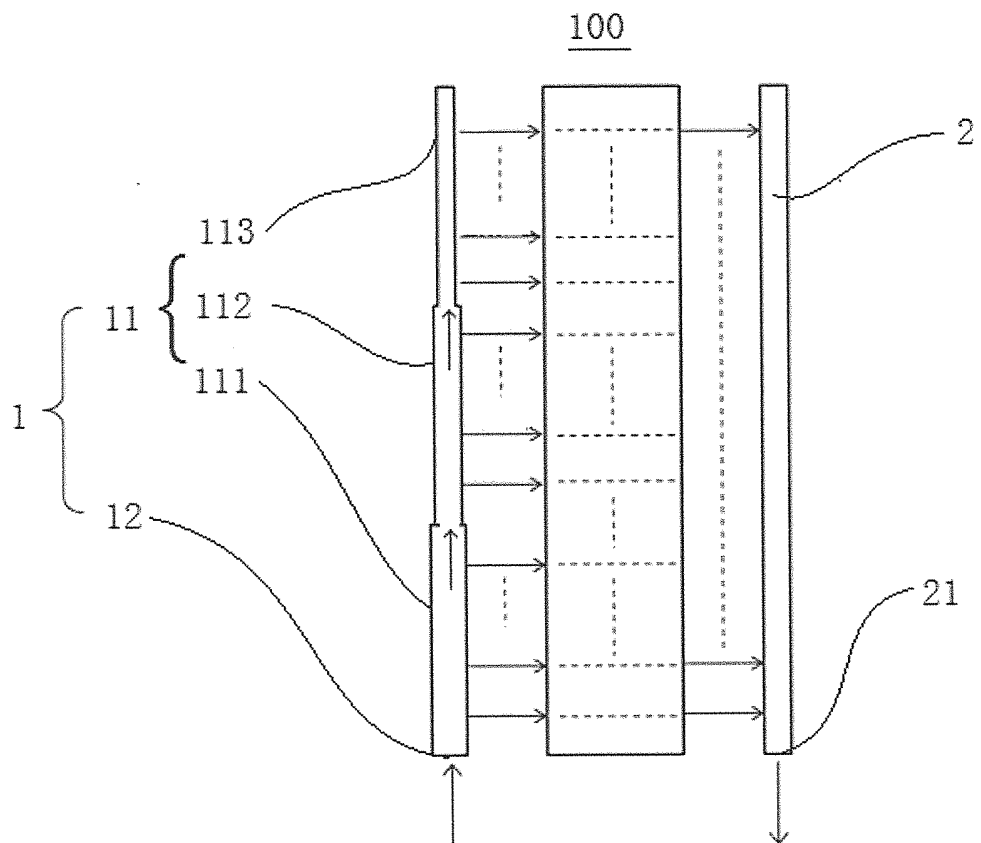


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/098131

A. CLASSIFICATION OF SUBJECT MATTER

F28F 9/00 (2006.01) i; F25B 39/00 (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)

F25B, F28F, F28D, F24F, F22B

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPODOC, WPI, CNPAT, CNKI: shunt, liquid separation, distribution, equipartition, flow rate, taper, divergent, section, passing surface, pipe diameter, inner diameter, header, dispens+, uniform+, flow, rate, even, decreas+, increas+, reduc+, converg+, step, cross, area, diameter, radius, pipe, conduit, tube

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6736191 B1 (POWER ENGINEERING CONTRACTORS), 18 May 2004 (18.05.2004), description, column 1, lines 30-37, column 3, lines 28-52 and column 9, line 55 to column 10, line 9, and figures 1 and 11	1-6
X	US 2010000721 A1 (LAI, M.C.), 07 January 2010 (07.01.2010), description, paragraphs [0020]-[0025], and figures 1-3	1-6
X	CN 104024731 A (ALSTOM TECHNOLOGY LTD.), 03 September 2014 (03.09.2014), description, paragraphs [0023]-[0036], and figure 4	1-6
X	DE 3310236 A1 (AUTOKUEHLER GES MBH), 27 September 1984 (27.09.1984), description, page 4, line 25 to page 7, line 12, and figures 1-3	1-6
X	JP H03260567 A (MITSUBISHI ELECTRIC CORP.), 20 November 1991 (20.11.1991), description, page 2, and figure 3	1-6
PX	CN 104764256 A (GUANGDONG MIDEA HEATING & VENTILATION EQUIPMENT CO., LTD. et al.), 08 July 2015 (08.07.2015), description, paragraphs [0024]-[0038], and figures 1 and 2	1-6

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

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent family

Date of the actual completion of the international search 07 January 2016 (07.01.2016)	Date of mailing of the international search report 10 March 2016 (10.03.2016)
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer GU, Xiaoyan Telephone No.: (86-10) 62084873

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2015/098131

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 H05264126 A (MATSUSHITA REFRIG CO., LTD.), 12 October 1993 (12.10.1993), the whole document	1-6
A	CN 103471427 A (ZHAO, Wei), 25 December 2013 (25.12.2013), the whole document	1-6

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2015/098131

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