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(71) Applicant: LG ELECTRONICS INC.
Yeongdeungpo-gu
Seoul 07336 (KR)

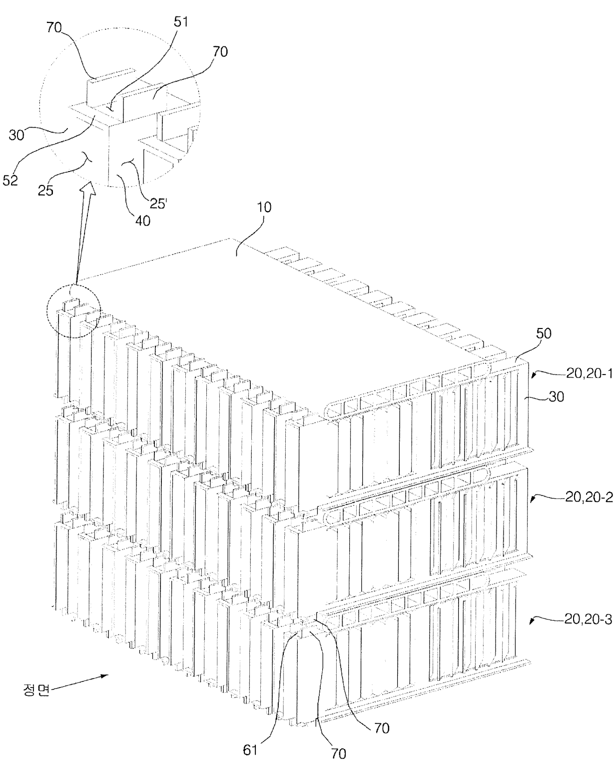
(72) Inventors:
- LEE, Eungyul
08592 Seoul (KR)
- JUNG, Seungmo
08592 Seoul (KR)
- KIM, Juhyok
08592 Seoul (KR)

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

(54) HEAT EXCHANGER

(57) Disclosed is a heat exchanger having the advantage of rapidly moving condensed water downward because a condensed water discharge fin formed on a first fin and a condensed water discharge fin formed on a second fin are spaced apart from each other, or are arranged in contact with each other.

FIG.2



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Description

[0001] The present invention relates to a heat exchanger, and more particularly, to a heat exchanger which may easily discharge condensed water when it is used as an evaporator.

[0002] Generally, a heat exchanger may be used as a condenser or an evaporator in a refrigeration cycle device, which is comprised of a compressor, a condenser, an expander, and an evaporator.

[0003] In addition, the heat exchanger is installed in, for example, a vehicle or a refrigerator, and performs heat exchange between refrigerant and air.

[0004] Heat exchangers may be sorted into a fin-tube-type heat exchanger and a micro-channel-type heat exchanger depending on the structure thereof.

[0005] The fin-tube-type heat exchanger is fabricated using copper, and the micro-channel-type heat exchanger is fabricated using aluminum.

[0006] The micro-channel-type heat exchanger defines micro flow-paths therein, and therefore, has higher efficiency than the fin-tube-type heat exchanger.

[0007] Although the fin-tube-type heat exchanger is easily fabricated by welding fins and tubes, the micro-channel-type heat exchanger disadvantageously requires high initial investment costs for fabrication thereof because it is fabricated via brazing after being introduced into a furnace.

[0008] FIG. 1 is a sectional view illustrating a conventional micro-channel-type heat exchanger.

[0009] The conventional micro-channel-type heat exchanger includes a plurality of flat tubes 1 having micro flow paths therein, fins 2 located between the respective flat tubes 1 to interconnect the flat tubes 1 in order to conduct heat, and headers 3 and 4 respectively assembled to one side and to the other side of the flat tubes 1.

[0010] The fins 2 are coupled to flat tubes 1 located at opposite sides thereof. The fins 2 are arranged in a zigzag arrangement in the longitudinal direction of the flat tubes 1.

[0011] The conventional micro-channel-type heat exchanger has considerably higher heat exchange efficiency between refrigerant and air than the fin-tube-type heat exchanger, but has difficulty in discharging condensed water when it is used as an evaporator.

[0012] The conventional micro-channel-type heat exchanger problematically causes deterioration in heat exchange efficiency because condensed water, which is generated when the heat exchanger is used as an evaporator, may not be discharged and the condensed water may stagnate and freeze between the fins.

[0013] A conventional heat exchanger is shown in Korean Patent Registration No. 10-0765557.

[0014] Therefore, the present invention has been made in view of the above problems, and it is an object of the present invention to provide a micro-channel-type heat exchanger, which may easily discharge condensed water.

[0015] It is another object of the present invention to provide a micro-channel-type heat exchanger, which may be fabricated via a fin roll method.

[0016] It is another object of the present invention to provide a micro-channel-type heat exchanger, which may easily move fluid in the longitudinal direction of flat tubes and in a direction perpendicular to the longitudinal direction of the flat tubes.

[0017] It is a further object of the present invention to provide a micro-channel-type heat exchanger, which may easily move condensed water, generated in upper fins, to lower fins.

[0018] These objects of the present invention are achieved with the features of the claims.

[0019] According to one aspect, the present invention provides a heat exchanger including a plurality of flat tubes formed in a micro-channel form, and a fin located between the flat tubes to conduct heat, wherein the fin includes a first fin portion located between two flat tubes, a first bent portion bent at the first fin portion so as to come into contact with one of the two flat tubes, a second fin portion bent at the first bent portion, the second fin portion being opposite the first fin portion and being located between the two flat tubes, a flow space defined between the first fin portion and the second fin portion, a second bent portion bent at the second fin portion so as to come into contact with a remaining one of the two flat tubes, and a condensed water discharge hole formed by cutting at least one of the first bent portion and the second bent portion and a condensed water discharge fin bent at one of the first bent portion and the second bent portion.

[0020] The condensed water discharge fin may be bent in the same direction as a direction in which the first fin portion or the second fin portion is formed.

[0021] Each flat tube may be located so as to come into close contact with the condensed water discharge fin.

[0022] The condensed water discharge fin and the condensed water discharge hole may be located at an edge of the fin.

[0023] Two condensed water discharge fins may be formed on opposite sides of the condensed water discharge hole.

[0024] The two condensed water discharge fins may be arranged so as to face each other.

[0025] The condensed water discharge fin may include a first condensed water discharge fin formed on the first bent portion and a second condensed water discharge fin formed on the second bent portion, and the first condensed water discharge fin and the second condensed water discharge fin may be bent in opposite directions.

[0026] The first condensed water discharge fin and the second condensed water discharge fin may be arranged in a line in a vertical direction.

[0027] The first condensed water discharge fin and the second condensed water discharge fin may be offset in a vertical direction.

[0028] At least one of the first fin portion and the second fin portion may be provided with a vent for communication of the flow space and an adjacent flow space with each other.

[0029] The fin portion may further be provided with a louver for forming the vent and guiding air.

[0030] The at least one of the first fin portion and the second fin portion may further be provided with a first vent and a second vent, and provided with a first-first louver for forming the first vent and a first-second louver for forming the second vent, and the first-first louver and the first-second louver may be formed in opposite directions.

[0031] The above and other objects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a sectional view illustrating a conventional micro-channel-type heat exchanger;
FIG. 2 is a perspective view of a micro-channel-type heat exchanger according to a first embodiment of the present invention;
FIG. 3 is a rear perspective view of FIG. 2;
FIG. 4 is a front view of FIG. 2;
FIG. 5 is a plan view of FIG. 2;
FIG. 6 is a left side view of FIG. 2;
FIG. 7 is a perspective view of a micro-channel-type heat exchanger according to a second embodiment of the present invention;
FIG. 8 is a front view of FIG. 7;
FIG. 9 is a plan view of FIG. 7; and
FIG. 10 is a right side view of FIG. 1.

[0032] Hereinafter, the present invention will be described in detail with reference to the accompanying drawings.

[0033] A micro-channel-type heat exchanger according to a first embodiment will be described with reference to FIGs. 2 to 6.

[0034] The micro-channel-type heat exchanger according to the present embodiment includes a plurality of flat tubes 10 defining a plurality of flow paths therein, fins 20 arranged between and respectively coupled to the two flat tubes 10 to conduct heat, and a first header (not illustrated) and a second header (not illustrated) assembled to respective ends of the flat tubes 10 to move refrigerant.

[0035] In the micro-channel-type heat exchanger, when refrigerant is supplied to the first header, the refrigerant passes through the flat tubes 10 and moves to the second header. On the other hand, when refrigerant is supplied to the second header, the refrigerant moves to the first header.

[0036] The first header and the second header have a structure that is well known to those skilled in the art, and thus, a detailed description thereof will be omitted herein.

[0037] The flat tubes 10 have a flat shape and define multiple flow paths therein. The flat tubes 10 are formed of a metal material. In the present embodiment, the flat tubes are formed of aluminum.

[0038] In the present embodiment, the flat tubes 10 are horizontally arranged, and the fins 20 are also arranged so as to extend horizontally. The micro-channel-type heat exchanger according to the present embodiment has a structure for the easy discharge of condensed water because the flat tubes 10 and the fins 20 are horizontally arranged.

[0039] Unlike the present embodiment, the flat tubes 10 and the fins 20 may be arranged so as to extend vertically.

[0040] The fins 20 are bent in the longitudinal direction of the flat tubes 10. The fins 20 have the advantage of low manufacturing costs because they may be fabricated by repeatedly conducting a fin-rolling method.

[0041] The fins 20 are formed of a metal material. In the present embodiment, the fins 20 are formed of aluminum, like the flat tubes 10. The fins 20 serve to rapidly conduct the heat in the flat tubes 10 so as to increase heat exchange efficiency.

[0042] The fins 20 are arranged between the flat tubes 10. By way of explanation, a fin 20 located at the uppermost position is defined as a first fin 20-1, a fin 20 located under the first fin 20-1 is defined as a second fin 20-2, and a fin 20 located under the second fin 20-2 is defined as a third fin 20-3.

[0043] Each fin 20 includes a first fin portion 30 located between the two flat tubes 10, a first bent portion 50 bent at the first fin portion 30 so as to come into contact with any one of the two flat tubes 10, a second fin portion 40 bent at the first bent portion 50 so as to be opposite the first fin portion 30 and to be located between the two flat tubes 10, and a second bent portion 60 bent at the second fin portion 40 so as to come into contact with the other one of the two flat tubes 10.

[0044] For convenience of description, the flat tube 10 that is in contact with the first bent portion 50, is defined as a first flat tube 11, and the flat tube 10 that is in contact with the second bent portion 60, is defined as a second flat tube 12.

[0045] The fin 20 is configured such that the first fin portion 30, the first bent portion 50, the second fin portion 40, and the second bent portion 60 are repeated.

[0046] The first fin portion 30 supports the first flat tube 11 and the second flat tube 12.

[0047] The first fin portion 30 is oriented perpendicular to the longitudinal direction of the first flat tube 11 and the second flat tube 12.

[0048] Like the first fin portion 30, the second fin portion 40 also supports the first flat tube 11 and the second flat tube 12, and is oriented perpendicular to the longitudinal direction of the first flat tube 11 and the second flat tube 12.

[0049] The first fin portion 30 and the second fin portion 40 are spaced apart from each other by a predetermined distance. A flow space 25 for the movement of air is defined between the first fin portion 30 and the second fin portion 40.

[0050] Air for heat exchange passes through the flow space 25 defined between the first fin portion 30 and the second fin portion 40.

[0051] The smaller the gap in the flow space 25 defined between the first fin portion 30 and the second fin portion 40, the greater the number of fin portions that can be installed, which may increase heat exchange efficiency.

[0052] However, when the gap in the flow space 25 is small, condensed water, generated when the heat exchanger operates as an evaporator, may be attached and fixed to the first fin portion 30 and the second fin portion 40 via surface tension. In the present embodiment, the flow space 25 has the gap to prevent condensed water from connecting the first fin portion 30 and the second fin portion 40 to each other via surface tension.

[0053] The condensed water generated in the first fin portion 30 and the second fin portion 40 comes into contact with air, which moves along the flow space 25, thus falling down.

[0054] At least one of the first fin portion 30 and the second fin portion 40 is provided with vents 21 and 22, which communicate with an adjacent flow space 25'.

[0055] In the present embodiment, both the first fin portion 30 and the second fin portion 40 are provided with the vents 21 and 22. Although each of the first fin portion 30 and the second fin portion 40 is provided with the two vents 21 and 22, only one vent may be provided, unlike the present embodiment.

[0056] For convenience of description, the vents 21 and 22 are defined as a first vent 21 and a second vent 22.

[0057] The vents 21 and 22 may take the form of holes or slits.

[0058] In the present embodiment, the vents 21 and 22 are formed by cutting the first fin portion 30 and the second fin portion 40.

[0059] The first fin portion 30 is provided with a first-first louver 31 for forming the first vent 21. Further, the first fin portion 30 is provided with a first-second louver 32 for forming the second vent 22.

[0060] The first-first louver 31 is formed by bending the cut first fin portion 30. The first vent 21 is formed in the location in which the first-first louver 31 is cut.

[0061] The first-second louver 32 is formed in the same method as the first-first louver 31.

[0062] The louvers 31 and 32 serve to guide some of the air moving along the flow space 25 to the neighboring flow space 25'.

[0063] In the present embodiment, the first-first louver 31 and the first-second louver 32 are formed so as to guide the air in different directions.

[0064] For example, when the first-first louver 31 is formed to guide the air from the adjacent flow space 25' to the flow space 25, the first-second louver 32 is formed to guide the air from the flow space 25 to the adjacent flow space 25'.

[0065] The louvers protrude from the first fin portion 30 or the second fin portion 40 to the flow space 25 or the adjacent flow space 25'.

[0066] The louver is formed perpendicular to the longitudinal direction of the first flat tube 11 and the second flat tube 12.

[0067] Louvers, formed in the second fin portion 40, have the same structure as the louvers formed in the first fin portion 30, and for convenience of description, are defined as a second-first louver 41 and a second-second louver 42.

[0068] The second fin portion 40 is provided with the first vent 21 formed by the second-first louver 41 and the second vent 22 formed by the second-second louver 42.

[0069] Because the first-first louver 31 and the first-second louver 32 are formed in opposite directions, the direction in which the fins 20 are installed need not be considered upon the installation of the heat exchanger.

[0070] The first bent portion 50 comes into close contact with the first flat tube 11 and conducts heat from the first flat tube 11.

[0071] The first bent portion 50 is formed into a plane in the present embodiment.

[0072] Although the first bent portion 50 is located at the top and the second bent portion 60 is located at the bottom in the present embodiment, they may be located at the opposite positions.

[0073] The first bent portion 50 is provided with a condensed water discharge fin 70; 71 to discharge condensed water from the flow space 25.

[0074] The condensed water discharge fin 70 is formed by cutting and bending the first bent portion 50.

[0075] As such, the first bent portion 50 is provided with a condensed water discharge hole 51 at the location at which the condensed water discharge fin 70 is present. The condensed water discharge hole formed in the first bent portion 50 is defined as a first condensed water discharge hole 51.

[0076] In the present embodiment, two condensed water discharge fins 70 are formed on the first bent portion 50 so as to face each other. Only one condensed water discharge hole 51 is provided.

[0077] Because the two condensed water discharge fins 70 are formed in a limited area, the length of the condensed water discharge fins 70 is half or less the width of the first bent portion 50.

[0078] In addition, a connector 52 for connecting the first fin portion 30 and the second fin portion 40 to each other is formed on the edge of the first bent portion 50.

[0079] The connector 52 is the portion that remains when the condensed water discharge fins 70 are formed. As such, the connector 52 is formed so as to be in contact with the condensed water discharge hole 51. The connector 52 connects the first fin portion 30 and the second fin portion 40 to each other, thus improving the strength of the fin 20.

[0080] The condensed water present in the flow space 25 may be discharged from the flow space 25 through the condensed water discharge hole 51.

[0081] The condensed water discharge fins 70 guide the flow of condensed water when the condensed water is discharged.

[0082] Likewise, the second bent portion 60 is provided with a condensed water discharge hole 61 and condensed water discharge fins 70; 72, in the same manner as the first bent portion 50. The condensed water discharge hole, formed in the second bent portion 60, is defined as a second condensed water discharge hole 61.

[0083] Because the flat tubes 10 are stacked one above another and the fins 20 are arranged between the flat tubes 10, the condensed water discharge fins 71 formed on the first bent portion 50 and the condensed water discharge fins 72 formed on the second bent portion 60 are vertically arranged.

[0084] For convenience of description, the condensed water discharge fin provided on the first bent portion 50 is defined as a first condensed water discharge fin 71 and the condensed water discharge fin provided on the second bent portion 60 is defined as a second condensed water discharge fin 72.

[0085] The first condensed water discharge fin 71 and the second condensed water discharge fin 72 may be vertically arranged. The first condensed water discharge fin 71 and the second condensed water discharge fin 72 may be aligned in a line. When the first condensed water discharge fin 71 and the second condensed water discharge fin 72 are aligned in a line, the first condensed water discharge fin 71 and the second condensed water discharge fin 72 may be spaced apart from each other by a predetermined distance.

[0086] The predetermined distance between the first condensed water discharge fin 71 and the second condensed water discharge fin 72 is the distance by which condensed water can move by surface tension.

[0087] In the present embodiment, the second condensed water discharge fin 72 of the first fin 20-1 and the first condensed water discharge fin 71 of the second fin 20-2 are spaced apart from each other by a predetermined distance. Unlike the present embodiment, the second condensed water discharge fin 72 of the first fin 20-1 and the first condensed water discharge fin 71 of the second fin 20-2 may come into contact with each other.

[0088] As such, condensed water, generated in the flow space 25 defined in the upper fin 20, may be discharged to the condensed water discharge hole 61 and may move downward along the second condensed water discharge fin 72. Then, the condensed water may move downward along the second condensed water discharge fin 72 and the first condensed water discharge fin 71 adjacent thereto.

[0089] The flat tube 10 may be located so as to come into close contact with the condensed water discharge fin 70. When the heat exchanger is used as an evaporator, the flat tube 10 has the lowest temperature. The condensed water, generated in the flat tube 10, may rapidly move downward through the condensed water discharge fin 70, which is in close contact with the flat tube 10. Through the rapid movement of the condensed water, it may be possible to minimize the freezing of condensed water on the surface of the flat tube 10.

[0090] In the present embodiment, the condensed water discharge fins 70 and the condensed water discharge holes 51 and 61 are formed only on one side of the fin 20. Unlike the present embodiment, the condensed water discharge fins 70 and the condensed water discharge holes 51 and 61 may be formed on opposite sides of the fin 20.

[0091] In addition, although the condensed water discharge fins 70 and the condensed water discharge holes 51 and 61 are formed by cutting the first bent portion 50 and the second bent portion 60 in the present embodiment, unlike the present embodiment, only the condensed water discharge holes 51 and 61 may be formed. In addition, when only the condensed water discharge holes 51 and 61 are formed, the holes 51 and 61 may be provided in a plural number along the first bent portion 50 or the second bent portion 60.

[0092] A micro-channel-type heat exchanger according to a second embodiment of the present invention will be described below with reference to FIGs. 7 to 10.

[0093] The heat exchanger according to the present embodiment has differences in terms of the position and alignment of the condensed water discharge fins compared to the first embodiment.

[0094] A fin 120 according to the present embodiment is provided with condensed water discharge fins 170 on opposite edges of the first bent portion 50. The fin 120 is provided with the condensed water discharge fins 170 on opposite edges of the second bent portion 60.

[0095] For convenience of description, the condensed water discharge fins provided on the first bent portion 50 are defined as first condensed water discharge fins 171, and the condensed water discharge fins provided on the second bent portion 60 are defined as second condensed water discharge fins 172.

[0096] The first bent portion 50 is provided on opposite edges thereof with condensed water discharge holes 51.

[0097] The second bent portion 60 is provided on opposite edges thereof with condensed water discharge holes 61.

[0098] Unlike the first embodiment, each condensed water discharge hole 51 or 61 is provided with one condensed water discharge fin 170.

[0099] The first condensed water discharge fin 171 and the second condensed water discharge fin 172, provided on the fin 120, are offset in the vertical direction. That is, the first condensed water discharge fin 171 and the second condensed water discharge fin 172 are not aligned in a line, unlike the first embodiment.

[0100] As such, when the fins 120 are stacked one above another, the first condensed water discharge fin 171 and the second condensed water discharge fin 172 are offset in the left-to-right direction. In particular, the first condensed water discharge fin 171 and the second condensed water discharge fin 172 are arranged so as to face each other at the offset positions.

[0101] In the state in which the fins 120 are stacked one above another, the second condensed water discharge fin 172 of the upper fin 120 and the first condensed water discharge fin 171 of the lower fin 120 are arranged so as to face each other.

[0102] In the present embodiment, when viewing the fins 120 from the front side, the first condensed water discharge fin 171 and the second condensed water discharge fin 172 are arranged in a line.

[0103] Unlike the present embodiment, the first condensed water discharge fin 171 may be offset when viewing the fins 120 from the front side. The second condensed water discharge fin 172 may also be offset when viewing from the front side.

[0104] The other configurations are the same as in the first embodiment, and thus a detailed description thereof will be omitted herein.

[0105] As is apparent from the above description, a heat exchanger of the present invention has one or more following effects.

[0106] First, the present invention has the advantage of easily discharging condensed water from a flow space, which is defined between a first fin portion and a second fin portion, through condensed water discharge holes and condensed water discharge fins.

[0107] Second, the present invention has the advantage of fabricating the heat exchanger using a fin-rolling machine because the condensed water discharge holes and the condensed water discharge fins are formed by cutting and bending the first fin portion and the second fin portion.

[0108] Third, the present invention has the advantage of reducing fabrication costs through the use of the fin-rolling machine.

[0109] Fourth, the present invention has the advantage of easily discharging condensed water by arranging the condensed water discharge fins in a line or in a zigzag arrangement.

[0110] Fifth, the present invention has the advantage of easily discharging condensed water by forming the condensed water discharge fins in the direction of gravity.

[0111] Sixth, the present invention has the advantage of rapidly discharging condensed water because the condensed water discharge fins are arranged in contact with the condensed water discharge holes, through which condensed water is discharged from the flow space.

[0112] Seventh, the present invention has the advantage of easily discharging condensed water generated inside fins even when flat tubes and the fins are horizontally installed.

Claims

1. A heat exchanger comprising: a plurality of flat tubes (10) formed in a micro-channel form; and a fin (20; 120) located between the flat tubes (10) to conduct heat,
wherein the fin (20; 120) includes:

    a first fin portion (30) located between two flat tubes (10);
    a first bent portion (50) bent at the first fin portion (30) so as to come into contact with one of the two flat tubes (10);
    a second fin portion (40) bent at the first bent portion (50), the second fin portion (40) being opposite the first fin portion (30) and being located between the two flat tubes (10);
    a flow space (25) defined between the first fin portion (30) and the second fin portion (40);
    a second bent portion (60) bent at the second fin portion (40) so as to come into contact with a remaining one of the two flat tubes (10); and
    a condensed water discharge hole (51; 61) formed by cutting at least one of the first bent portion (50) and the second bent portion (60) and a condensed water discharge fin (70; 170) bent at one of the first bent portion (50) and the second bent portion (60).

2. The heat exchanger according to claim 1, wherein the condensed water discharge fin (70; 170) is bent in the same direction as a direction in which the first fin portion (30) or the second fin portion is (40) formed.

3. The heat exchanger according to claim 1, or 2, wherein each flat tube (10) is located so as to come into close contact with the condensed water discharge fin (70; 170).

4. The heat exchanger according to claim 1, 2, or 3, wherein the condensed water discharge fin (70; 170) and the condensed water discharge hole (51; 61) are located at an edge of the fin (20; 120).

5. The heat exchanger according to claim 1, wherein two condensed water discharge fins (70, 71, 72; 170, 171, 172) are formed on opposite sides of the condensed water discharge hole (51; 61).

6. The heat exchanger according to claim 5, wherein the two condensed water discharge fins (70, 71, 72; 170, 171, 172) are arranged so as to face each other.

7. The heat exchanger according to claim 1, wherein the condensed water discharge fin (70; 170) includes a first condensed water discharge fin (71; 170) formed on the first bent portion (50) and a second condensed water discharge fin (72; 172) formed on the second bent portion (60), and
wherein the first condensed water discharge fin (71; 171) and the second condensed water discharge fin

(72; 172) are bent in opposite directions.

8. The heat exchanger according to claim 7, wherein the first condensed water discharge fin (71; 171) and the second condensed water discharge fin (72; 172) are arranged in a line in a vertical direction.

9. The heat exchanger according to claim 7, wherein the first condensed water discharge fin (71; 171) and the second condensed water discharge fin (72; 172) are offset in a vertical direction.

10. The heat exchanger according to any one of claims 1 to 9, wherein at least one of the first fin portion (30) and the second fin portion (40) is provided with a vent (21, 22) for communication of the flow space (25) and an adjacent flow space (25') with each other.

11. The heat exchanger according to claim 10, wherein the at least one fin portion (30, 40) is further provided with a louver (31, 32, 41, 42) for forming the vent (21, 22) and guiding air.

12. The heat exchanger according to claim 10, or 11, wherein the at least one of the first fin portion (30) and the second fin portion (40) is further provided with a first vent (21) and a second vent (22), and provided with a first-first louver (31) for forming the first vent (21) and a first-second louver (32) for forming the second vent (22), and the first-first louver (31) and the first-second louver (32) are formed in opposite directions.

FIG.1

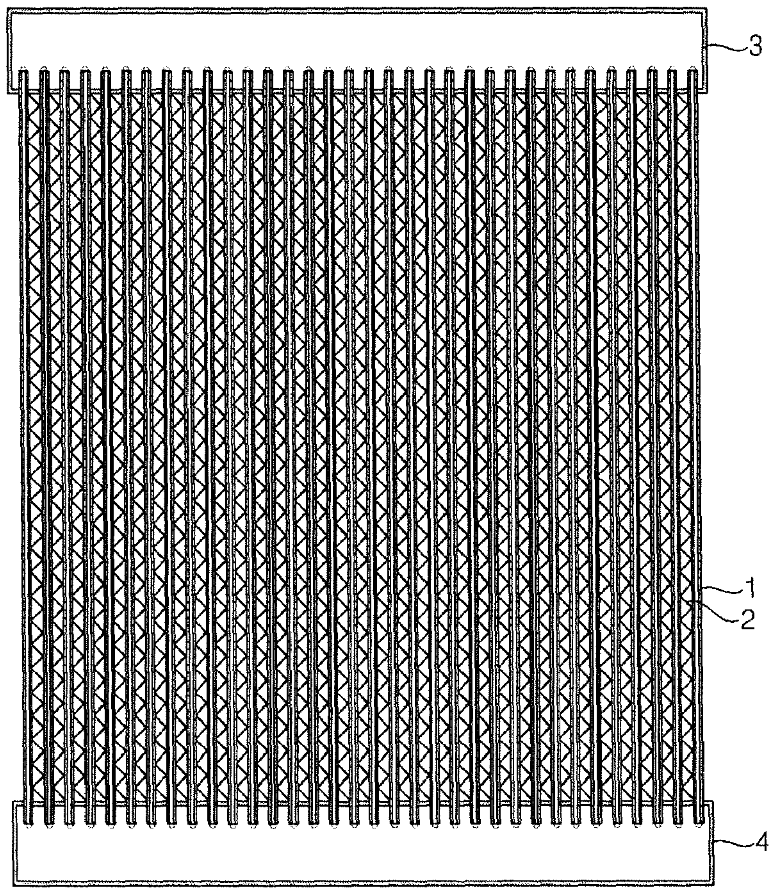

FIG.2

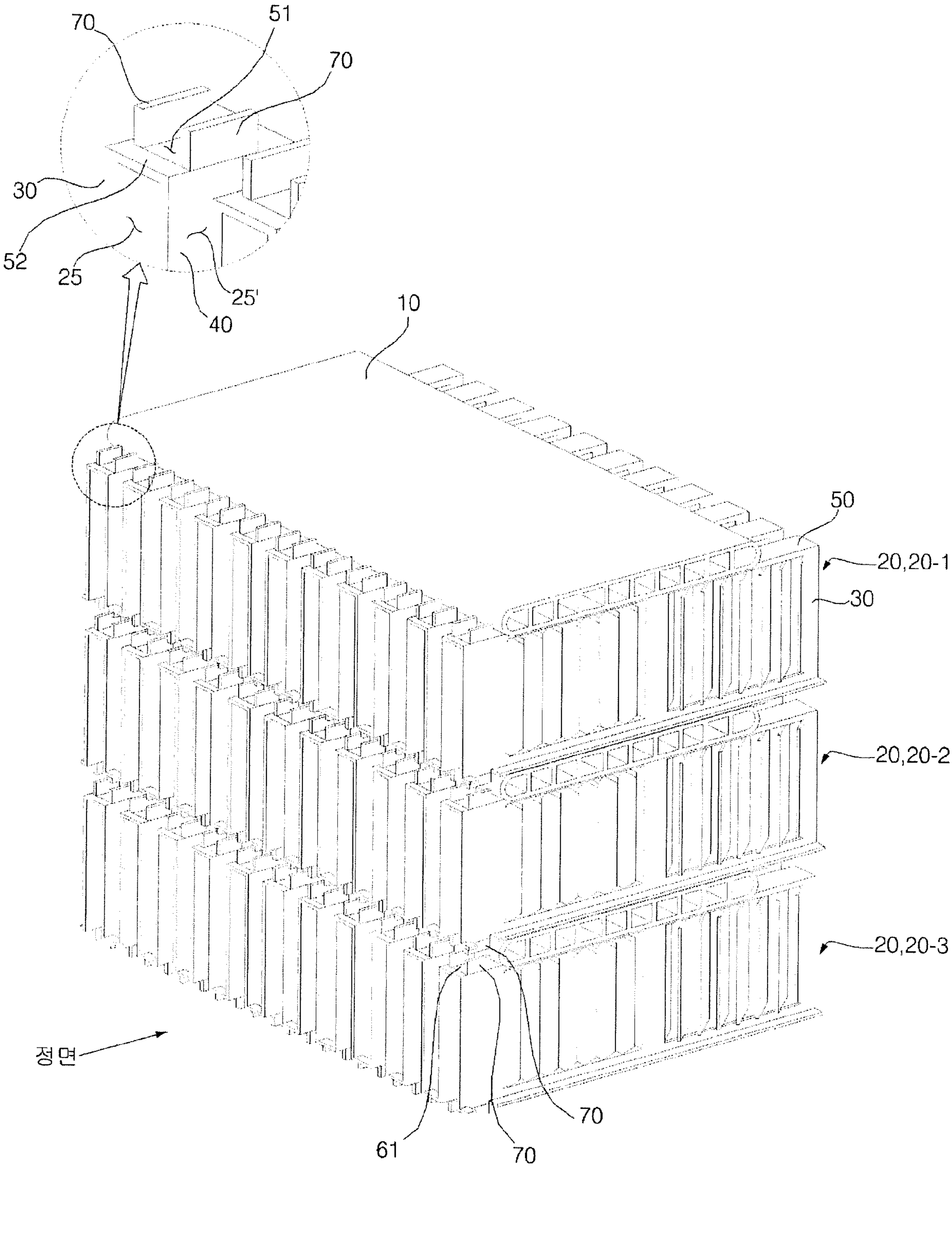

FIG.3

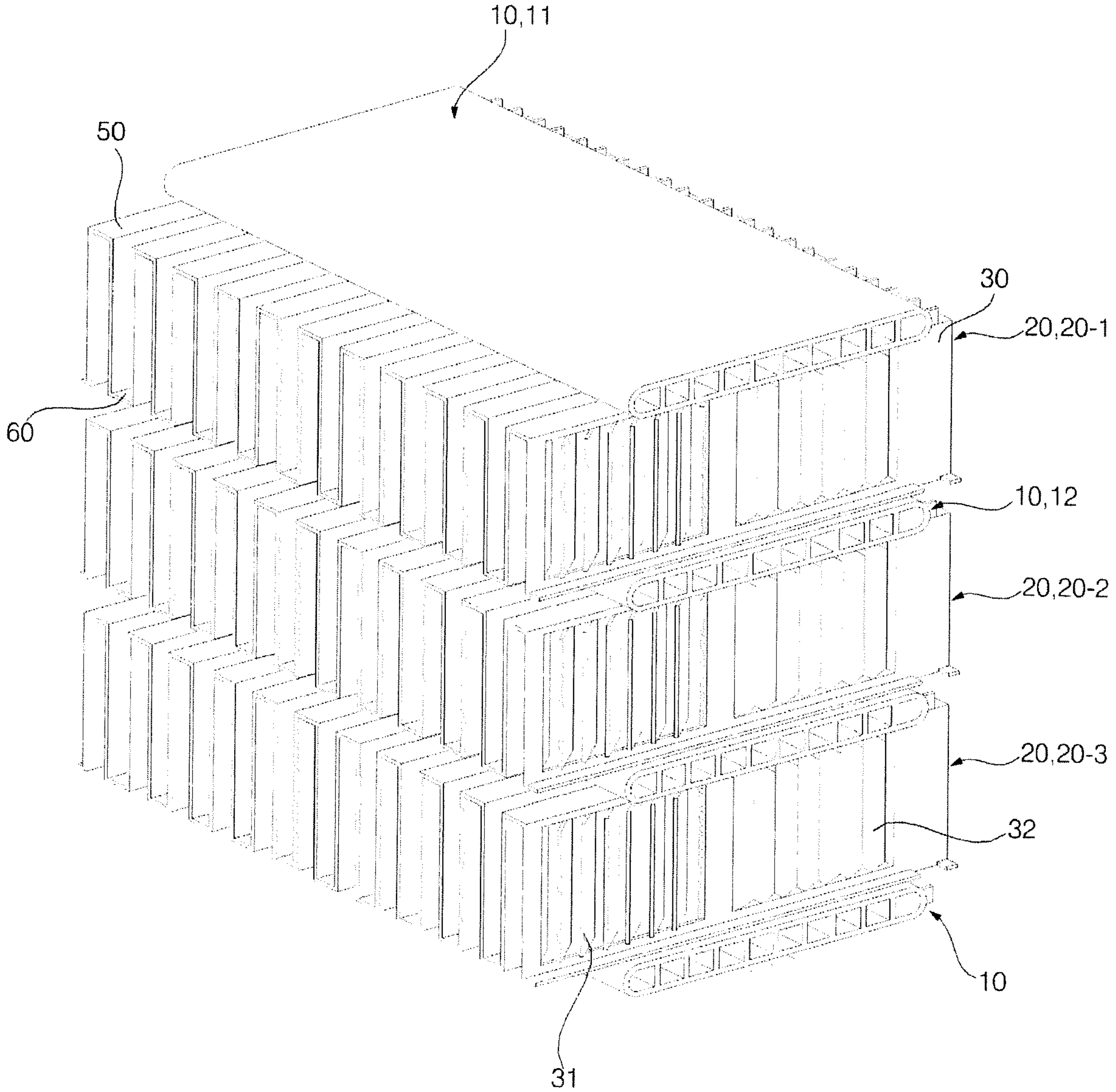

FIG.4

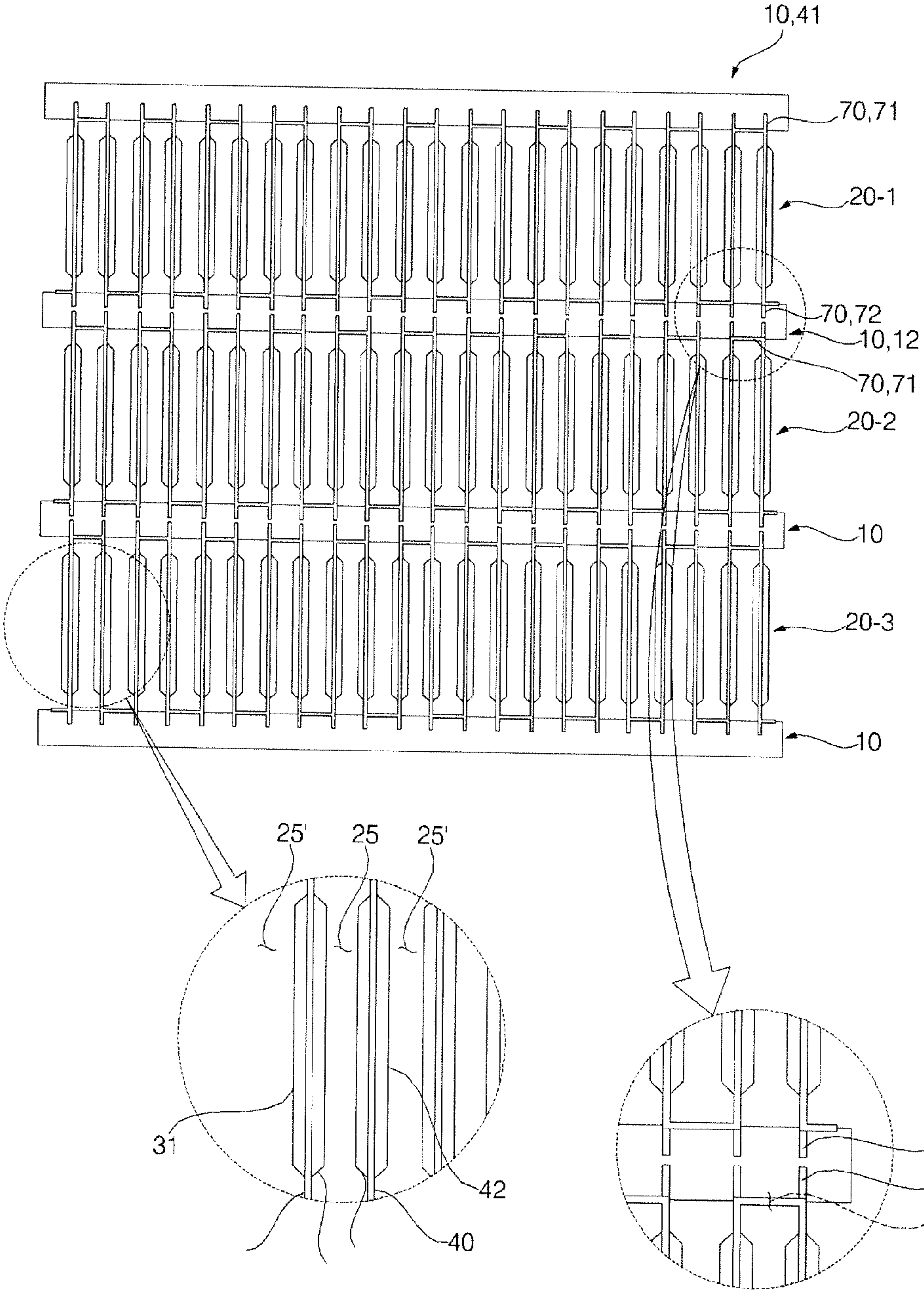
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FIG.5

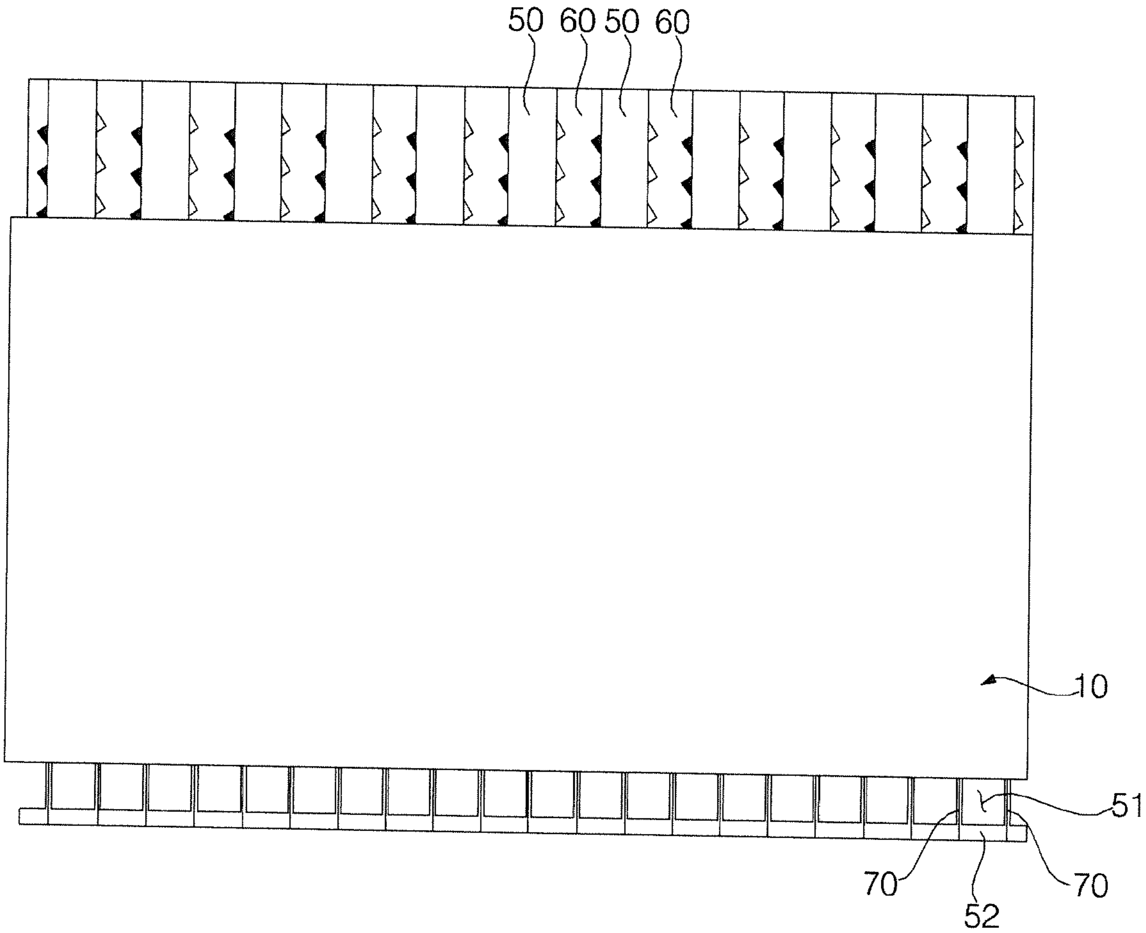


FIG.6

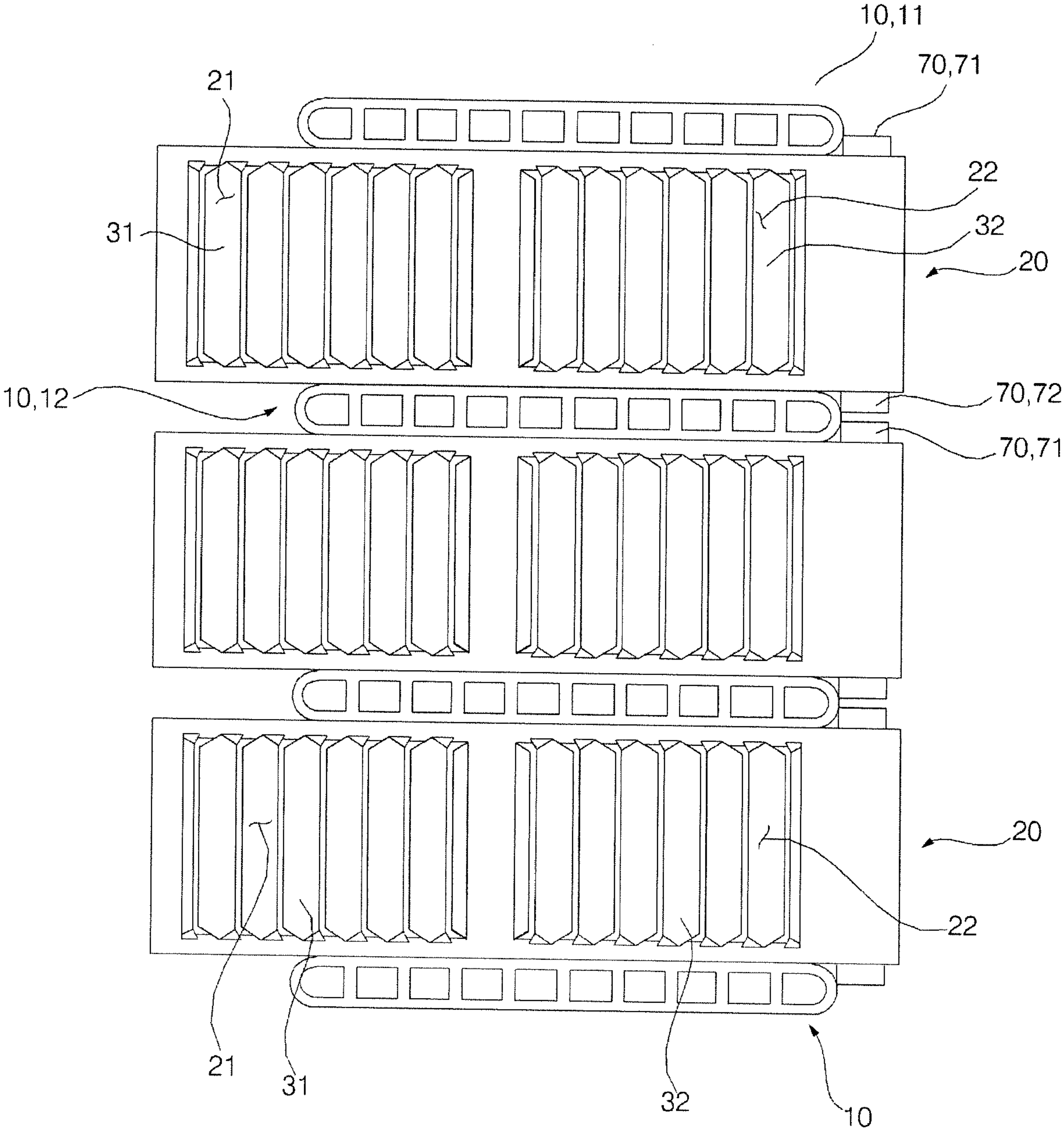


FIG.7

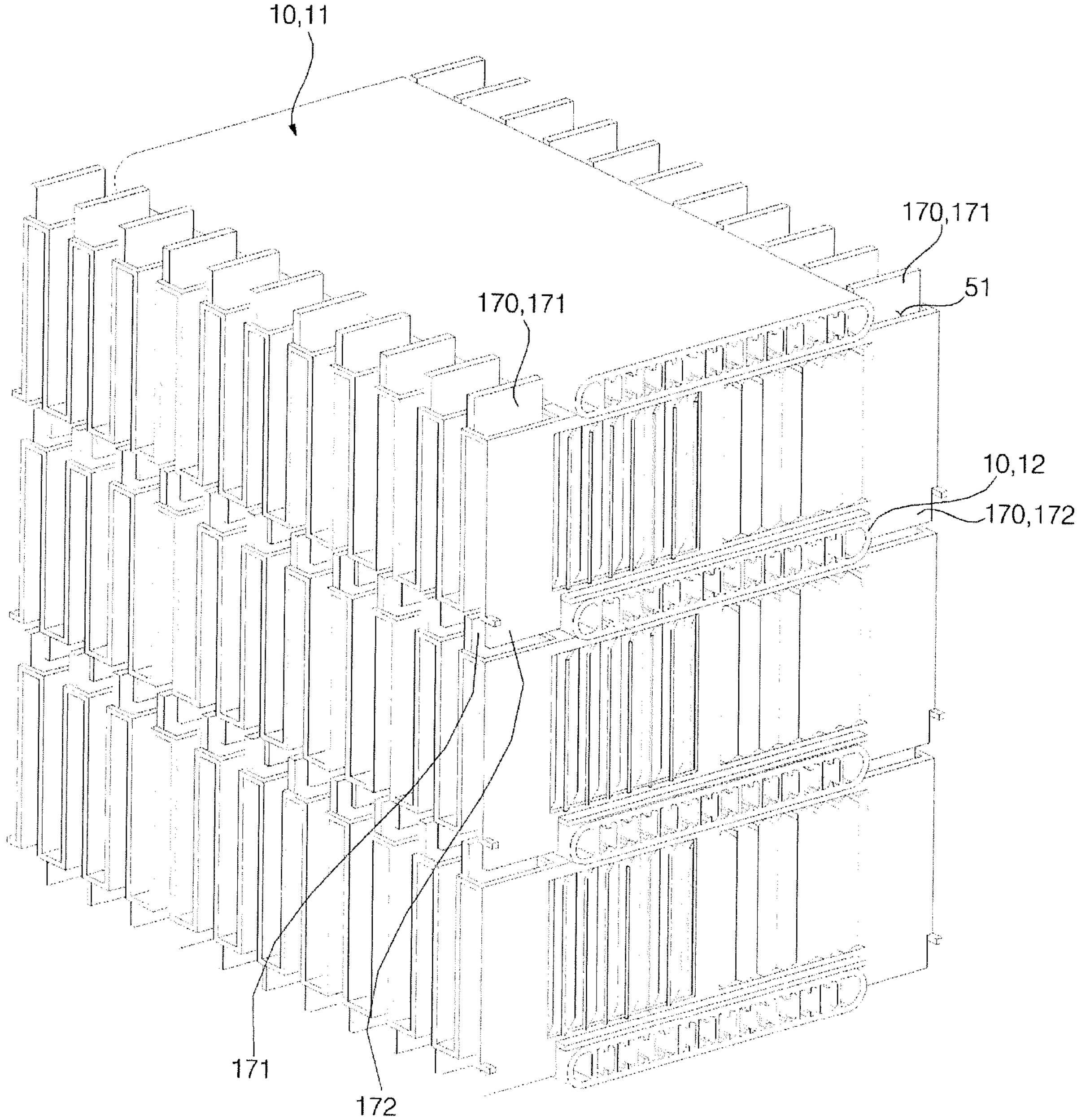


FIG.8

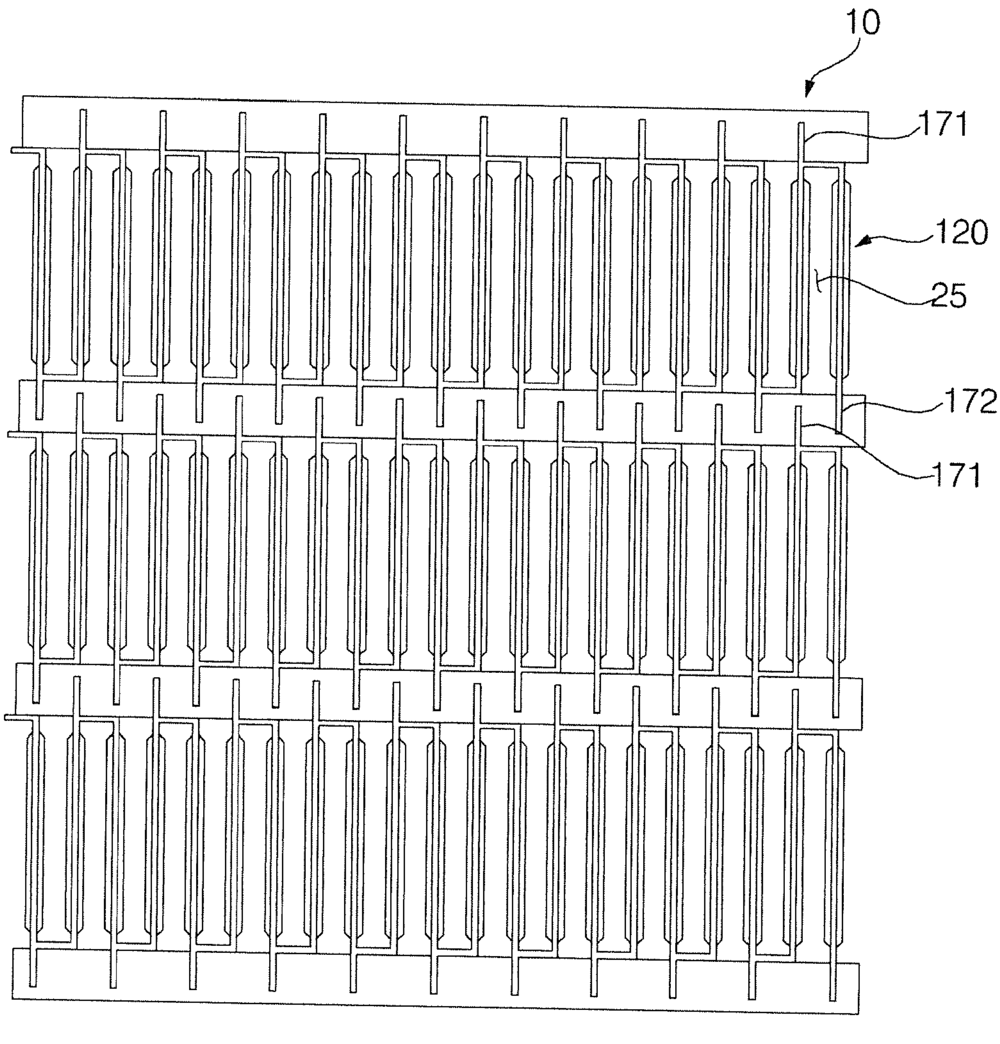


FIG.9

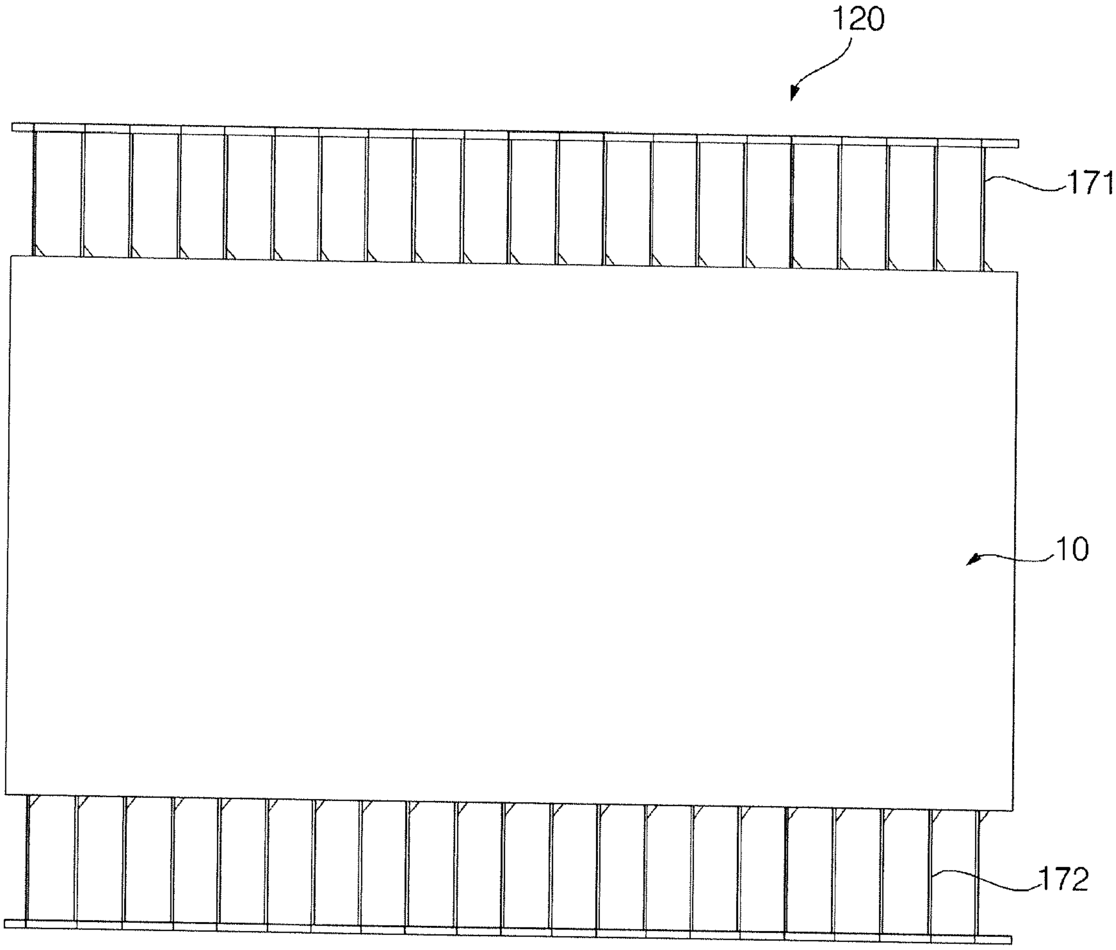
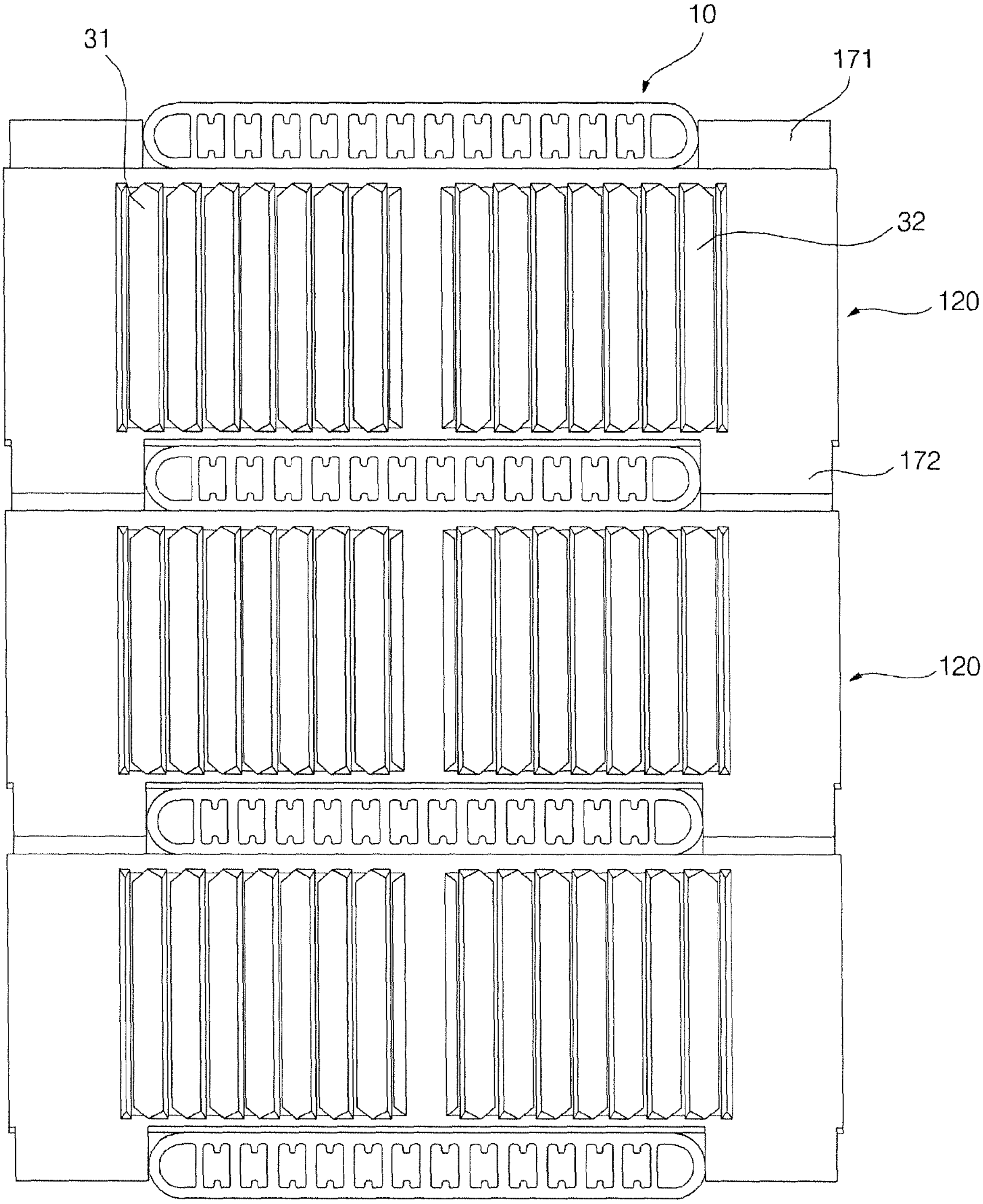


FIG.10



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EUROPEAN SEARCH REPORT

Application Number
EP 16 18 2173

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 653 819 A1 (DAIKIN IND LTD [JP]) 23 October 2013 (2013-10-23) * page 1 - page 13; figures 4,5,9,12 * -----	1-12	INV. F28D1/053 F28F1/12 F28F17/00 F28B9/08
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F28D
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The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
Munich	22 November 2016	Bloch, Gregor

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 16 18 2173

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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