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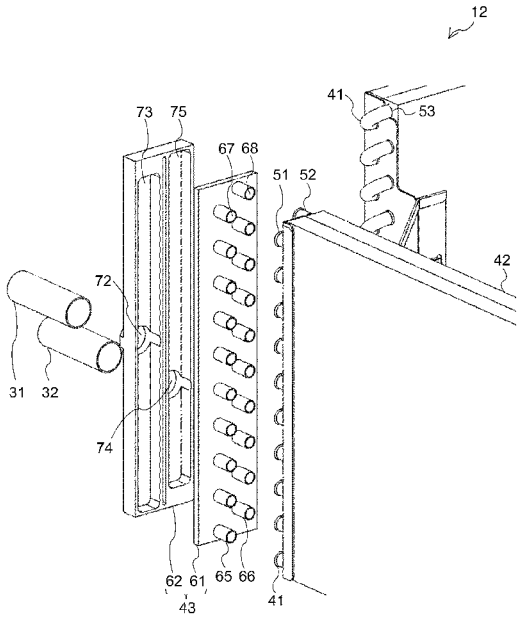
(54) **Title:** INDOOR HEAT EXCHANGER AND AIR-CONDITIONER INDOOR UNIT

(54) 発明の名称： 室内熱交換器、及び空気調和機の室内機

[図4]



(57) **Abstract:** Provided is an indoor heat exchanger including: a plurality of heat transfer tubes that have channels inside which water serving as a heat medium flows; and a header that distributes, to the plurality of heat transfer tubes, water flowing from an inlet pipe connected to a heat source side. The header has: a first plate-like member that has a plurality of start-end openings communicating with start ends of the plurality of heat transfer tubes; and a second plate-like member that has an inflow port, through which water flows from the inlet pipe, and a distribution depression, which is formed so as to face the plurality of start-end openings and which communicates with the inflow port, and that is joined with the first plate-like member.

(57) 要約：室内熱交換器は、内部に熱媒体の水が流れる流路を有する複数の伝熱管と、熱源側に接続された流入管から流入した水を複数の伝熱管に分配するヘッダと、を備え、ヘッダは、複数の伝熱管の始端と連通する複数の始端開口を有する第1の板状部材と、流入管から水が流入する流入口と、複数の始端開口に対向して形成され、流入口と連通する分配窪みと、を有し、第1の板状部材と接合された第2の板状部材と、を有する。

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[続葉有]

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一　国際調査報告(条約第21条(3))

Technical Field

[0001]

The present disclosure relates to an indoor heat exchanger that uses water as a heat medium, and also to an indoor unit that is included in an air-conditioning apparatus and includes the indoor heat exchanger.

Background

[0002]

In the past, an indoor heat exchanger provided with a plurality of flow passages has been known. Patent Literature 1 discloses an indoor heat exchanger provided with a header that includes a header body formed in the shape of a circular tube and a plurality of branch tubes that branch off from the header body in association with respective flow passages.

Patent Literature

[0003]

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2014-215011

[0004]

In general, in the case where water is used as a heat medium that flows in an indoor heat exchanger, and flows at a high velocity, heat transfer tubes of the indoor heat exchanger corrode. In view of this point, an indoor heat exchanger is formed to have a larger number of flow passages in order to reduce the flow velocity of water. However, if the indoor heat exchanger in Patent Literature 1 is made to have a larger number of flow passages, the number of branch tubes would be increased, and the size of the entire header would also be increased. In addition, in the indoor heat exchanger of Patent Literature 1, a header body is also formed to have a larger diameter in order to reduce the flow velocity of water. However, in the case where the header body is formed to have a larger diameter, the size of the entire header is also increased. If the size of the header is increased, it is necessary to increase the size of a housing that accommodates the indoor heat exchanger therein.

[0005]

The present disclosure is applied in view of the above problems, and relates to an indoor heat exchanger that uses water as a heat medium and that eliminates the need to increase the size of a housing of an indoor unit, while preventing corrosion of heat transfer tubes, and also to an indoor unit that is included in an air-conditioning apparatus and is provided with the indoor heat exchanger. It is desired to address or alleviate one or more disadvantages or limitations of the prior art, or to at least provide a useful alternative.

Summary

[0006]

An indoor heat exchanger according to an embodiment of the present disclosure includes: a plurality of heat transfer tubes including respective flow passages therein through which water flows as a heat medium; and a header configured to distribute water that flows into the header from an inflow tube connected to a heat source side to the plurality of heat transfer tubes, and cause water that collects from the plurality of heat transfer tubes to flow out to an outflow tube to the heat source side. The header includes: a first plate-like member; and a second plate-like member, wherein the first plate-like member includes

a plurality of start-portion openings that communicate with respective start portions of the plurality of heat transfer tubes, and a plurality of end-portion openings that communicate respective end portions of the plurality of heat transfer tubes, and

wherein the second plate-like member includes an inlet port through which water flows from the inflow tube into the second plate-like member, a distribution recess that is formed opposite to the plurality of start-portion openings and communicates with the inlet port, an outlet port through which water flows out to the outflow tube, and

a collection recess that is formed opposite to the plurality of end-portion openings and communicates with the outlet port.

[0007]

According to an embodiment of the present disclosure, the header of the indoor heat exchanger includes the first plate-like member. Because of provision of the first plate-like member, it is possible to form the header such that the header has a larger

number of passages, by making the first plate-like member have a larger number of start-portion openings, without increasing the size of the first plate-like member. Therefore, even when the indoor heat exchanger uses water as a heat medium, it is possible to reduce the probability with which the heat transfer tubes will corrode, without increasing the size of the housing of the indoor unit.

Brief Description of Drawings

[0008]

One or more embodiments of the present invention are hereinafter described, by way of example only, with reference to the accompanying drawings in which:

[Fig. 1] Fig. 1 is a top perspective view illustrating an indoor unit 1 according to Embodiment 1.

[Fig. 2] Fig. 2 is a perspective view illustrating an indoor heat exchanger 12 according to Embodiment 1.

[Fig. 3] Fig. 3 is an exploded perspective view illustrating the indoor heat exchanger 12 according to Embodiment 1.

[Fig. 4] Fig. 4 is another exploded perspective view illustrating the indoor heat exchanger 12 according to Embodiment 1.

[Fig. 5] Fig. 5 is an exploded perspective view illustrating an indoor heat exchanger 112 according to Embodiment 2.

[Fig. 6] Fig. 6 is another exploded perspective view illustrating the indoor heat exchanger 112 according to Embodiment 2.

[Fig. 7] Fig. 7 is a side view illustrating the indoor heat exchanger 112 according to Embodiment 2.

[Fig. 8] Fig. 8 is a sectional view illustrating the indoor heat exchanger 112 according to Embodiment 2.

[Fig. 9] Fig. 9 is another sectional view illustrating the indoor heat exchanger 112 according to Embodiment 2.

[Fig. 10] Fig. 10 is still another sectional view illustrating the indoor heat exchanger 112 according to Embodiment 2.

Detailed Description

[0009]

Embodiment 1

An indoor unit 1 of an air-conditioning apparatus according to Embodiment 1 will be described. Regarding Embodiment 1, the following description is made by referring to by way of example the case where the indoor unit 1 of an air-conditioning apparatus is attached to a ceiling and used as a variable refrigerant flow (VRF) system. The indoor unit 1 is connected to a relay unit by a heat medium pipe in which water flows as a heat medium. The relay unit supplies the indoor unit 1 with heating energy or cooling energy that is generated by a heat source unit.

[0010]

Fig. 1 is a top perspective view illustrating the indoor unit 1 according to Embodiment 1. In the following description, terms related to directions such as "up" and "down" are used with reference to the orientation of the indoor unit 1 which is installed in a usable state. The indoor unit 1 sucks air in a room from an air inlet (not illustrated) formed at the center of the indoor unit 1, and blows conditioned air from air outlets (not illustrated) formed on four sides around the air inlet. As illustrated in Fig. 1, the indoor unit 1 includes a housing 11, an indoor heat exchanger 12, and an indoor fan 13.

[0011]

The housing 11 includes a casing 21 and an inner cover 22. The casing 21 is a box that is open on its top side and has a bottom surface having a substantially square shape. The casing 21 forms the outer shell of the indoor unit 1. The casing 21 is made of, for example, metal or resin. The casing 21 is fixed to a ceiling. In the casing 21, the air inlet and the air outlets are formed. The inner cover 22 is a box made of resin and provided on the inner side of the casing 21 to reinforce the casing 21.

[0012]

The indoor heat exchanger 12 is provided in the casing 21 along four sides of the casing 21. An inflow tube 31 and an outflow tube 32 are connected to the indoor heat exchanger 12. The inflow tube 31 is connected to a heat medium pipe, and allows water that flows from the relay unit to flow into the indoor heat exchanger 12. The

outflow tube 32 is connected to the heat medium pipe, and allows water to flow out from the indoor heat exchanger 12 to the relay unit side. The indoor heat exchanger 12 causes heat exchange to be performed between water that flows in the indoor heat exchanger 12 and an indoor air to adjust the temperature of the room air. The configuration of the indoor heat exchanger 12 will be described later in detail.

[0013]

The indoor fan 13 is provided at the center of the housing 11, and is surrounded by the indoor heat exchanger 12. The indoor fan 13 is, for example, a turbo fan, and has a rotation shaft that extends in an up-down direction. When being rotated, the indoor fan 13 sends air in various directions to promote heat exchange at the indoor heat exchanger 12.

[0014]

Fig. 2 is a perspective view illustrating the indoor heat exchanger 12 according to Embodiment 1. As illustrated in Fig. 2, the indoor heat exchanger 12 includes heat transfer tubes 41, fins 42, and a header 43. It should be noted that each of the figures in the present disclosure schematically illustrates a plurality of fins 42 collectively.

[0015]

Fig. 3 is an exploded perspective view illustrating the indoor heat exchanger 12 according to Embodiment 1. Fig. 4 is another exploded perspective view illustrating the indoor heat exchanger 12 according to Embodiment 1. Figs. 3 and 4 more enlargedly illustrate the indoor heat exchanger 12 which is in an exploded state than Fig. 2. In addition, Figs. 3 and 4 illustrate the indoor heat exchanger 12 as viewed from different angles. As illustrated in Figs. 3 and 4, the indoor heat exchanger 12 includes a plurality of heat transfer tubes 41. For example, the heat transfer tubes 41 are made of copper, and has respective flow passages in each of which a heat medium flows. As described above, water is used as the heat medium. In the indoor heat exchanger 12 of Embodiment 1, 10 heat transfer tubes 41 are used, and accordingly include 10 flow passages therein. Each of the plurality of heat transfer tubes 41 includes a start portion 51 and an end portion 52 that are connected to the header 43. The heat transfer tube 41 is turned back at a hair-pin portion 53. It should be noted

that a flow passage extending from the start portion 51 of the heat transfer tube 41 to the hair-pin portion 53 will be referred to as "outward passage," and a flow passage extending from the hair-pin portion 53 to the end portion 52 will be referred to as "return passage." The plurality of heat transfer tubes 41 are bent in such a manner as to be formed in the shape of a substantially square as a whole. The header 43 and the hair-pin portions 53 are located at the same corner of this square.

[0016]

In Embodiment 1, the hair-pin portions 53 of all the heat transfer tubes 41 are arranged such that the heat transfer tubes 41 are turned back obliquely upward from the outward passage toward the return passage. In each of the heat transfer tubes 41, the outward passage and the return passage extend in parallel with each other. Thus, the heat transfer tube 41 is connected to the header 43 such that the end portion 52 is located obliquely above the start portion 51. The heat transfer tubes 41 extend in parallel with each other and are arranged in the up-down direction such that the positions of the start portions 51 in a lateral direction coincide with each other and the positions of the end portions 52 in the lateral direction coincide with each other. That is, in the header 43, the start portions 51 are arranged in the up-down direction as a plurality of lines of start portions 51 and the end portions 52 are arranged in the up-down direction as a plurality of lines of end portions 52, and the plurality of lines of start portions 51 and the plurality of lines of end portions 52 are alternately arranged.

[0017]

A plurality of fins 42 are provided for the plurality of heat transfer tubes 41. For example, the fins 42 are plate fins through which the heat transfer tubes 41 are inserted. The plurality of fins 42 are arranged in the direction in which the heat transfer tubes 41 extend. The fins 42 promotes heat exchange between air and water flowing in the heat transfer tubes 41.

[0018]

The inflow tube 31 and the outflow tube 32 are connected to the header 43. The header 43 distributes water that flows from the inflow tube 31 to the start portions 51. The header 43 collects water that flows from the end portions 52 and cause the

collected water to flow to the outflow tube 32. The flow of water in the indoor heat exchanger 12 will be described later in detail.

[0019]

The header 43 includes a first plate-like member 61 and a second plate-like member 62. The first plate-like member 61 and the second plate-like member 62 are joined together such that their surfaces face each other. The first plate-like member 61 has a substantially rectangular shape, and is made of a dezincing resistant brass alloy. The first plate-like member 61 has a width and a height that are substantially equivalent to those of the fins 42 as viewed in the extending direction of the inflow tube 31 and the outflow tube 32. The first plate-like member 61 includes first insertion portions 65 and second insertion portions 66.

[0020]

Each of the first insertion portions 65 has a circular tubular shape and a start-portion opening 67 formed at the center of a start portion of the first insertion portion 65. The first insertion portions 65 are provided on one surface of the first plate-like member 61 that is located opposite to the other surface thereof that faces the second plate-like member 62. The start-portion opening 67 extends through the first insertion portion 65 from a tip end thereof to the above other surface of the first plate-like member 61 that faces the second plate-like member 62. The first insertion portions 65 are provided at positions associated with the respective start portions 51 of the heat transfer tubes 41. The first insertion portions 65 are inserted into the respective start portions 51 of the heat transfer tubes 41, and fixed to the start portions 51 by brazing. As a result, the outward passages of the heat transfer tubes 41 communicate with the respective start-portion openings 67.

[0021]

Each of the second insertion portions 66 has a circular tubular shape and an end-portion opening 68 formed at the center of an end portion of the end-portion opening 68. The second insertion portions 66 are provided on the above one surface of the first plate-like member 61 that is located opposite to the above other surface thereof that faces the second plate-like member 62. The end-portion opening 68 extends through

the second insertion portion 66 from a tip end thereof to the other surface of the first plate-like member 61 that faces the second plate-like member 62. The second insertion portions 66 are provided at positions associated with the respective end portions 52 of the heat transfer tubes 41. The first insertion portions 65 are inserted into the respective end portions 52 of the heat transfer tubes 41, and fixed to the end portions 52 by brazing. As a result, the return passages of the heat transfer tubes 41 communicate with the respective end-portion opening 68.

[0022]

The number of the first insertion portions 65 and the number of the second insertion portions 66, that is, the number of the start-portion openings 67 and the number of the end-portion openings 68, are appropriately adjusted such that each of these numbers is equal to the number of the heat transfer tubes 41, that is, the number of flow passages. In the indoor heat exchanger 12, in the case of increasing the number of flow passages to reduce the flow velocity of water, it surfaces to change the number of the start-portion openings 67 and the number of the end-portion openings 68; that is, it is not necessary to increase the size of the first plate-like member 61.

[0023]

The second plate-like member 62 has a substantially rectangular shape, and is made of a dezincing resistant brass alloy. The second plate-like member 62 has a width and a height that are substantially equivalent to those of the fins 42 as viewed in the extending direction of the inflow tube 31 and the outflow tube 32. The inflow tube 31 and the outflow tube 32 are connected to the second plate-like member 62. In the second plate-like member 62, an inlet port 72, a distribution recess 73, an outlet port 74, and a collection recess 75 are formed. The inlet port 72 is formed in one surface of the second plate-like member 62 that is located opposite to the other surface thereof that faces the first plate-like member 61. The inlet port 72 communicates with the flow passage of the inflow tube 31. The distribution recess 73 is formed in the above other surface of the second plate-like member 62 that faces the first plate-like member 61, and is opposite to the start-portion openings 67. The distribution recess 73 communicates with the inlet port 72. The distribution recess 73 distributes water that

passes through the inflow tube 31 to the outward passages of the heat transfer tubes 41.

[0024]

The outlet port 74 is formed in the above one surface of the second plate-like member 62 that is located opposite to the first plate-like member 61. The outlet port 74 communicates with the flow passage of the outflow tube 32. The collection recess 75 is formed in the above other surface of the second plate-like member 62 that faces the first plate-like member 61, and is opposite to the end-portion openings 68. The collection recess 75 communicates with the outlet port 74. The collection recess 75 collects water that passes through the return passages of the heat transfer tubes 41 and allows the collected water to flow to the outflow tube 32.

[0025]

The first plate-like member 61 and the second plate-like member 62 are joined together by brazing, at edge portions of their surfaces facing each other. The edge portion of the surface of the first plate-like member 61 that faces the second plate-like member 62 is a region located outward of a region where the start-portion openings 67 and the end-portion openings 68 are formed. The edge portion of the surface of the second plate-like member 62 that faces the first plate-like member 61 is a region located outward of a region where the distribution recess 73 and the collection recess 75 are formed.

[0026]

The flow of water in the indoor heat exchanger 12 of Embodiment 1 will be described. First, water that has flowed from the inflow tube 31 into the indoor heat exchanger 12 passes through the inlet port 72, and flows to the distribution recess 73 of the second plate-like member 62. The water that has flowed to the distribution recess 73 passes through the start-portion openings 67 of the first plate-like member 61, and is then distributed to the outward passages of the heat transfer tubes 41. The water that flows through the outward passages of the heat transfer tubes 41 turns back at the hair-pin portions 53 and flows to the return passages of the heat transfer tubes 41. The water that flows through the return passages of the heat transfer tubes 41 passes

through the end-portion openings 68 of the first plate-like member 61, collects at the collection recess 75 of the second plate-like member 62, passes through the outlet port 74, and then flows out to the outflow tube 32.

[0027]

In Embodiment 1, the header 43 of the indoor heat exchanger 12 includes the first plate-like member 61. Thus, it is possible to make the header 43 have a larger number of flow passages by increasing the number of the start-portion openings 67 of the first plate-like member 61, without increasing the size of the first plate-like member 61. Therefore, even when the indoor heat exchanger 12 uses water as a heat medium, it is possible to reduce the probability with which the heat transfer tubes 41 will be corroded, and it is not necessary to increase the size of the housing 11 of the indoor unit 1.

[0028]

Furthermore, the header 43 of Embodiment 1 is formed to include the first plate-like member 61 and the second plate-like member 62 that are stacked together. Thus, the header 43 of Embodiment 1 has a smaller thickness than a header provided with a plurality of branch tubes.

[0029]

In addition, in Embodiment 1, even in the case where general-purpose copper tubes are used as the heat transfer tubes 41, it is also possible to reduce the probability with which the heat transfer tubes 41 will be corroded.

[0030]

In Embodiment 1, the first plate-like member 61 and the second plate-like member 62 are made of a dezincing resistant brass alloy. It is therefore possible to reduce the probability with which the first plate-like member 61 and the second plate-like member 62 will be subjected to dezincification corrosion.

[0031]

According to Embodiment 1, the header 43 has both a distribution function and a collection function. Therefore, the first plate-like member 61 and the second plate-like member 62 can be brazed together with a small amount of brazing material, as

compared with the case where one of separate components is made to have a distribution function and the other is made to have a collection function.

[0032]

Embodiment 2

Fig. 5 is an exploded perspective view illustrating an indoor heat exchanger 112 according to Embodiment 2. Fig. 6 is another exploded perspective view illustrating the indoor heat exchanger 112 according to Embodiment 2. Figs. 5 and 6 illustrate an exploded state of the indoor heat exchanger 112. Figs. 5 and 6 illustrate the indoor heat exchanger 112 from different angles. As illustrated in Figs. 5 and 6, in the indoor heat exchanger 112 according to Embodiment 2, a header 143 includes a third plate-like member 181. In this regard, Embodiment 2 is different from Embodiment 1. Regarding Embodiment 2, components that are the same as those in Embodiment 1 are denoted by the same reference signs, and their descriptions will thus be omitted. The following description is made by referring mainly to the differences between Embodiments 1 and 2.

[0033]

In Embodiment 2, the hair-pin portions 53 of the upper four of the heat transfer tubes 41 are turned back directly upward from the outward passages toward the return passages. Thus, these upper four heat transfer tubes 41 are connected to the header 43 such that the end portions 52 are located directly above the respective start portions 51. The hair-pin portions 53 of the lower six of the heat transfer tubes 41 are turned back obliquely upward from the outward passages toward the return passages as in Embodiment 1. Thus, these upper six heat transfer tubes 41 are connected to the header 43 such that the end portions 52 are located obliquely above the respective start portions 51.

[0034]

The third plate-like member 181 is provided between the first plate-like member 61 and the second plate-like member 62 to form the flow passages. The third plate-like member 181 has a substantially rectangular shape, and is made of a dezincing resistant brass alloy. In the third plate-like member 181, distribution adjustment

openings 191, collection adjustment openings 192, and adjustment recesses 193 are formed.

[0035]

More specifically, the distribution adjustment openings 191 are formed in the third plate-like member 181. The distribution adjustment openings 191 are formed in such a manner as to face the start-portion openings 67, and extend through the third plate-like member 181 from one surface of the third plate-like member 181 that faces the first plate-like member 61 to the other surface thereof that faces the second plate-like member 62. Each of the distribution adjustment openings 191 causes an associated one of the start-portion openings 67 to communicate with the distribution recess 73. The collection adjustment openings 192 are formed in the third plate-like member 181. The collection adjustment openings 192 are formed in such a manner as to face the end-portion openings 68, and extend through the third plate-like member 181 from one surface of the third plate-like member 181 that faces the first plate-like member 61 to the other surface of the third plate-like member 181 that faces the second plate-like member 62. Each of the collection adjustment openings 192 causes an associated one of the end-portion openings 68 to communicate with the collection recess 75.

[0036]

The number of the adjustment recesses 193 is two. The two adjustment recesses 193 are formed in one surface of the third plate-like member 181 that face the first plate-like member 61. At the above one surface of the third plate-like member 181 that faces the first plate-like member 61, each of the adjustment recesses 193 faces an end-portion opening 68 associated with the end portion 52 of one of associated two heat transfer tubes 41 that are turned back in the up-down direction, and also faces an start-portion opening 67 associated with the start portion 51 of the other of the above two heat transfer tube 41. The adjustment recesses 193 do not reach the other surface of the third plate-like member 181 that faces the second plate-like member 62. Each of the adjustment recesses 193 causes the end-portion opening 68 associated with the end portion 52 of one of the associated two heat transfer tubes 41 and the start-portion opening 67 associated with the start portion 51 of the other of the two heat

transfer tube 41 to communicate with each other; that is, the adjustment recess 193 causes the end-portion opening 68 and the start-portion opening 67 which the adjustment recess 193 face to communicate with each other. That is, the adjustment recesses 193 are intended to cause water to flow from the return passage of one of the associated heat transfer tubes 41 to the outward passage of the other heat transfer tube 41. In Embodiment 2, because of formation of the two adjustment recesses 193, in two sets of two heat transfer tubes 41 of 10 heat transfer tubes 41, water continuously flows without collecting therein. Thus, in the indoor heat exchanger 112, eight flow passages are present.

[0037]

The first plate-like member 61 and the third plate-like member 181 are fixed together by brazing, at edge portions of their surfaces that face each other. In this brazing, the edge portion of that surface of the third plate-like member 181 that faces the first plate-like member 61 is a region of the third plate-like member 181 that is located outward of a region thereof where the distribution adjustment openings 191, the collection adjustment openings 192, and the adjustment recesses 193 are formed. Similarly, the second plate-like member 62 and the third plate-like member 181 are fixed together by brazing, at edge portions of their surfaces that face each other. In this brazing, the edge portion of the above surface of the third plate-like member 181 that faces the second plate-like member 62 is a region of the third plate-like member 181 that is located outward of a region thereof where the distribution adjustment openings 191 and the collection adjustment openings 192 are formed.

[0038]

The header 143 has distribution part and collection part that are formed integrally with each other. Thus, the entire adjustment recesses 193 of the third plate-like member 181 face the first plate-like member 61. Therefore, the third plate-like member 181 causes the outward passage and the return passage of each of the heat transfer tubes 41 to communicate with each other through the adjustment recess 193, and thus can form the flow passages.

[0039]

Fig. 7 is a side view illustrating the indoor heat exchanger 112 according to Embodiment 2. Fig. 8 is a sectional view illustrating the indoor heat exchanger 112 according to Embodiment 2. Fig. 9 is another sectional view illustrating the indoor heat exchanger 112 according to Embodiment 2. Fig. 10 is still another sectional view illustrating the indoor heat exchanger 112 according to Embodiment 2. To be more specific, Fig. 8 is a sectional view of the header 143 of the indoor heat exchanger 112 as illustrated in Fig. 7 that is taken along line A-A; Fig. 9 is a sectional view of the header 143 of the indoor heat exchanger 112 as illustrated in Fig. 7 that is taken along line B-B; and Fig. 10 is a sectional view of the header 143 of the indoor heat exchanger 112 as illustrated in Fig. 7 that is taken along line C-C. In Figs. 8 to 10, sold arrows indicate flows of water. Particularly, it should be noted that the arrows denoted by the same reference signs in Figs. 8 and 9 indicate a continuous flow of water.

[0040]

It will be described with reference to Figs. 8 to 10 how water flows in the indoor heat exchanger 112. First, as illustrated in Fig. 8, water that has flowed from the inflow tube 31 passes through the inlet port 72, and flows to the distribution recess 73 of the second plate-like member 62. The water (F1 to F8) that has flowed to the distribution recess 73 passes through the distribution adjustment openings 191 of the third plate-like member 181 and the start-portion openings 67 of the first plate-like member 61, and is then distributed to the outward passages of the heat transfer tubes 41. As illustrated in Fig. 9, the water (F1 to F8) that flows through the outward passages of the heat transfer tubes 41 turns back at the hair-pin portions 53 and flows to the return passages of the plurality of heat transfer tubes 41. The water (F1 to F6) that has flowed through the return passages of lower six of the heat transfer tubes 41 passes through the end-portion openings 68 of the first plate-like member 61 and the collection adjustment openings 192 of the third plate-like member 181, collects at the collection recess 75 of the second plate-like member 62, passes through the outlet port 74, and then flows out to the outflow tube 32.

[0041]

As illustrated in Fig. 8, the water (F7 and F8) that has flowed through the return passages of upper four of the heat transfer tubes 41 passes through the end-portion openings 68 of the first plate-like member 61, and thereafter turns back at the adjustment recesses 193. As illustrated in Fig. 9, the water (R1 and R2) that has turned back at the adjustment recesses 193 passes through the start-portion openings 67 of the first plate-like member 61, and re-flows through the outward passages of the heat transfer tubes 41. Thereafter, the water (E1 and E2) that flows through the outward passages of the heat transfer tubes 41 turns back at the hair-pin portions 53 and flows to the return passages of the heat transfer tubes 41. The water (E1 and E2) that has flowed through the return passages passes through the end-portion openings 68 of the first plate-like member 61 and the collection adjustment openings 192 of the third plate-like member 181, then collects at the collection recess 75 of the second plate-like member 62, passes through the outlet port 74, and then flows out to the outflow tube 32.

[0042]

In general, as the number of flow passages is excessively increased, the flow velocity of water is excessively decreased. If the flow velocity of water is excessively decreased, time for which oxygen contained in the water contacts the heat transfer tubes 41 is increased, and there is thus a possibility that the heat transfer tubes 41 will corrode. In Embodiment 2, the indoor heat exchanger 112 includes the third plate-like member 181. Thus, in the indoor heat exchanger 112, it is possible to reduce the number of flow passages in order to prevent the flow velocity of water from being excessively decreased. Therefore, the indoor heat exchanger 112 can reduce the probability with which the heat transfer tubes 41 will corrode.

[0043]

Furthermore, even in the case where an indoor heat exchanger in which refrigerant flows is used as the indoor heat exchanger 112 of Embodiment 2, and water is used in place of refrigerant, it is possible to adjust the number of flow passages simply by providing the third plate-like member 181, and reduce the probability with which the heat transfer tubes 41 will corrode.

[0044]

In addition, according to Embodiment 2, the header 43 has both a distribution function and a collection function. Thus, the first plate-like member 61 and the third plate-like member 181 are brazed together, and the second plate-like member 62 and the third plate-like member 181 are brazed together, with a smaller amount of brazing material than in the case where one of separate components is made to have a distribution function and the other is made to have a collection function.

[0045]

Modification 1 of Embodiment 2

In Modification 1 of Embodiment 2, the second plate-like member 62 and the third plate-like member 181 are made of resin. The second plate-like member 62 and the third plate-like member 181 are welded together using ultrasonic waves or by other ways. The first plate-like member 61 and the second plate-like member 62 are fastened together by screws, with the third plate-like member 181 interposed between the first plate-like member 61 and the second plate-like member 62. In such a manner, the header 143 of the indoor heat exchanger 112 is manufactured without using a large-sized blazing machine.

[0046]

Although the indoor heat exchangers of the embodiments are described above, the descriptions concerning the indoor heat exchangers of the present disclosure are not limiting, and the indoor heat exchanges can be variously modified.

[0047]

For example, the indoor heat exchanger 12 of Embodiment 1 may be applied not only to the indoor unit 1 for use in the VRF system, but also to an indoor unit that is attached to a wall or other portions of a room in a house to blow air from the front side of the housing 11.

[0048]

Regarding Embodiment 1, it is described above by way of example that the number of the heat transfer tubes 41 is 10 and the number of flow passages is also 10. However, it suffices that an adequate flow velocity of water is maintained to prevent the

heat transfer tubes 41 from being corroded by water, and the number of heat transfer tubes 41 and that of flow passages may be two to nine or eleven or more. Furthermore, the heat transfer tubes 41 may be provided such that three lines or more of start portions 51 and end portions 52 are arranged in the header 43.

[0049]

The header 43 may be a header including the distribution part only.

[0050]

The location where the adjustment recesses 193 are formed in the third plate-like member 181 of Embodiment 2, the number of the adjustment recesses 193, and other factors may also be appropriately adjusted from the viewpoint of maintaining an adequate flow velocity of water. Furthermore, in addition to the third plate-like member 181, a plate-like member that defines the flow passages may be provided between the first plate-like member 61 and the second plate-like member 62.

[0051]

In Modification 1 of Embodiment 2, the second plate-like member 62 and the third plate-like member 181 are made of resin. However, either the second plate-like member 62 or the third plate-like member 181 in Embodiment 2 may be made of resin. Furthermore, the second plate-like member 62 in Embodiment 1 may be made of resin. In addition, as described above, a plate-like member provided between the first plate-like member 61 and the second plate-like member 62 in addition to the third plate-like member 181 may be made of resin.

[0051a]

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

[0051b]

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an

acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

Reference Signs List

[0052]

1: indoor unit, 11: housing, 12: indoor heat exchanger, 13: indoor fan, 21: casing, 22: inner cover, 31: inflow tube, 32: outflow tube, 41: heat transfer tube, 42: fin, 43: header, 51: start portion, 52: end portion, 53: hair-pin portion, 61: first plate-like member, 62: second plate-like member, 65: first insertion portion, 66: second insertion portion, 67: start-portion opening, 68: end-portion opening, 72: inlet port, 73: distribution recess, 74: outlet port, 75: collection recess, 112: indoor heat exchanger, 181: third plate-like member, 191: distribution adjustment opening, 192: collection adjustment opening, 193: adjustment recess

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

[Claim 1]

An indoor heat exchanger comprising:

a plurality of heat transfer tubes including respective flow passages therein through which water flows as a heat medium; and

a header configured to distribute water that flows into the header from an inflow tube connected to a heat source side to the plurality of heat transfer tubes, and cause water that collects from the plurality of heat transfer tubes to flow out to an outflow tube to the heat source side,

wherein the header includes a first plate-like member, and a second plate-like member joined to the first plate-like member,

wherein the first plate-like member includes

a plurality of start-portion openings that communicate with respective start portions of the plurality of heat transfer tubes, and

a plurality of end-portion openings that communicate respective end portions of the plurality of heat transfer tubes, and

wherein the second plate-like member includes

an inlet port through which water flows from the inflow tube into the second plate-like member,

a distribution recess that is formed opposite to the plurality of start-portion openings and communicates with the inlet port,

an outlet port through which water flows out to the outflow tube, and

a collection recess that is formed opposite to the plurality of end-portion openings and communicates with the outlet port.

[Claim 2]

The indoor heat exchanger of claim 1, wherein the header further includes a third plate-like member provided between the first plate-like member and the second plate-like member to form the flow passages.

[Claim 3]

The indoor heat exchanger of claim 2, wherein the third plate-like member includes

a plurality of distribution adjustment openings through which the plurality of start-portion openings communicate with the distribution recess,

a plurality of collection adjustment openings through which the plurality of end-portion openings communicate with the collection recess, and

an adjustment recess through which the plurality of start-portion openings communicate with the plurality of end-portion openings.

[Claim 4]

The indoor heat exchanger of claim 2 or 3, wherein the first plate-like member, the second plate-like member, and the third plate-like member are made of a dezincing resistant brass alloy.

[Claim 5]

The indoor heat exchanger of claim 2 or 3, wherein the first plate-like member is made of a dezincing resistant brass alloy, the second plate-like member is made of resin, and the third plate-like member is made of resin.

[Claim 6]

The indoor heat exchanger of any one of claims 1 to 5, wherein the plurality of heat transfer tubes are made of copper.

[Claim 7]

An indoor unit of an air-conditioning apparatus, comprising:

the indoor heat exchanger of any one of claims 1 to 6; and

an indoor fan configured to send room air to the indoor heat exchanger to promote exchange heat between the room air and water that serves as a heat medium and flows through the plurality of heat transfer tubes.

FIG. 1

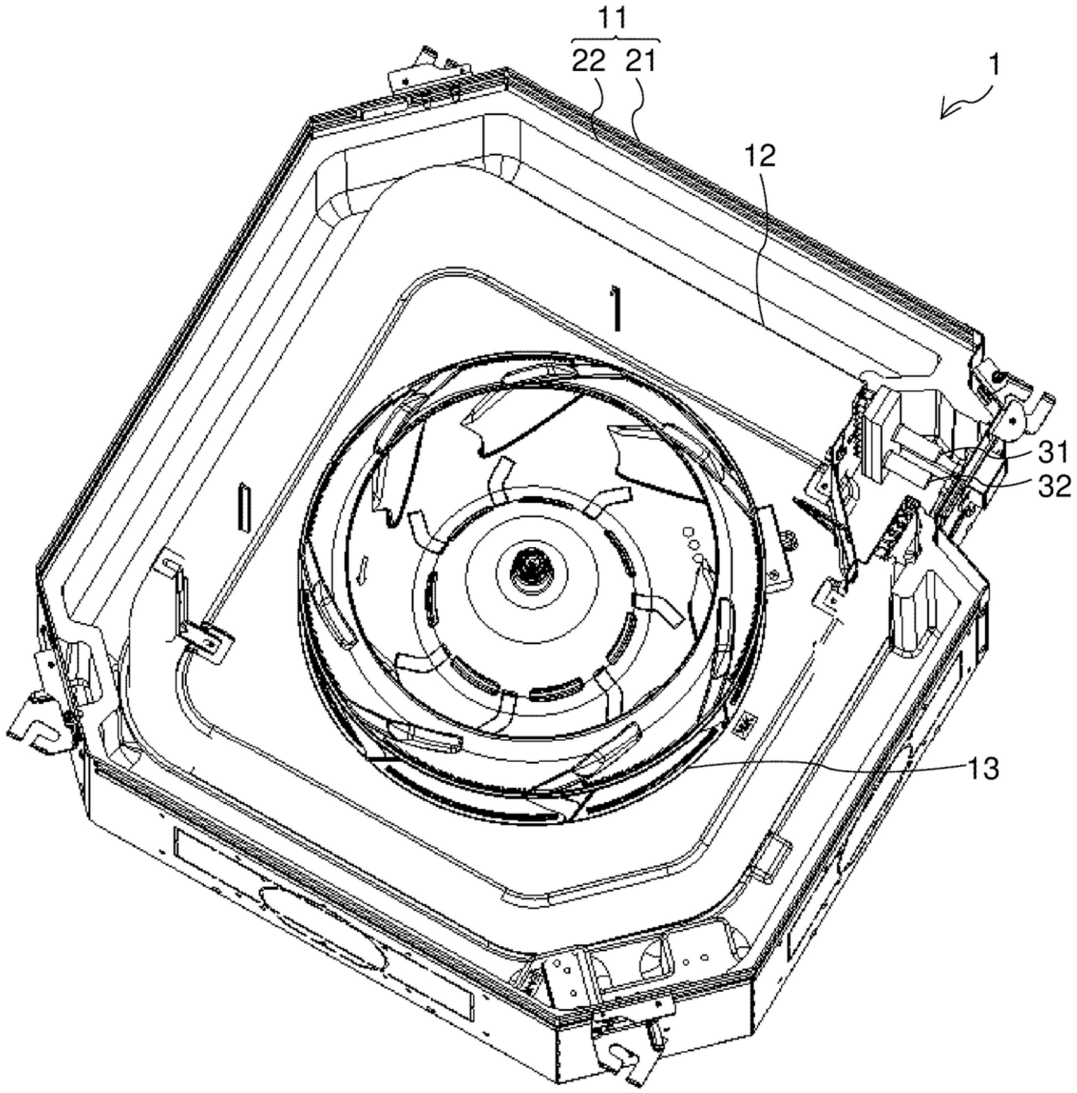

FIG. 2

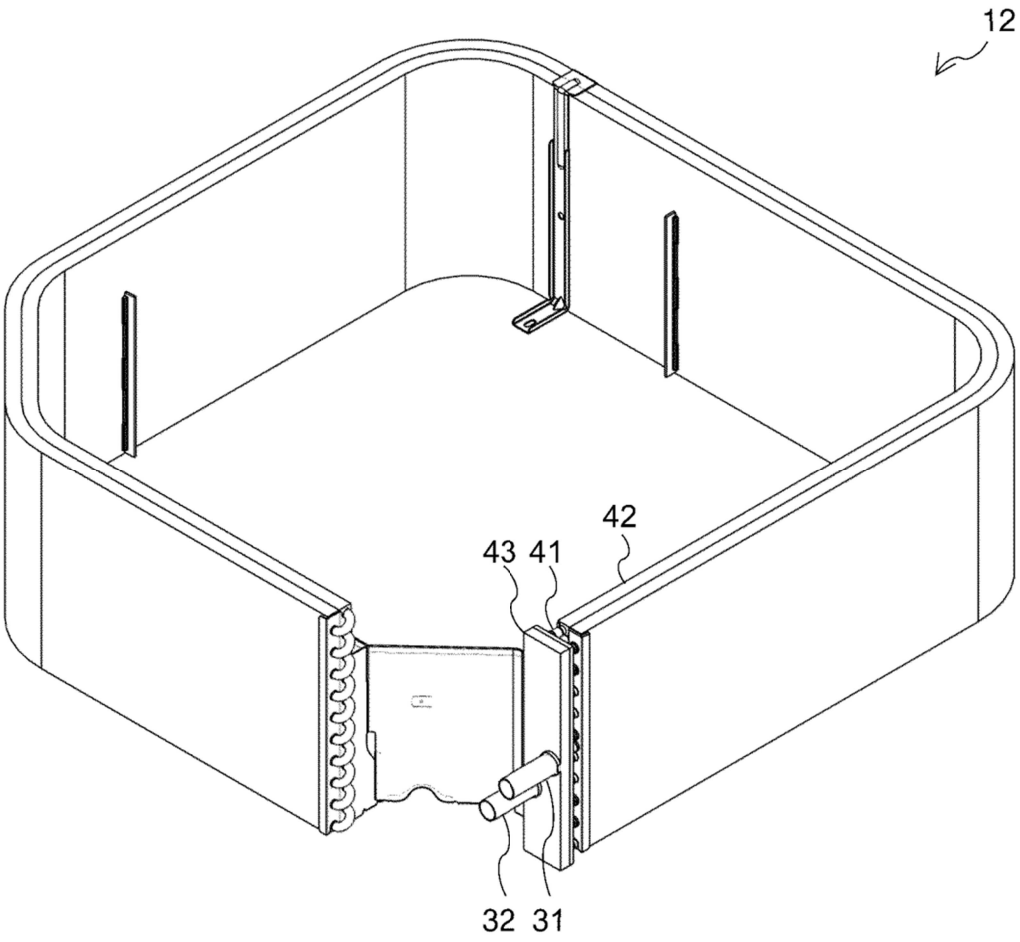

FIG. 3

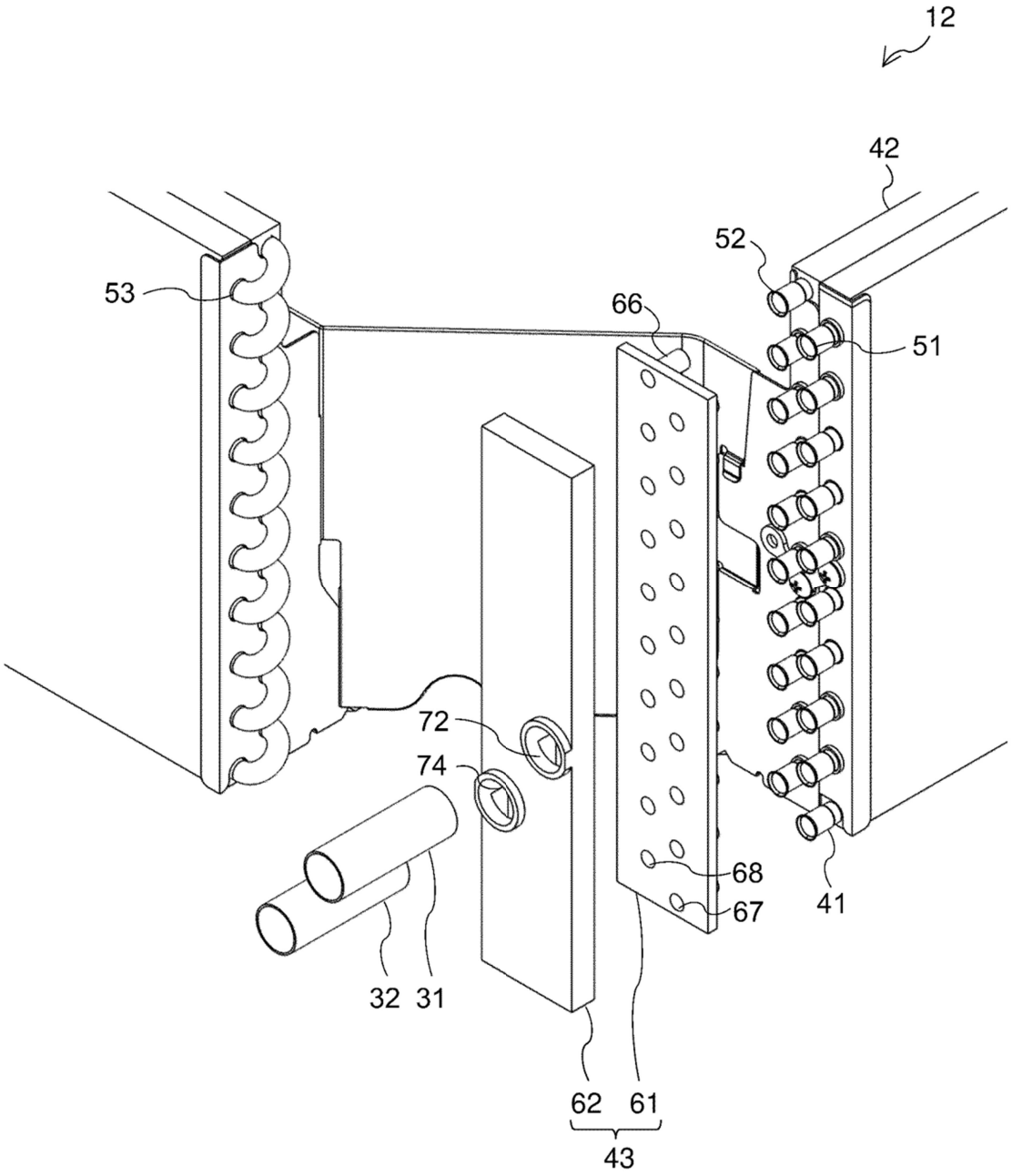

FIG. 4

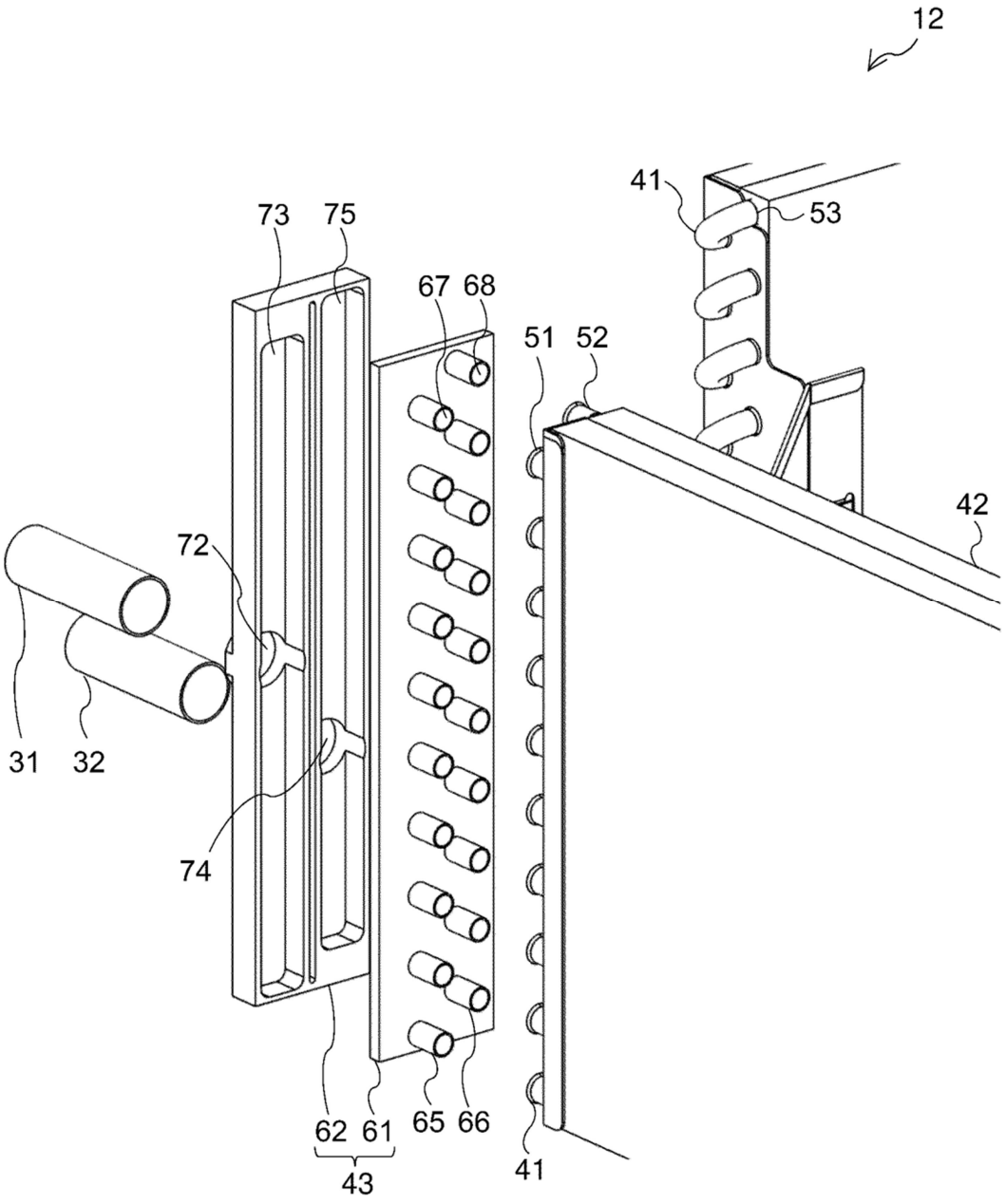

FIG. 5

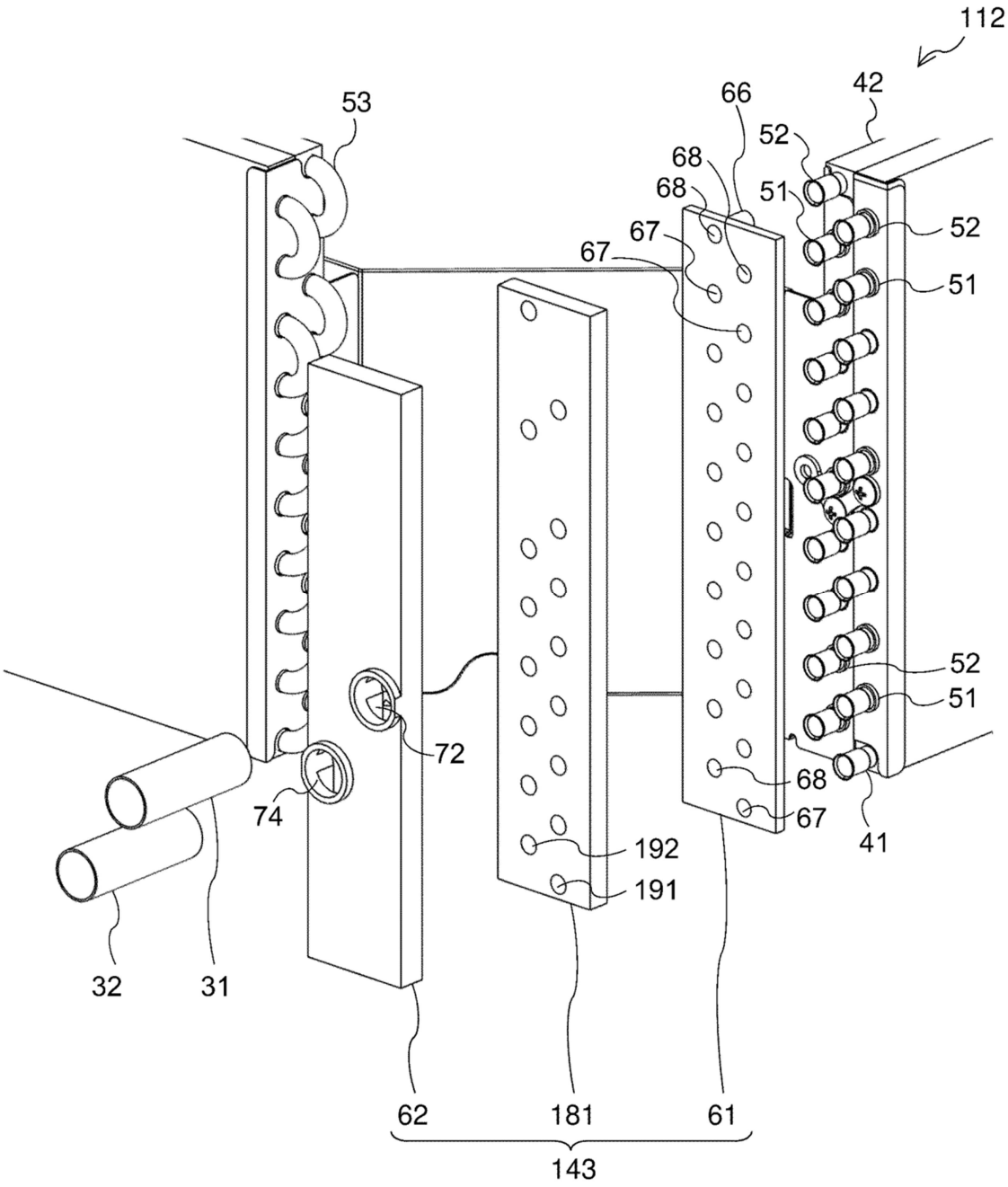

FIG. 6

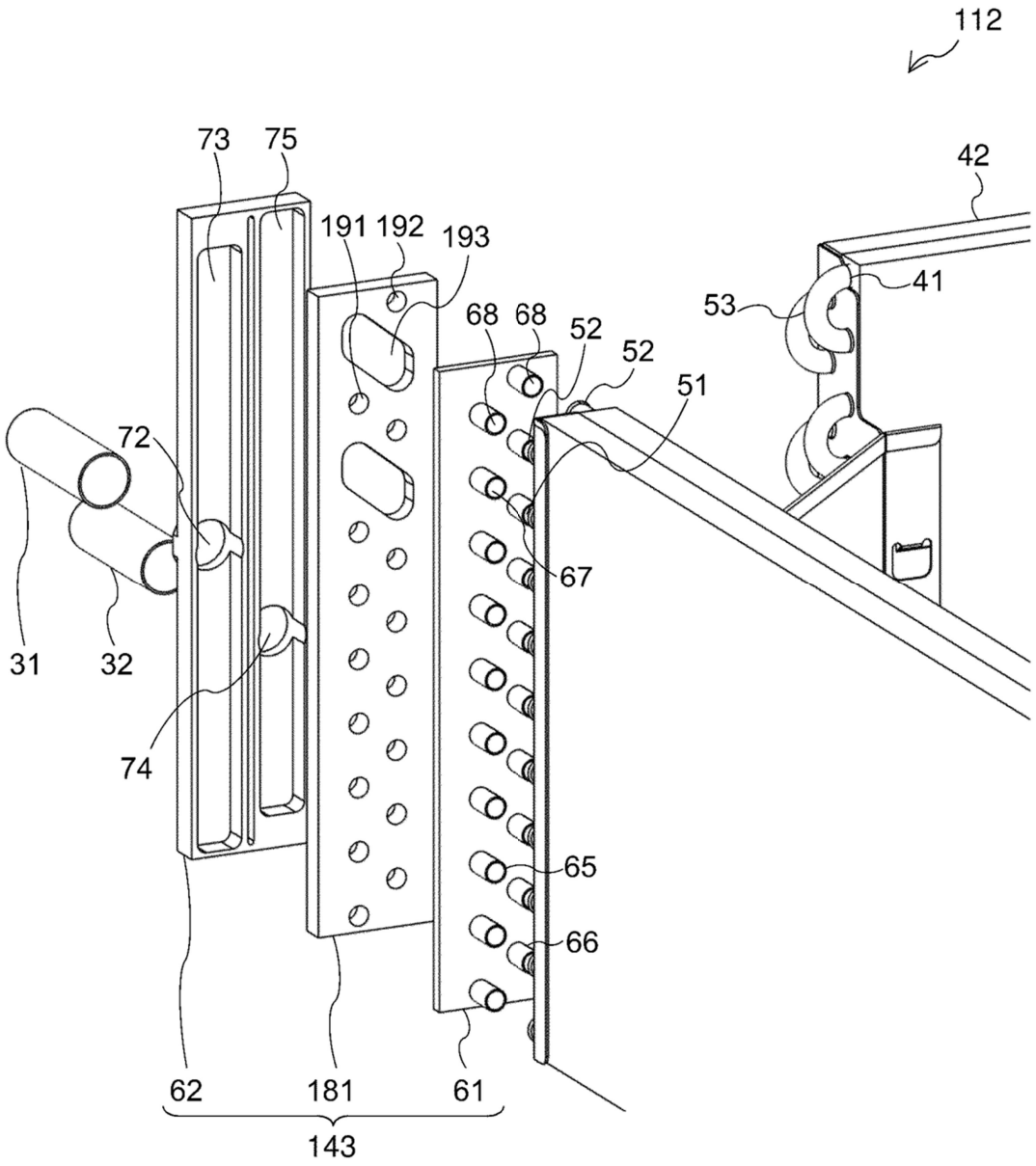

FIG. 7

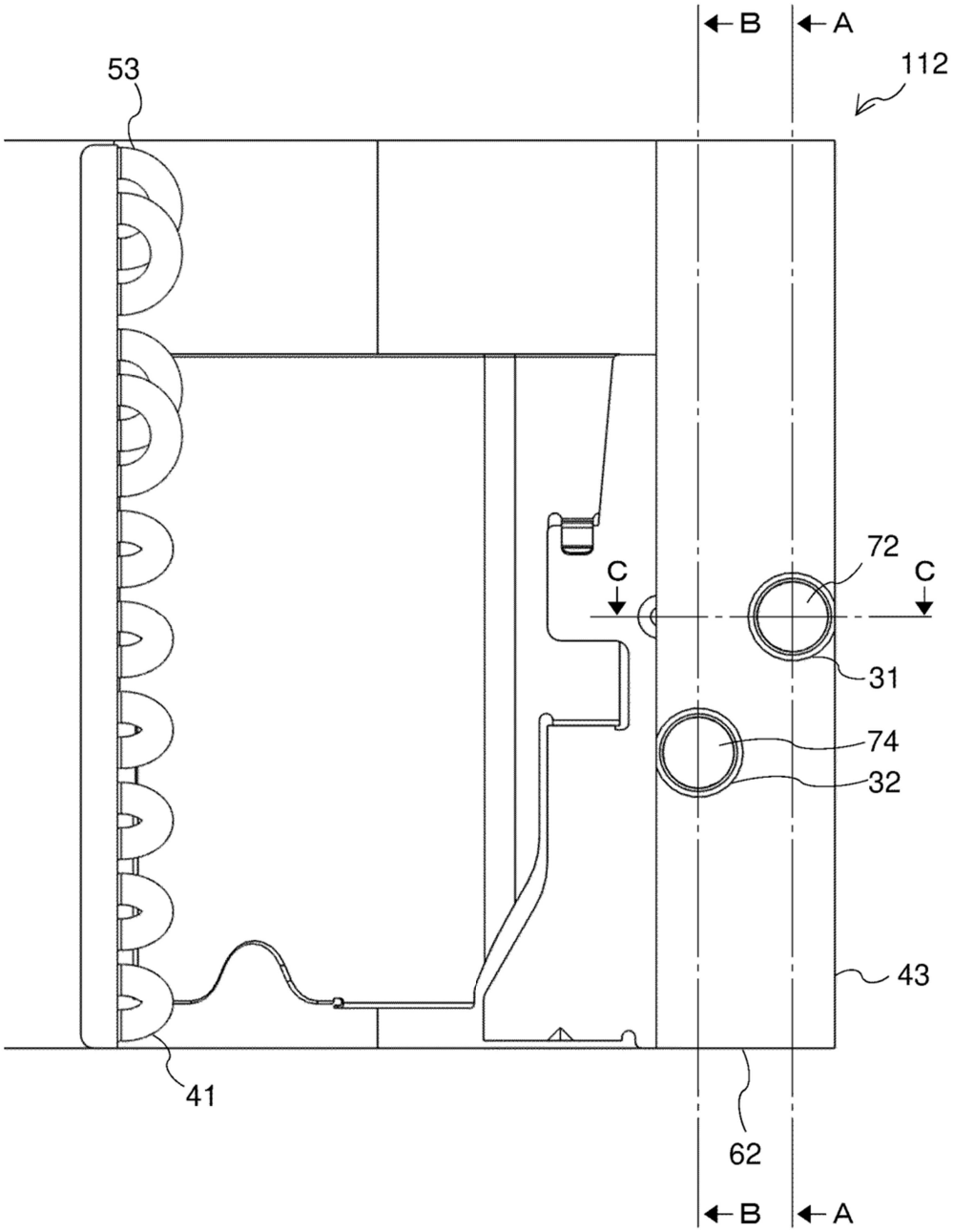

FIG. 8

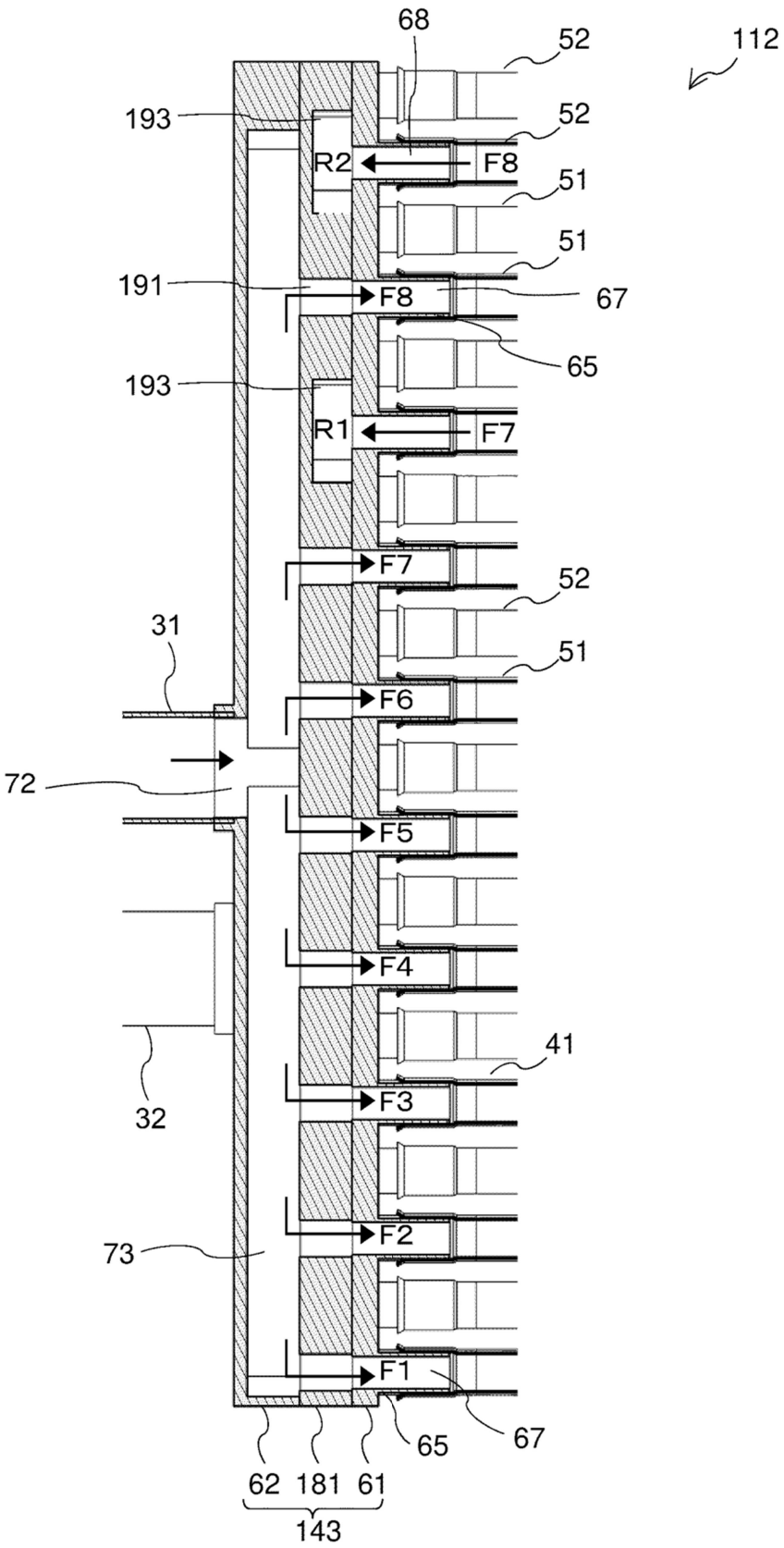

FIG. 9

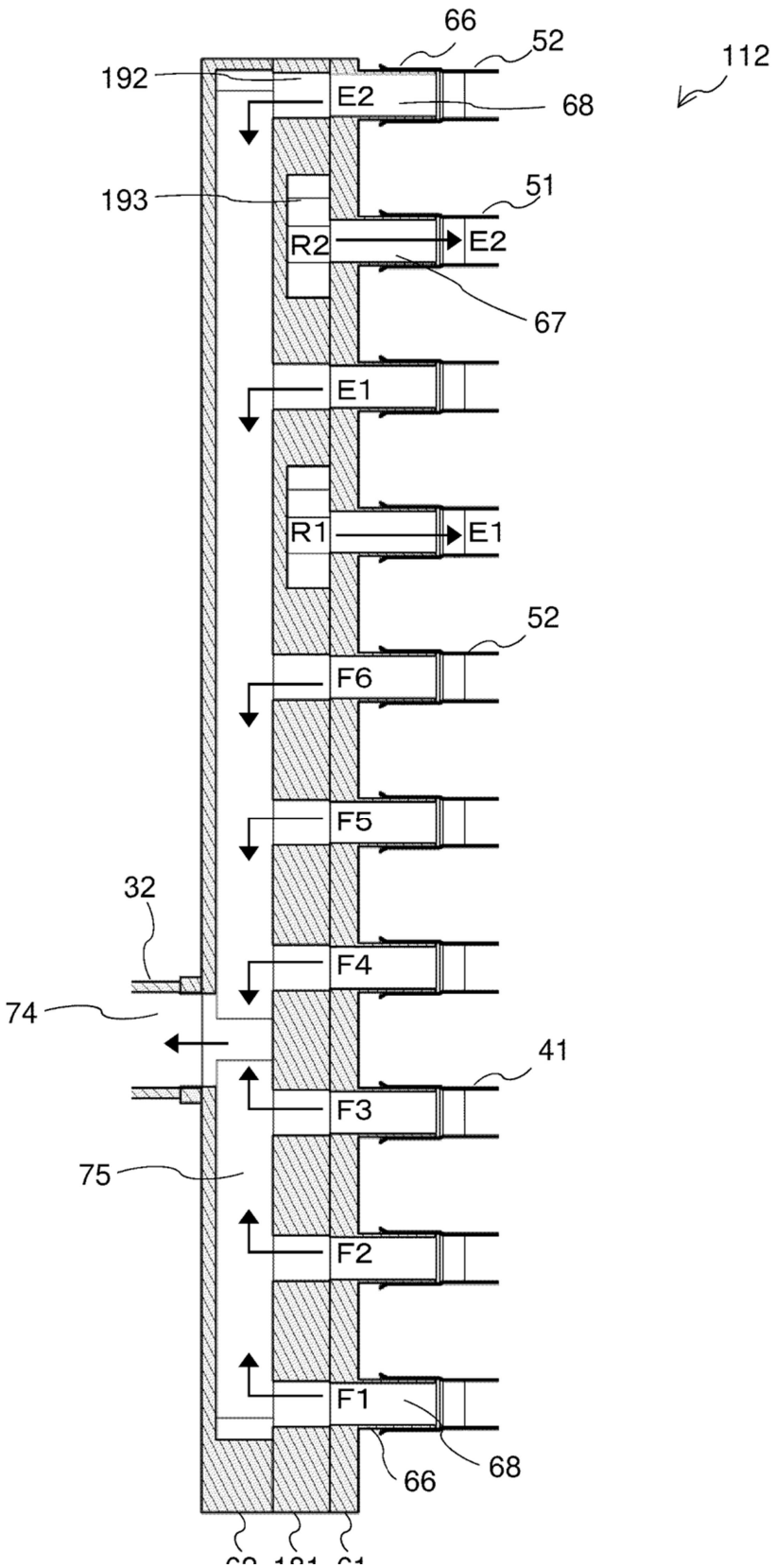

FIG. 10