(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 4 102 156 A1

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

(43) Date of publication:
14.12.2022 Bulletin 2022/50

(21) Application number: **21763817.0**

(22) Date of filing: **26.02.2021**

(51) International Patent Classification (IPC):
F25B 41/45 *(2021.01)*

(52) Cooperative Patent Classification (CPC):
F25B 41/45

(86) International application number:
PCT/JP2021/007539

(87) International publication number:
WO 2021/177191 (10.09.2021 Gazette 2021/36)

(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:
KH MA MD TN

(30) Priority: **03.03.2020 JP 2020036208**

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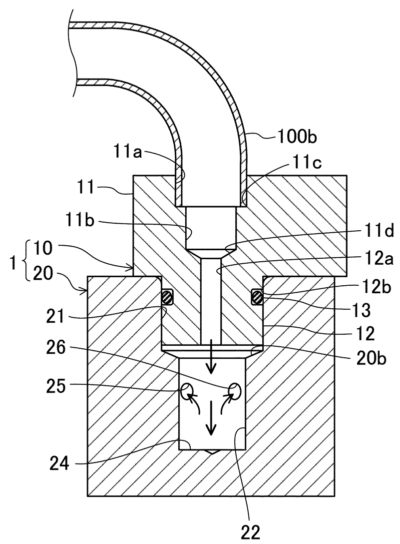
(54) REFRIGERANT DISTRIBUTOR

(57) A refrigerant distributor 1 includes: a reducing portion 12a extending straight from a downstream end of a supply path 11b to which a refrigerant supply pipe 100b is connected and having a diameter smaller than that of the supply path 11b; a refrigerant stirring chamber 22 configured to stir refrigerant from the reducing portion 12a; a refrigerant strike surface 24 to be struck by refrigerant, and first and second branch channels 25 and 26 communicating with the refrigerant stirring chamber 22.

FIG. 3



EP 4 102 156 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a refrigerant distributor that distributes inflow refrigerant to a plurality of channels.

BACKGROUND ART

[0002] A known heat exchanger used as a refrigerant evaporator of a refrigeration cycle includes a plurality of heat transfer pipes in some cases. In such cases, a refrigerant distributor can be used for distributing refrigerant from an inflow pipe to the heat transfer pipes (see, for example, Patent Document 1).

[0003] A refrigerant distributor of Patent Document 1 is constituted by fitting a first body having a refrigerant supply path and a reducing portion and a second body having a refrigerant flow strike portion and first and second branch channels to each other and uniting these bodies together. The diameter of the downstream end of the refrigerant supply path is reduced through a tapered surface, thereby forming the reducing portion. On the other hand, the refrigerant flow strike portion of the second body faces a downstream end opening of the refrigerant supply path, and is constituted by a semi-spherical concave surface. The first and second branch channels are open outward of the refrigerant flow strike portion. Refrigerant flowing in the refrigerant supply path passes through the reducing portion and then strikes the refrigerant flow strike portion, and then is branched into the first and second branch channels.

CITATION LIST

PATENT DOCUMENT

[0004] Patent Document 1: Japanese Patent Application Publication No. 11-257801

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0005] In the configuration of Patent Document 1, since the refrigerant flow strike portion faces the opening of the reducing portion, unless refrigerant from the reducing portion is caused to flow straight, the refrigerant cannot strike the refrigerant flow strike portion as intended.

[0006] However, the reducing portion is provided only in a tapered shape in the downstream end of the refrigerant supply path, and thus, the length of the reducing portion is short, and it is difficult to control the flow direction of refrigerant by using the reducing portion. Thus, a pipe communicating with the reducing portion needs to be formed in a straight pipe shape along a predetermined length so that the portion having the straight pipe shape is used to set the refrigerant flow direction to cause refrigerant to strike the refrigerant flow strike portion as intended. When the portion having the straight pipe shape is to be provided along the predetermined length, a pipe layout around the refrigerant distributor might be difficult.

[0007] It is therefore an object of the present invention to enable refrigerant distribution as intended irrespective of the shape of a pipe upstream of a reducing portion.

SOLUTION TO PROBLEM

[0008] To achieve the object, according to the present invention, the length of a reducing portion is made long, and a refrigerant strike surface is provided to face an opening of the reducing portion.

[0009] In a first aspect, a refrigerant distributor configured to distribute refrigerant from a refrigerant supply pipe to first and second refrigerant outflow pipes, includes: a supply path to which the refrigerant supply pipe is connected; a reducing portion extending straight from a downstream end of the supply path and having a diameter smaller than a diameter of the supply path; a refrigerant stirring chamber communicating with a downstream end of the reducing portion and configured to stir refrigerant from the reducing portion; a refrigerant strike surface facing the downstream end of the reducing portion with a predetermined interval and configured such that refrigerant from the reducing portion strikes the refrigerant strike surface; a first branch channel having an upstream end and a downstream end, the upstream end communicating with a portion of the refrigerant stirring chamber separated from the refrigerant strike surface, the downstream end communicating with the first refrigerant outflow pipe; and a second branch channel having an upstream end and a downstream end, the upstream end communicating with a portion of the refrigerant stirring chamber separated from the refrigerant strike surface and from the upstream end of the first branch channel, the downstream end communicating with the second refrigerant outflow pipe.

[0010] With this configuration, refrigerant flowing in the refrigerant supply pipe flows into the supply path and then flows into the reducing portion. Since the reducing portion extends straight, refrigerant has its flow rate increased while flowing in the reducing portion as well as being controlled in the outflow direction when flowing out of the reducing portion. In particular, controllability of the outflow direction is enhanced by controlling the outflow direction of refrigerant at a high flow rate. The refrigerant that has flowed from the reducing portion into the refrigerant stirring chamber strikes the refrigerant strike surface violently, and thus, liquid-phase refrigerant and gas-phase refrigerant are well stirred in the refrigerant stirring chamber. The refrigerant in the refrigerant stirring chamber is stirred and then distributed to the first refrigerant outflow pipe and the second refrigerant outflow pipe through the first branch channel and the second branch channel, respectively.

[0011] In a second aspect, the refrigerant strike surface may be disposed on an extension line of an axis of the reducing portion from the downstream end of the reducing portion, and the upstream ends of the first branch channel and the second branch channel may be open at a wall surface of the refrigerant stirring chamber between the downstream end of the reducing portion and the refrigerant strike surface.

[0012] In a third aspect, the upstream ends of the first branch channel and the second branch channel may be open at positions closer to the reducing portion than a center portion between the downstream end of the reducing portion and the refrigerant strike surface.

[0013] In this configuration, the upstream ends of the first branch channel and the second branch channel are separated from the refrigerant strike surface. Thus, refrigerant that has struck the refrigerant strike surface and has been sufficiently stirred can flow into the upstream ends of the first branch channel and the second branch channel.

[0014] In a fourth aspect, the upstream ends of the first branch channel and the second branch channel may be disposed with an interval along the extension line on the wall surface of the refrigerant stirring chamber.

[0015] In this configuration, the upstream end of the first branch channel can be sufficiently separated from the upstream end of the second branch channel. Thus, refrigerant that has been sufficiently stirred can flow into these upstream ends.

[0016] In a fifth aspect, the refrigerant distributor may further include: a first distributor component provided with the supply path and the reducing portion; and a second distributor component provided with the refrigerant stirring chamber, the refrigerant strike surface, the first branch channel, and the second branch channel. The first distributor component may be provided with the reducing portion disposed inside the first distributor component. A front end surface of the first distributor component may have a projecting cylindrical portion at which the downstream end of the reducing portion is open. The second distributor component may have a fitting hole to which the projecting cylindrical portion is fitted. The refrigerant stirring chamber may communicate with an inner side of the fitting hole.

[0017] In this configuration, in uniting the first distributor component and the second distributor component, the projecting cylindrical portion of the first distributor component is fitted in the fitting hole of the second distributor component so that the first and second distributor components can be thereby united while being positioned relative to each other. In addition, since the projecting cylindrical portion of the first distributor component has the reducing portion and the second distributor component includes the refrigerant stirring chamber communicating with the fitting hole, refrigerant from the reducing portion can be caused to flow into the refrigerant stirring chamber and be stirred therein.

[0018] In a sixth aspect, the fitting hole may have a diameter larger than a diameter of the refrigerant stirring chamber.

[0019] In this configuration, the diameter of the fitting hole of the second distributor component is increased so that even a large-diameter projecting cylindrical portion of the first distributor component can be thereby fitted in the fitting hole. Accordingly, strength of the first distributor component and strength of the refrigerant distributor in fitting can be enhanced. In addition, since the fitting hole of the second distributor component has a large diameter and the refrigerant stirring chamber has a small diameter, the fitting hole and the refrigerant stirring chamber can be easily processed.

[0020] In a seventh aspect, the supply path may extend in a direction intersecting an extension line of an axis of the reducing portion.

[0021] Specifically, in a possible case, the direction in which the supply path extends intersects an extension line of the axis of the reducing portion depending on the influence of, for example, arrangement of the refrigerant supply pipe. According to the present invention, however, since the reducing portion extends straight, the outflow direction can be controlled by using the reducing portion so that refrigerant strikes the refrigerant strike surface as intended irrespective of the direction in which the supply path extends.

[0022] In an eighth aspect, the supply path may extend coaxially with an extension line of an axis of the reducing portion.

[0023] In this configuration, refrigerant can flow smoothly from the supply path to the reducing portion.

[0024] In a ninth aspect, the refrigerant strike surface may be circular, and the downstream end of the reducing portion may be disposed such that an extension line of an axis of the reducing portion passes through a center of the refrigerant strike surface.

[0025] In this configuration, refrigerant from the reducing portion strikes the center of the refrigerant strike surface so that the refrigerant flow is less likely to be biased, and liquid-phase refrigerant and gas-phase refrigerant can be well stirred.

[0026] In a tenth aspect, the refrigerant strike surface may be substantially perpendicular to the extension line of the axis of the reducing portion.

[0027] In this configuration, since the refrigerant flow is substantially perpendicular to the refrigerant strike surface, distribution performance of a refrigerant flow that has struck the refrigerant strike surface can be enhanced.

ADVANTAGEOUS EFFECTS OF INVENTION

[0028] According to the present invention, refrigerant from the reducing portion extending from the downstream end of the supply path to which the refrigerant supply pipe is connected is caused to strike the refrigerant strike surface of the refrigerant stirring chamber so that liquid-phase refrigerant and gas-phase refrigerant can be well stirred. In addition, the refrigerant stirring chamber communicates with the first branch channel and the second branch channel so that refrigerant distribution can be obtained as intended, irrespective of the shape of a pipe upstream of the reducing portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029]

[FIG. 1] A circuit configuration diagram of a battery cooling device including a refrigerant distributor according to a first embodiment of the present invention.
[FIG. 2] A cross-sectional view of the refrigerant distributor.
[FIG. 3] A cross-sectional view illustrating a state before a first distributor component is fixed to a second distributor component.
[FIG. 4] A plan view of the second distributor component.
[FIG. 5] A side view of the second distributor component.
[FIG. 6] A rear view of the second distributor component.
[FIG. 7] A cross-sectional view taken along line VII-VII in FIG. 6.
[FIG. 8] A view corresponding to FIG. 2 according to a second embodiment of the present invention.
[FIG. 9] A cross-sectional view taken along line IX-IX in FIG. 8.

DETAILED DESCRIPTION

[0030] Embodiments of the present invention will be described in detail with reference to the drawings. The following embodiments are merely preferred examples in nature, and are not intended to limit the invention, applications, and use of the applications.

FIRST EMBODIMENT

[0031] FIG. 1 is a circuit configuration diagram of a battery cooling device 100 including a refrigerant distributor 1 according to a first embodiment of the present invention. The battery cooling device 100 is, for example, a device for cooling a battery 200 mounted on an electric vehicle, a hybrid vehicle (including a vehicle of a plug-in type), or other vehicles. Although not shown, the battery 200 is used for supplying electric power to a driving motor of a vehicle. In the case of a hybrid vehicle, the battery 200 can be charged by regenerative control of a driving motor and driving of an electric generator by an engine. In the case of an electric vehicle and a plug-in type hybrid vehicle, the battery 200 can be charged from an unillustrated commercial power supply or charged by regenerative control of a driving motor. The temperature of the battery 200 rises during charging and discharging. To suppress this temperature rise, the battery 200 is configured to be cooled by a battery cooling device 100.

(Configuration of Battery Cooling Device 100)

[0032] The battery cooling device 100 includes at least a compressor 101, a condenser 102, a receiver tank 103, a battery cooler expansion valve 104, a battery cooler 105, and an accumulator 106. In this embodiment, the battery cooling device 100 is configured to perform air conditioning on the cabin, and thus, the battery cooling device 100 includes an evaporator 107 as a cooling heat exchanger for cooling air-conditioning air, and an air-conditioning expansion valve 108.

[0033] The compressor 101 is constituted by an electric compressor. High-temperature and high-pressure refrigerant discharged from the compressor 101 flows into the condenser 102. Outside air is sent to the condenser 102 by a fan 102a. Refrigerant that has passed through the condenser 102 flows into the receiver tank 103, and then flows into one or both of a bypass pipe 100a and a bypass-cooler-side pipe 100b.

[0034] The bypass-cooler-side pipe 100b is provided with a battery-cooler-side gate valve 100c. The battery-cooler-side gate valve 100c is a valve for opening and closing the bypass-cooler-side pipe 100b. The battery cooler expansion valve 104 is disposed downstream of the battery-cooler-side gate valve 100c in the bypass-cooler-side pipe 100b. Refrigerant that has passed through the battery cooler expansion valve 104 is decompressed. The refrigerant distributor 1 according to the present invention is disposed downstream of the battery cooler expansion valve 104 in the bypass-cooler-side pipe 100b.

[0035] The refrigerant distributor 1 is used for distributing refrigerant from the bypass-cooler-side pipe (refrigerant supply pipe) 100b to a first refrigerant outflow pipe 100f and a second refrigerant outflow pipe 100g. That is, the battery cooler 105 is constituted by a heat exchanger (evaporator) that supplies cold energy for cooling the battery 200 to the battery 200, and this battery cooler 105 is provided with a plurality of unillustrated tubes. The refrigerant distributor 1 is provided in order to distribute refrigerant to these tubes. Although refrigerant is distributed to two pipes in this example, refrigerant can be distributed to three or more pipes. The refrigerant distributor 1 may distribute refrigerant to the first refrigerant outflow pipe 100f and the second refrigerant outflow pipe 100g evenly, or may distribute refrigerant such that a fractional flow rate in one pipe is larger than that in the other pipe.

[0036] The bypass-cooler-side pipe 100b, the first refrigerant outflow pipe 100f, and the second refrigerant outflow pipe 100g may have the same diameter or may have different diameters. Each of the bypass-cooler-side pipe 100b, the first refrigerant outflow pipe 100f, and the second refrigerant outflow pipe 100g is made of a pipe member of an aluminium alloy, for example. The bypass-cooler-side pipe 100b, the first refrigerant outflow pipe

100f, and the second refrigerant outflow pipe 100g have substantially circular cross sections.

[0037] The bypass pipe 100a is provided with a bypass-side gate valve 100d. The bypass-side gate valve 100d is a valve for opening and closing the bypass pipe 100a. The bypass pipe 100a is connected to the evaporator 107. The air-conditioning expansion valve 108 is disposed downstream of the bypass-side gate valve 100d in the bypass pipe 100a. Refrigerant from the evaporator 107 flows into the accumulator 106, and then is sucked into the compressor 101. Air-conditioning air is sent to the evaporator 107 by a blower 120. Air-conditioning air is cooled by the evaporator 107 and then supplied to the cabin.

[0038] Thus, opening/closing of the battery-cooler-side gate valve 100c and the bypass-side gate valve 100d switches refrigerant among a mode in which refrigerant flows only in the battery cooler 105, a mode in which refrigerant flows only in the evaporator 107, and a mode in which refrigerant flows in both the battery cooler 105 and the evaporator 107.

(Configuration of Refrigerant Distributor 1)

[0039] As illustrated in FIGS. 2 and 3, the refrigerant distributor 1 includes a first distributor component 10 and a second distributor component 20. Each of the first distributor component 10 and the second distributor component 20 is made of, for example, a block material of, for example, an aluminium alloy. The first distributor component 10 includes a base 11 and a projecting cylindrical portion 12 projecting from the base 11. The projecting cylindrical portion 12 has a circular cross section. The base 11 and the projecting cylindrical portion 12 may be integrally formed, or may be formed of different materials and then combined and united.

[0040] The base 11 has a supply-side pipe connection hole 11a to which the downstream end of the bypass-cooler-side pipe 100b is inserted and connected. The supply-side pipe connection hole 11a has a circular cross section. The outer peripheral surface of the bypass-cooler-side pipe 100b is brazed to the inner peripheral surface of the supply-side pipe connection hole 11a along the entire periphery.

[0041] The base 11 has a supply path 11b communicating with the inner side (i.e., downstream side in a refrigerant flow) of the supply-side pipe connection hole 11a. The supply-side pipe connection hole 11a is open at the upper surface of the base 11. The supply path 11b has a circular cross-sectional shape smaller than the cross-sectional shape of the supply-side pipe connection hole 11a. The supply path 11b extends straight, and the supply path 11b and the supply-side pipe connection hole 11a are coaxial. A step 11c is formed at the boundary between the supply path 11b and the supply-side pipe connection hole 11a. An insertion depth of a downstream end portion of the bypass-cooler-side pipe 100b is defined by contact with the step 11c with the downstream end portion of the bypass-cooler-side pipe 100b inserted in the supply-side pipe connection hole 11a. The bypass-cooler-side pipe 100b is connected to the supply path 11b while being inserted in the supply-side pipe connection hole 11a.

[0042] The downstream end portion of the supply path 11b is formed by a tapered surface 11d. The diameter of the tapered surface 11d gradually decreases toward the downstream side in the refrigerant flow direction. The tapered surface 11d and the supply path 11b are coaxial.

[0043] The first distributor component 10 has a reducing portion 12a extending straight from the downstream end of the supply path 11b and having a diameter smaller than that of a portion of the supply path 11b except for the tapered surface 11d. Specifically, the reducing portion 12a is disposed inside the projecting cylindrical portion 12 of the first distributor component 10. The downstream end of the reducing portion 12a is open at the center of the front end surface of the projecting cylindrical portion 12. The reducing portion 12a has a circular cross-sectional shape. Similarly, the downstream end of the reducing portion 12a that is open at the front end surface of the projecting cylindrical portion 12 also has a circular cross-sectional shape. The diameter of the reducing portion 12a is uniform from the upstream end to the downstream end thereof. The length of the reducing portion 12a is larger than the length of the supply path 11b including the tapered surface 11d. Accordingly, the reducing portion 12a has a shape whose inner diameter is uniform along a predetermined length.

[0044] The length of the reducing portion 12a is larger than the diameter of the reducing portion 12a. The length of the reducing portion 12a can be, for example, 7 mm or more, and is preferably 10 mm or more. The inner diameter of the reducing portion 12a can be set such that a refrigerant flow rate per a unit area is within the range from 1.0 g/s·mm^2 to 4.0 g/s·mm^2, for example. With this range, liquid-phase refrigerant and gas-phase refrigerant can be well mixed in a refrigerant stirring chamber described later, and a pressure loss can be reduced. A part of the reducing portion 12a may be formed in the base 11.

[0045] The outer peripheral surface of the projecting cylindrical portion 12 has an annular groove 12b. An O-ring 13 as a sealing member of, for example, rubber is fitted in the annular groove 12b.

[0046] The second distributor component 20 has a fitting hole 21 in which the projecting cylindrical portion 12 is fitted. The fitting hole 21 is open at the upper surface of the second distributor component 20 and has a circular cross-sectional shape. The length of the fitting hole 21 is substantially equal to the projection length of the projecting cylindrical portion 12. Thus, when the projecting cylindrical portion 12 is inserted and fitted in the fitting hole 21, the lower surface of the base 11 of the first distributor component 10 is brought into contact with the upper surface of the second distributor component 20. Although not shown, the first distributor component 10 and the second distributor component 20 can be fastened together with, for example, a bolt. FIG. 4 shows a screw hole 20a in which the bolt is screwed. When the projecting cylindrical portion 12 is inserted in the fitting hole 21, a gap between the projecting cylindrical portion 12 and the fitting hole 21 is sealed by the O-ring 13.

[0047] The second distributor component 20 includes a refrigerant stirring chamber 22 at the inner side of the fitting hole 21. The refrigerant stirring chamber 22 communicates with the inner side of the fitting hole 21. The refrigerant stirring chamber 22 has a circular cross-sectional shape smaller than the cross-sectional shape of the fitting hole 21. Accordingly, the diameter of the fitting hole 21 is larger than that of the refrigerant stirring chamber 22, and the step 20b is formed at the boundary between the fitting hole 21 and the refrigerant stirring chamber 22. The step 20b can be formed by a tapered surface. As illustrated in FIG. 4, since the cross-sectional shape of the refrigerant stirring chamber 22 is smaller than that of the fitting hole 21, in forming the refrigerant stirring chamber 22 and the fitting hole 21, the refrigerant stirring chamber 22 can be formed with, for example, a rotation tool, before the fitting hole 21 is formed, or the fitting hole 21 can be formed before the refrigerant stirring chamber 22 is formed.

[0048] By fixing the first distributor component 10 to the second distributor component 20, the lower end of the reducing portion 12a communicates with the refrigerant stirring chamber 22. The refrigerant stirring chamber 22 forms space for stirring refrigerant from the reducing portion 12a. The length of the refrigerant stirring chamber 22 in the axial direction can be approximately equal to the length of the reducing portion 12a, but may be larger than or smaller than the length of the reducing portion 12a. Specifically, as illustrated in FIG. 2, a length B of the refrigerant stirring chamber 22 in the axial direction can be 10 mm or more, and is preferably 15 mm or more.

[0049] The diameter of the refrigerant stirring chamber 22 is sufficiently larger than that of the reducing portion 12a, and space that is large enough to stir refrigerant from the reducing portion 12a can be obtained in the refrigerant stirring chamber 22. Since refrigerant from the reducing portion 12a flows in the battery cooler expansion valve 104, this refrigerant can be in the state of gas-liquid two-layer refrigerant as a mixture of liquid-phase refrigerant and gas-phase refrigerant. This gas-liquid two-layer refrigerant is stirred in the refrigerant stirring chamber 22 so that the liquid-phase refrigerant and the gas-phase refrigerant can be thereby mixed.

[0050] The second distributor component 20 has a refrigerant strike surface 24 configured to be struck by refrigerant from the reducing portion 12a. The refrigerant strike surface 24 is disposed to face the downstream end of the reducing portion 12a with a predetermined interval. The refrigerant strike surface 24 is circular. The refrigerant strike surface 24 is disposed on an extension line of the axis of the reducing portion 12a extending from the downstream end of the reducing portion 12a. The downstream end of the reducing portion 12a is disposed such that the extension of the axis of the reducing portion 12a passes through the center of the refrigerant strike surface 24. The refrigerant strike surface 24 may be flat or curved. In the case where the refrigerant strike surface 24 is flat, the refrigerant strike surface 24 is substantially perpendicular to the extension of the axis of the reducing portion 12a.

[0051] The second distributor component 20 has a first branch channel 25 and a second branch channel 26. The upstream ends of the first branch channel 25 and the second branch channel 26 communicate with portions of the refrigerant stirring chamber 22 separated from the refrigerant strike surface 24. That is, the upstream ends of the first branch channel 25 and the second branch channel 26 are open at a wall surface of the refrigerant stirring chamber 22 between the downstream end of the reducing portion 12a and the refrigerant strike surface 24. More specifically, the upstream ends of the first branch channel 25 and the second branch channel 26 are open at portions closer to the reducing portion 12a than the center between the downstream end of the reducing portion 12a and the refrigerant strike surface 24. Accordingly, the refrigerant strike surface 24 can be separated from the upstream ends of the first branch channel 25 and the second branch channel 26. As illustrated in FIG. 2, a separation distance A between the refrigerant strike surface 24 and the center of the upstream ends of the first branch channel 25 and the second branch channel 26 can be 9 mm or more and 13.5 mm or less. The upstream ends of the first branch channel 25 and the second branch channel 26 may be open at the center between the downstream end of the reducing portion 12a and the refrigerant strike surface 24, or may be open at a position closer to the refrigerant strike surface 24 than the center.

[0052] The upstream ends of the first branch channel 25 and the second branch channel 26 are spaced apart from each other along an extension of the axis of the reducing portion 12a on the wall surface of the refrigerant stirring chamber 22. That is, the upstream ends of the first branch channel 25 and the second branch channel 26 are disposed with an interval in the circumferential direction of the wall surface of the refrigerant stirring chamber 22, and separated from each other by a predetermined distance in the circumferential direction. As illustrated in FIG. 7, the first branch channel 25 and the second branch channel 26 are closest to each other at the upper ends thereof, and the separation distance between these channels increases toward the downstream ends thereof.

[0053] The second distributor component 20 has a first outflow-side pipe connection hole 20c to which the upstream end of the first refrigerant outflow pipe 100f is inserted and connected. The first outflow-side pipe connection hole 20c has a circular cross-sectional shape. In this positional relationship, the axis of the first outflow-side pipe connection hole 20c and the axis of first branch channel 25 intersect each other. The downstream end of the first branch channel 25 communicates with a portion separated from the axis of the first outflow-side pipe connection hole 20c in the radial direction. The outer peripheral surface of the first refrigerant outflow pipe 100f is brazed to the inner peripheral surface of the first outflow-side pipe connection hole 20c along the entire periphery. Accordingly, the downstream end of the first branch channel 25 communicates with the upstream end of the first refrigerant outflow pipe 100f.

[0054] The second distributor component 20 has a second outflow-side pipe connection hole 20d to which the upstream end of the second refrigerant outflow pipe 100g is inserted and connected. The second outflow-side pipe connection hole 20d has a circular cross-sectional shape. In this positional relationship, the axis of the second outflow-side pipe connection hole 20d and the axis of second branch channel 26 intersect each other. The downstream end of the second branch channel 26 communicates with a portion separated from the axis of the second outflow-side pipe connection hole 20d in the radial direction. The outer peripheral surface of the second refrigerant outflow pipe 100g is brazed to the inner peripheral surface of the second outflow-side pipe connection hole 20d along the entire periphery. Accordingly, the downstream end of the second branch channel 26 communicates with the upstream end of the second refrigerant outflow pipe 100g.

(Advantages of Embodiments)

[0055] Thus, as illustrated in FIG. 3, when gas-liquid two-layer refrigerant flows into the supply path 11b from the bypass-cooler-side pipe 100b, the gas-liquid two-layer refrigerant can be caused to flow into the reducing portion 12a. Since the reducing portion 12a extends straight and has a predetermined length, refrigerant has its flow rate increased while flowing in the reducing portion 12a as well as being controlled in the outflow direction when flowing out of the reducing portion 12a. In particular, controllability of the outflow direction is enhanced by controlling the outflow direction of refrigerant at a high flow rate. Refrigerant that has flowed from the reducing portion 12a into the refrigerant stirring chamber 22 strikes the refrigerant strike surface 24 violently, and thus, liquid-phase refrigerant and gas-phase refrigerant are well stirred in the refrigerant stirring chamber 22. After the stirring, refrigerant in the refrigerant stirring chamber 22 is evenly distributed to the first refrigerant outflow pipe 100f and the second refrigerant outflow pipe 100g through the first branch channel 25 and the second branch channel 26, respectively.

[0056] In a case where a pipe located immediately upstream of the refrigerant distributor 1 is bent, flow velocity distribution of refrigerant flowing into the refrigerant distributor 1 is biased. On the other hand, since the reducing portion 12a is straight in this embodiment, the bias of flow velocity distribution of refrigerant is reduced while the refrigerant flows in the reducing portion 12a. Accordingly, distribution of refrigerant can be made uniform, irrespective of the shape of the pipe located immediately upstream of the refrigerant distributor 1.

SECOND EMBODIMENT

[0057] FIG. 8 is a view according to a second embodiment of the present invention. The second embodiment is different from the first embodiment in that refrigerant is distributed to four directions and that the axial directions of the bypass-cooler-side pipe 100b and the reducing portion 12a intersect each other. In the following description, the same components as those of the first embodiment are denoted by the same reference characters and will not be described again, and components different from those of the first embodiment will be described in detail.

[0058] In the second embodiment, the supply path 11b extends in a direction intersecting an extension line of the axis of the reducing portion 12a. That is, as illustrated in FIG. 8, the supply path 11b extends in the horizontal direction, whereas the reducing portion 12a extends in the top-bottom direction. Accordingly, the direction in which the supply path 11b extends is substantially perpendicular to the axis of the reducing portion 12a in this positional relationship.

[0059] As illustrated in FIG. 9, the second distributor component 20 includes a third branch channel 27 and a fourth branch channel 28 in addition to the first branch channel 25 and the second branch channel 26. The second distributor component 20 has a third outflow-side pipe connection hole 20e to which the upstream end of a third refrigerant outflow pipe (not shown) is inserted and connected. The downstream end of the third branch channel 27 communicates with the third outflow-side pipe connection hole 20e. The second distributor component 20 has a fourth outflow-side pipe connection hole 20f to which the upstream end of the fourth refrigerant outflow pipe (not shown) is inserted and connected. The downstream end of the fourth branch channel 28 communicates with the fourth outflow-side pipe connection hole 20f.

[0060] In this second embodiment, advantages similar to those of the first embodiment can be obtained, and refrigerant can be distributed to four directions. In a case where the direction in which the supply path 11b extends intersects an extension line of the axis of the reducing portion 12a under the influence of, for example, arrangement of a pipe, since the reducing portion 12a extends straight, the flow direction can be controlled by using the reducing portion 12a so that refrigerant can strike the refrigerant strike surface 24 as intended, irrespective of the direction in which the supply path 11b extends.

[0061] The above-described embodiments are merely an example in all respects, and should not be construed as limiting. Further, all variations and modifications belonging to the equivalent scope of the claims are within the scope of the present invention. The refrigerant distributor 1 is applicable not only to the battery cooling device 100 but also to a case where refrigerant is distributed to tubes constituted by a heat exchanger of an air conditioner. The first branch channel 25, the second branch channel 26, the third branch channel 27, and the fourth branch channel 28 may extend in any directions. The number of branch channels may be three or five or more.

INDUSTRIAL APPLICABILITY

[0062] As described above, the refrigerant distributor according to the present invention is applicable to, for example, a battery cooling device and an air conditioner.

DESCRIPTION OF REFERENCE CHARACTERS

[0063]

1	refrigerant distributor
10	first distributor component
11b	supply path
12	projecting cylindrical portion
12a	reducing portion
20	second distributor component
21	fitting hole
22	refrigerant stirring chamber
24	refrigerant strike surface
25	first branch channel
26	second branch channel
100b	bypass-cooler-side pipe (refrigerant supply pipe)
100f	first refrigerant outflow pipe
100g	second refrigerant outflow pipe

Claims

1. A refrigerant distributor configured to distribute refrigerant from a refrigerant supply pipe to first and second refrigerant outflow pipes, the refrigerant distributor comprises:

a supply path to which the refrigerant supply pipe is connected;
a reducing portion extending straight from a downstream end of the supply path and having a diameter smaller than a diameter of the supply path;
a refrigerant stirring chamber communicating with a downstream end of the reducing portion and configured to stir refrigerant from the reducing portion;
a refrigerant strike surface facing the downstream end of the reducing portion with a predetermined interval and configured such that refrigerant from the reducing portion strikes the refrigerant strike surface;
a first branch channel having an upstream end and a downstream end, the upstream end communicating with a portion of the refrigerant stirring chamber separated from the refrigerant strike surface, the downstream end communicating with the first refrigerant outflow pipe; and
a second branch channel having an upstream end and a downstream end, the upstream end communicating with a portion of the refrigerant stirring chamber separated from the refrigerant strike surface and from the upstream end of the first branch channel, the downstream end communicating with the second refrigerant outflow pipe.

2. The refrigerant distributor according to claim 1, wherein

the refrigerant strike surface is disposed on an extension line of an axis of the reducing portion from the downstream end of the reducing portion, and
the upstream ends of the first branch channel and the second branch channel are open at a wall surface of the refrigerant stirring chamber between the downstream end of the reducing portion and the refrigerant strike surface.

3. The refrigerant distributor according to claim 2, wherein
the upstream ends of the first branch channel and the second branch channel are open at positions closer to the reducing portion than a center portion between the downstream end of the reducing portion and the refrigerant strike surface.

4. The refrigerant distributor according to claim 2, wherein
the upstream ends of the first branch channel and the second branch channel are disposed with an interval along the extension line on the wall surface of the refrigerant stirring chamber.

5. The refrigerant distributor according to claim 1, further comprising:

a first distributor component provided with the supply path and the reducing portion; and
a second distributor component provided with the refrigerant stirring chamber, the refrigerant strike surface, the first branch channel, and the second branch channel, wherein
the first distributor component is provided with the reducing portion disposed inside the first distributor component, a front end surface of the first distributor component has a projecting cylindrical portion at which the downstream end of the reducing portion is open,
the second distributor component has a fitting

hole to which the projecting cylindrical portion is fitted, and
the refrigerant stirring chamber communicates with an inner side of the fitting hole.

6. The refrigerant distributor according to claim 5, wherein
the fitting hole has a diameter larger than a diameter of the refrigerant stirring chamber.

7. The refrigerant distributor according to claim 1, wherein
the supply path extends in a direction intersecting an extension line of an axis of the reducing portion.

8. The refrigerant distributor according to claim 1, wherein
the supply path extends coaxially with an extension line of an axis of the reducing portion.

9. The refrigerant distributor according to claim 1, wherein

the refrigerant strike surface is circular, and
the downstream end of the reducing portion is disposed such that an extension line of an axis of the reducing portion passes through a center of the refrigerant strike surface.

10. The refrigerant distributor according to claim 9, wherein
the refrigerant strike surface is substantially perpendicular to the extension line of the axis of the reducing portion.

FIG. 1

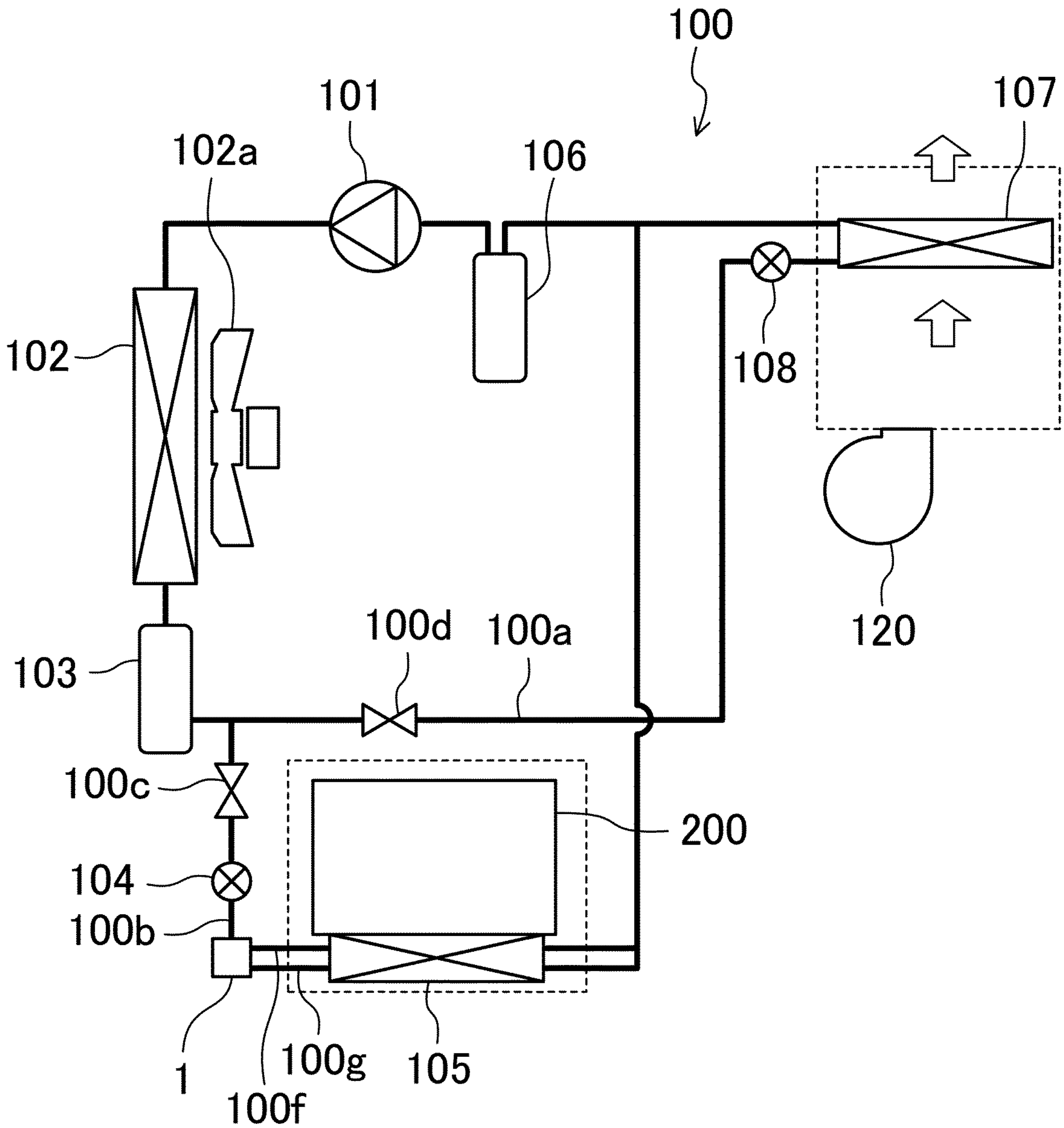

100
101
102a
106
107
102
108
120
100d
100a
103
100c
200
104
100b
1
100g
105
100f

FIG. 2

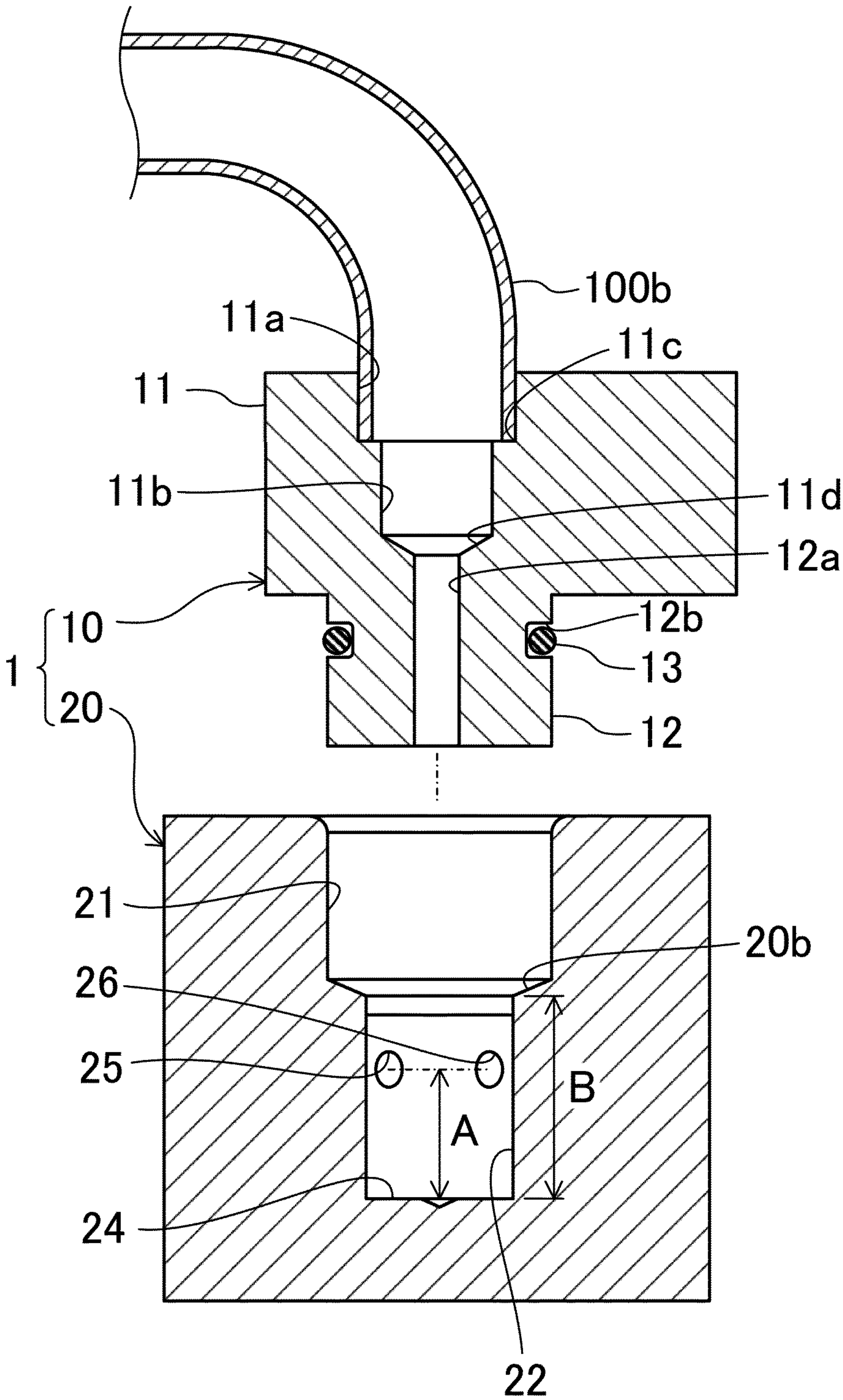


FIG. 3

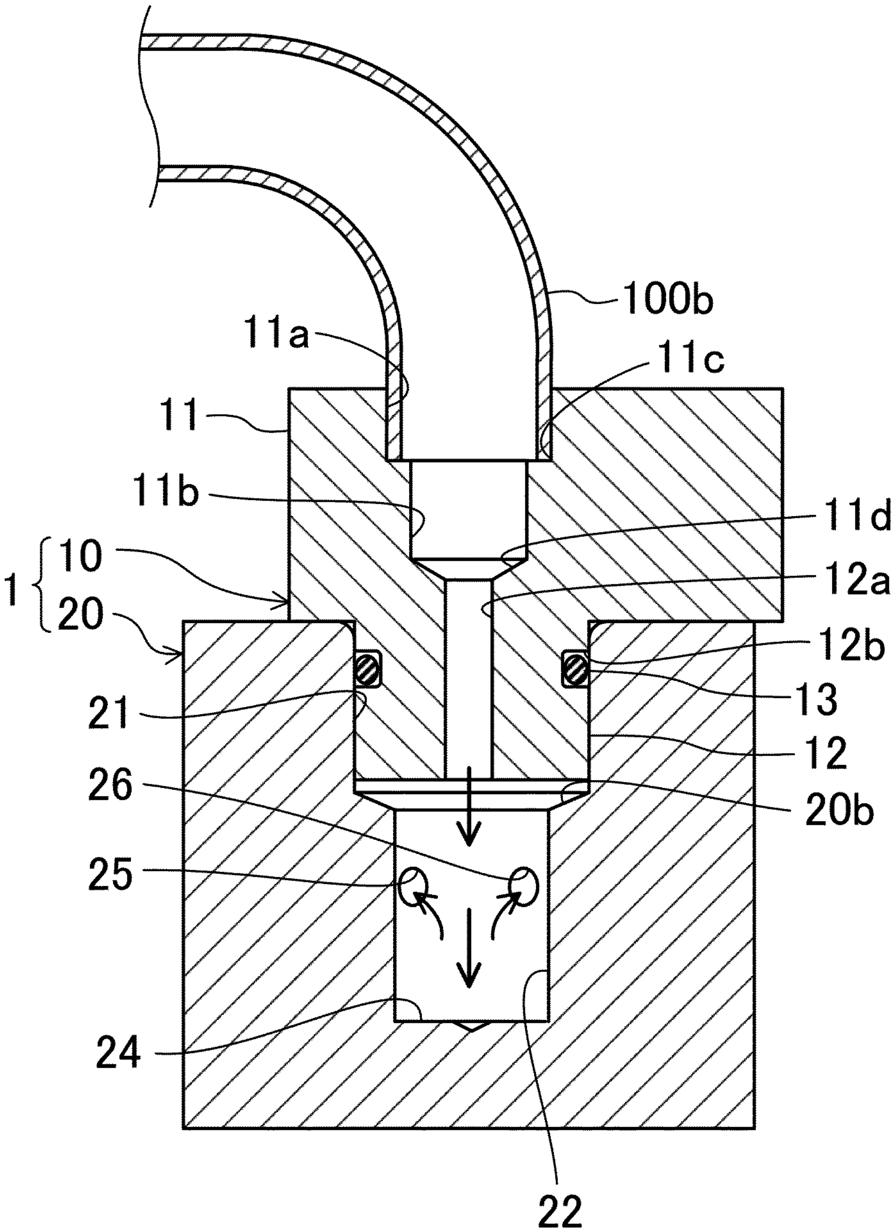


FIG. 4

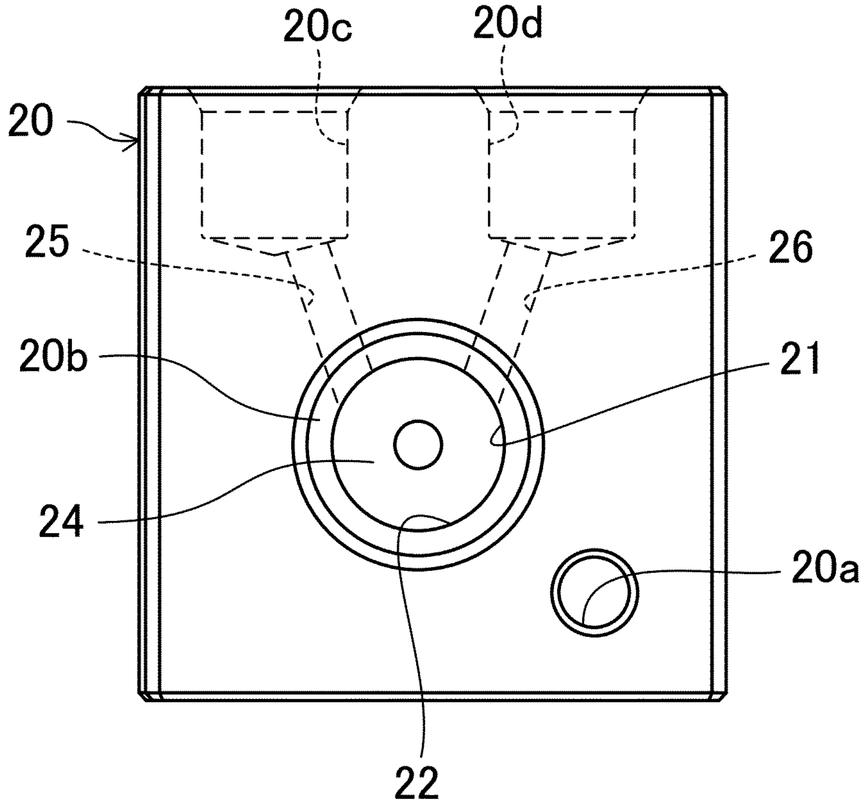


FIG. 5

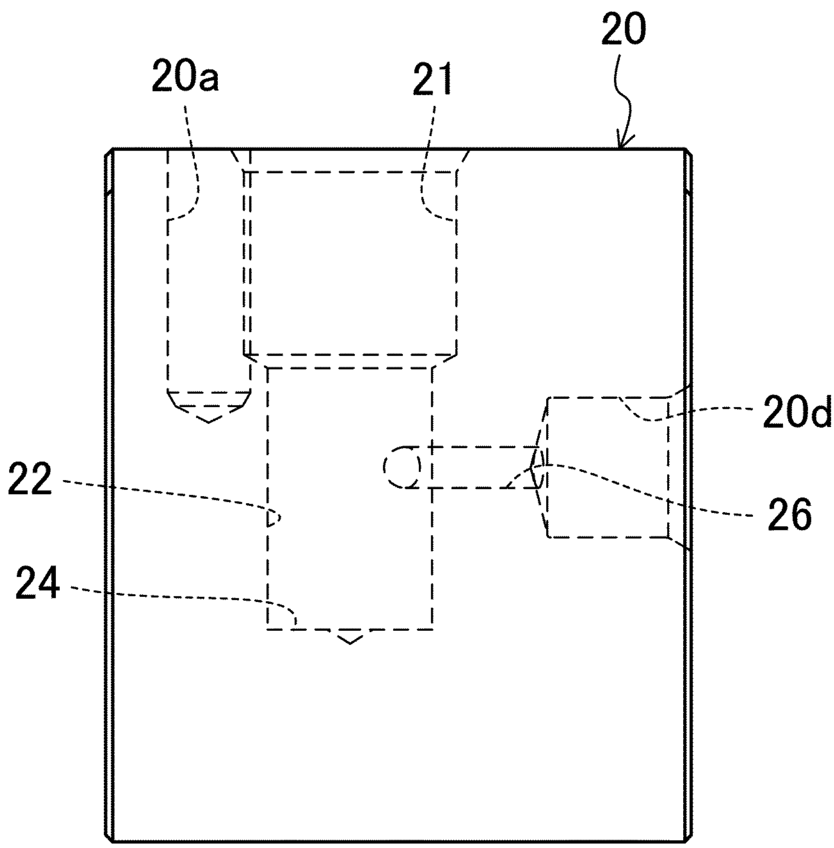


FIG. 6

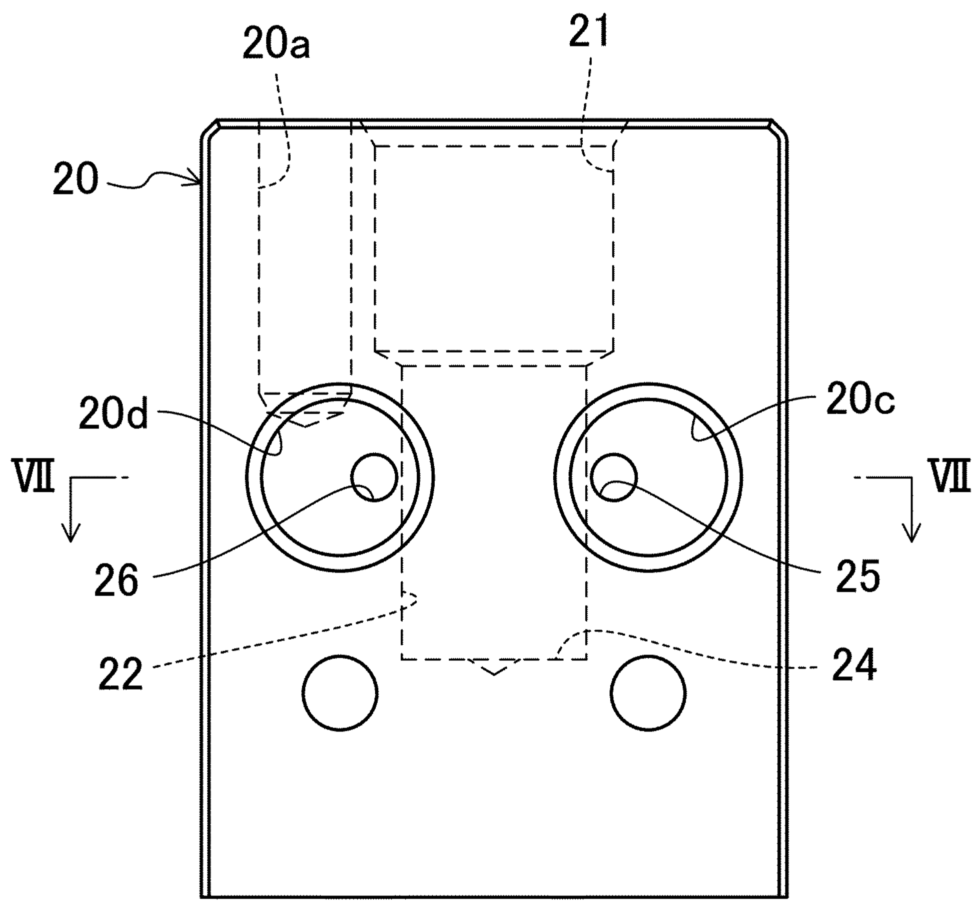


FIG. 7

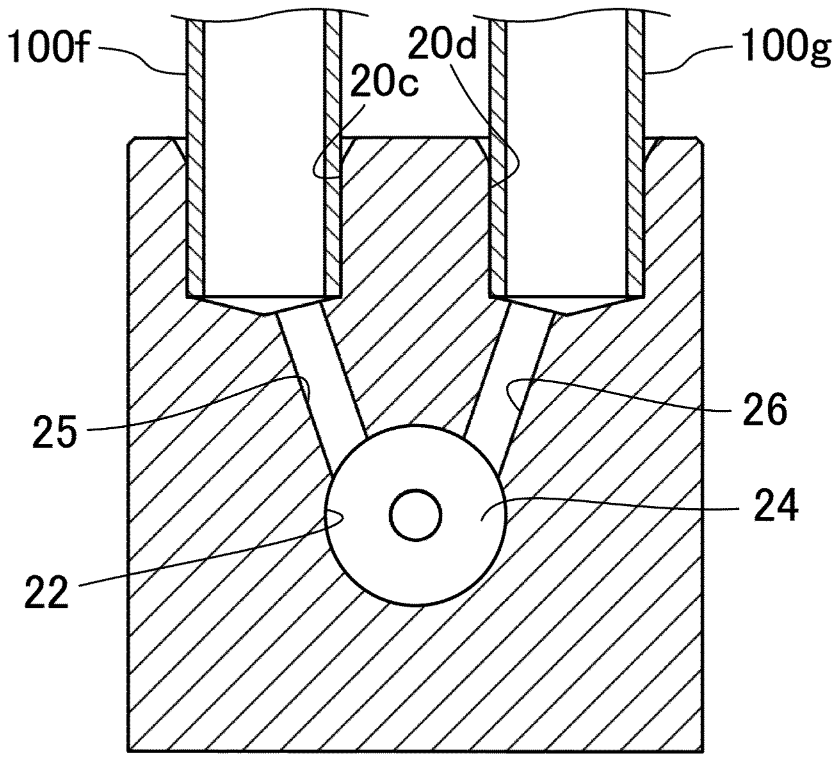


FIG. 8

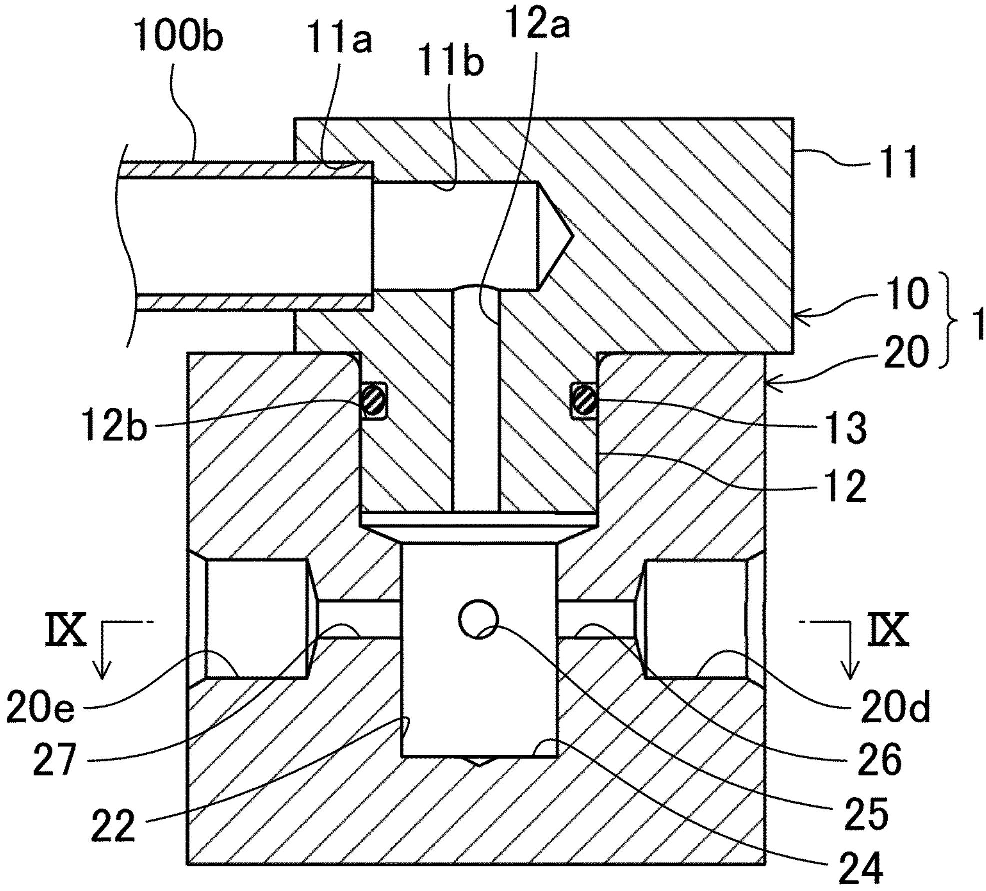
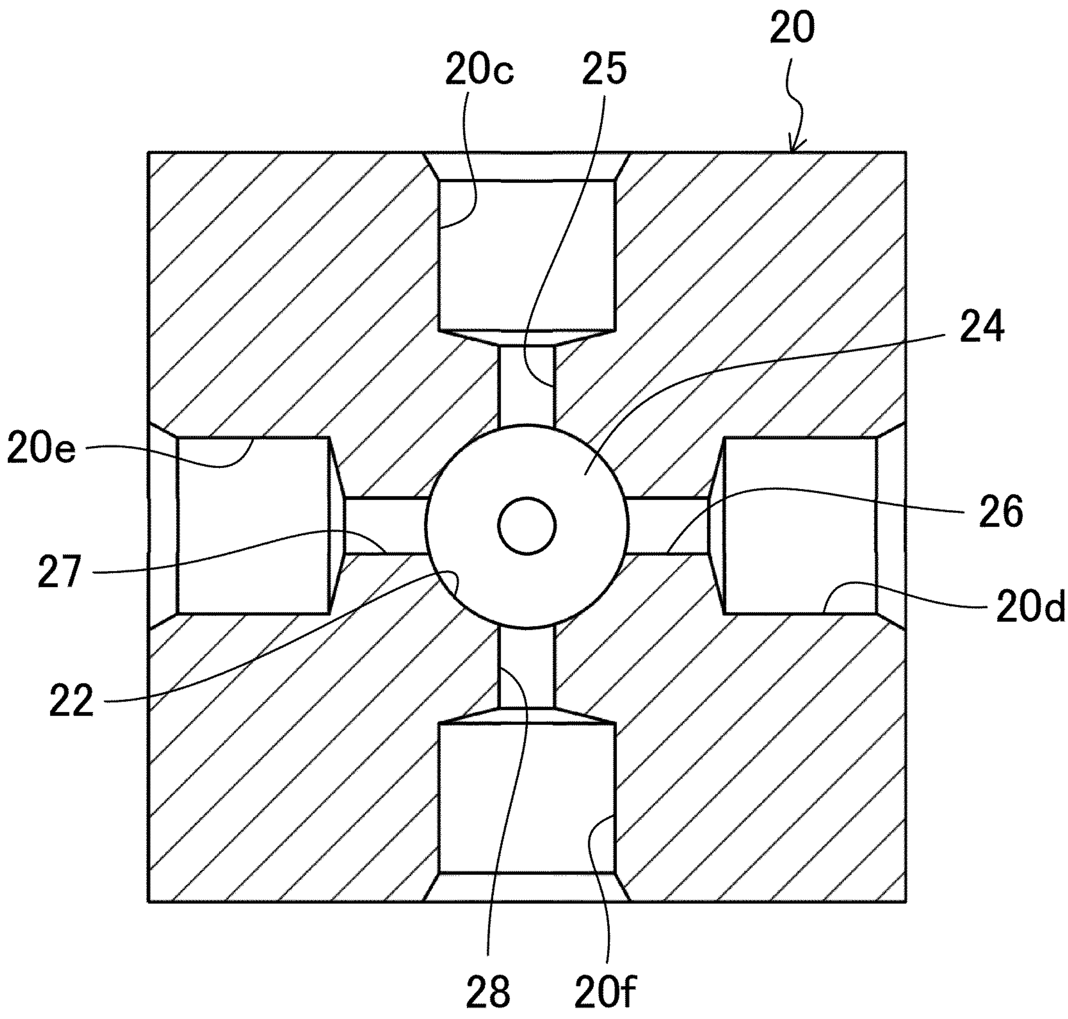


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP20217007539

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F25B41/45(2021.01)i
FI: F25B41/00D

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl. F25B41/45

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2021
Registered utility model specifications of Japan	1996-2021
Published registered utility model applications of Japan	1994-2021

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 11-257801 A (DAIKIN INDUSTRIES, LTD.) 24 September 1999 (1999-09-24), paragraphs [0030]-[0043], fig. 1	1, 8-9 2-7, 10
Y	JP 2014-81149 A (HITACHI APPLIANCES INC.) 08 May 2014 (2014-05-08), paragraphs [0025], [0026], [0035]-[0037], fig. 6, 11	2-4, 7, 10
Y	JP 8-296778 A (NIPPON DENSO CO., LTD.) 12 November 1996 (1996-11-12), paragraphs [0025]-[0036], fig. 1, 4	5-6
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 134526/1980 (Laid-open No. 60074/1982) (DAIKIN INDUSTRIES, LTD.) 09 April 1982 (1982-04-09), page 5, line 8 to page 6, line 13, fig. 2-6	1-10

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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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
"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
"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
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 March 2021	06 April 2021

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

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP20217007539

JP 11-257801 A	24 September 1999	(Family: none)
JP 2014-81149 A	08 May 2014	(Family: none)
JP 8-296778 A	12 November 1996	(Family: none)
JP 57-60074 U1	09 April 1982	(Family: none)

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- JP 11257801 A **[0004]**