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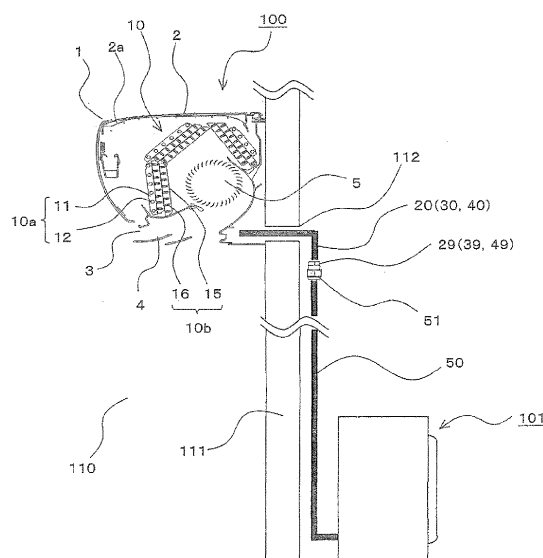
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(54) **Heat exchanger and air conditioner on which this heat exchanger is mounted**

(57) A heat exchanger in which a breakage of a connection pipeline during installation or the like can be prevented is obtained.

A heat exchanger (10) is provided with a heat transfer pipe which is formed of aluminum or aluminum alloy and a connection pipeline (20) through which a refrigerant flowing in from the heat transfer pipe or a refrigerant flowing into the heat transfer pipe passes and is disposed in an air conditioner, and the connection pipeline (20) has a gas pipeline (30) and a liquid pipeline (40). Also, each of the gas pipeline (30) and the liquid pipeline (40) is constituted by connecting an aluminum pipeline (31) or (41) formed of aluminum or aluminum alloy and a copper pipeline (32) or (42) formed of copper or copper alloy by a connection portion (37) or (47), respectively, and each of descending portions (33) and (43) is formed. Each of the connection portions (37) and (47) is arranged in straight portions (35) and (45) of the descending portions (33) and (43), respectively, and in the straight portions (35) and (45), the aluminum pipelines (31) and (41) are longer than the copper pipelines (32) and (42).

FIG. 1



Description**BACKGROUND OF THE INVENTION**

1. Field of the Invention

[0001] The present invention relates to a heat exchanger and an air conditioner on which this heat exchanger is mounted and particularly to a heat exchanger in which a heat transfer pipe is formed of aluminum or aluminum alloy and an air conditioner on which this heat exchanger is mounted.

2. Description of the Related Art

[0002] Heat exchangers in which a heat transfer pipe is made of aluminum or aluminum alloy (hereinafter referred to as a heat exchanger made of aluminum) are known. This type of heat exchanger is incorporated in a refrigerating cycle circuit by connecting a refrigerant pipeline formed of copper or copper alloy (hereinafter referred to as a copper pipeline) to a heat transfer pipe formed of aluminum or aluminum alloy (or a refrigerant pipeline formed of aluminum or aluminum alloy connected to this heat transfer pipe. Hereinafter this is referred to as an aluminum pipeline). In the case of incorporation of the heat exchanger made of aluminum in the refrigerating cycle circuit by using the copper pipeline as described above, if water adhering to the copper pipeline adheres to the heat transfer pipe or the aluminum pipeline, there has been a problem that electric corrosion (galvanic corrosion) occurs in the heat transfer pipe or the aluminum pipeline.

[0003] Thus, heat exchangers in which electric corrosion (galvanic corrosion) occurring in the heat transfer pipe or the aluminum pipeline formed of aluminum or aluminum alloy is prevented have been proposed. As this type of a heat exchanger made of aluminum, for example, a heat exchanger "comprising an air conditioner main body and a fixing member 11 that fixes a refrigerating cycle unit including a compressor, a heat exchanger 6 made of aluminum or aluminum alloy, and a refrigerant pipeline 7 made of copper or copper alloy connected to this heat exchanger 6 to the air conditioner main body, by making all of the parts located at an upper position of the heat exchanger 6 of the refrigerant pipeline 7 be composed of a water droplet falling prevention pipeline portion 9 inclined downward toward the refrigerant pipeline 7 from the heat exchanger 6 so that the droplets flow downward through the pipeline and electric corrosion of the heat exchanger 6 by copper ions is prevented" is proposed (See Japanese Unexamined Patent Application Publication No. 6-300303 (Abstract and Fig. 1), for example).

SUMMARY OF THE INVENTION

[0004] When an air conditioner on which a prior-art heat exchanger made of aluminum is mounted (an indoor unit, for example) is installed or transferred, a connection pipeline (the above-described aluminum pipeline and copper pipeline) of this heat exchanger made of aluminum is twisted to an arbitrary direction in order to connect the heat exchanger made of aluminum to the refrigerating cycle circuit. At this time, since no consideration is given to a load applied to the connection pipeline during the installation or transfer in the prior-art heat exchanger made of aluminum, there is a problem that the connection pipeline may be broken during the installation or transfer.

[0005] The present invention was made to solve the above-described problems and an object thereof is to obtain a heat exchanger made of aluminum that can prevent a breakage of a connection pipeline during installation or transfer and an air conditioner on which this heat exchanger is mounted.

[0006] A heat exchanger according to the present invention is a heat exchanger which is provided with a heat transfer pipe formed of aluminum or aluminum alloy and a connection pipeline through which a refrigerant flowing from the heat transfer pipe or the refrigerant flowing into the heat transfer pipe passes and provided in an air conditioner, in which the connection pipeline has a gas pipeline through which a gas refrigerant flows and a liquid pipeline through which a liquid refrigerant or a gas-liquid two-phase refrigerant flows. Also, the gas pipeline and the liquid pipeline are constituted by a first refrigerant pipeline formed of aluminum or aluminum alloy and a second refrigerant pipeline formed of copper or copper alloy connected by a connection portion, and the first refrigerant pipeline is connected to the heat transfer pipe so as to form a descending portion which falls from the heat transfer pipe. The connection portion is arranged at a straight part of the descending portion, and in the straight part of the descending portion, the first refrigerant pipeline is longer than the second refrigerant pipeline.

[0007] Also, an air conditioner according to the present invention is an air conditioner on which the above-described heat exchanger is mounted.

[0008] In the present invention, the connection portion between the first refrigerant pipeline (a refrigerant pipeline formed of aluminum or aluminum alloy) and the second pipeline (a refrigerant pipeline formed of copper or copper alloy) in the connection pipeline is arranged in the straight part of the descending portion. In the straight part of the descending

portion, the first refrigerant pipeline is longer than the second refrigerant pipeline. Thus, even if the connection pipeline is twisted and a load is applied to the connection pipeline, a breakage of the connection pipeline can be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is an explanatory diagram illustrating an installed state of an air conditioner according to an embodiment of the present invention.

Figs. 2 are perspective views illustrating a heat exchanger according to the embodiment of the present invention.

Fig. 3 is a front view (an enlarged view of an essential part) illustrating the heat exchanger according to the embodiment of the present invention.

Fig. 4 is a side view illustrating the heat exchanger according to the embodiment of the present invention.

Fig. 5 is a plan view illustrating an indoor unit according to the embodiment of the present invention.

Fig. 6 is a sectional view illustrating a connected state between an aluminum pipeline and a copper pipeline according to the embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] In an embodiment below, an example in which a heat exchanger according to the present invention is mounted on an indoor unit of an air condition will be described. Also, in the present invention, an example using a wall-hanging type indoor unit will be described.

Embodiment.

[0011] Fig. 1 is an explanatory diagram illustrating an installed state of an air conditioner according to an embodiment of the present invention.

As illustrated in Fig. 1, the air conditioner according to this embodiment is provided with an indoor unit 100 and an outdoor unit 101. The indoor unit 100 is installed on a wall 111 of an air-conditioned space 110. The outdoor unit 101 is installed outside the room.

[0012] The indoor unit 100 is provided with a housing 1, a blower 5, an indoor heat exchanger 10 and the like. The housing 1 has a substantially rectangular-solid box shape, and, for example, an inlet 2 is formed on an upper part, and an outlet 3 is formed on a lower part. In the inlet 2, a filter 2a that collects dust and the like from indoor air sucked into the housing 1 is disposed. In the outlet 3, an air-direction adjustment mechanism 4 that adjusts the direction of air-conditioning air blown out of the outlet 3 is disposed.

[0013] The blower 5 is a cross-flow fan, for example, and is disposed within the housing 1. Also, the indoor heat exchanger 10 is arranged so as to cover a front face portion, a top face portion, and an upper part of a rear face portion of this blower 5.

[0014] The indoor heat exchanger 10 according to this embodiment is a fin-tube-type heat exchanger. Also, in this embodiment, the indoor heat exchanger 10 is constituted by a plurality of heat exchangers 10a, each using a circular-pipe-shaped heat transfer pipe 12, and a plurality of heat exchangers 10b, each using a flat-pipe-shaped heat transfer pipe 16. The heat exchangers 10a are provided with a plurality of fins 11, each formed of aluminum or aluminum alloy and the plurality of heat transfer pipes 12 (each having a circular-tube shape), each formed of aluminum or aluminum alloy. The fins 11 are layered at predetermined intervals, and the heat transfer pipes 12 (each having a circular-tube shape) are disposed so as to extend through these fins 11. The heat exchangers 10b are provided with a plurality of fins 15 formed of aluminum or aluminum alloy and the plurality of the heat transfer pipes 16 (each having a flat-tube shape), each formed of aluminum or aluminum alloy. The fins 15 are layered at predetermined intervals, and the heat transfer pipes 16 (each having a flat-tube shape) are disposed so as to extend through these fins 15.

[0015] When the blower 5 is driven, the indoor air of the air-conditioned space 110 is sucked into the housing 1 through the inlet 2. This indoor air is heated or cooled while passing through the indoor heat exchanger 10 and becomes air-conditioning air. This air-conditioning air is blown out of the outlet 3. That is, the indoor heat exchanger 10 according to this embodiment is formed such that the heat exchangers 10a using the circular-pipe-shaped heat transfer pipes 12 are arranged on the upstream side of an air path and the heat exchangers 10b using the flat-pipe-shaped heat transfer pipes 16 are arranged on the downstream side of the air path. The indoor heat exchanger 10 has a configuration that can be thermally divided into two parts (between the heat exchangers 10a and the heat exchangers 10b, for example), and a decompressing device 8 for re-heating and dehumidifying (an expansion valve, for example) is connected between the heat exchangers thermally divided into two parts. As a result, a part of the indoor heat exchanger 10 can be made to function as a condenser during a cooling operation, for example, and the remaining part of the indoor heat exchanger

10 can be made to function as an evaporator. By thermally dividing the indoor heat exchanger 10 into two parts as above, when dehumidification is performed during the cooling operation, the temperature of the air-conditioning air blown out of the outlet 3 is prevented from falling excessively.

[0016] This indoor heat exchanger 10 is provided with a connection pipeline 20. That is, one of the ends of the connection pipeline 20 is connected to the heat transfer pipe (at least either of the heat transfer pipe 12 and the heat transfer pipe 16) of the indoor heat exchanger 10. This connection pipeline 20 is a pipeline formed of copper or copper alloy and is pulled to the outside of the room through a hole portion 112 formed in the wall 111. On the other end of the connection pipeline 20, a flare-nut connection portion 29 is disposed. By connecting a flare-nut connection portion 51 of an extension pipeline 50 connected to the outdoor unit 101 with the flare-nut connection portion 29, the indoor unit 100 and the outdoor unit 101 are connected to each other. That is, by connecting the flare-nut connection portion 51 and the flare-nut connection portion 29 to each other, the indoor heat exchanger 10 is connected to constituent elements (such as a compressor, an outdoor heat exchanger and the like, not shown) of the refrigerating cycle circuit disposed in the indoor unit 101, thus forming a refrigerating cycle circuit.

[0017] As will be described later, the connection pipeline 20 is constituted by two pipelines (a gas pipeline 30 and a liquid pipeline 40). Thus, the flare-nut connection portion 29 is also constituted by two flare-nut connection portions (a flare-nut connection portion 39 of the gas pipeline 30 and a flare-nut connection portion 49 of the liquid pipeline 40). Therefore, the extension pipeline 50 is also constituted by two pipelines, and the flare-nut connection portion 51 of the extension pipeline 50 is also constituted by two flare-nut connection portions.

[0018] Subsequently, details of the connection pipeline 20 will be described.

[0019] Figs. 2A and 2B are perspective views illustrating a heat exchanger according to the embodiment of the present invention. Also, Fig. 3 is a front view (enlarged view of an essential part) illustrating this heat exchanger, and Fig. 4 is a side view illustrating this heat exchanger. Fig. 2A and Fig. 2B are separate diagrams used to explain the gas pipeline 30 and the liquid pipeline 40 and they are the same except for the reference numerals used. By using Figs. 2A to 4, details of the connection pipeline 20 according to this embodiment will be described.

[0020] The connection pipeline 20 is provided with the gas pipeline 30 and the liquid pipeline 40. Here, the gas pipeline corresponds to a first refrigerant pipeline in the present invention, and the liquid pipeline corresponds to a second refrigerant pipeline in the present invention.

[0021] The gas pipeline 30 is a refrigerant pipeline through which mainly a gas refrigerant flows. Thus, in the case of a cooling operation (if the indoor heat exchanger 10 functions as an evaporator), the refrigerant flowing through heat transfer pipes 12 and 16 of the indoor heat exchanger 10 flows out of the indoor unit 100 through the gas pipeline 30. Also, in the case of a heating operation (if the indoor heat exchanger 10 functions as a condenser), the refrigerant flowing through the heat transfer pipes 12 and 16 of the indoor heat exchanger 10 flows thereinto through the gas pipeline 30.

[0022] The liquid pipeline 40 is a refrigerant pipeline through which mainly a liquid refrigerant flows. Thus, in the case of a cooling operation (when the indoor heat exchanger 10 functions as an evaporator), the refrigerant flowing through heat transfer pipes 12 and 16 of the indoor heat exchanger 10 flows thereinto through the liquid pipeline 40. Also, in the case of a heating operation (if the indoor heat exchanger 10 functions as a condenser), the refrigerant having flowed through the heat transfer pipes 12 and 16 of the indoor heat exchanger 10 flows out of the indoor unit 100 through the liquid pipeline 40. Depending on the configuration of the refrigerating cycle circuit, the refrigerant having flowed through a decompressing device, which is a constituent element of the refrigerating cycle circuit, might flow through the liquid pipeline 40. In this case, the refrigerant flowing through the liquid pipeline 40 is a liquid-rich gas-liquid two-phase refrigerant.

[0023] In this embodiment, the gas pipeline 30 is constituted by an aluminum pipeline 31 formed of aluminum or aluminum alloy and a copper pipeline 32 formed of copper or copper alloy. At the same time, the liquid pipeline 40 is constituted by an aluminum pipeline 41 formed of aluminum or aluminum alloy and a copper pipeline 42 formed of copper or copper alloy. That is because of the following reasons.

[0024] Usually, the flare-nut connection portions that connect the extension pipeline 50, which has two pipelines, to the gas pipeline 30 and the liquid pipeline 40 have female screw portions disposed on pipelines (the extension pipeline 50, for example) and male screw portions disposed on the other pipelines (the gas pipeline 30 and the liquid pipeline 40, for example), which are connected respectively. Each of the female screw portions has a female screw formed on the inner face thereof, and a through hole communicating with a space where this female screw is formed is formed. One of the pipelines (the extension pipeline 50, for example) has the diameter of the end portion thereof expanded by flare working and is inserted into this through hole. Also, the male screw portion disposed on each of the other pipelines (the gas pipeline 30 and the liquid pipeline 40, for example) is attached to the pipeline end portion by brazing. By screwing the male screw portion and the female screw portion together, the flare-worked end portion of each of the pipelines (the extension pipeline 50, for example) is sandwiched between the female screw portion and the male screw portion, and the extension pipeline 50, which has two pipelines, is connected to the gas pipeline 30 and the liquid pipeline 40. Usually, the male screw portion and the female screw portion are formed of brass, considering workability, brazing performances with the copper pipeline and the like.

[0025] At this time, if the gas pipeline 30 is formed only by the aluminum pipeline 31, and the flare-nut connection portion 39 of the gas pipeline 30 is made to be a male screw portion made of brass, for example, brazing between the aluminum pipeline 31 and the flare-nut connection portion 39 becomes difficult. Also, since the aluminum pipeline 31 and the flare-nut connection portion 39 are metals that are different from each other, electric corrosion (galvanic corrosion) as will be described later might occur at the connection portion between both metals. Also, if the gas pipeline 30 is formed only by the aluminum pipeline 31 and the flare-nut connection portion 39 of the gas pipeline 30 is made to be a female screw portion made of brass, for example, since the aluminum pipeline 31 and the flare-nut connection portion 39 are metals that are different from each other, electric corrosion (galvanic corrosion) as will be described later might occur at the connection portion between both metals.

[0026] Also, if the gas pipeline 30 is formed only by the aluminum pipeline 31, and if the flare-nut connection portion 39 of the gas pipeline 30 is made to be a male screw portion made of aluminum or aluminum alloy, for example, the strength of the thread of the flare-nut connection portion 39 becomes insufficient. Also, at this time, since the flare-nut connection portion 51 of the extension pipeline 50, which is a copper pipeline, is a female screw portion made of brass, electric corrosion (galvanic corrosion) as will be described later might occur between the flare-nut connection portion 39 of the gas pipeline 30 and the flare-nut connection portion 51 of the extension pipeline 50.

[0027] Also, if the gas pipeline 30 is formed only by the aluminum pipeline 31, and if the flare-nut connection portion 39 of the gas pipeline 30 is made to be a female screw portion made of aluminum or aluminum alloy, for example, the strength of the thread of the flare-nut connection portion 39 becomes insufficient. Also, when the distal end portion of the aluminum pipeline 31 is to be flare-worked, the occurrence of cracking at the distal end portion of the aluminum pipeline 31 becomes a concern. Also, since the flare-nut connection portion 51 of the extension pipeline 50, which is a copper pipeline, is a male screw portion made of brass, electric corrosion (galvanic corrosion) as will be described later might occur at the connection portion between the flare-nut connection portion 39 of the gas pipeline 30 and the flare-nut connection portion 51 of the extension pipeline 50.

[0028] Also, if the gas pipeline 30 is formed only by the aluminum pipeline 31 and the flare-nut connection portion 39 of the gas pipeline 30 and the flare-nut connection portion 51 of the extension pipeline 50 are formed of aluminum or aluminum alloy, for example, the strength of the threads of the flare-nut connection portion 39 and the flare-nut connection portion 51 becomes insufficient. Also, if the flare-nut connection portion 39 of the gas pipeline 30 is made to be a female screw portion, when the distal end portion of the aluminum pipeline 31 is to be flare-worked, the occurrence of cracking at the distal end portion of the aluminum pipeline 31 becomes a concern. Also, in order to prevent electric corrosion (galvanic corrosion) as will be described later in the connection portion between the extension pipeline 50 and the flare-nut connection portion 51, it is necessary to form the extension pipeline 50 out of aluminum or aluminum alloy. Thus, if the flare-nut connection portion 51 of the extension pipeline 50 is made to be a female screw portion, when the distal end portion of the extension pipeline 50 is to be flare-worked, the occurrence of cracking at the distal end portion of the extension pipeline 50 becomes a concern.

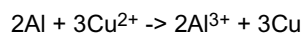
[0029] Then, in this embodiment, the gas pipeline 30 is constituted by the aluminum pipeline 31 and the copper pipeline 32. That is, a flare-nut connection portion 39 made of brass, which is a male screw portion or a female screw portion, is disposed in the distal end portion of the copper pipeline 32 so as to prevent the thread from having insufficient strength or the occurrence of cracking in the pipeline distal end portion during the flare-working, which is a concern. Similarly, the liquid pipeline 40 is constituted by the aluminum pipeline 41 and the copper pipeline 42, and the flare-nut connection portion 49 made of brass, which is a male screw portion or a female screw portion, is disposed in the distal end portion of the copper pipeline 42 so as to prevent the thread from having insufficient strength or the occurrence of cracking in the pipeline distal end portion during the flare-working, which is a concern.

[0030] Here, in this embodiment, a connection portion 37 between the aluminum pipeline 31 and the copper pipeline 32 is connected by eutectic bonding. Also, an end portion on the side opposite the connection portion 37 of the aluminum pipeline 31 is connected to the heat transfer pipe 12 or the heat transfer pipe 16 by brazing, for example. Similarly, a connection portion 47 between the aluminum pipeline 41 and the copper pipeline 42 is connected by eutectic bonding. Also, an end portion on the side opposite the connection portion 47 of the aluminum pipeline 41 is connected to the heat transfer pipe 12 or the heat transfer pipe 16 by brazing, for example.

[0031] In more detail, the connection portions 37 and 47 of the aluminum pipelines 31 and 41 and the copper pipelines 32 and 42 are illustrated in Fig. 6. That is, the distal end portions of the copper pipelines 32 and 42 are inserted into the distal end portions of the aluminum pipelines 31 and 41. Then, the both connection portions are eutectic bonded (bonding by forming eutectic alloy by bringing the metals into contact at a certain temperature). If water adheres to the connection portions 37 and 47, electric corrosion (galvanic corrosion) occurs in the connection portions 37 and 47 (or in more detail, a portion made of aluminum or aluminum alloy) due to the principle, which will be described later. Thus, in order to make the connection portions 37 and 47 waterproof, it is desirable that the connection portions 37 and 47 are covered by a heat shrinkable tube or the connection portions 37 and 47 are painted.

[0032] Also, in this embodiment, in order to prevent the occurrence of electric corrosion (galvanic corrosion) in the aluminum pipelines 31 and 41, the gas pipeline 30 and the liquid pipeline 40 are formed in the form as described below.

[0033] If water containing copper ions (Cu^{2+}) splashes over aluminum or aluminum alloy, aluminum or aluminum alloy becomes:



due to a difference in ionization tendency. That is, aluminum is ionized, and electric corrosion (galvanic corrosion) occurs in aluminum or aluminum alloy.

[0034] On the other hand, even when water droplets containing aluminum ions (Al^{3+}) adhere to aluminum or aluminum alloy, since they are the same atoms, electric corrosion (galvanic corrosion) does not occur in aluminum or aluminum alloy. Even when water droplets containing aluminum ions (Al^{3+}) adhere to copper or copper alloy, since copper has an ionization tendency smaller than that of aluminum, electric corrosion (galvanic corrosion) does not occur in copper or copper alloy.

[0035] Thus, in this embodiment, a descending portion 33 where the gas pipeline 30 is arranged substantially in the perpendicular direction is formed in the gas pipeline 30. The descending portion 33 is formed of an upper curved portion 34, a straight portion 35, and a lower curved portion 36. Also, the upper part of the descending portion 33 is the aluminum pipeline 31, and the lower part of the descending portion 33 is the copper pipeline 32. The connection portion 37 between the aluminum pipeline 31 and the copper pipeline 32 is arranged in the straight portion 35 of the descending portion 33.

[0036] Similarly, a descending portion 43 where the liquid pipeline 40 is arranged substantially in the perpendicular direction is formed in the liquid pipeline 40. The descending portion 43 is formed of an upper curved portion 44, a straight portion 45, and a lower curved portion 46. Also, an upper part of the descending portion 43 is the aluminum pipeline 41, and a lower part of the descending portion 43 is the copper pipeline 42. The connection portion 47 between the aluminum pipeline 41 and the copper pipeline 42 is arranged in the straight portion 45 of the descending portion 43.

[0037] As described above, by forming the descending portions 33 and 43 in the gas pipeline 30 and the liquid pipeline 40, and by arranging the connection portions 37 and 47 in the straight portions 35 and 45 of the descending portions 33 and 43, the copper pipelines 32 and 42 are arranged in the lower part in the gravity direction than the aluminum pipelines 31 and 41. Thus, the adhesion of water adhering to the copper pipelines 32 and 42 to the aluminum pipelines 31 and 41 can be prevented, and the occurrence of electric corrosion (galvanic corrosion) in the aluminum pipelines 31 and 41 can be prevented.

[0038] In this embodiment, the descending portions 33 and 43 are arranged substantially in the perpendicular direction, but it is needless to say that the descending portions 33 and 43 may be arranged diagonally. That is, it is only necessary that in the descending portions 33 and 43, the copper pipelines 32 and 42 are arranged in the lower part in the gravity direction than the aluminum pipelines 31 and 41.

[0039] Also, in this embodiment, when the gas pipeline 30 is bent at installation or transfer of the indoor unit 100, in order to prevent the gas pipeline 30 from being crushed, a spring 60 made of spring steel, for example, covers the descending portion 33 from the lower curved portion 36 to the straight portion 35. Thus, the connection portion 37 of the aluminum pipeline 31 with the copper pipeline 32 is arranged above the upper end portion of the spring 60. As a result, since the spring 60 is not brought into contact with the aluminum pipeline 31, water adhering to the spring 60 is prevented from adhering to the aluminum pipeline 31, and the occurrence of electric corrosion (galvanic corrosion) in the aluminum pipeline 31 can be also prevented. Also, even if water adhering to the copper pipeline 32 rises through the spring 60, the adhesion of this water to the aluminum pipeline 31 can be prevented, and the occurrence of electric corrosion (galvanic corrosion) in the aluminum pipeline 31 can be prevented.

[0040] In this embodiment, the spring 60 is disposed only on the gas pipeline 30. That is because the gas pipeline 30 is more easily crushed than the liquid pipeline 40 since the pipe diameter of the gas pipeline 30 is larger than that of the liquid pipeline 40. In this embodiment, the gas pipeline 30 is formed by connecting the aluminum pipeline 31 of $\phi 9.52 \text{ mm} \times t 1.0 \text{ mm}$ and the copper pipeline 32 of $\phi 9.52 \text{ mm} \times t 0.8 \text{ mm}$. Also, the liquid pipeline 40 is formed by connecting the aluminum pipeline 41 of $\phi 7.00 \text{ mm} \times t 0.75 \text{ mm}$ and the copper pipeline 42 of $\phi 7.00 \text{ mm} \times t 0.60 \text{ mm}$.

[0041] Also, in this embodiment, the spring 60 is not disposed on the liquid pipeline 40, but it is desirable that the connection portion 47 of the liquid pipeline 40 (the connection portion between the aluminum pipeline 41 and the copper pipeline 42) is arranged above the upper end portion of the spring 60. This is because the liquid pipeline 40 and the gas pipeline 30 are disposed close to each other in many cases. By arranging the connection portion 47 of the liquid pipeline 40 above the upper end portion of the spring 60, the spring 60 is no longer brought into contact with the aluminum pipeline 41, and the adhesion of water adhering to the spring 60 to the aluminum pipeline 41 can be prevented, and the occurrence of electric corrosion (galvanic corrosion) in the aluminum pipeline 41 can be prevented. Also, even if water adhering to the copper pipeline 32 of the gas pipeline 30 rises through the spring 60, the adhesion of this water to the aluminum pipeline 41 of the liquid pipeline 40 can be prevented, and the occurrence of electric corrosion (galvanic corrosion) in the aluminum pipeline 41 can be prevented.

[0042] Also, in this embodiment, in order to prevent breakage of the gas pipeline 30 and the liquid pipeline 40 during installation or transfer of the indoor unit 100, the gas pipeline 30 and the liquid pipeline 40 are formed in the shapes

described below.

[0043] As illustrated in Fig. 1, when the indoor unit 100 is installed, the connection pipeline 20 (the gas pipeline 30 and the liquid pipeline 40) is pulled to the outside through the hole portion 112 in the wall 111. At this time, the position of the hole portion 112 in the wall 111 and the installation position of the indoor unit 100 are different depending on installation environment. Thus, the gas pipeline 30 and the liquid pipeline 40 should be able to be twisted in a desired direction within a range of approximately 180° around the descending portions 33 and 43 as illustrated in Fig. 5 (plan view).

[0044] If the gas pipeline 30 and the liquid pipeline 40 are twisted around the descending portions 33 and 43, twisting deformation occurs in the descending portions 33 and 43 by a twisting moment applied to them. Because of this twisting deformation, leakage of a refrigerant caused by a breakage or the occurrence of refrigerant pressure loss caused by a pipeline being crushed is a concern in the descending portions 33 and 43.

[0045] Thus, in this embodiment, in the straight portion 35 of the descending portion 33 of the gas pipeline 30, a length L1 of the aluminum pipeline 31 is set longer than a length L2 of the copper pipeline 32 as illustrated in Fig. 2A. Also, as illustrated in Fig. 2B, in the straight portion 45 in the descending portion 43 of the liquid pipeline 40, a length L3 of the aluminum pipeline 41 is set longer than a length L4 of the copper pipeline 42. As a result, a breakage of the gas pipeline 30 and the liquid pipeline 40 during installation or transfer of the indoor unit 100 is prevented.

[0046] In more detail, the aluminum pipelines 31 and 41 have lower resistance to a twisting moment than the copper pipelines 32 and 42. Thus, when a twisting moment is applied to the straight portions 35 and 45, the aluminum pipelines 31 and 41 are more easily deformed than the copper pipelines 32 and 42. Therefore, by setting the ratios of the aluminum pipelines 31 and 41 which are easily deformed to be larger than those of the copper pipelines 32 and 42, a twisting angle per unit length of each of the aluminum pipelines 31 and 41 can be made small. As a result, the portions of aluminum pipelines 31 and 41 in the straight portions 35 and 45 can flexibly respond to the applied twisting moment. That is, breakage (cracking, crushing or the like) in the portions of the aluminum pipelines 31 and 41 in the straight portions 35 and 45 can be prevented, and the occurrence of leakage of the refrigerant and refrigerant pressure loss can be prevented.

[0047] On the other hand, since the copper pipelines 32 and 42 have higher resistance to the twisting moment larger than those of the aluminum pipelines 31 and 41, deformation amounts in the portions of the copper pipelines 32 and 42 in the straight portions 35 and 45 are smaller. Thus, the portions of the copper pipelines 32 and 42 in the straight portions 35 and 45 are hardly broken (cracking, crushing or the like).

[0048] In the straight portions 35 and 45, for example, if the lengths L1 and L3 of the aluminum pipelines 31 and 41 are set shorter than the lengths L2 and L4 of the copper pipelines 32 and 42, in the aluminum pipelines 31 and 41, which are more easily deformed than the copper pipelines 32 and 42, the twisting angle per unit length becomes large. Thus, the portions of the aluminum pipelines 31 and 41 in the descending portions 33 and 43, leakage of the refrigerant caused by a breakage or the occurrence of refrigerant pressure loss caused by a pipeline being crushed is a concern.

[0049] Also, in order to reduce the twisting angle per unit length of the aluminum pipelines 31 and 41, the relative strength of the aluminum pipelines 31 and 41 can be improved with respect to the copper pipelines 32 and 42, but this method is not preferable. If the thickness of each of the aluminum pipelines 31 and 41 is increased, for example, an increase in the pressure loss in the aluminum pipelines 31 and 41 lowers the refrigerating cycle efficiency or raises the cost of the indoor heat exchanger 10. On the contrary, if the thickness of each of the copper pipelines 32 and 42 is decreased, the withstanding pressure or corrosion margin becomes insufficient.

[0050] As described above, in the indoor heat exchanger 10 according to this embodiment, in the straight portion 35 of the descending portion 33 of the gas pipeline 30, the length L1 of the aluminum pipeline 31 is made larger than the length L2 of the copper pipeline 32. Also, in the straight portion 45 in the descending portion 43 of the liquid pipeline 40, the length L3 of the aluminum pipeline 41 is set larger than the length L4 of the copper pipeline 42. Thus, in the descending portions 33 and 43, the twisting angle per unit length of each of the aluminum pipelines 31 and 41, which are easy to be deformed, can be made small. Therefore, when the indoor unit 100 is to be installed or transferred, a breakage of the connection pipeline 20 (the gas pipeline 30 and the liquid pipeline 40) can be prevented.

[0051] Here, by selecting a material which grows well from aluminum or aluminum alloy for the materials of the aluminum pipelines 31 and 41, the twisting angle which results in a breakage can be made larger, and a breakage of the connection pipeline 20 (the gas pipeline 30 and the liquid pipeline 40) can be prevented more effectively. Similarly, by selecting a material which stretches well from copper or copper alloy for the materials of the copper pipelines 32 and 42, the twisting angle which results in a breakage can be made larger, and a breakage of the connection pipeline 20 (the gas pipeline 30 and the liquid pipeline 40) can be prevented more effectively. In this embodiment, for the materials of the aluminum pipelines 31 and 41, A3003-O, which stretches well, is used. Also, for the materials of the copper pipelines 32 and 42, C1220-O, which stretches well, is used. According to JISH4000, A3003-O has stretch of 23% or more in a plate-shaped sample having the thickness of 0.8 to 1.3 mm. Also, according to JISH3100, C1220-O has stretch of 35% or more in a plate-shaped sample having the thickness of 0.3 to 30 mm.

[0052] In this embodiment, an example in which the heat exchanger according to the present invention is mounted on the indoor unit 100 has been described, but it is needless to say that the heat exchanger according to the present invention may be mounted on an outdoor heat exchanger. That is, in this embodiment, the example in which the heat

exchanger according to the present invention is used as the indoor heat exchanger 10 has been described, but it is needless to say that the heat exchanger according to the present invention may be used as an outdoor heat exchanger. [0053] Also, in this embodiment, the circular-pipe-shaped heat transfer pipe 12 and the flat-pipe-shaped heat transfer pipe 16 are both used in the indoor heat exchanger 10, but only either of them may be used. Also, in this embodiment, the present invention has been described using a fin-tube-type heat exchanger (indoor heat exchanger 10) as an example, but it is needless to say that the present invention can be applied to various types of heat exchangers. That is, the present invention can be put into practice by connecting the gas pipeline 30 and the liquid pipeline 40 described in this embodiment to a heat exchanger provided with a heat transfer pipe formed of aluminum or aluminum alloy.

Explanation of Reference Numerals

[0054]

1 housing, 2 inlet, 2a filter, 3 outlet, 4 air-direction adjustment mechanism, 5 blower, 8 decompressing device for re-heating and dehumidifying, 10 indoor heat exchanger, 10a heat exchanger, 10b heat exchanger, 11 fin, 12 heat transfer pipe (circular-pipe-shaped), 15 fin, 16 heat transfer pipe (flat-pipe), 20 connection pipeline, 29 flare-nut connection portion, 30 gas pipeline, 31 aluminum pipeline, 32 copper pipeline, 33 descending portion, 34 upper curved portion, 35 straight portion, 36 lower curved portion, 37 connection portion, 39 flare-nut connection portion, 40 liquid pipeline, 41 aluminum pipeline, 42 copper pipeline, 43 descending portion, 44 upper curved portion, 45 straight portion, 46 lower curved portion, 47 connection portion, 49 flare-nut connection portion, 50 extension pipeline, 51 flare-nut connection portion, 60 spring, 100 indoor unit, 101 outdoor unit, 110 air-conditioned space, 111 wall, 112 hole portion.

Claims

1. A heat exchanger (10) comprising:

a heat transfer pipe (12) formed of aluminum or aluminum alloy; and
a connection pipeline (20) through which a refrigerant flowing in from said heat transfer pipe (12) or a refrigerant flowing into said heat transfer pipe (12) passes, and mounted in an air conditioner, wherein:

said connection pipeline (20) has a gas pipeline (30) through which a gas refrigerant flows and a liquid pipeline (40) through which a liquid refrigerant or a gas-liquid two-phase refrigerant flows;
each of said gas pipeline (30) and said liquid pipeline (40) is constituted by connecting a first refrigerant pipeline (31, 41) formed of aluminum or aluminum alloy and a second refrigerant pipeline (32, 42) formed of copper and copper alloy using a connection portion (37, 47);
the first refrigerant pipeline (31, 41) is connected to said heat transfer pipe (12) to form a descending portion (33, 43) descending from said heat transfer pipe (12);
said connection portion (37, 47) is arranged in a straight part of said descending portion (33, 43); and
in the straight part of said descending portion (33, 43), said first refrigerant pipeline (31, 41) is longer than said second refrigerant pipeline (32, 42).

2. The heat exchanger (10) of Claim 1, wherein

a spring (60) that suppresses deformation of said gas pipeline (30) covers on a lower part of said descending portion (33, 43) of said gas pipeline (30); and
in a state when an air conditioner having the heat exchanger (10) is installed, said connection portion (37, 47) is arranged above an upper end portion of said spring (60).

3. The heat exchanger (10) of Claim 2, wherein

in the state when the air conditioner having the heat exchanger (10) is installed, said connection portion (37, 47) of said liquid pipeline (40) is arranged above the upper end portion of said spring (60) that covers said gas pipeline (30).

4. An air conditioner comprising the heat exchanger (10) according to any one of Claims 1 to 3.

FIG. 1

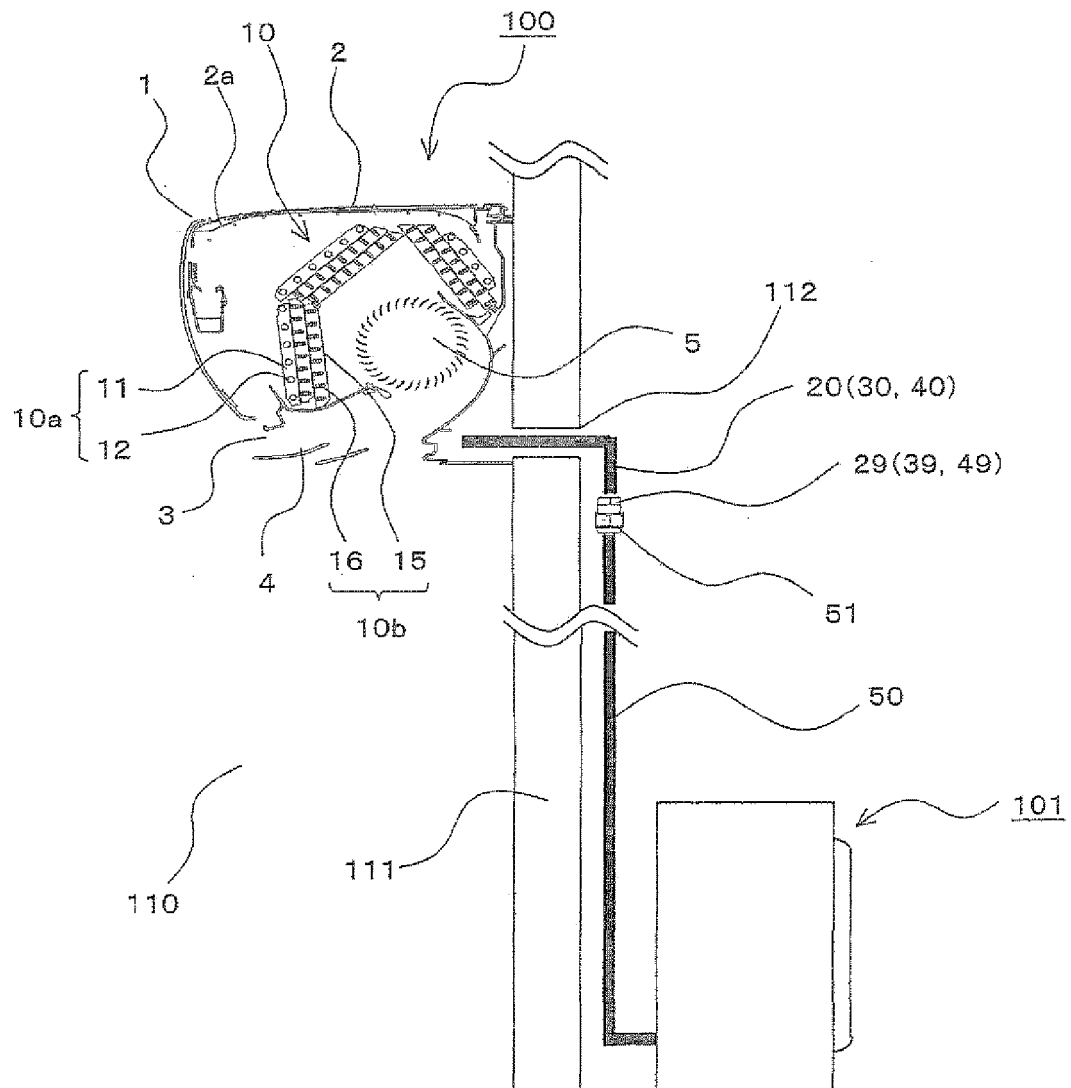


FIG. 2

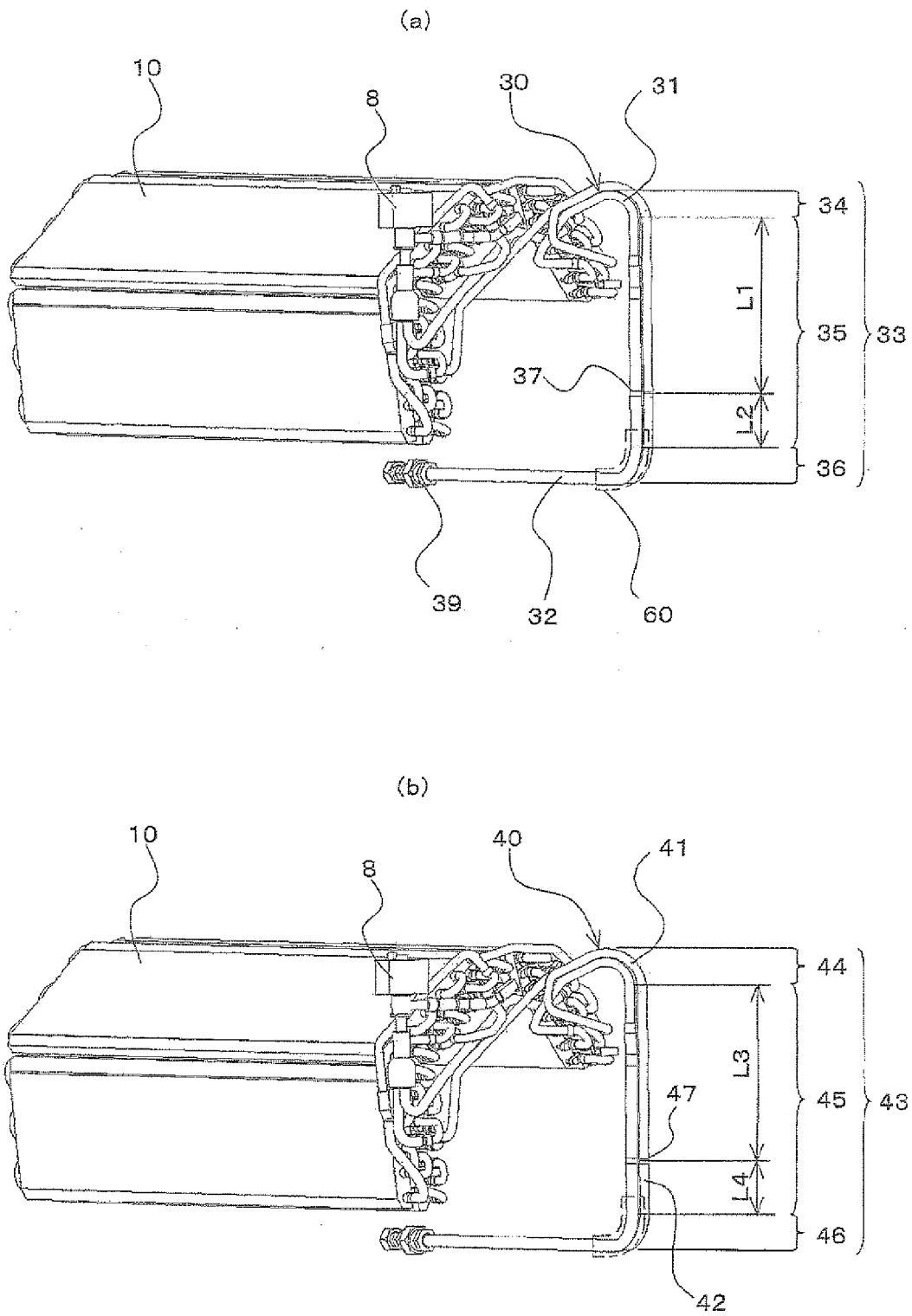


FIG. 3

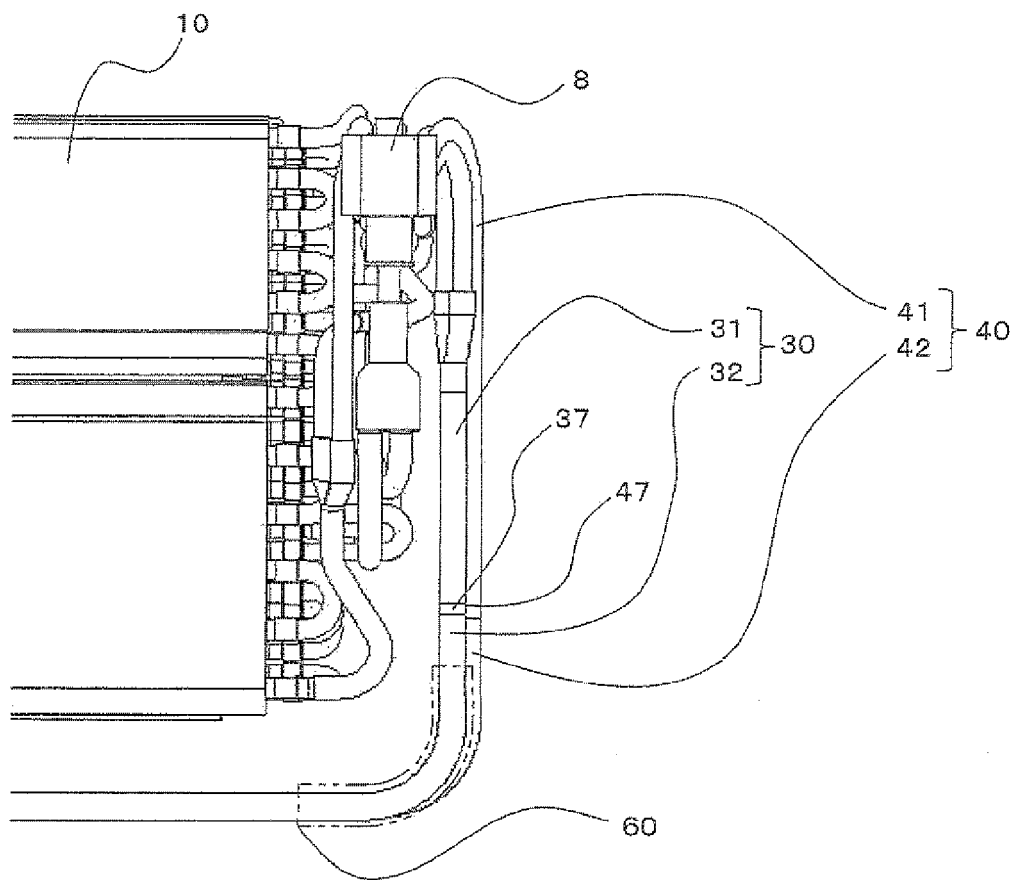


FIG. 4

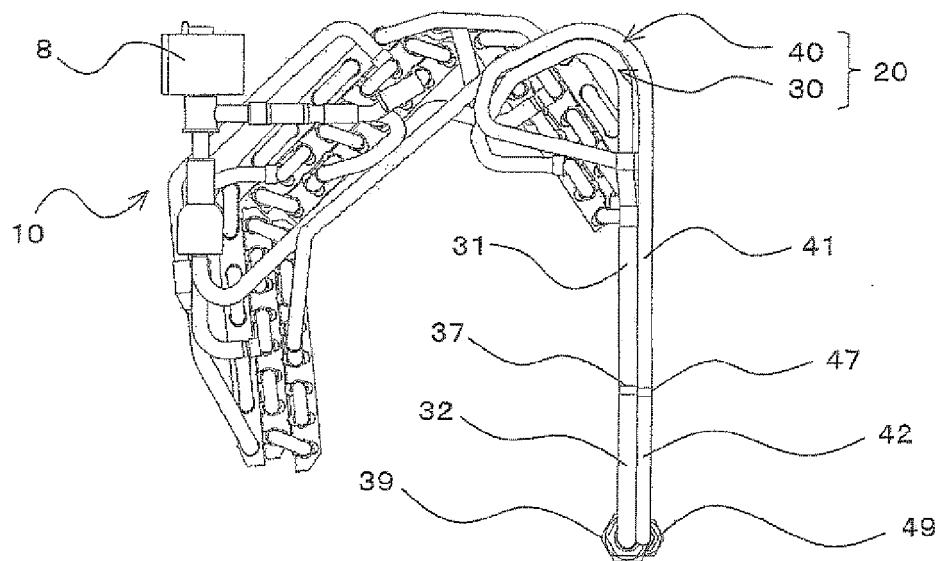


FIG. 5

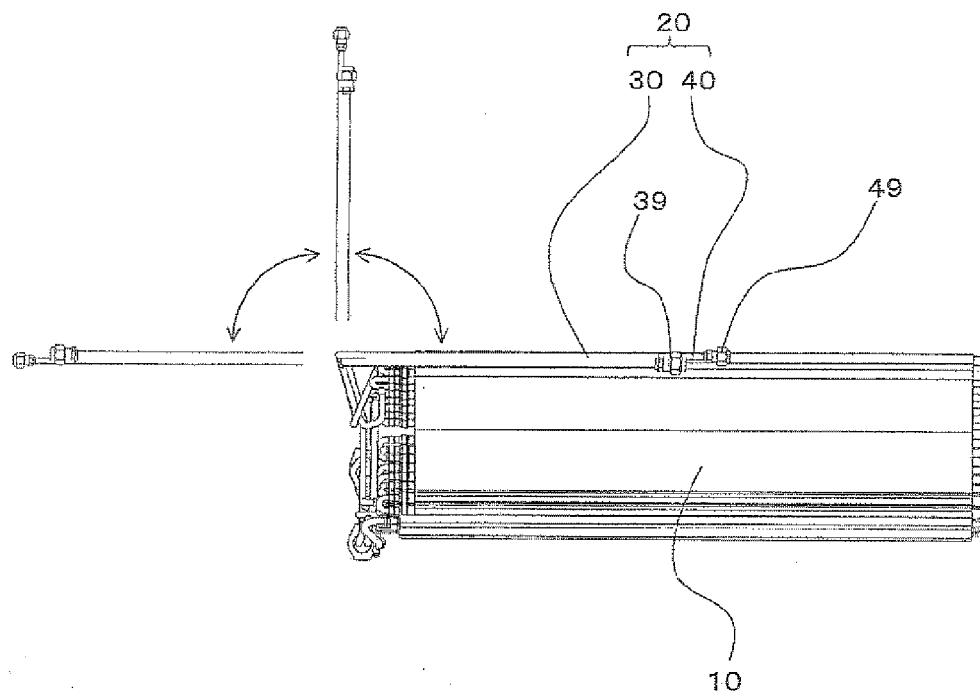
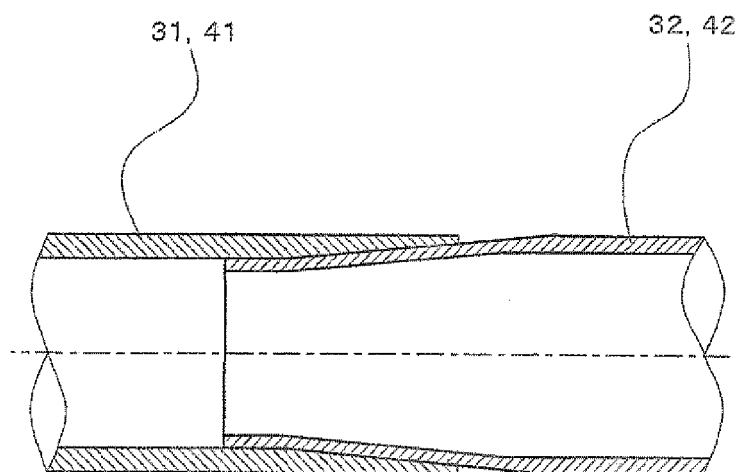


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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