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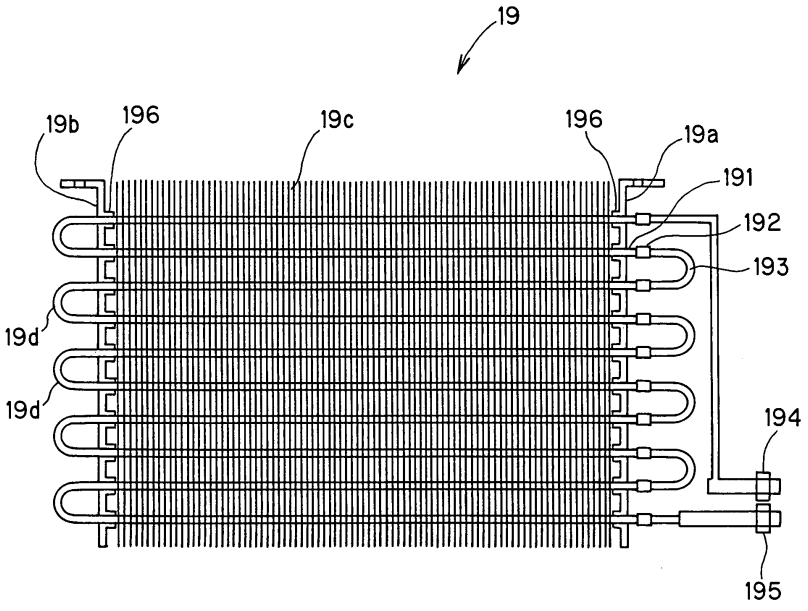
(54) Heat exchanger and air conditioner using the same

(57) In an air conditioner equipped with a heat exchanger (19) including a pair of pipe plates (19a, 19b), plural radiating fins (19c) located between the pair of pipe plates, and a refrigerant pipe (19d) that are passed through holes formed in the pair of pipe plates and the radiating fins in a meandering form, gap keeping projections are provided on the inner surfaces of the pipe plates that face the radiating fins adjacent to the pipe plates so that eachpipe plate is spaced from the corresponding adjacent radiating fin at a predetermined distance.

FIG. 3



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a heat exchanger and an air conditioner using the same, and particularly to an heat exchanger having a rust preventing mechanism for preventing occurrence of rust in an U-shaped portion of a refrigerant pipe, and an air conditioner using the heat exchanger.

2. Description of the Related Art

[0002] There is known an air conditioner including a heat exchanger, an air blower and a drain pan having a drain pool in which the lower end portion of the heat exchanger is submerged under water. The heat exchanger comprises a pair of pipe plates formed of sheet metal, plural radiating fins disposed between the pair of pipe plates, and a refrigerant pipe which is passed through holes formed in the pair of pipe plates and the plural radiating fins in a meandering form (see JP-A-9-243291).

[0003] In the air conditioner, the heat exchanger is designed so that the gap between each pipe plate and the radiating fin adjacent to the pipe plate concerned is narrow, and thus drain stocked in the drain pan rises up along the gap by the capillary phenomenon, and then invades into the clearance gaps of the holes formed in the pipe plates through which the refrigerant pipe is passed. Here, the capillary water invading into the clearance gaps of the holes formed in the pipe plates is evaporated by air flowing from the primary air side to the second air side through the respective gaps between the radiating fins in an indoor heat exchanger. Accordingly, it is estimated that the clearance gaps of the holes formed in the pipe plates through which the refrigerant pipe is passed are repetitively and alternately wetted and dried. In such a heat exchanger, the pipe plates are generally formed of iron, and the refrigerant pipe is generally formed of copper. That is, the pipe plates and the refrigerant pipe are formed of different kinds of metal. When capillary water invades into the gap between the pipe plate and the refrigerant pipe (i.e., different kinds of metal), and also particularly when salt content is dissolved in the capillary water, the same phenomenon as a so-called voltaic cell appears, and ions flow from the pipe plates of iron through the capillary water into the refrigerant pipe of copper, so that the heat exchanger is exposed to such an atmosphere that rust easily occurs in the cooper refrigerant pipe.

[0004] According to one type of heat exchanger, U-shaped pipes achieved by bending copper straight pipes in U-shape are inserted from the opposite side to the refrigerant pipe take-out side so as to pass through holes formed in a pair of pipe plates and plural radiating fins before fabrication, and the straight pipes thus passed are brazed to one another through bend pipes (copper pipes) at the refrigerant pipe take-out side. In this type of heat exchanger, the U-turn (U-shaped) portions of the refrigerant pipe which are turned in U-shape at the outside of the pipe plate are bent by cold working. Therefore, when distortion is accumulated at the U-turn portions, they are exposed to a more easily rusting atmosphere.

SUMMARY OF THE INVENTION

[0005] The present invention has been implemented in view of the foregoing situation, and has an object to provide a heat exchanger that can suppress occurrence of rust at U-shaped portions of a refrigerant pipe at the outside of a pipe plate due to the capillary phenomenon of drain water stocked in a drain pan, and an air conditioner using the heat exchanger.

[0006] In order to attain the above object, according to a first aspect of the present invention, there is provided a heat exchanger (19) comprising a pair of pipe plates (19a, 19b), plural radiating fins (19c) located between the pair of pipe plates, and a refrigerant pipe (19d) that are passed through holes formed in the pair of pipe plates and the radiating fins in a meandering form, characterized in that gap keeping projections are provided on the inner surfaces of the pipe plates that face the radiating fins adjacent to the pipe plates so that each pipe plate is spaced from the corresponding adjacent radiating fin at a predetermined distance.

[0007] In the above heat exchanger, the gap keeping projections are formed so as to surround the refrigerant pipe.

[0008] In the above heat exchanger, the gap keeping projections are formed by subjecting the holes in the pipe plates to burring processing.

[0009] Furthermore, according to a second aspect of the present invention, there is provided an air conditioner comprising a heat exchanger (19), an air blower (17), and a drain pan (18) having a drain pool in which the lower end portion of the heat exchanger is submerged, the heat exchanger comprising a pair of pipe plates (19a, 19b), plural radiating fins (19c) located between the pair of pipe plates, and a refrigerant pipe (19d) that are passed through holes formed in the pair of pipe plates and the radiating fins in a meandering form, characterized in that gap keeping projections are provided on the inner surfaces of the pipe plates that face the radiating fins adjacent to the pipe plates so that eachpipeplate is spaced from the corresponding adjacent radiating fin at a predetermined distance.

[0010] In the above air conditioner, the gap keeping projections are formed so as to surround the refrigerant pipe.

[0011] In the above air conditioner, the gap keeping projections are formed by subjecting the holes in the pipe plates to burring processing.

[0012] According to the heat exchanger and the air conditioner of the present invention, by providing the gap

keeping projections, the gap interval between the pipe plate and the adj acent radiating fin in the heat exchanger can be set to be larger than the normal interval. Therefore, drain water stocked in the drain pan can be prevented from rising up along the gap between the pipe plate and the radiating fin by capillary phenomenon. Therefore, the clearance gaps of the holes which are not submerged in the drain water and through which the refrigerant pipe is passed can be prevented from being repetitively wetted and dried, and thus an atmosphere under which occurrence of rust can be suppressed can be provided to the air conditioner.

[0013] According to the present invention, the gap interval between the pipe plate and the radiating fin adjacent to the pipe plate can be secured by the gap keeping projections. Therefore, the drain water stocked in the drainpan canbeprevented from rising up along the gap between the pipe plate and the radiating fin by the capillary phenomenon, and thus occurrence of rust at the places of the pipe plates through which the refrigerant pipe is passed can be suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a longitudinally-sectional side view showing an air conditioner of the present invention;
Fig. 2A is a bottom view showing the air conditioner of Fig. 1 from which a face panel and a drain pan are detached, and Fig. 2B is an enlarged side view showing a securing state of a motor which is viewed from A side of Fig. 2A; and
Fig. 3 is a front view showing an indoor heat exchanger of the air conditioner.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] Preferred embodiments according to the present invention will be described hereunder with reference to the accompanying drawings.

[0016] Fig. 1 is a longitudinally-sectional side view showing an air conditioner of the present invention. Fig. 2A is a bottom view showing the air conditioner which is suspended and fixed in the ceiling space from which a face panel and a drain pan are detached.

[0017] The air conditioner 10 of this embodiment includes an indoor heat exchanger, an air blower 17 and a drain pan 18 having drain pool 18a in which the lower end portion of the heat exchanger 19 is submerged under water, these elements being accommodated in an outer box 11 formed of sheet metal. The heat exchanger 19 comprises a pair of pipe plates 19a, 19b formed of sheet metal, plural radiating fins 19c located between the pair of pipe plates 19a, 19b, and a refrigerant pipe having a refrigerant pipe 19d which is passed through holes formed in the pair of pipe plates 19a, 19b and the plural radiating fins 19c in a meandering form. Particularly, the refrigerant pipe is folded back in U-shape at the outside of the pipe plates 19a, 19b as shown in Fig. 3.

[0018] The air conditioner 10 of this embodiment is characterized in that each of the pipe plates 19a and 190b of the indoor heat exchanger 19 is provided with a gap keeping member 196 for keeping a predetermined gap (interval) between the pipe plate 19a (19b) and the radiating fin 19c (nearest to each pipe plate). Specifically, the gap keeping member 196 comprise projections 196 formed on a surface of each pipe plate 19a, 19b which faces the radiating fin side, and the projections 196 serve to separate each pipe plate 19a, 19b from the adjacent radiating fin 19c at a predetermined distance (see Fig. 3).

[0019] Here, the air conditioner of this embodiment will be described in detail.

[0020] As shown in Figs. 1 and 2, the air conditioner 10 has the outer box 11 which is formed of a box-type sheet metal, designed to be opened at the lower end thereof and suspended from a ceiling slab 50. The inside of the outer box 11 is compartmented into a machine chamber 16 for accommodating the air blowing fan 17, and a heat exchanger chamber 14 for accommodating the indoor heat exchanger 19 by a partition plate 42. An internal heat insulating member 21 formed of resin foam (foamed polystyrene) is disposed in the heat exchanger chamber 15, and a drain 18 waterproof-coated with resin foam (foamed polystyrene) is provided so as to abut against the lower end of the internal heat insulating member 21. The indoor heat exchanger 19 is disposed on the drain pan 18 so that the upper surface thereof is in close contact with the internal heat insulating member 21. The air conditioner 10 is further provided with a face panel 14 that has an air suction port 12 and an air blow-out port 13 and fixedly covered on the opening of the lower end of the outer box 11. In Fig. 1, reference numeral 27 represents an electrically-driven expansion valve.

[0021] The air conditioner 10 thus constructed is a so-called one-way air blow-out type air conditioner. According to this air conditioner 10, indoor air is sucked from the air suction port 12 of the face panel 14 by driving the air blowing fan 17, and fed to a primary air side 15a of the heat exchanger 15. Then, the indoor air is passed through the respective gaps between the radiating fins of the indoor heat exchanger 19 to heat-exchange the air and refrigerant, and the heat-exchanged air is blown out from the air blow-out port 13.

[0022] The outer box 11 is designed as an box type having a front wall at the air blow-out port 13 side, a rear wall at the air suction port 12 side, and right and left side walls, an upper wall and an opened bottom, and suspending tags are provided to the right and left side walls. The lower end of a suspending bolt 31 suspended from the ceiling slab 50 is inserted through each suspending tag 30 and fastened by a nut, whereby the air conditioner is accommodated in the in-ceiling space under suspension. The box-shaped internal heat insulating member 21 formed of resin foam is provided in close contact with

the internal surface of the heat exchanger chamber 15 of the sheet metal outer box 11.

[0023] As shown in Fig. 1, the face panel 14 is covered on the opening of the lower end of the outer box 11 and fixed by screws. When the face panel 14 is detached, the inside of the machine chamber 16 of the outer box 11 is exposed and the drain pan 18 is exposed as shown in Fig. 2A. The face panel 14 has a grille 51 having plural openings arranged in a grid form, and the grille 51 is provided to the air suction port 12 so as to be detachable from the air suction port 12. A filter member 33 is provided on the grille 51 so as to be exchangeable byanewone. Furthermore, the air blow-out port 13 of the face panel 14 is provided with an air flow direction changing plate 34 formed of synthetic resin which is swingable within the vertical section in the width direction of the air blow-out port 13, and the tilt of the air flow direction changing plate 34 is adjustable by a micro-motor 35 so that the air flow direction can be changed. The driving and rotational direction of the micro-motor 35 can be controlled by transmitting a control signal (electrical waves) from a remote controller to an electrical equipment box 28 and by operating buttons of a controller (not shown) provided on the wall of the room.

[0024] As shown in Fig. 1, the partition plate 42 through which the indoor heat exchanger 19 and the air blowing fan 17 are partitioned in the outer box 11 is provided with an opening, and the air blowing port 17a of the air blowing fan 17 is fitted in the opening concerned. A sirocco fan is preferably used as the air blowing fan 17, and it is rotated by a motor 36.

[0025] The securing state of the motor 36 in the outer box 11 is as follows. As shown in Fig. 2A, the motor 36 has a shaft 60 extending in the right and left direction thereof, and the shaft 60 is fitted in a bearing 52. As shown in Fig. 2B, the partition plate 42 and the upper surface portion 61 are orthogonal to each other, and a motor bracket 37 is fixed by screws so as to stride between the partition plate 42 and the upper surface portion 61. The bearing 52 is mounted on a receiving portion 63 of the motor bracket 37, and fixed by a bearing holding member 62.

[0026] The driving of the motor 36 can be controlled by transmitting a control signal (electric waves) from the remote controller to the electric equipment box 28, and also by operating the buttons of the control device (not shown) provided on the wall of the room.

[0027] The indoor heat exchanger 19 is disposed so that the upper surface thereof is substantially in close contact with the upper wall of the internal heat insulating member 21, the lower surface thereof is mounted on the drain pan 18 formed of resin foam and the primary air side 15a and the secondary air side 15b are partitioned by the indoor heat exchanger 19.

[0028] In the indoor heat exchanger 19, dew condensation occurs in the radiating fin and other portions at which some temperature difference occurs during cooling operation. This dew condensation is received by the water-proof coated drain pan 18 formed of resin foam. As shown in Fig. 2, a liquid level senor 39 and a drain pump 40 are equipped to the bracket 38 provided to the partition plate 42 as a drain discharging unit. The liquid level sensor 39 and the drain pump 40 are located at the lowest position of the drain pool of the drain pan 18.

[0029] The drain pump 40 is actuated when the drain is stocked, and it pumps up the drain water and discharges the drain water from a drain port 41. The liquid level sensor 39 does not serve to turn on/off the drain pump. When the drain pump 40 breaks down or the like and thus drain water is stocked by the amount corresponding to the permissible limit level of the drain pan 18, the liquid level sensor 39 serves as an emergency unit for detecting this state and outputting a signal to the electrical equipment box 28 so that the operation of the air conditioner 10 is stopped and an alarm is output or the like.

[0030] Particularly, as shown in Fig. 3, the indoor heat exchanger 19 of this embodiment comprises a pipe plate 19a formed of sheet metal (iron) at the refrigerant pipe take-out side, a pipe plate 19b of sheet metal (iron) at the opposite side to the refrigerant pipe take-out side, plural radiating fins 19c formed of aluminum interposed between the pipe plates 19a, 19b, and a refrigerant pipe 19d arranged in a meandering form.

[0031] The refrigerant pipe 19d is constructed as follows. U-shaped pipes 191 each of which is achieved by bending a copper pipe inU-shapebefore fabrication are inserted and passed through holes formed in the pipe plates 19a and 19b and the plural radiating fins 19c from the opposite side to the refrigerant take-out side, and the respective end portions of the U-shaped pipes 191 at the refrigerant pipe take-out side are covered by sockets 192 and brazed. Then, bend pipes (copper pipes) 193 are inserted into the sockets 192 and brazed, thereby forming the meandering refrigerant pipe 19d. The refrigerant pipe 19d has refrigerant pipe take-out portions 194 and 195 (see Figs. 2A and 3).

[0032] Here, each of the pipe plates 19a and 19b at both the sides has a gap keepingmember on the inner surface thereof (the surface at the radiating fin side), and the gap keeping member serves to keep each pipe plate spaced from the radiating fin (the radiating fin adjacent to the pipe plate) at a predetermined distance. Specifically, the gap keeping member comprises gap keeping projections 196 projecting to the radiating fin side as shown in Fig. 3. Each of the gap keeping projections 196 is provided so as to surround each hole through which the refrigerant pipe 19d is passed. In this embodiment, the holes formed in the pipe plate through which the refrigerant pipe 19d are subjected to burring processing from the outer surface side of the pipe plate to form burrs (circumferential projections) projecting toward the radiating fins, and theseburrs serve as the gap keeping projections.

[0033] According to this embodiment, the gap keeping projections 196 are provided on the inner surfaces of the pipe plates 19a, 19b, and thus the gap interval between

the pipe plate 19a (19b) of the indoor heat exchanger 19 and the adjacent radiating fin 19c can be set to be larger than the normal gap interval. Accordingly, the drain water stocked in the drain pan 18 can be prevented from rising up along the gap between the pipe plate 19a (19b) and the adjacent radiating fin 19c by the capillary phenomenon. Therefore, the clearance gaps of the holes which are not submerged in the drain water and through which the refrigerant pipe 19d is passed can be prevented from being repetitively and alternately wetted and dried, and thus an atmosphere under which occurrence of rust can be suppressed can be provided to the heat exchanger (air conditioner). The predetermined gap interval at which the pipe plate and the radiation fin are spaced from each other to suppress occurrence of rust may be set to a value larger than the normal gap interval by 1mm to 2mm.

[0034] According to this embodiment, the gap keeping projections 196 are constructed as burrs (circumferential projections) projecting to the radiating fin side from the inner surface of the pipe plate. Therefore, the uniform gap can be easily secured between the pipe plate 19b and the radiating fin 19c, and also the number of steps is not increased, thereby preventing the cost-up.

[0035] The present invention is not limited to the above embodiment, and various kinds of modifications may be made without departing from the subject matter of the present invention.

[0036] In the above embodiment, the holes of the pipe plates through which the refrigerant pipe 19d is passed are subjected to the burring processing to form the gap keeping projections 196. However, the gap keeping projections may be formed at positions on the pipe plates which are spaced from the holes through which the refrigerant pipe 19d is passed.

[0037] In the above embodiment, the gap keeping projections are provided to all the holes formed in the pipe plates. However, it is not necessary to provide the gap keeping projections to all the holes formed in the pipe plates, and the gap keeping projections may be provided to some holes selected from all the holes formed in the pipe plates at proper positions so that the gap interval between the pipe plate and the radiating fin can be stably and surely set to a predetermined distance or more (i.e., to the extent that no rust occurs). Accordingly, in order to stably and surely keep the gap interval concerned, othermembers than the gap keeping projections may be provided. For example, washers, annular pins or the like may be used.

[0038] Furthermore,in the above embodiment,the presentinvention is applied to such a type of heat exchanger (air conditioner) that before the heat exchanger is assembled, the U-shaped pipes achieved by bending copper pipes in U-shape are inserted and passed through the holes formed in the pair of pipe plates and the plural radiating fins from the opposite side to the refrigerant pipe take-out side, and the straight pipes are brazed to one another through the bend pipes (copper pipes) at the refrigerant pipe take-out side. However, the present inventionmaybe applied to such a type of heat exchanger (air conditioner) that straight pipes (copper pipes) are passed through the holes formed in the pair of pipe plates and the plural radiating fins and these straight pipes are brazed to one another through bend pipes (copper pipes) at both the outer sides of the pipe plates.

[0039] Still furthermore, the present invention is applied to a one-way blow-out type air conditioner. However, the present invention may be applied to a two-way blow-out type or four-way blow-out type air conditioner. In addition, the present invention may be applied to other types of air conditioners such as a wall-mount type air conditioner, a built-in type air conditioner, a ceiling suspended type air conditioner, etc.

Claims

1. A heat exchanger (19) comprising a pair of pipe plates (19a, 19b), plural radiating fins (19c) located between the pair of pipe plates, and a refrigerant pipe (19d) that are passed through holes formed in the pair of pipe plates and the radiating fins in a meandering form, **characterized in that** gap keeping projections are provided on the inner surfaces of the pipe plates that face the radiating fins adjacent to the pipe plates so that each pipe plate is spaced from the corresponding adjacent radiating fin at a predetermined distance.

2. The heat exchanger according to claim 1, wherein the gap keeping projections are formed so as to surround the refrigerant pipe.

3. The heat exchanger according to claim 2, wherein the gap keeping projections are formed by subjecting the holes in the pipe plates to burring processing.

4. An air conditioner comprising a heat exchanger (19), an air blower (17), and a drain pan (18) having a drain pool in which the lower end portion of the heat exchanger is submerged, the heat exchanger comprising a pair of pipe plates (19a, 19b), plural radiating fins (19c) located between the pair of pipe plates, and a refrigerant pipe (19d) that are passed through holes formed in the pair of pipe plates and the radiating fins in a meandering form, **characterized in that** gap keeping projections are provided on the inner surfaces of the pipe plates that face the radiating fins adjacent to the pipe plates so that each pipe plate is spaced from the corresponding adjacent radiating fin at a predetermined distance.

5. The air conditioner according to claim 4, wherein the gap keeping projections are formed so as to surround the refrigerant pipe.

6. The air conditioner according to claim 5, wherein the

gap keeping projections are formed by subjecting the holes in the pipe plates to burring processing.

FIG. 1

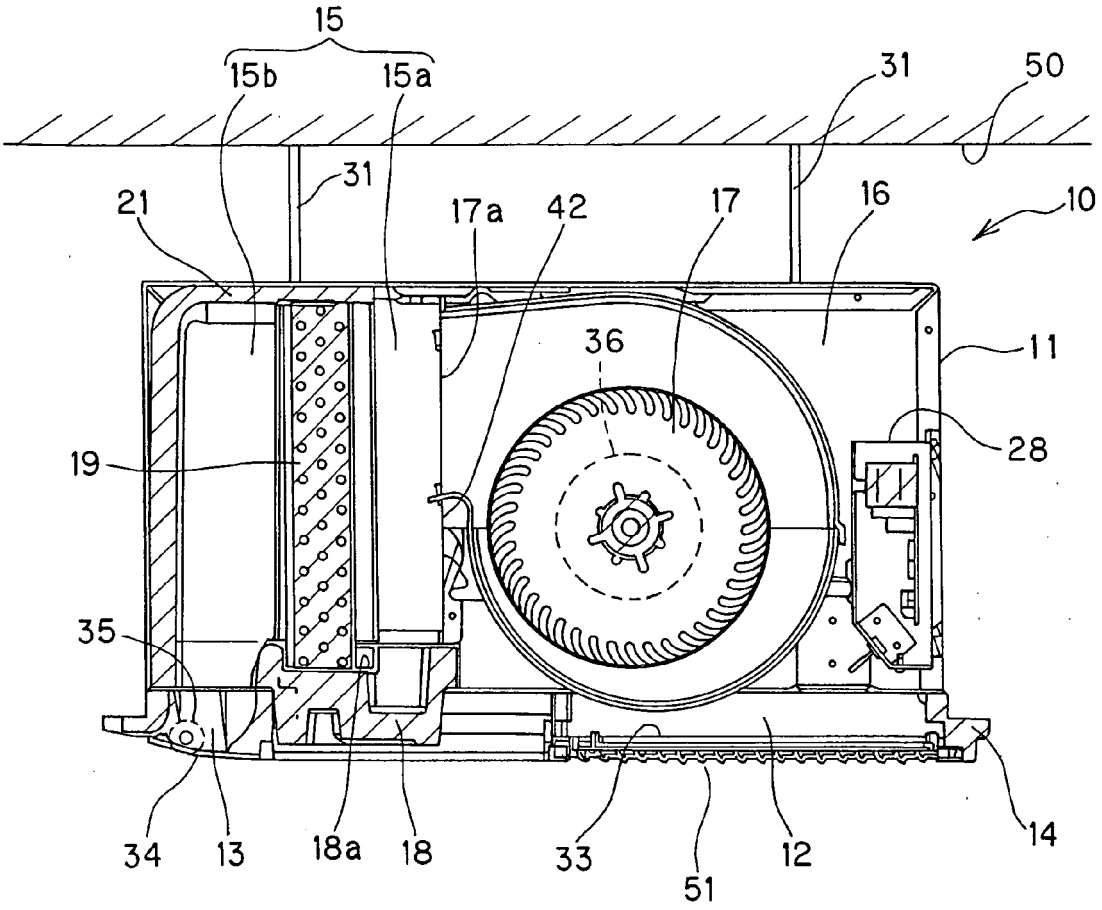
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FIG. 2A

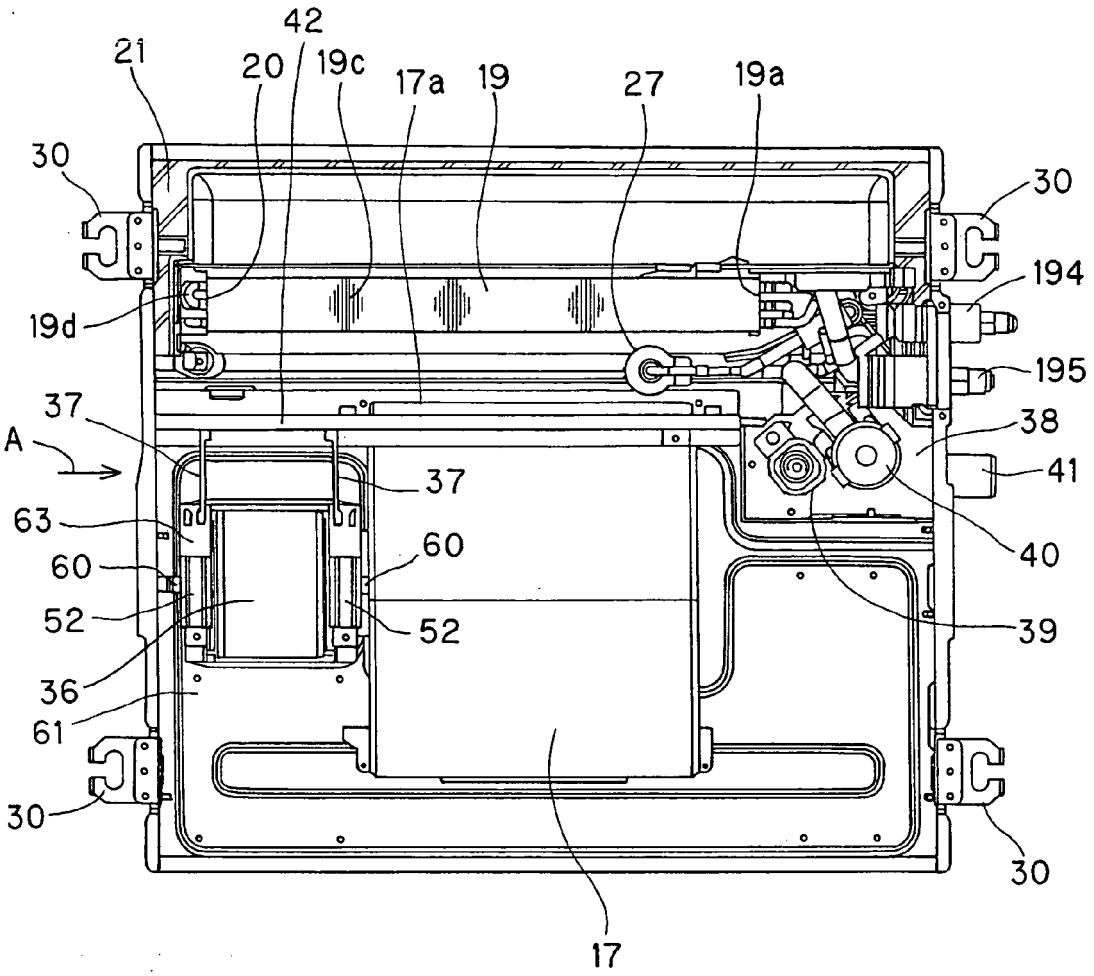
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FIG. 2B

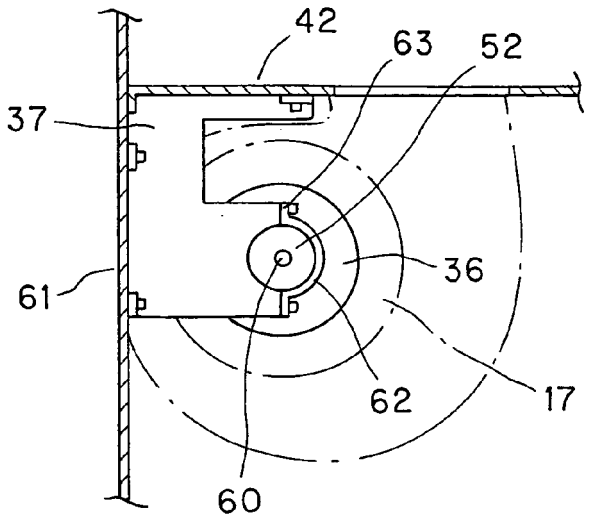
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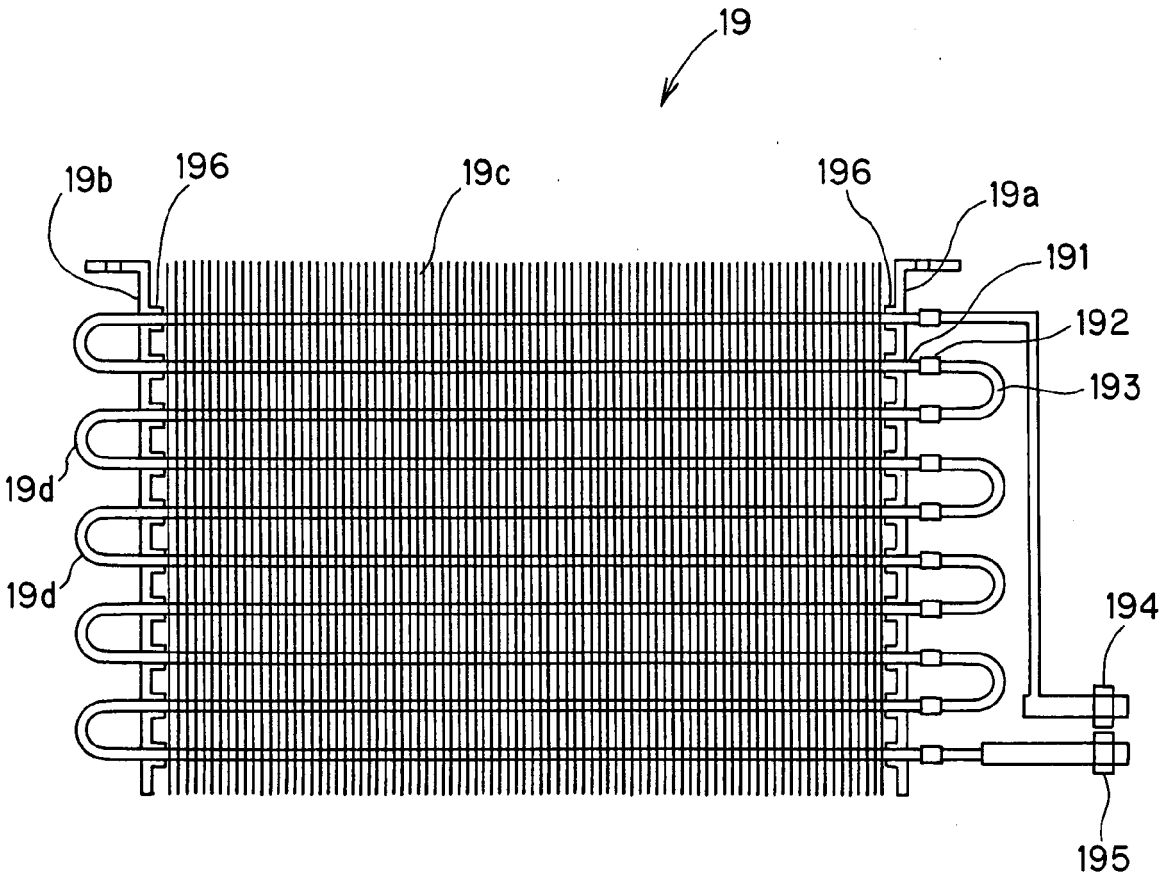
FIG. 3



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 9243291 A **[0002]**