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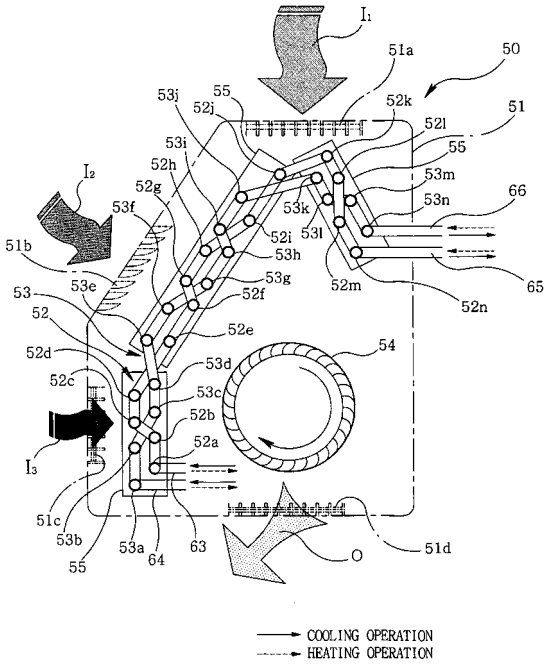
(54) Heat exchanger for improving thermal efficiency and air conditioner mounted therewith

(57) A heat exchanger of an air conditioner is disclosed whereby refrigerant is not biased to a particular heat exchange line but evenly flows in all the heat exchange lines. The heat exchanger comprises: a housing (51) having air inlets (51a, 51b,51c) and an air outlet (51d); and a plurality of heat exchange lines (52,53) each formed inside the housing (51) in a serpentine shape for refrigerant to flow and switch the flow direction, and wherein the plurality of heat exchange lines (52,53) are arranged in such a manner that each line crosses each other before and after the infusion directions of air introduced via the air inlets.

FIG. 3



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Description

[0001] The document relates to an air conditioner. More particularly, the document relates to a heat exchanger for air conditioner configured to prevent refrigerant from being excessively concentrated to a particular heat exchange line.

[0002] In general, the air conditioner refers to a cooler for cooling an indoor air and a heater for heating the indoor air. Recently, the air conditioner is developed to a multi-type air conditioner which can cool and heat at the same time enabling to cool or heat all the rooms in the same operation mode for maintaining a more comfortable room environment without being influenced from external weather or environment.

[0003] FIG. 1 is a representation schematically illustrating a multi-type air conditioner according to the prior art. The air conditioner shown in FIG.1 largely includes an outdoor unit (10) installed in outdoor and an indoor heat exchanger (20) installed in indoor. The outdoor unit (10) further includes a compressor (11) for compressing refrigerant to high pressure and high temperature, an outdoor heat exchanger (12) for heat exchanging the refrigerant with an outdoor air, an outdoor fan device (13) for forcibly blowing ambient air of the outdoor heat exchanger (12) to promote the heat exchange of the outdoor heat exchanger (12), and an expansion device (14) for adiabatic expansion of the refrigerant.

[0004] Furthermore, the indoor heat exchanger (20) includes first and second heat exchange lines (21. 22) in which the refrigerant circulates, and an indoor fan device (23) for forcibly blowing the ambient air of the indoor heat changer (20). Meanwhile, a refrigerant circle (a refrigerant cycling loop) is constructed in the form of the compressor (11)-the outdoor heat exchanger (12)-the expansion device (14)-the indoor heat exchanger (20).

[0005] In the air conditioner thus described according to the prior art, the outdoor heat exchanger (12) functions as a condensing device during cooling operation, the indoor heat exchanger (20) functions as an evaporating device and the refrigerant is circulated in the solid arrow direction to form a cooling cycle.

[0006] The refrigerant compressed in the compressor (11) to high temperature and high pressure in the cooling cycle is transferred to the outdoor heat exchanger (12), and the refrigerant in the outdoor heat exchanger (12) releases the heat in outdoor air to be condensed into a liquid refrigerant of middle temperature and high pressure state. The liquid refrigerant thus condensed passes the expansion device (14) is converted into a liquid refrigerant of low temperature and low pressure and transferred toward the indoor heat exchanger (20) via a first refrigerant tube (31).

[0007] The refrigerant transferred to the first refrigerant pipe (31) is divided at first and second branched tubes (33. 34) and flows into the first and second heat exchange lines (21. 22) and extracts the heat from the indoor air to cool the indoor. The refrigerant having passed the first heat exchange line (21) while conducting the cooling operation is discharged via a third branched tube (35), and the refrigerant having passed the second heat exchange line (22) is discharged via a fourth branched tube (36) to be converged at a second refrigerant tube (32) and flows into the compressor (11).

[0008] Meanwhile, in the air conditioner, the outdoor heat exchanger (10) functions as an evaporating device during heating operation, and the indoor heat exchanger (20) functions as a condensing device, where the refrigerant circulates along the arrow illustrated in FIG.1 to form a heating cycling loop.

[0009] The refrigerant in the heating cycle is compressed by the compressor (11) to flow toward the indoor heat exchanger (20) via the second refrigerant tube (32). The refrigerant having flowed toward the indoor heat exchanger (20) is divided by the first and second heat exchange lines (21. 22) via the third and fourth branched tubes (35. 36), and discharges heat into the indoor air and heats the indoor.

[0010] The refrigerant having finished the heating process converges on the first refrigerant tube (31) to flow into the expansion device (14). The refrigerant at the expansion device (14) is converted to a liquid refrigerant of low temperature and low pressure, which in turn passes the outdoor heat exchanger (12) to evaporate to a gaseous refrigerant of low temperature and low pressure and returns to the compressor (11).

[0011] FIG.2 illustrates a process in which the refrigerant in the indoor heat exchanger (20) heat-exchanges with the indoor air during the cooling and heating operations of the air conditioner.

[0012] Referring to FIG.2, the indoor heat exchanger (20) is frontally disposed with air intakes (20a. 20b. 20c) for sucking the air, each at an appropriate location. The indoor heat exchanger (20) is further disposed thereunder at an appropriate location thereof with an air outlet (20d) for discharging the air forcibly blown by the indoor fan device (23), where the air is introduced to i_1, i_2, i_3 directions via air inlets (20a.20b.20c)and discharged to 'o' direction.

[0013] As indicated in the solid arrow during the cooling operation, the refrigerant of low pressure and low temperature branched via the first branched tube (33) flow into the first heat exchange line (21) and the refrigerant branched via the second branched tube (34) flows to the second heat exchange line (22).

[0014] The first heat exchange line(21) is comprised of first through fourteenth tubes (21a) (21b) (21c) (21d) (21e) (21f) (21g) (21h) (21i) (21j) (21k) (21l)(21m)(21n)disposed on the indoor heat exchanger(20), and the second heat exchange line is comprised of first through fourteenth tubes (22a) (22b) (22c) (22d) (22e) (22f) (22g) (22h) (22i) (22j) (22k) (22l)(22m)(22n)disposed underneath the indoor heat exchanger (20).

[0015] However, with regard to flow of refrigerant passing through the first and second heat exchange lines (21.22) thus described, if there is a significant difference of quantity of the air introduced into the indoor heat exchanger (20) relative to introduction direction thereof, there occurs a difference of exchanged heat quantity passing through the first

and second heat exchangers (21.22). As a result, if there is a difference of exchanged heat amount of refrigerant according to the heat exchange lines, it is certain that a phenomenon occurs where flow rate of refrigerant is concentrated toward a particular heat exchange line due to change of phase difference of refrigerant.

[0016] In other words, the refrigerant is circulated in low flow rate in the second heat exchange line (22) on top of the indoor heat exchanger (20) during the cooling operation due to brisk heat exchange and vaporization. Meanwhile, the refrigerant is circulated in high flow rate in the first heat exchange line (21) underneath the indoor heat exchanger (20) due to dull heat exchange and vaporization. Particularly, the fifth through eighth tubes (21e through 21h) disposed at a lower end (A) of the first heat exchange line (21) can hardly contact the air, such that the refrigerant shows an abnormal circulation of low dryness at this end (A).

[0017] Meanwhile, the refrigerant of high pressure and high temperature is branched and flows to the first and second heat exchange lines (21.22) via the third and fourth branched tubes (35.36) along the arrow indicated in FIG.2. The refrigerant in the second heat exchange line (22) shows a high flow due to smooth heat exchange and condensation, while the refrigerant of high temperature and high pressure in the first heat exchange line (21) shows a low flow due to bad heat exchange and condensation. Particularly, the fifth through eighth heat exchange tubes (21e through 21h) having less air contact experience an abnormal flow of high dryness.

[0018] As described above, if there occurs a difference in air quantity infused into the indoor heat exchanger (20) due to infusion direction, there has occurred a phenomenon in the conventional air conditioner where refrigerant quantity is concentrated into a particular heat exchange line regardless of whether it is a cooling operation or a heating operation. The said flow concentration of refrigerant naturally tends to decrease the heat exchange efficiency of a heat exchanger and contribute to a direct cause of an entire performance of an air conditioner.

[0019] The present invention is disclosed to solve the aforementioned problems and it is an object of the present invention to provide a heat exchanger for an air conditioner, the heat exchanger configured to heat exchange by branching refrigerant into a plurality of heat exchange lines, the heat exchanger further configured to prevent the refrigerant from being excessively concentrated to a particular heat exchange line and to allow the refrigerant to flow evenly into all heat exchange lines.

[0020] Another object is to provide an air conditioner having an improved structure of a heat exchanger by allowing an even flow rate of the refrigerant in all the heat exchange lines, thereby enabling to enhance the heating and cooling efficiency.

[0021] In accordance with one object of the present invention, there is provided a heat exchanger for an air conditioner, the heat exchanger comprising: a housing having at least one air inlet and at least one air outlet; and a plurality of heat exchange lines each disposed in the housing and branched from a refrigerant tube into which refrigerant branched via a refrigerant tube is infused and in which the refrigerant switches flowing directions along the respective interiors thereof, wherein the plurality of heat exchange lines are arranged in such a manner that each line crosses before and after an infusion direction of air introduced via the air inlet.

[0022] In accordance with another object of the present invention, there is provided an air conditioner comprising: a compressor for compressing refrigerant; an outdoor heat exchanger connected to the compressor to allow the refrigerant to move therein and for heat exchanging between the refrigerant and outside air; an expansion device connected to the outdoor heat exchanger for the refrigerant to move therein; and an indoor heat exchanger connected to the expansion device and the compressor via refrigerant tubes for the refrigerant to move therein and for heat exchanging between the refrigerant and indoor air, wherein the indoor heat exchanger comprises: a housing having at least one air inlet and at least one air outlet for infusing and discharging the indoor air; and a plurality of heat exchange lines respectively disposed inside the housing, and into which the refrigerant branched via the refrigerant tube is infused and in which the refrigerant flows along each interior thereof changing flow directions, and wherein the plurality of heat exchange lines are arranged in such a manner that each line crosses before and after the infusion directions of air introduced via the air inlets.

[0023] Each heat exchange line is substantially the same in diameter and length thereof, and the air quantity initially contacting each heat exchange line is substantially the same, out of the air infused into the housing via the air inlets, and the heat exchanged quantity of the refrigerant passing through each heat exchange line is substantially the same.

[0024] Preferably, refrigerant inlets of each heat exchange line are contiguous thereamong so as to converge at one side of an interior of the housing, and refrigerant outlets of each heat exchange line are contiguous thereamong so as to converge at one side of an interior of the housing.

[0025] The heat exchanger according to the present invention may comprise: a heat transmission member coupled.to each heat exchange line for increasing a heat exchanging area of each heat exchange line; a housing having at least one air inlet and at least one air outlet; and a plurality of heat exchange lines into which refrigerant branched via a refrigerant tube is infused and in which the refrigerant switches flowing directions along the respective interiors thereof, wherein the plurality of heat exchange lines are arranged in such a manner that each line crosses before and after the infusion directions of air introduced via the air inlet.

[0026] According to the embodiment of the present invention, the refrigerant is prevented from being excessively

concentrated to a particular heat exchange line and allowed to flow evenly into all heat exchange lines, because the heat exchanged refrigerant flowing along each branched heat exchange line shows the same quantity of flow rate at the entire heat exchange line.

[0027] These and/or-other aspects and advantages of the present invention will become apparent and more readily appreciated from the following detailed description, taken in conjunction with the accompanying drawings in which:

FIG.1 is a schematic view of a conventional cooling-cum-heating air conditioner;
FIG.2 is an extracted view of an indoor heat exchanger of an air conditioner illustrated in FIG.1;
FIG.3 is a schematic exemplary structural view of a heat exchanger of an air conditioner according to the present invention;
FIG.4 is a schematic view illustrating a construction of an air conditioner disposed with a heat exchanger according to an embodiment of the present invention;
FIGS.5a and 5b are graphs each illustrating an operational effect of a heat exchanger according an embodiment of the present invention; and
FIG.6 is a schematic view illustrating a construction of an air conditioner disposed with a heat exchanger according to another embodiment of the present invention.

[0028] Preferred embodiments of a heat exchanger for an air conditioner according to the present invention will now be described with reference to the accompanying drawings.

[0029] FIG.3 is a schematic exemplary structural view of a heat exchanger of an air conditioner according to the present invention, FIG.4 is a schematic view illustrating a construction of an air conditioner disposed with a heat exchanger according to an embodiment of the present invention, and FIGS.5a and 5b are graphs each illustrating an operational effect of a heat exchanger according an embodiment of the present invention.

[0030] Referring to FIG.3, a heat exchanger according to an embodiment of the present invention is used as an indoor heat exchanger of an air conditioner where an indoor heat exchanger and an outdoor heat exchanger are separately provided. The heat exchanger includes a housing (51) having air inlets (51a. 51b. 51c) and an air outlet (51d); and first and second heat exchange lines (52. 53) in which refrigerant flows and heat exchanges.with ambient air, and an indoor fan device (54) for forcibly blowing the air inside the housing (51) outside of the housing (51) via the air outlet (51d).

[0031] The first heat exchange line (52) is disposed with first through fourteenth tubes (52a. 52b. 52c. 52d. 52e. 52f. 52g. 52h. 52i. 52j. 52k. 521. 52m. 52n), each approximately perpendicular to the air infused through the air inlets (51a. 51b. 51c), and connected to form an overall shape of a serpent. The flow direction of the refrigerant between the adjacent tubes is opposite. The first tube (52a) which is an inlet of the first heat exchange line (52) is connected to a first branched tube (63) and the fourteenth tube (52n) which is an outlet of the first heat exchange line (52) is connected to a third branched tube (65).

[0032] The second heat exchange line (53) which corresponds as a structurally composing element to the first heat exchange line (52) is the same in diameter and length as those of the first heat exchange line (52). The second heat exchange line (53) is also disposed with first through fourteenth tubes (53a. 53b. 53c. 53d. 53e. 53f. 53g. 53h. 53i. 53j. 53k. 53l. 53m. 53n), each approximately perpendicular to the air infused through the air inlets (51a. 51b. 51c), and connected to form an overall shape of a serpent. The first tube (53a) which is an inlet of the second heat exchange line (53) is connected to a second branched tube (64) and the fourteenth tube (53n) which is an outlet is connected to a fourth branched tube (66).

[0033] Referring again to FIG.3, the first heat exchange line (52) and the second heat exchange line (53) cross each other before and after the air inlets (51a. 51b. 51c).

[0034] In other words, the first heat exchange line (52) is arranged such that the third, fourth, seventh, eighth, tenth, eleventh and twelfth tubes (52c. 52d. 52g. 52h. 52j. 52k. 521) are disposed in front of the housing (51) which is in front of the second heat exchange line (53). The other remaining first, second, fifth, sixth, ninth, thirteenth and fourteenth tubes (52a. 52b. 52e. 52f. 52i. 52m. 52n) are disposed behind the housing (51) which is behind the second heat exchange line (53).

[0035] Furthermore, the second heat exchange line (53) is arranged such that the first, second, fifth, sixth, ninth, tenth, thirteenth and fourteenth tubes (53a. 53b. 53e. 53f. 53i. 53j. 53m. 53n) are disposed in front of the first heat exchange line (52) which is at the rear of the housing (51), and the remaining third, fourth, seventh, eighth, eleventh and twelfth tubes (53c. 53d. 53g. 53h. 53k. 531) are disposed at the rear of the first heat exchange line (52) which is at the rear of the housing (51).

[0036] Each first tube (52a. 53a) of the first and second heat exchange lines (52. 53) where the refrigerant is infused and discharged are adjacently disposed therebetween at one side of front lower end of the housing (51), and the fourteenth tubes (52n. 53n) which are respectively another inlet and outlet of refrigerant of the first and second heat exchange lines (52. 53) are adjacently disposed therebetween at one side of rear upper end of the housing (51).

[0037] Each tube of the first and second heat exchange lines (52. 53) where the refrigerant flows is coupled to a heat

transmission member (55) for increasing the air contact area so that the heat exchanges of refrigerant can be briskly performed.

[0038] Now, operation and effect of the heat exchanger of the air conditioner thus described according to the embodiments of the present invention will be explained in detail with reference to the annexed drawings.

[0039] Referring to FIG.4, a heat exchanging device disposed with a heat exchanger according to an embodiment of the present invention includes a compressor (41) for compressing refrigerant; an outdoor heat exchanger (42) connected to the compressor (41) to allow the refrigerant to move therein and for heat exchanging between the refrigerant and outside air; an expansion device (43) connected to the outdoor heat exchanger (42) for the refrigerant to move therein; and an indoor heat exchanger (50) connected to the expansion device (43) and the compressor (41) via first and second refrigerant tubes (61. 62) for the refrigerant to move therein and for heat exchanging between the refrigerant and indoor air.

[0040] When an air conditioner thus constructed is operated for cooling, the refrigerant flows toward a solid arrow. The refrigerant in the cooling cycle is initially compressed in the compressor (41) to high temperature and high pressure and is condensed to a liquid refrigerant of high pressure and middle temperature. The refrigerant thus condensed passes the expansion device (43) to be changed to liquid refrigerant of low temperature and low pressure, and flows toward the indoor heat exchanger (50) via the first refrigerant tube (61). The refrigerant flowing along the first refrigerant tube (61) is branched into the first and second heat exchange lines (52. 53) by the first and second branched tubes (63. 64) connected to the first refrigerant tube (61) and is kept flowing.

[0041] As illustrated in FIG.3, the refrigerant transmitted via the first refrigerant tube (61) zigzags from the first tube (52a) to the fourteenth tube (52n) of the first heat exchange line (52) and is heat exchanged by the driving of the indoor fan device (54) with the indoor air infused into the housing (51) via the air inlets (51a. 51b. 51c).

[0042] When the refrigerant flows along the third, fourth, seventh, eighth, tenth, eleventh and twelfth tubes (52c. 52d. 52g. 52h. 52j. 52k. 521) initially contacted by the air adjacent to the air inlets (51a. 51b. 51c), the heat exchange is briskly realized. However, when the refrigerant passes the first, second, fifth, sixth, ninth, thirteenth and fourteenth tubes (52a. 52b. 52e. 52f. 52i. 52m. 52n) disposed at the rear of the second heat exchange line (53), the heat exchanges are not that briskly realized. The refrigerant having passed the last fourteenth tube (52n), of the first heat exchange line (52) flows into the third branched tube (65).

[0043] Furthermore, the refrigerant transmitted to the second refrigerant tube (64) zigzags from the first tube (53a) to the fourteenth tube (53n) of the second heat exchange line (53) to heat exchange with the indoor air infused into the housing (51). When the refrigerant flows along the second heat exchange line (53), the heat exchange is briskly realized at the first, second, fifth, sixth, ninth, tenth, thirteenth and fourteenth tubes (53a. 53b. 53e. 53f. 53i. 53j. 53m. 53n) adjacent to the air inlets (51a. 51b. 51c), and when the refrigerant passes the third, fourth, seventh, eighth, eleventh and twelfth tubes (53c. 53d. 53g. 53h. 53k. 531) at the rear of the first heat exchange line (52); the heat exchange is a bit dulled. The refrigerant having passed the last fourteenth tube (53n) of the second heat exchange line (53) slips out via the fourth branched tube (66).

[0044] As mentioned above, because each tube of the first and second heat exchange lines (52. 53) crosses each other before and after the air inlet direction, the air quantity initially contacting the first heat exchange line (52) and the air quantity initially contacting the second heat exchange line (53) are almost the same, out of the air infused into i_1, i_2; i_3 directions via the air inlets (51a. 51b. 51c).

[0045] Although the inlet air initially contacts the seven tubes in the first heat exchange line (52), and the inlet air initially contacts the eight tubes in the second heat exchange line (53), the heat exchanged quantity at the first and second heat exchange lines (52. 53) is substantially the same because the tenth, eleventh and twelfth tubes (52j. 52k. 521) of the first heat exchange line (52) are disposed near the air inlet (51a) above the housing (51) where the air infusion quantity is large.

[0046] As a result, degree of vaporization and dryness of refrigerant passing the first and second heat exchange lines (52. 53) are the same, and the refrigerant quantity discharged from the fourteenth tube (52n) of the first heat exchange line (52) to the third branched tube (65) and the refrigerant quantity discharged from the fourteenth tube (53n) of the second heat.exchange line (53) to the fourth branched tube (66) are the same.

[0047] Referring to FIG.4, the refrigerant discharged into the third and fourth branched tubes (65. 66) merges at the second refrigerant tube (62) and is returned to the compressor (41), and the heat exchanged air is discharged by the drive of the indoor fan device (54) to the '0' direction via the air outlet (51d).

[0048] Meanwhile, when the air conditioner disposed with the heat exchanger according to the present invention is operated for heating, the refrigerant flows to the dotted arrow as shown in FIG.4.

[0049] The refrigerant of high pressure and high temperature discharged from the compressor (41) flows toward the indoor heat exchanger (50) along the second refrigerant tube (62). The refrigerant flowing along the second refrigerant tube (62) is branched by the third and fourth branched tubes (65. 66) to flow toward the first and second heat exchange lines (52. 53), as shown in FIG.3.

[0050] The refrigerant flowing toward the third branched tube (65) is infused into the fourteenth tube (52n) to zigzag along each tube and is heat exchanged with the indoor air introduced in the housing (51). The refrigerant flowing toward

the fourth branched tube (66) is introduced into the fourteenth tube (53n) and passes each tube to flow to the first tube (53a) and to discharge heat via the air infused into the housing (51).

[0051] As in the cooling operation, the air quantity initially contacting the first heat exchange line (52) and the air quantity initially contacting second heat exchange line (53) are the same, out of the air introduced into the housing (51) via the air inlets (51a. 51b. 51c), whereby the heat exchange quantity of refrigerant at each heat exchange line (52. 53) is the same.

[0052] As a result, the refrigerant flows in the same quantity and in the same state in the first and second heat exchange lines (52. 53) without showing any flow abnormalcy where the refrigerant is over-cooled due to over-discharge of heat from a certain heat exchange line and the refrigerant shows a high dryness due to insufficient heat exchange at a certain heat exchange line.

[0053] The air heated by the heat exchange of the refrigerant is discharged outside of the housing (51) via the air outlet (51d) by the drive of the indoor fan device (54). Furthermore, the refrigerant having heated the indoor air and slipped out of the first tube (52a) of the first heat exchange line (52) and the refrigerant having slipped out of the first tube (53a) of the second heat exchange line (53) converge at the first refrigerant tube (61) and flows toward the outdoor unit (40). The refrigerant is transformed to liquid refrigerant of low temperature and low pressure at the expansion device (43), to flow toward the outdoor heat exchanger (42), and the refrigerant is vaporized to a gas of low temperature and low pressure at the outdoor heat exchanger (42) and is returned to the compressor (41).

[0054] As mentioned earlier, because the degree of phase change of the refrigerant passing each heat exchange line is the same, the refrigerant is not biased to a particular heat exchange line and flows in an even liquid quantity according to each heat exchange line. Consequently, the heat exchange performance is improved to increase the entire efficiency of the air conditioner. The experimental data relative to this operational effect is shown in FIGS. 5a and 5b.

[0055] Referring to FIG.5a, it shows that, if Coefficient of Performance (COP) of an air conditioner using the conventional heat exchanger is 3.03 during cooling operation, the COP of an air conditioner using the heat exchanger under the same condition according to the present invention is increased to 3.06, while the electric power consumption of a compressor drops to 1,209KW from 1,210KW.

[0056] Furthermore, an air conditioner using the conventional heat exchanger showed a COP of 3.37 during heating operation, and the electric power consumption of a compressor was 1,030W, while the COP was increased to 3.42 but electric power consumption of a compressor dropped to 1,026W when a heat exchanger according to the present invention was used under the same condition, showing that an overall performance of the air conditioner has been upgraded.

[0057] FIG.6 is a schematic view illustrating a construction of an air conditioner disposed with a heat exchanger according to another embodiment of the present invention.

[0058] The heat exchanger illustrated in FIG.6 according to another embodiment of the present invention also uses an indoor heat exchanger as the one in the above preferred embodiment.

[0059] A first heat exchange line (52') and a second heat exchange line (S3') are so aligned as to cross each other before and after the air inlet direction.

[0060] Only difference is that a first branched tube (63') branched from a first refrigerant tube (61') connected to an expansion device (43') is connected to a fourteenth tube (52n') of a first heat exchange line (52'), a second branched tube (64') branched from a first refrigerant tube (61') is connected to a fourteenth tube (53n') which is a distal end of a second heat exchange line (53'), a first tube (52a') of the first heat exchange line (52') is connected to a third branched tube (65') branched from a second refrigerant tube (62'), and a first tube (53a') of the second heat exchange line (53') is connected to a fourth branched tube (66'). Other detailed description thereto will be omitted as construction, operation and effect are the same as those of the heat exchanger according to the hitherto-mentioned earlier preferred embodiment of the present invention.

[0061] Meanwhile, although in the present invention, description has been made on a so-called two-branch indoor heat exchanger having two heat exchange lines, the present invention is not limited thereto, and can be applied to various heat exchangers using a plurality of heat exchange lines regardless of indoor heat exchanger or outdoor heat exchanger.

[0062] According to the embodiments of the present invention mentioned earlier, heat exchange lines formed by being branched inside a heat exchanger are so aligned as to cross before and after an air inlet direction, such that the heat exchanged quantity between refrigerant and air at each heat exchange line is same, and the refrigerant is not biased to a particular heat exchange line but evenly flows in all the heat exchange lines. Consequently, a heat exchange efficiency of a heat exchanger can be improved.

[0063] Furthermore, as the heat exchange efficiency of a heat exchanger is improved, cooling and heating efficiency of an air conditioner disposed with the improved heat exchanger can be enhanced at the same time.

[0064] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided that they come within the scope of the appended claims and

their equivalents.

Claims

1. A heat exchanger for an air conditioner, the heat exchanger comprising:

   a housing having at least one air inlet and at least one air outlet; and
   a plurality of heat exchange lines each disposed in the housing and branched from a refrigerant tube at least one into which refrigerant is infused and in which the refrigerant switches flowing directions along the respective interiors thereof, wherein the plurality of heat exchange lines are arranged in such a manner that each line crosses before and after an infusion direction of air introduced via the air inlet.

2. The heat exchanger as defined in claim 1, wherein each heat exchange line is substantially the same in diameter and length thereof, and the air quantity initially contacting each heat exchange line is substantially the same, out of the air infused into the housing via the air inlet, and the heat exchanged quantity of the refrigerant passing through each heat exchange line is substantially the same.

3. The heat exchanger as defined in claim 1 or 2, wherein refrigerant inlets of each heat exchange line are contiguous thereamong so as to converge at one side of an interior of the housing; and refrigerant outlets of each heat exchange line are contiguous thereamong so as to converge at the other side of an interior of the housing.

4. The heat exchanger as defined in any of claims 1 to 3 comprising a heat transmission member coupled to each heat exchange line for increasing a heat exchanging area of each heat exchange line.

5. A heat exchanger of an air conditioner comprising:

   a housing having at least one air inlet and at least one air outlet; and
   a first heat exchange line branched from a single refrigerant tube disposed inside the housing and in which refrigerant switches flowing directions along an interior thereof:

      a second heat exchange line branched from the single refrigerant tube disposed inside the housing and in which refrigerant switches flowing directions along an interior thereof, and wherein the first and second heat exchange lines are arranged in such a manner that each line crosses before and after an infusion direction of air introduced via the air inlet.

6. The heat exchanger as defined in claim 5, wherein the first and second heat exchange lines are substantially the same in diameter and length thereof, and an air quantity initially contacting the first heat exchange line and an air quantity initially contacting the second heat exchange line are substantially the same, out of the air infused into the housing via the air inlet, and the heat exchanged quantity of the refrigerant passing through the first and second heat exchange lines is substantially the same.

7. The heat exchanger as defined in claim 5 or 6, wherein each refrigerant inlet of the first and second heat exchange lines is contiguous thereamong so as to converge at one side of an interior of the housing, and each refrigerant outlet of the first and second heat exchange lines is contiguous thereamong so as to converge at the other side of an interior of the housing.

8. The heat exchanger as defined in any of claims 5 to 7 comprising a heat transmission member coupled to each heat exchange line for increasing heat exchanging areas of the first and second heat exchange lines.

9. An air conditioner comprising:

   a compressor for compressing refrigerant;
   an outdoor heat exchanger connected to the compressor to allow the refrigerant to move therein and for heat exchanging between the refrigerant and outside air;
   an expansion device connected to the outdoor heat exchanger for the refrigerant to move therein; and
   an indoor heat exchanger connected to the expansion device and the compressor via refrigerant tube for the refrigerant to move therein and for heat exchanging between the refrigerant and indoor air, wherein the indoor

heat exchanger comprises:

a housing having at least one air inlet and at least one air outlet for infusing and discharging the indoor air; and a plurality of heat exchange lines respectively disposed inside the housing, branched from the refrigerant tube and into which the refrigerant is infused and in which the refrigerant flows along each interior thereof changing flow directions, and wherein the plurality of heat exchange - lines are arranged in such a manner that each line crosses before and after the infusion directions of air introduced via the air inlet.

10. The air conditioner as defined in claim 9, wherein each heat exchange line is substantially the same in diameter and length thereof, and the air quantity initially contacting each heat exchange line is substantially the same, out of the air infused into the housing via the air inlet, and the heat exchanged quantity of the refrigerant passing through each heat exchange line is substantially the same.

11. The air conditioner as defined in claim 9 or 10, wherein refrigerant inlets of each heat exchange line are contiguous thereamong so as to converge at one side of an interior of the housing, and refrigerant outlets of each heat exchange line are contiguous thereamong so as to converge at the other side of an interior of the housing.

12. The air conditioner as defined in any of claims 9 to 11 comprising a heat transmission member coupled to each heat exchange line for increasing a heat exchanging area of each heat exchange line.

13. An air conditioner comprising:

a compressor for compressing refrigerant;
an outdoor heat exchanger connected to the compressor to allow the refrigerant to move therein and for heat exchanging between the refrigerant and outside air;
an expansion device connected to the outdoor heat exchanger for the refrigerant to move therein; and
an indoor heat exchanger connected to the expansion device and the compressor via refrigerant tubes for the refrigerant to move therein and for heat exchanging between the refrigerant and indoor air, wherein the indoor heat exchanger comprises:

a housing having at least one air inlet and at least one air outlet; and
a first heat exchange line disposed inside the housing and branched from the refrigerant tube in which refrigerant switches flowing directions along an interior thereof;
a second heat exchange line disposed inside the housing and branched from the single refrigerant tube in which refrigerant switches flowing directions along an interior thereof, and wherein the first and second heat exchange lines are arranged in such a manner that each line crosses before and after an infusion direction of air introduced via the air inlet.

14. The air conditioner as defined in claim 13, wherein the first and second heat exchange lines are substantially the same in diameter and length thereof, and an air quantity initially contacting the first heat exchange line and an air quantity initially contacting the second heat exchange line are substantially the same, out of the air infused into the housing via the air inlets, and the heat exchanged quantity of the refrigerant passing through the first and second heat exchange lines is substantially the same.

15. The air conditioner as defined in claim 13 or 14, wherein each refrigerant inlet of the first and second heat exchange lines is contiguous thereamong so as to converge at one side of an interior of the housing, and each refrigerant outlet of the first and second heat exchange lines is contiguous thereamong so as to converge at the other side of an interior of the housing.

16. The air conditioner as defined in any of claims 13 to 15 comprising a heat transmission member coupled to each heat exchange line for increasing heat exchanging areas of the first and second heat exchange lines.

17. The apparatus as defined in any of claims 1 to 16 comprising a fan device disposed inside the housing for forcibly blowing the air heat-exchanged inside the housing via the air outlet.

18. A method for operating an apparatus according to any of claims 1 to 17.

FIG. 1
(PRIOR ART)

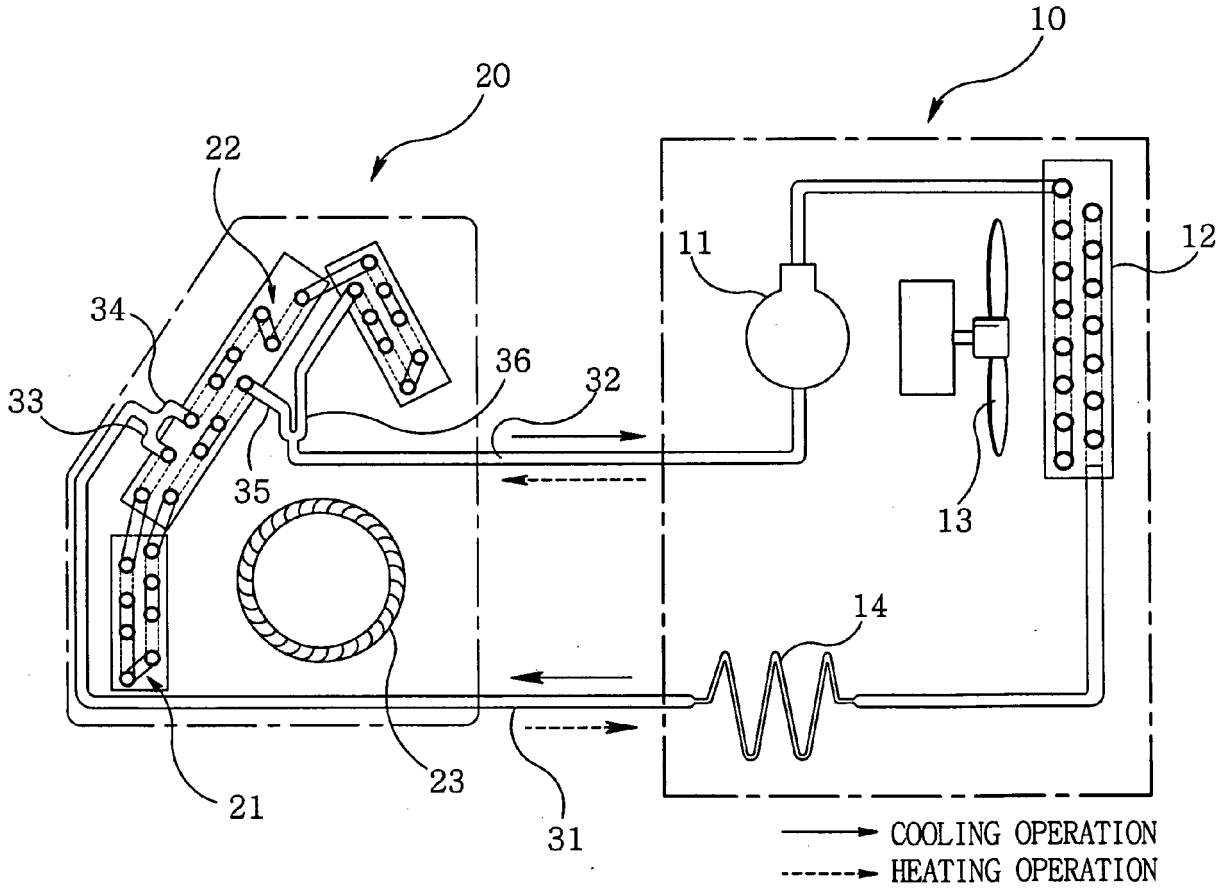


FIG. 2
(PRIOR ART)

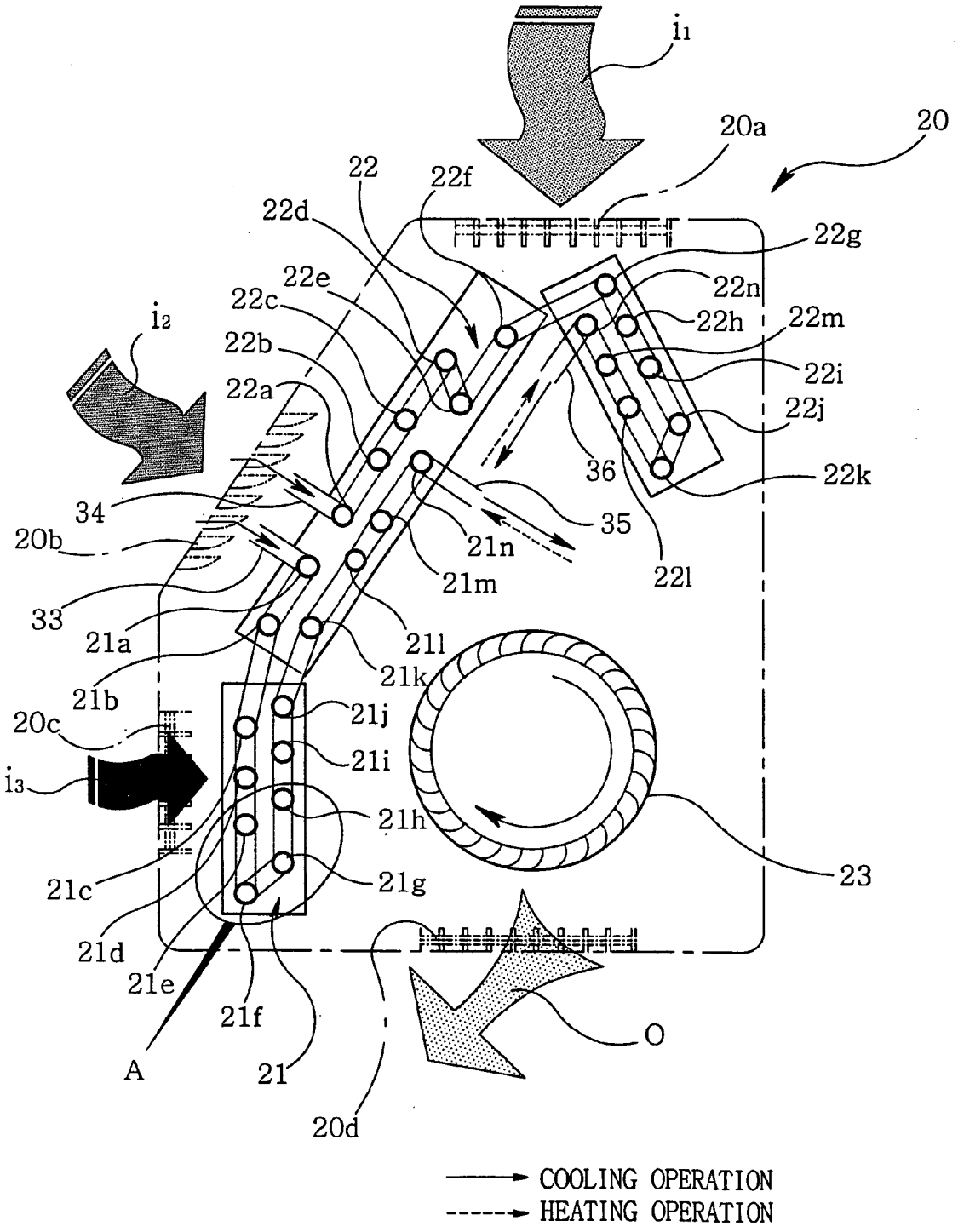
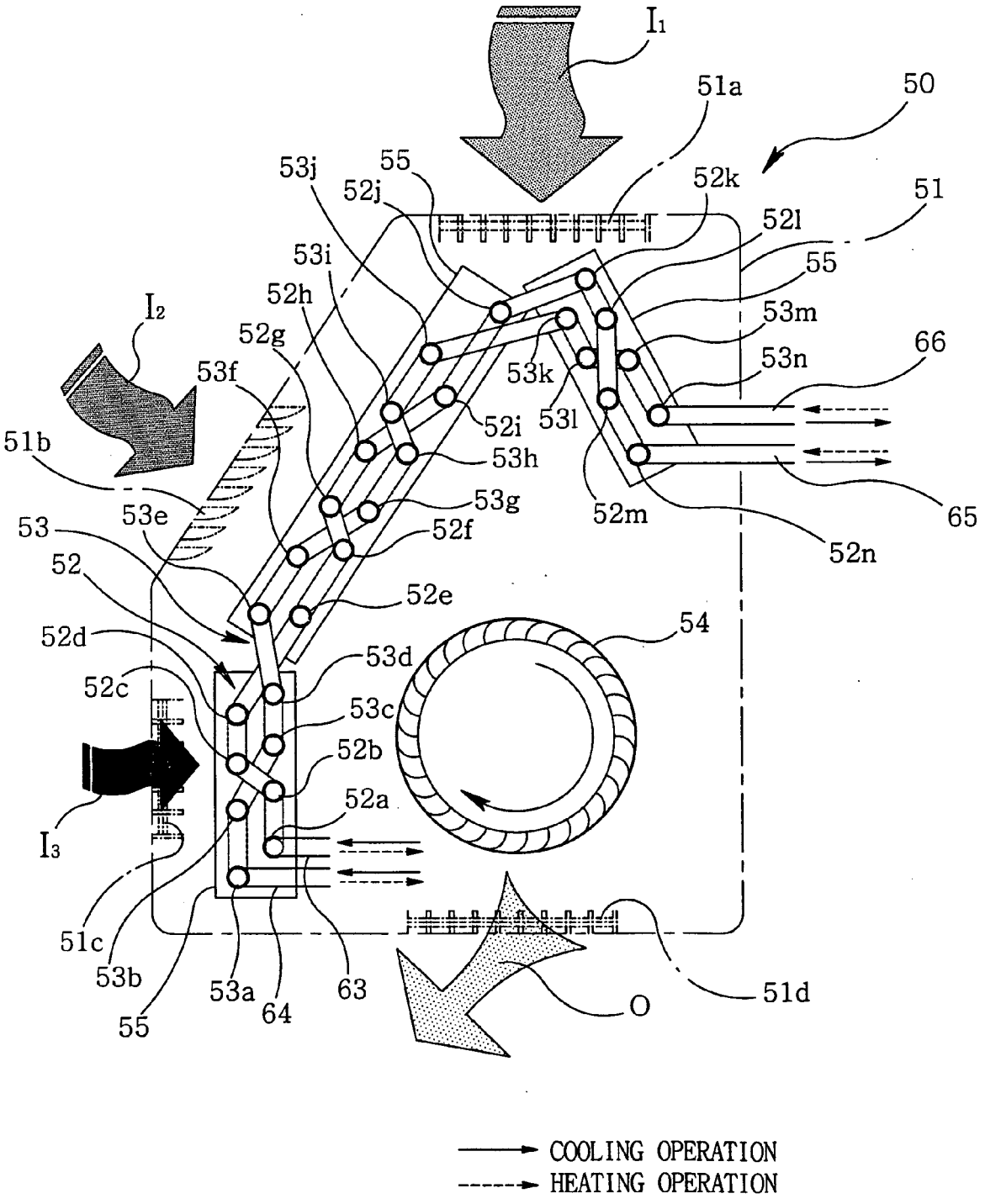


FIG. 3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I2
I3
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51d
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52h
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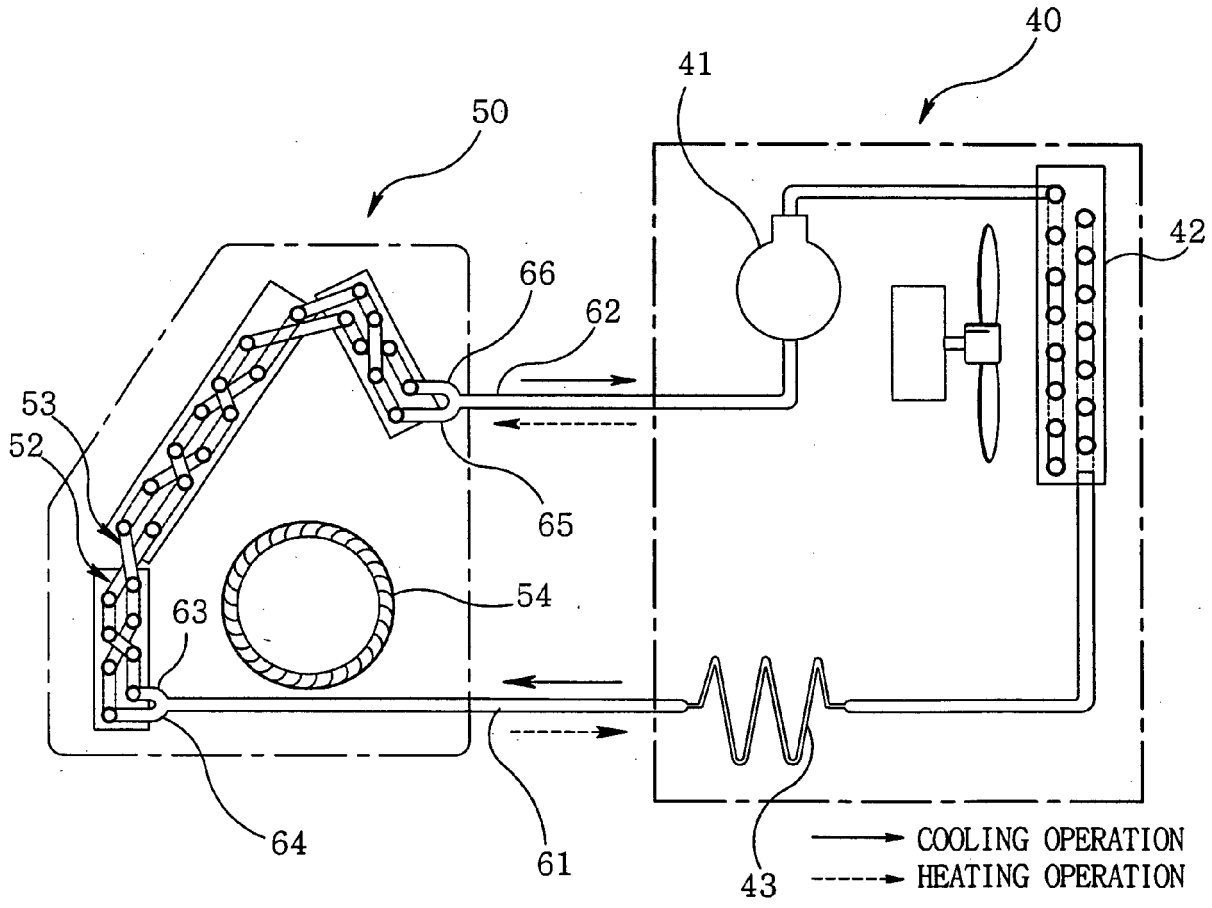
53f
53g
53h
53i
53j
53k
53l
53m
53n
54
55
63
64
65
66
O
COOLING OPERATION
HEATING OPERATION

FIG. 4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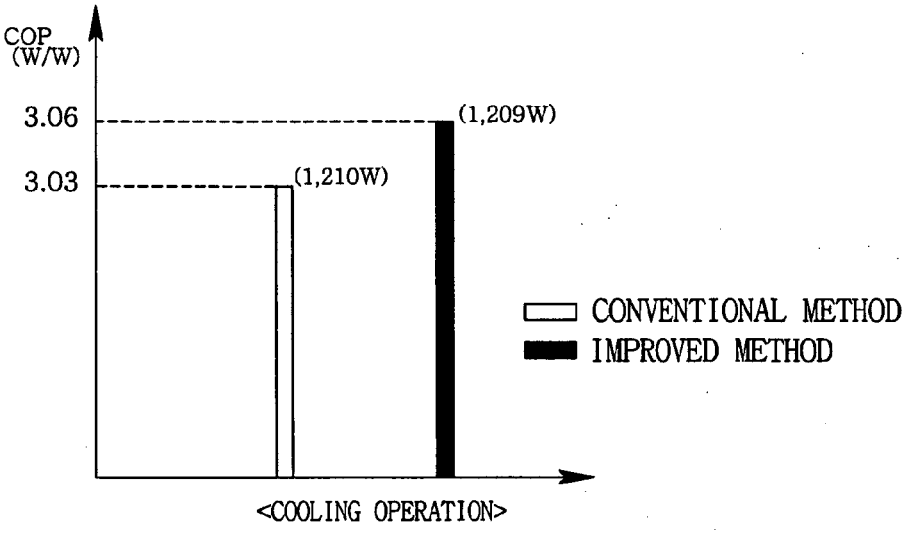
61
43
COOLING OPERATION
HEATING OPERATION

FIG. 5a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IMPROVED METHOD
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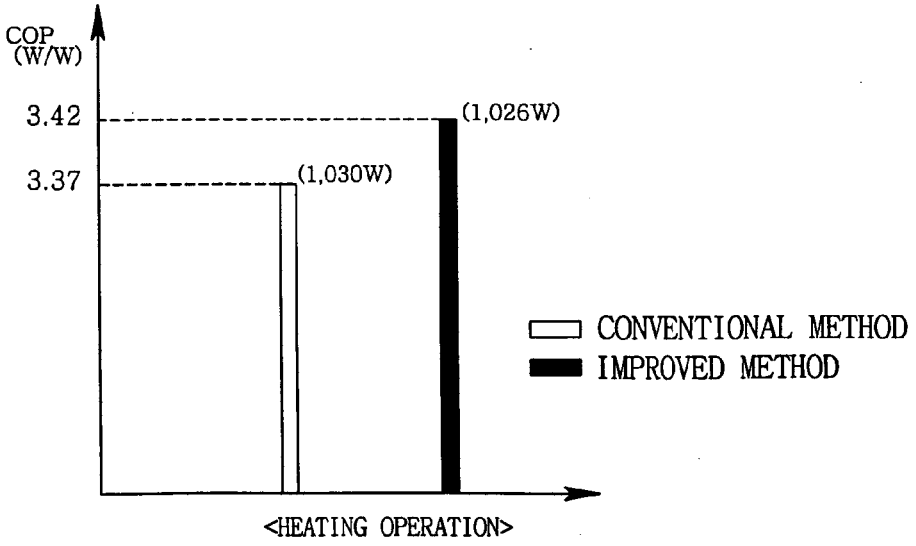
FIG. 5b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IMPROVED METHOD
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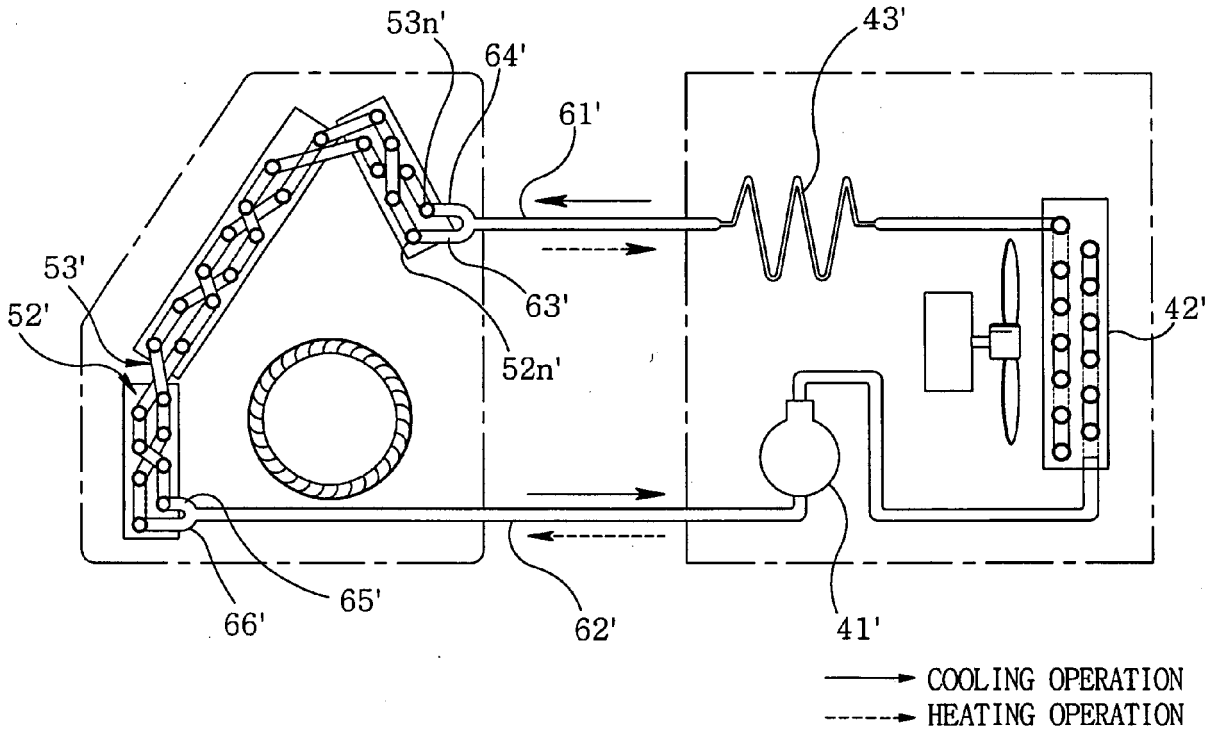
FIG. 6


53n'
64'
43'
61'
53'
52'
63'
42'
52n'
65'
66'
62'
41'
COOLING OPERATION
HEATING OPERATION