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(54) **A heat pump**

Wärmepumpe

Pompe à chaleur

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Description

Technical field

[0001] The invention relates to a heat pump consisting of a pair of air/coolant heat exchangers connected to a coolant feed piping into a compressor and further connected to a coolant return piping from a coolant/water heat exchanger.

Background art

[0002] There are known heat pumps coupled with a low-temperature heat source. The low-temperature heat source is positioned outside of the building. The heat pump in a well-known manner heats coolant, which is through a circulating coolant piping led into a heat exchanger coolant/water inbuilt to the construction of the heat pump. This water is further used in a correspondent heat consumer, for instance in a building heating system for a building heating. A low-temperature heat source can e.g. be an earth heat (from an appropriate hole) water heat or air heat. Particularly in systems taking the heat off the air, which consist of a ventilator providing air circulating round pipes with coolant in the heat exchanger air/coolant, occurs however a frost formation on this part of pipes, or if you like on this exchanger, by means of which is decreased the heat take-off performance from the air and is decreased the heating capacity of the heat pump.

[0003] For decreasing or removing this negative effect is known a number of defrosting systems. Nevertheless it is not basically possible to use mechanical methods because in most cases this is the question of a frost on relatively tender members of the appliances and there is a danger of damage during removing the frost mechanically. Thus there is used a way of progressive defrosting.

[0004] There is known defrosting on a heat exchanger air/coolant using electric heating rods or cables built in the heat exchanger air/coolant, which is however demanding from the economical and operational point of view with regard to control of the entire defrosting process, i.e. turning on and off the entire process, when it is necessary to determine the right moment for starting and stopping the defrosting.

[0005] There is further known melting the frost from the heat exchanger air/coolant in the way that temporarily is turned off the heating capacity delivery of the heat pump into the heat consumer, for instance into the building heating system and the heating capacity of the heat pump is led into the heat exchanger air/coolant, which progressively defrosts. Consequently is again turned on the heating capacity delivery of the heat pump into the heat consumer, for instance into the building heating system.

[0006] There is also known use of an auxiliary heating circuit, in which is in the coolant return piping from the heat exchanger coolant/water (after coolant passes its

heat to the heat consumer, for instance building heating) into the heat exchanger air/coolant formed an additional heat exchanger coolant/water because coolant has in the coolant return piping from the heat exchanger coolant/water into the heat exchanger air/coolant a residual temperature around 35°C to 40°C. Water heated in the additional heat exchanger coolant/water is by means of the auxiliary circular pump led through the auxiliary piping into the heat exchanger air/coolant, which is this way heated and defrosted.

[0007] There is also known an application of a pair of heat exchangers air/coolant, where in case of frost creation is on one exchanger switched the heat pump operation to the second heat exchanger air/coolant and concurrently is shut down heat transfer from the heat pump to the heat consumer, for instance building heating system and the entire heat produced by the heat pump is used to heat the shut-down heat exchanger air/coolant. After defrosting this heat exchanger air/coolant is stopped heat delivery into the heat exchanger air/coolant that is being defrosted and there is turned on the heat delivery from the heat pump to the heat consumer. In the moment of frost creation on the currently used heat exchanger air/coolant is switched to previously defrosted heat exchanger air/coolant, the heat delivery from the heat pump into the heat consumer is shut down and the entire heating capacity of the heat pump is used to melting the frosted heat exchanger air/coolant. The entire cycle is repeated continuously.

[0008] The common disadvantage of the last three mentioned solution is that for reaching the proper defrosting on the heat exchanger air/coolant is necessary to temporarily shut down the heat pump from the functioning into the heat consumer, for instance building heating system, by means of which occurs irregular heating capacity delivered to the heat consumer and thus for example occur temperature fluctuations inside the heated building or temperature fluctuations of sanitary water etc. and all that with all negative drawbacks. Another disadvantage of the background art are high demands on control of the entire defrosting system, when for the automated operation of the entire system must be used expensive and complex diagnostic technology increasing the price of the entire system and also the possibility of failure creation and heat pump outages. Because it is very difficult to monitor the frost extent and to determine the moment to turn on and off the frost melting and shut-down the heat pump from the heat consumer. During continuous run of the defrosting systems according to the background art would occur strong rise in price of the entire heat pump operation.

[0009] The goal of the technical solution intends to eliminate or at least to minimize the drawbacks of the art.

[0010] GB-A-2 167 543 discloses a heat pump according to the preamble of claim 1.

Principle of the invention

[0011] The goal of the invention has been reached by a heat pump according to the features of claim 1.

[0012] This solution enables by simply and relatively inexpensive means and without demands on a complex control device to provide a reliable and continuous melting the frost from the heat exchangers air/coolant and all that without a need to cut off the heating capacity flow of the heat pump into the heat consumer, for instance building heating system because there is always melting the frost from one of the pair of heat exchangers air/coolant by means of a residual heat of the coolant, while the second heat exchanger air/coolant immediately after passing the coolant through the heat exchanger air/coolant that is being defrosted uses this coolant for taking-off the heat from the air. By means of this is removed the necessity to cut off the heating capacity transmission from the heat consumer and is provided a continuous heating capacity of the heat pump transmission into the heat consumer, e.g. building heating system.

[0013] According to one preferred embodiment are both branches of the coolant return piping fitted with closing valves coupled with the control device.

[0014] From the point of control simplicity of the closing valves it is preferred if the control device of closing valves consists of a time control device.

[0015] To increase the utility value and efficiency particularly in season with no danger of frost creation on the heat exchangers air/coolant it is preferred, if each of the branches of the coolant return piping is fitted with a controllably closable bypass of its part forming a heating piping, which is according to one example embodiment formed that the first branch of the return piping is between the coolant return piping branching point and the first heating piping connected to the first auxiliary piping, which is to the first branch of the coolant return piping connected in front of the evaporation inlet of the second heat exchanger air/coolant, while the second branch of the return coolant piping is between the branching point of the coolant return piping and the second heating piping connected to the second auxiliary piping, which is to the second branch of the coolant return piping connected in front of the evaporating inlet of the first heat exchanger air/coolant and both auxiliary piping are fitted with a controllable valve connected to the control device.

Description of the drawing

[0016] The invention is schematically shown in the drawings in which Fig. 1 represents an arrangement of a heat pump without a controllably closable and openable bypass of its part forming a heating piping and Fig. 2 represents an arrangement of a heat pump with a controllably openable and closable bypass of its part forming a heating piping.

Specific description

[0017] A heat pump consists of a compressor 1, whose suction is connected by a feed piping 2 with a coolant outlet 33 from a pair of heat exchangers 3 air/coolant. Coolant in the outlet 33 from the heat exchangers 3 air/coolant transmits the heat taken off the air. The compressor 1 compresses this coolant, by means of which the coolant temperature further increased, usually to values around 85° C. Coolant is from the compressor 1 led into a heat exchanger 4 coolant/water. Water heated in this way is further used for a heat consumer, for instance for a building heating etc. From the heat exchanger 4 coolant/water comes out coolant cooled down to a residual temperature usually around 35° C to 40° C and is by means of a coolant return piping 5 led towards the heat exchangers 31, 32 air/coolant, while the return piping 5 is in front of the heat exchangers 31, 32 air/coolant split in two branches 51, 52.

[0018] The first branch 51 of the coolant return piping 5 is through the first controllable closable valve 91 led into the first heat exchanger 31 air/coolant. In the first heat exchanger 31 air/coolant the first branch 51 of the coolant return piping 5 forms the first heating piping 81 for defrosting this heat exchanger 31 air/coolant. From the first heat exchanger 31 air/coolant continues the first branch 51 into an evaporating inlet 320 of the second heat exchanger 32 air/coolant. In the second heat exchanger 32 air/coolant takes place a known coolant expansion coupled with a heat take-off from the air surrounding the second heat exchanger 32 air/coolant by means of coolant. Coolant with the heat gathered by this way is led though an outlet 33 into the coolant feed piping 2 towards the compressor 1.

[0019] The second branch 52 of the coolant return piping 5 is through a second controllable closable valve 91 led into the second heat exchanger 32. In the second heat exchanger 32 air/coolant forms the second branch 52 of the coolant return piping 5 the second heating piping 82 for defrosting this heat exchanger 32 air/coolant. From the second heat exchanger 32 air/coolant continues the second branch 52 into an evaporating inlet 310 of the first heat exchanger 32 air/coolant. In the first heat exchanger 32 air/coolant takes place a known coolant expansion coupled with a heat take-off from the air surrounding the first heat exchanger 32 air/coolant by means of coolant. Coolant with the heat gathered by this way is led though an outlet 33 into the coolant feed piping 2 towards the compressor 1.

[0020] Closing valves 91, 92 are for the automation purposes connected to appropriate control members, they can be for instance represented by electromagnetically operated valves connected to a competent control device.

[0021] An evaporating coolant inlet 310, 320 into the appropriate heat exchanger 31, 32 air/coolant consists of an appropriate evaporating jet 72, which provides coolant evaporation and its distribution into an appropriate

heat exchanger 31, 32 air/coolant, where this coolant takes off heat from the air.

[0022] Heat exchangers 31, 32 air/coolant are fitted with a ventilator 30 connected to a drive for increasing the air circulation along heat transfer surfaces of the heat exchangers 31, 32 air/coolant.

[0023] In the embodiment shown in Fig. 2 is the first branch 51 of the coolant return piping 5 between the branching point of the coolant return piping 5 to branches 51, 52 and the first heating piping 81 connected through the first auxiliary piping 510 with the point between the end of the first heating piping 81 and the evaporating inlet 320 of the second heat exchanger 32 air/coolant. The first auxiliary piping 510 is fitted with a controllable valve 5100. Equivalently is the second branch 52 of the coolant return piping 5 between the branching point of the coolant return piping 5 to branches 51, 52 and the second heating piping 81 connected through the second auxiliary piping 520 with the point between the end of the second heating piping 82 and the evaporating inlet 310 of the first heat exchanger 31 air/coolant. The second auxiliary piping 520 is fitted with a controllable valve 5200. Controllable valves 5100, 5200 are coupled with the control device.

[0024] In the represented example on the Fig. 2 are the first and the second auxiliary piping 510, 520 onto the point between the branching point of the coolant return piping 5 to branches 51, 52 and the heating piping 81, 82 connected in the coolant flow direction behind the controllable valves 91, 92. In a not represented example are the first and the second auxiliary piping 510, 520 onto the point between the branching point of the coolant return piping 5 to branches 51, 52 and the heating piping 81, 82 connected in the coolant flow direction in front of the controllable valves 91, 92.

[0025] The heat pump according to the invention operates for instance that the first closing valve 91 controlling the inlet of the coolant with a residual heat into the first branch 51 of the coolant return piping 5 is open and the second closing valve 92 controlling the inlet of the coolant with a residual heat into the second branch 52 of the coolant return piping 5 is closed. By means of that the coolant with a residual heat flows first into the first exchanger 31 air/coolant as a heating medium and provides melting the frost from this first heat exchanger 31 air/coolant. No sooner than now the coolant flows into the second heat exchanger 32 air/coolant, where it expands and takes off the heat from the air and with this heat flows towards the compressor¹, by means of which is compressed (temperature of coolant increases) and led into the heat exchanger 4 coolant/water for the heat consumer, for instance for the building heating. In a certain moment, e.g. according to sensors information or simply after some defined time interval comes to closing the first 91 and to opening the second closing valve 92, by means of which is opened inlet for the coolant with a residual heat to influx the second branch 52 of the coolant return piping 5 and concurrently comes to closing the first branch 51 of the coolant return piping 5. This way the

coolant with a residual heat first flows into the second heat exchanger 32 air/coolant as a heating medium and provides melting the frost from this second heat exchanger 32 air/coolant, which served before for heat take-off from the air into the coolant. No sooner than now the coolant flows into the first heat exchanger 32 air/coolant, where it expands and takes off the heat from the air and heated by this heat flows towards the compressor¹, by means of which is compressed (temperature of coolant increases) and led into the heat exchanger 4 coolant/water, for instance for the building heating.

[0026] Switching the closing valves 9 (91, 92) controlling the coolant influx into particular branches 51, 52 of the coolant return piping 5 can be controlled for instance on a simple time principle, when for a defined time period, e.g. 30 minutes, coolant flows through the first branch 51, then comes to switching and for another defined time period, for instance also 30 minutes, coolant flows through the second branch 52. The time span of operation of particular branches 51, 52 of the coolant return piping 5 can be also be controlled automatically, for instance according to actual humidity and temperature round heat exchangers 31, 32 air/coolant etc.

[0027] The pair of closing valves 91, 92 can be replaced for another appropriate control member, for instance a valve coupled with a control member controlling switching coolant between the branches 51, 52 etc.

[0028] In cases of no risk of frost formation on heat exchangers 31, 32 air/coolant and thus when there is no need to heat the heat exchangers 31, 32 air/coolant is coolant led through auxiliary piping 510, 520 other than heating piping 81, 82 from the branching point of the coolant return piping 5 to branches 51, 52 directly in front of the evaporating inlets 310, 320 of both heat exchangers 31, 32 air/coolant. By means of that it is possible to gain heat from both exchangers 31, 32, increase the performance factor of the heat pump and the utility value is increased.

List of reference marks

[0029]

1	compressor
2	feed piping
3	heat exchanger air/coolant
30	propeller
31	first heat exchanger air/coolant
310	evaporating inlet of the first heat exchanger air/coolant
32	second heat exchanger air/coolant
320	evaporating inlet of the second heat exchanger air/coolant
33	coolant outlet from the heat exchanger air/coolant
4	heat exchanger coolant/water
5	coolant return piping
51	first branch of the coolant return piping

510	first auxiliary piping	
5100	controllable valve	
52	second branch of the coolant return piping	
520	second auxiliary piping	
5200	controllable valve	5
72	evaporating jet	
81	first heating piping	
82	second heating piping	
91	first closing valve	
92	second closing valve	10

Claims

1. A heat pump consisting of a pair of air/coolant heat exchangers (31, 32) connected with their outlets (33) to a coolant feed piping (2), which is connected with an inlet of a compressor (1) whose outlet is connected with an inlet of a coolant/water heat exchanger (4) whose outlet is connected with a coolant return piping (5) which is divided into two branches (51, 52) each of them is connected with one evaporating inlet (310, 320) of each of the air/coolant heat exchangers (31, 32) **characterized by** that the first branch (51) of the coolant return, piping (5), before entering the evaporating inlet (320) of the second air/coolant heat exchanger (32), is incorporated with the first heat exchanger (31) as a first heating piping (81) and the second branch (52) of the coolant return piping (5), before entering the evaporating inlet (310) of the first air/coolant heat exchanger (31), is incorporated with the second heat exchanger (32) as a second heating piping (82) and each of the branches (51, 52) of the coolant return piping (5) has closing means.
2. A heat pump as claimed in Claim 1, **characterized by** that the branches (51, 52) of the coolant return piping (5) are fitted with closing valves (9) coupled with a control device.
3. A heat pump as claimed in Claim 2, **characterized by** that the control device of closing valves (9) comprises a time control device.
4. A heat pump as claimed in any of Claims 1 to 3, **characterized by** that each of the branches (51, 52) of the coolant return piping (5) is fitted with a controllable opening and closing by-pass of its part forming a heating piping (81,82).
5. A heat pump as claimed in Claim 4, **characterized by** that the first branch (51) of the coolant return piping (5) is between the point of dividing the coolant return piping (5) into the two branches (51, 52) and a first heating piping (81) connected with a first auxiliary piping (510), which is connected to the first branch (51) of the coolant return piping (5) in front of an evaporating inlet (320) of the second air/coolant

heat exchanger (32) and the second branch (52) of the coolant return piping (5) is between the point of dividing the coolant return piping (5) into the two branches (51, 52) and the second heating piping (82) connected with a second auxiliary piping (520), which is connected with the second branch (52) of the coolant return piping (5) in front of the evaporating inlet (310) of the first air/coolant heat exchanger (31) and both auxiliary piping (510, 520) are fitted with a controllable valve (5100, 5200) connected to the control device.

Patentansprüche

1. Wärmepumpe, die ein Paar der Wärmeaustauscher (31, 32) Luft/Kühlmittel aufweist, die mit deren Ausgängen (33) an die Zuleitung (2) des Kühlmittels angeschlossen sind, die mit dem Eingang des Kompressors (1) verbunden ist, dessen Ausgang mit dem Eingang des Wärmeaustauschers (4) Kühlmittel/Wasser verbunden ist, dessen Ausgang mit der Rücklaufleitung (5) des Kühlmittels verbunden ist, die auf zwei Zweige (51, 52) aufgeteilt ist, von denen jeder mit einem Verdampfungseingang (310, 320) von jedem der Wärmeaustauscher (31, 32) Luft/Kühlmittel verbunden ist, **dadurch gekennzeichnet, dass** der erste Zweig (51) der Rücklaufleitung (5) des Kühlmittels vor dem Eingang in den Verdampfungseingang (320) des zweiten Wärmeaustauschers (32) Luft/Kühlmittel als die erste Anwärmlleitung (81) gebildet ist, die mit dem ersten Wärmeaustauscher (31) verkoppelt ist, und der zweite Zweig (52) der Rücklaufleitung (5) des Kühlmittels vor dem Eingang in den Verdampfungseingang (310) des ersten Wärmeaustauschers (31) Luft/Kühlmittel als die zweite Anwärmlleitung (82) gebildet ist, die mit dem zweiten Wärmeaustauscher (32) verkoppelt ist, und jeder der Zweige (51, 52) der Rücklaufleitung (5) des Kühlmittels verschließbar ist.
2. Wärmepumpe nach dem Anspruch 1, **dadurch gekennzeichnet, dass** die Zweige (51, 52) der Rücklaufleitung (5) des Kühlmittels die Absperrventile (9) aufweisen, die mit der Steuereinrichtung verkoppelt sind.
3. Wärmepumpe nach dem Anspruch 2, **dadurch gekennzeichnet, dass** die Steuereinrichtung der Absperrventile (9) eine Zeitsteuereinrichtung beinhaltet.
4. Wärmepumpe nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** jeder der Zweige (51, 52) der Rücklaufleitung (5) des Kühlmittels steuerbar aufschließbare und verschließbare Überbrückung (By Pass) seines Teiles aufweist, der die Anwärmlleitung (81, 82) bildet.

5. Wärmepumpe nach dem Anspruch 4, **dadurch gekennzeichnet, dass** der erste Zweig (51) der Rücklaufleitung (5) des Kühlmittels zwischen der Stelle der Verteilung der Rücklaufleitung (5) des Kühlmittels in zwei Zweige (51, 52) und der ersten Anwärmlleitung (81) an die erste Hilfsrohrleitung (510) angeschlossen ist, die an den ersten Zweig (51) der Rücklaufleitung (5) des Kühlmittels vor dem Verdampfungseingang (320) des zweiten Wärmeaustauschers (32) Luft/Kühlmittel angeschlossen ist und der zweite Zweig (52) der Rücklaufleitung (5) des Kühlmittels zwischen der Stelle der Verteilung der Rücklaufleitung (5) des Kühlmittels in zwei Zweige (51, 52) und der zweiten Anwärmlleitung (82) an die zweite Hilfsrohrleitung (520) angeschlossen ist, die an den zweiten Zweig (52) der Rücklaufleitung (5) des Kühlmittels vor dem Verdampfungseingang (310) des ersten Wärmeaustauschers (31) Luft/Kühlmittel angeschlossen ist und beide Hilfsrohrleitungen (510, 520) ein steuerbares Ventil (5100, 5200) aufweisen, das an die Steuereinrichtung angeschlossen ist.

Revendications

1. La pompe thermique comprenant une paire d'échangeurs (31, 32) thermiques air / agent frigorigène assemblés par leurs sorties (33) à la tuyauterie (2) d'arrivée de l'agent frigorigène qui est attachée à l'entrée du compresseur (1), dont la sortie est attachée à l'entrée de l'échangeur (4) thermique agent frigorigène / eau, la sortie duquel est attachée à la tuyauterie réversible (5) de l'agent frigorigène qui est divisée en deux branches (51, 52), dont chacune d'entre elles est attachée à une entrée d'évaporation (310, 320) de chacun des échangeurs (31, 32) thermiques air / agent frigorigène, **caractérisé en ce que** la première branche (51) de la tuyauterie réversible (5) de l'agent frigorigène est formée avant l'entrée dans le système d'évaporation (320) du deuxième échangeur (32) thermique air / agent frigorigène comme la première tuyauterie de réchauffage (81) attachée au premier échangeur (31) et, la deuxième branche (52) de la tuyauterie réversible (5) de l'agent frigorigène est formée avant l'entrée dans le système d'évaporation (310) du premier échangeur (31) thermique air / agent frigorigène comme la deuxième tuyauterie de réchauffage (82) attachée au deuxième échangeur (32), et, chacune des branches (51, 52) de la tuyauterie réversible (5) de l'agent frigorigène peut être fermée.
2. La pompe thermique selon la revendication 1, **caractérisé en ce que** les branches (51, 52) de la tuyauterie réversible (5) de l'agent frigorigène sont pourvues de soupapes d'arrêt (9), accouplées avec le dispositif de commande.

3. La pompe thermique selon la revendication 2, **caractérisé en ce que** le dispositif de commande des soupapes d'arrêt (9) comprend le mécanisme de commande de temps.
4. La pompe thermique selon quelconque des revendications de 1 à 3, **caractérisé en ce que** chacune des branches (51, 52) de la tuyauterie réversible (5) de l'agent frigorigène est pourvue de by-pass d'ouverture et de fermeture manœuvrable de sa partie formant la tuyauterie de réchauffage (81, 82).
5. La pompe thermique selon la revendication 4, **caractérisé en ce que** la première branche (51) de la tuyauterie réversible (5) de l'agent frigorigène est attachée, entre le lieu de division de la tuyauterie réversible (5) de l'agent frigorigène en deux branches (51, 52) et la première tuyauterie de réchauffage (81), à la première tuyauterie auxiliaire (510) qui est attachée à la première branche (51) de la tuyauterie réversible (5) de l'agent frigorigène avant l'entrée dans le système d'évaporation (320) du deuxième échangeur (32) thermique air / agent frigorigène et, la deuxième branche (52) de la tuyauterie réversible (5) de l'agent frigorigène est, entre le lieu de division de la tuyauterie réversible (5) de l'agent frigorigène en deux branches (51, 52) et la deuxième tuyauterie de réchauffage (82), attachée à la deuxième tuyauterie auxiliaire (520) qui est attachée à la deuxième branche (52) de la tuyauterie réversible (5) de l'agent frigorigène avant l'entrée d'évaporation (310) du premier échangeur (31) thermique air / agent frigorigène, et, toutes les deux tuyauteries auxiliaires (510, 520) sont pourvues de la soupape manœuvrable (5100, 5200) attachée au dispositif de commande.

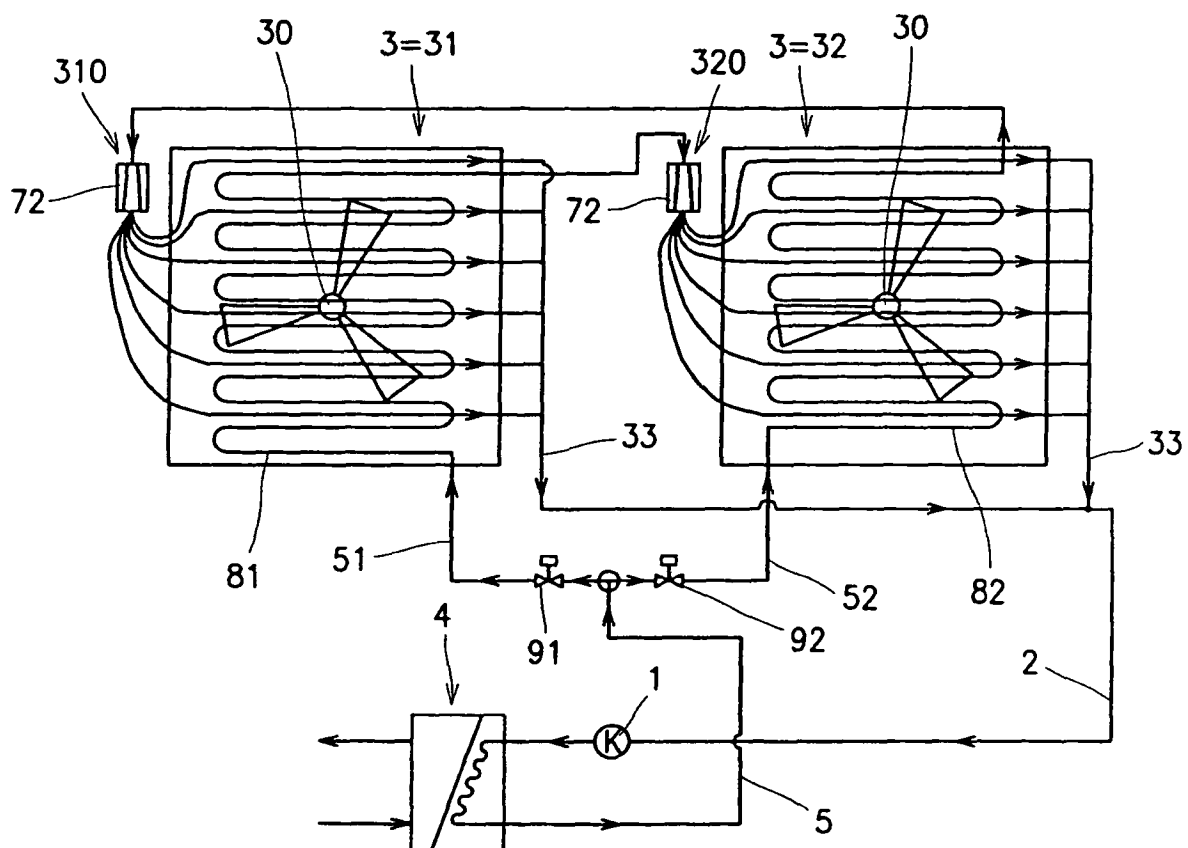


Fig. 1

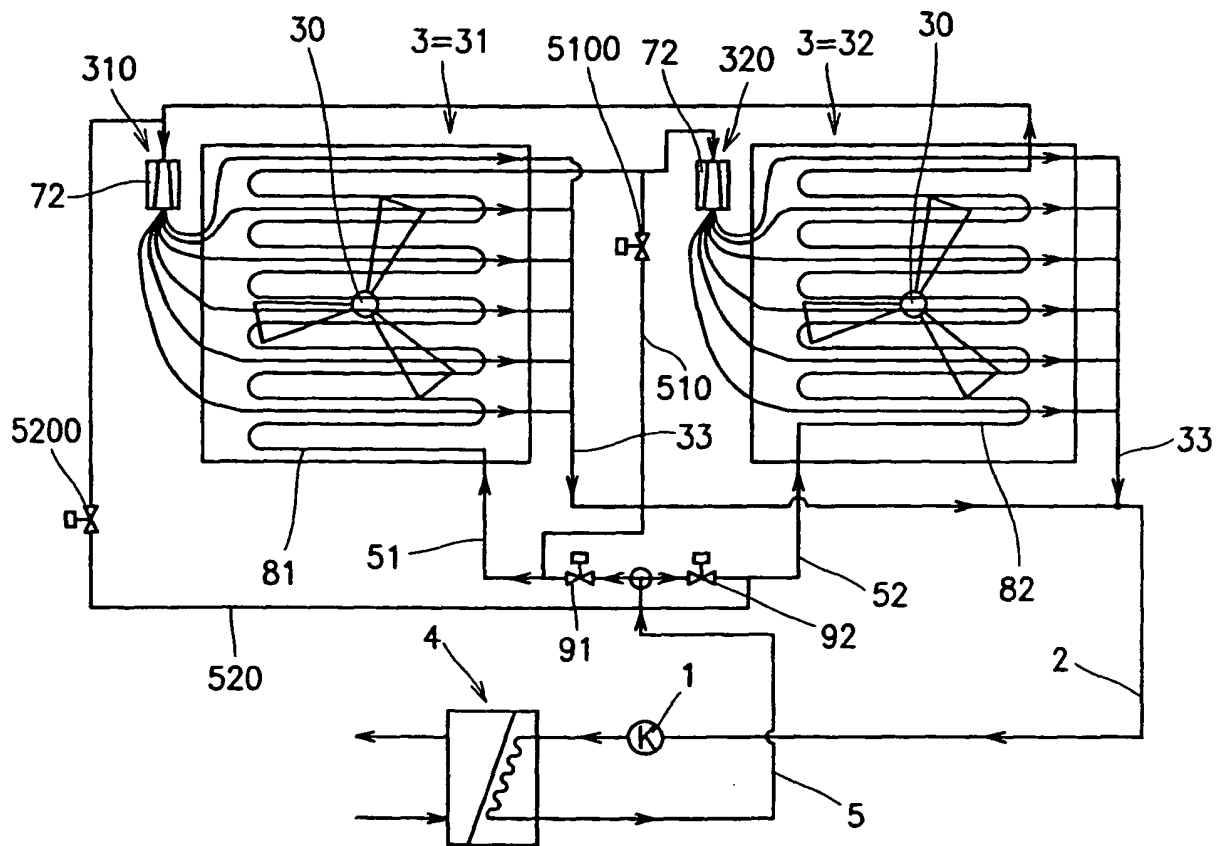


Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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