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(54) **A heat pump**

(57) The invention relates to a heat pump consisting of a pair of heat exchangers (31, 32) air/coolant connected to a coolant feed piping (2) into a compressor (1) and further connected to a coolant return piping (5) from a heat exchanger (4) coolant/water. The invention consists in that the coolant return piping (5) from the heat exchanger (4) coolant/water is before entering exchange-

ers (31,32) air/coolant split in two branches (51, 52), where each of them is connected to an evaporating inlet of one heat exchanger (31, 32) air/coolant, while each of the branches (51, 52) before entering one of the pair of heat exchangers (31, 32) air/coolant forms a heating piping (81, 82) of the second from the pair of heat exchangers (31, 32) air/coolant and each of the branches (51, 52) of the coolant return piping (5) is closable.

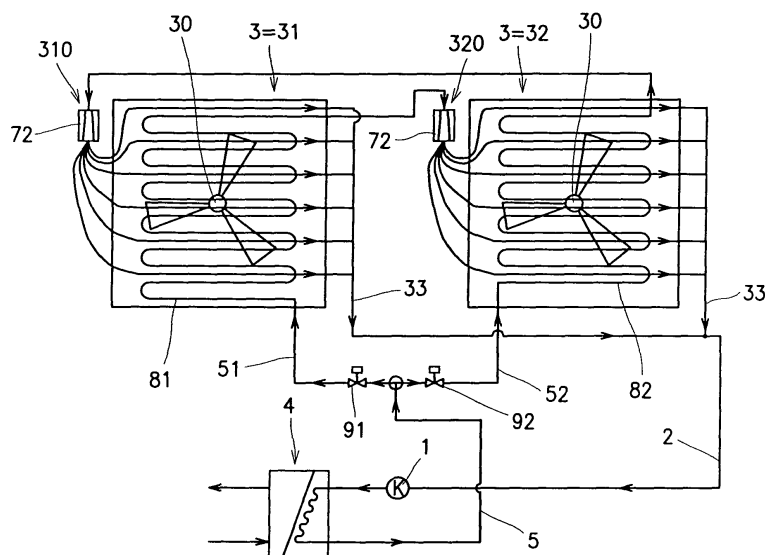


Fig. 1

Description

Technical field

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

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.

Principle of the invention

[0010] The goal of the invention has been reached by

a heat pump, whose principle consists in that a coolant return piping from the heat exchanger coolant/water is in front of the inlet to heat exchangers air/coolant split in two branches, from which each of them is connected to an evaporating inlet of one heat exchangers air/coolant, while each of the branches before entering one of the pair of heat exchangers air/coolant forms a heating piping of the second from the pair of heat exchangers air/coolant and each of the branches of the coolant return piping can be closed.

[0011] 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.

[0012] According to one preferred embodiment are both branches of the coolant return piping fitted with closing valves coupled with the control device.

[0013] 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.

[0014] 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

[0015] 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

[0016] 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.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] 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.

[0021] 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.

[0022] 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.

[0023] 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**.

[0024] 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 **31** 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.

[0025] 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.

[0026] 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.

[0027] 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

[0028]

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	5	
4	heat exchanger coolant/water		
5	coolant return piping		
51	first branch of the coolant return piping		
510	first auxiliary piping	10	
5100	controllable valve		
52	second branch of the coolant return piping		
520	second auxiliary piping		
5200	controllable valve		
72	evaporating jet	15	
81	first heating piping		
82	second heating piping		
91	first closing valve		
92	second closing valve		
		20	

piping (81) connected to 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 heat exchanger (32) air/coolant, while the second branch (52) of the coolant return piping (5) is between the point of the coolant return piping (5) branching to the branches (51, 52) and the second heating piping (82) connected to a second auxiliary piping (520), which is with the second branch (52) of the coolant return piping (5) connected in front of the evaporating inlet (310) of the first heat exchanger (31) air/coolant and both auxiliary piping (510, 520) are fitted with a controllable valve (5100, 5200) connected to the control device.

Claims

1. A heat pump consisting of a pair of heat exchangers air/coolant connected to a coolant feed piping into a compressor further connected to a coolant return piping from a heat exchanger coolant/water, **characterized by** that the coolant return piping (5) from the heat exchanger (4) coolant/water is before entering the heat exchangers (31, 32) air/coolant split in two branches (51, 52), where each of them is connected to an evaporating inlet of one heat exchanger (31, 32) air/coolant, while each of the branches (51, 52) forms before entering one of the pair of heat exchangers (31, 32) air/coolant a heating piping (81, 82) of the second from the pair of heat exchangers (31, 32) air/coolant and each of the branches (51, 52) of the coolant return piping (5) is closable.
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 return piping (5) is between the point of the coolant return piping (5) branching to branches (51, 52) and a first heating

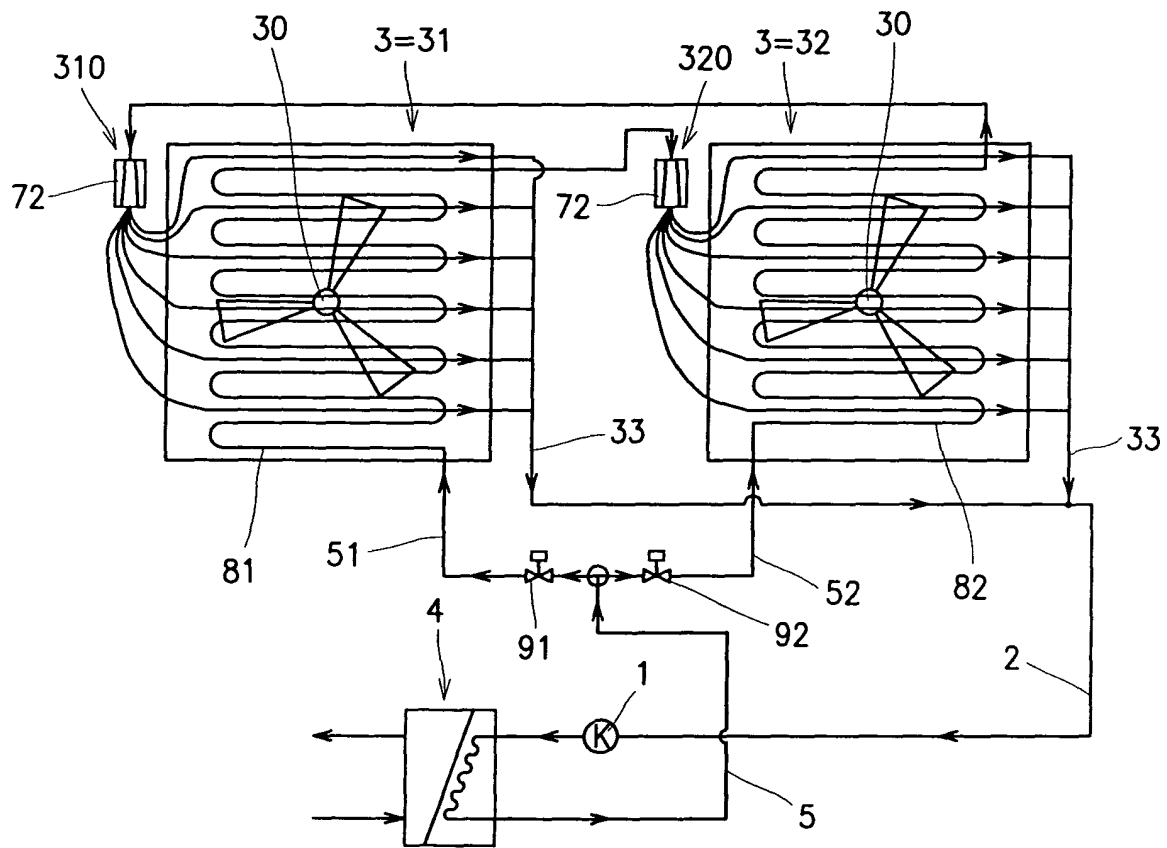


Fig. 1

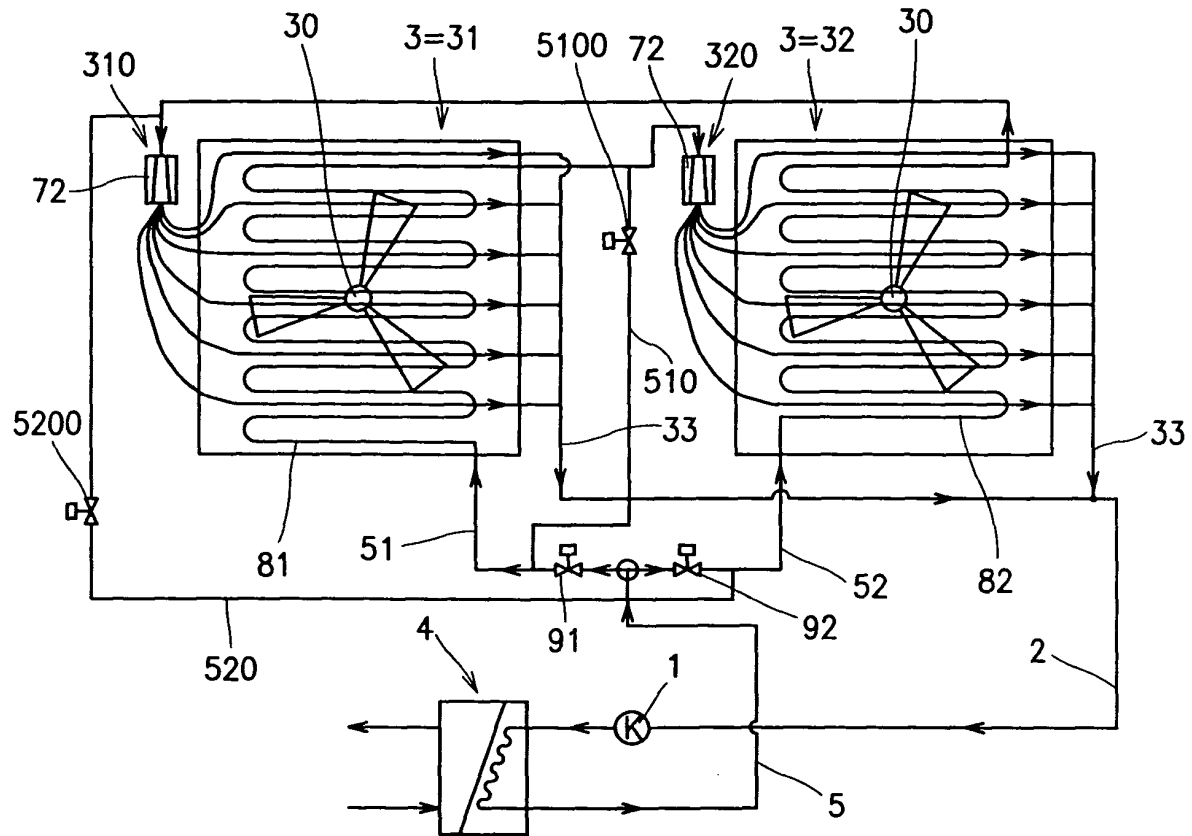


Fig. 2