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(54) REFRIGERATING CIRCUIT AND METHOD FOR SELECTIVELY DEFROSTING COLD CONSUMER UNITS OF A REFRIGERATING CIRCUIT

KÄLTEKREIS UND VERFAHREN ZUR SELEKTIVEN ENTFROSTUNG VON
KÄLTEVERBRAUCHEREINHEITEN EINES KÄLTEKREISES

CIRCUIT DE RÉFRIGÉRATION ET PROCÉDÉ DE DÉGIVRAGE SÉLECTIF D'UNITÉS
CONSOMMATRICES DE FROID D'UN CIRCUIT DE RÉFRIGÉRATION

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EP 2 496 893 B1

Description

[0001] The invention relates to a refrigerating circuit and to a method for selectively defrosting cold consumers in a refrigerating circuit.

[0002] Conventional vapor compression refrigerating circuits are well-known. Nowadays, the number of refrigerating circuits that are operated with carbon dioxide as refrigerant is rapidly increasing, since carbon dioxide is environment-friendly and has excellent refrigerating properties. From the WO2006015741 a so-called booster system is known that employs a first compressor unit for the refrigeration consumers of the normal refrigeration cycle and a second compressor unit for the cold consumers of the freezing cycle; according to the preamble of claim 1.

[0003] The evaporators of the cold consumers, in particular the evaporators of the cold consumers of the freezing cycle, are subject to icing and consequently they have to be defrosted quite often. At present, these cold consumers are often defrosted electrically meaning that a heating is arranged at those evaporators and this heating is operated at regular intervals melting the ice at the evaporator coils and thus defrosting the evaporators of the cold consumers. However, such heatings cause additional costs for the installation and they consume a significant amount of energy.

[0004] Accordingly it would be beneficial to provide a refrigerating circuit and a corresponding method avoiding such additional heating units and allowing selective and efficient defrosting of iced evaporator coils.

[0005] According to exemplary embodiments of the invention, the first aspect of the invention concerns a refrigeration circuit according to claim 1.

[0006] According to exemplary embodiments of the invention, the second aspect of the invention concerns a method according to claim 14.

[0007] Exemplary embodiments of the invention will be described in greater detail below taking reference to the accompanying drawings.

[0008] Fig. 1 shows a connection diagram of a refrigeration circuit according to an exemplary embodiment of the invention.

[0009] The refrigerating circuit 2 comprises, in flow direction of the refrigerant, a compressor unit 4 having three compressors connected in parallel, a pressure line 6 leading to a condenser/gas cooler (not shown), an intermediate expansion device (not shown) after the condenser/gas cooler, a return line 8 from the condenser/gas cooler, a collecting container 10 in which liquid refrigerant collects in the lower liquid space portion and gaseous refrigerant collects in the upper gas space portion, a heat exchanger 12, a liquid line 14 to the cold consumer unit, a cold consumer of the normal refrigeration circuit comprising a first expansion device 16 and an evaporator 18 with appropriate evaporator coils, and a suction line 20 leading the gaseous refrigerant that has been evaporated in the evaporator 18 to the input side of the compressor

unit 4.

[0010] The heat exchanger 12 cools down the liquid refrigerant coming from the lower liquid space portion of the collecting container 10 against gaseous refrigerant coming from the gas space portion of the collecting container 10 in a flash gas line 34 and flowing to the suction line 20 of the compressor unit 4 afterwards.

[0011] The refrigeration circuit 2 further comprises a freezing branch comprising a partial liquid line branching off from the common liquid line 14 after the heat exchanger 12, a freezing cold consumer unit comprising a second expansion device 22 and an evaporator 24, a suction line 26 feeding the gaseous refrigerant that has been evaporated in the freezing cold consumer 24 to the input side of a compressor unit 28 that comprises three compressors connected in parallel, a pressure line 30 having a desuperheating unit 32 arranged therein and leading to the flash gas line 34 after the heat exchanger 12 that leads to the suction line 20 of the first compressor unit 4.

[0012] In the second expansion device 22, the liquid refrigerant is relieved to such an extent that the evaporator 24 provides freezing temperatures.

[0013] Since the pressure line 30 from the compressor unit 28 feeds into the suction line 20 leading to the compressor unit 4, the compressor units 28 and 4 are connected in series, and the compressor unit of the freezing circuit 28 compresses the gaseous refrigerant from the suction line 26 to a pressure level corresponding to the pressure of the gaseous refrigerant in the suction line 20. Such a refrigerating circuit is also referred to as booster system.

[0014] In the refrigerating circuit 2 the compressor unit 4, the pressure line 6, the condenser/gas cooler (not shown), the intermediate expansion device (not shown), the line 8, the collecting container 10, the heat exchanger 12, the liquid line 14 and its partial line leading to the first expansion device 16, the expansion device 16, the cold consumer 18, the suction line 20 and the flash gas line 34 form a normal refrigeration circuit.

[0015] Likewise, the compressor unit 4, the pressure line 6, the condenser/gas cooler (not shown), the intermediate expansion device (not shown), the line 8, the collecting container 10, the heat exchanger 12, the liquid line 14 and its partial line leading to the second expansion device 22, the second expansion device 22, the evaporator 24, the suction line 26, the compressor unit 28, the pressure line 30 having the desuperheating 32 arranged therein and leading to the suction line 20 form a freezing circuit.

[0016] Since the compressor unit 4, the pressure line 6, the condenser/gas cooler (not shown), the intermediate expansion device (not shown), the line 8, the collecting container 10, the heat exchanger 12, the first common part of the liquid line 14 and the last part of the suction line 20 are used by both the normal refrigeration circuit and the freezing circuit, a normal refrigeration branch is formed by the second part of the liquid line 14 leading to the evaporator 18, the first expansion device 16, the

evaporator 18 and the first part of the suction line 20, and, likewise, a freezing branch is formed by the second part of the liquid line 14 leading to the evaporator 24, the second expansion device 22, the evaporator 24, the suction line 26, the compressor unit 28, the pressure line 30 and the desuperheating unit 32.

[0017] The refrigeration circuit 2 further comprises a defrosting line 36 branching-off from the pressure line 6 that divides near the cold consumers 18 and 24 into a first defrosting line branch 44 leading to an attaching point in the line between the first expansion device 16 and the evaporator 18 and into a second defrosting line branch 48 leading to an attaching point in the line between the second expansion device 22 and the evaporator 24. At the entry side of the defrosting line 36, a pressure reduction valve 38 is arranged that in operation reduces the pressure of the pressurized refrigerant from the pressure line 6 to an acceptable pressure range value. By the pressure reduction valve 38, the pressure of the gaseous refrigerant can be reduced from a pressure value in the pressure line 6 lying typically in the range of 60 to 115 bar to the highest acceptable pressure given by the construction of the defrosting line 36 and the evaporator 18, 24 to be defrosted.

[0018] Behind the pressure reduction valve 38, a solenoid valve 40 is arranged at the entry portion of the defrosting line 36, another solenoid valve 46 is arranged in the first defrosting line branch 44 and still another solenoid valve 50 is arranged in the second defrosting line branch 48. By opening and closing the solenoid valves 40, 46 and 50 the defrosting line 36 and the defrosting line branches 44 and 48 can be opened and closed selectively. Behind the solenoid valve 40 there is arranged a safety valve 42 in the defrosting line 36, this safety valve 42 monitors the pressure of the refrigerant flowing in the defrosting line 36 and closes the defrosting line 36 if the pressure of the refrigerant within the defrosting line 36 leaves an acceptable pressure range, in particular exceeds a predetermined upper value.

[0019] There is also a control unit (not shown) that is connected to the elements of the refrigerating circuit 2 shown in Fig. 1 and being configured to control and operate them.

[0020] In the following, a method for defrosting a cold consumer unit 24 while the cold consumer unit 18 maintains its refrigeration mode is explained.

[0021] In the normal refrigerating mode, the elements of the refrigeration circuit are running and effect cooling at normal refrigeration temperatures in the evaporator 18 and cooling at freezing temperatures in the evaporator 24, and the defrosting line 36 is closed by the solenoid valves 40, 46 and 50.

[0022] At the beginning of the defrosting mode, the desuperheating unit 32 is switched off which causes an increase of the temperature of the pressurized gas both at the input side of the compressor unit 4 and in the pressure line 6.

[0023] Then the pressure end value of the compressor

unit 4 is reduced. This causes a reduction of the pressure end value of the compressor unit 28 as well and thus an increase of the performance of the compressor unit 28. In other words, the refrigerant flow in the pressure lines 30 and 6 is made bigger.

[0024] Then the second expansion device 22 is closed and the refrigerating operation of the cold consumer unit 24 is stopped.

[0025] Subsequently, the pressure in the defrosting line 36 is reduced to an acceptable pressure level by the pressure reduction valve 38, then the solenoid valve 40 is opened and pressurized gas enters the defrosting line 36, and thereafter the solenoid valve 50 is opened leading hot pressurized gaseous refrigerant to the cold consumer unit 24.

[0026] Thus, a higher total refrigerant flow in the pressure line 6 is needed, and by reducing the pressure end value of the compressor unit 4 what causes a reduction of the pressure and value of the compressor unit 28 and an increase in performance of the compressor unit 28 such increased refrigerant flow is provided.

[0027] The cold consumer unit 24 is defrosted by the hot pressurized gaseous refrigerant that has been pressurized in two steps by the compressor unit 28 and the compressor unit 4, that has been branched off from the pressure line 6 to the defrosting line 36 and the pressure of it has been reduced to a pressure level to be acceptable for the cold consumer unit 24. The hot pressurized gaseous refrigerant defrosting the cold consumer unit 24 does not change its aggregate state, it rather maintains its gaseous form and is sucked in by the compressor unit 28 thereafter.

[0028] While the cold consumer unit 24 is being defrosted, the cold consumer unit 28 maintains its refrigerating operation. The hot pressurized gas in the pressure line 6 is divided up into two partial flows, the first partial flow being led over the condenser/gas cooler (not shown) to the cold consumer unit 18 for refrigeration and the second partial flow flowing through the defrosting line 36 to the cold consumer unit 24 for defrosting.

[0029] The defrosting mode is stopped either if a predetermined defrosting end temperature in the cold consumer unit 24 has been reached, what can be sensed by a temperature sensor provided at the cold consumer unit 24 (not shown), or after a predetermined time interval.

[0030] The temperature in the pressure line 6 or at the output side of the compressor unit 4 can be monitored by a temperature sensor (not shown), and in case this temperature leaves an acceptable temperature range, in particular exceeds a predetermined upper threshold value, then the desuperheating unit 32 can be switched on again. Likewise, if this temperature has reached the acceptable temperature range again, in particular has fallen below the upper threshold value again, the desuperheating unit can be switched off again.

[0031] When the defrosting mode is stopped, at first the solenoid valve 40 is closed and the refrigerant in the

portion of the defrosting line 36 after the solenoid valve 40 is sucked off and the pressure is reduced to bring the defrosting line portion to the pressure of the evaporator level. Then the solenoid valve 50 is closed. The pressure should remain slightly higher than the suction pressure in order that the solenoid valve 50 closes tightly. Thereafter, the desuperheating unit 32 is switched on again, and the second expansion device 22 is opened again. The reduced pressure end value of the compressor unit 4 can be maintained for a predetermined time interval in order to ensure a fast cooling of the defrosted cold consumer unit 24. After this predetermined time interval the pressure end value of the compressor unit 4 can be set to the regular value again.

[0032] As a matter of cause, the embodiment of Fig. 1 is only exemplary.

[0033] In an alternative exemplary embodiment more than one cold consumer unit of the normal refrigeration branch and more than one cold consumer unit of the freezing branch are provided. These cold consumer units are connected in parallel in between the liquid line 14 and the suction lines 20 and 26, respectively. In this embodiment, the refrigerant from the evaporator(s) of the freezing branch to be defrosted flows back to the compressor unit of the freezing branch, and the refrigerant from the evaporator of the normal refrigerating branch to be defrosted flows back to the first compressor unit.

[0034] According to another exemplary embodiment the defrosting line 36 does not have defrosting line branches to the cold consumer units of the normal refrigeration branch, but only to the plurality of cold consumer units of the freezing branch. These cold consumer units are connected in parallel in between the liquid line 14 and the suction line 26, respectively.

[0035] According to exemplary embodiments, as described above, there is provided a refrigerating circuit and a corresponding method that allow for selective and efficient defrosting of iced cold consumers, in particular of iced evaporator coils. An inefficient and costly electrical defrosting is avoided. In some conventional defrosting systems, additional compressors of the second compressor unit have been needed solely for the defrosting and this waste of resources is also reliably avoided by the refrigerating circuit and the corresponding method according to exemplary embodiments of the invention, as described above. In comparison to other systems, the defrosting performance is increased by leading the gaseous refrigerant pressurized by the compressor unit of the freezing branch into the suction line of the first compressor unit, thereby increasing the temperature of the pressurized gaseous refrigerant leaving the first compressor unit. It is not necessary to raise the pressure level provided by the first compressor unit as has been the case with other conventional defrosting methods.

[0036] While the refrigerating circuit and the corresponding method according to exemplary embodiments, as described above, is generally suitable for a wide variety of refrigerants, carbondioxide (CO₂) is particularly

well suited. A combined hot gas defrosting for simultaneously defrosting of partial consumers of normal refrigerating and freezing temperature ranges in CO₂ installations according to the booster principle is disclosed.

[0037] By the pressure reduction valve in the defrosting line it is assured that the respective evaporators are defrosted by gaseous refrigerant the pressure of which is in an acceptable range for the evaporator(s).

[0038] According to a further exemplary embodiment, the control unit is configured to operate at least one of the evaporators in a defrosting mode, whereas the other evaporator(s) are operated in the refrigerating mode. By this embodiment some evaporators can be operated in the refrigerating mode, whereas other evaporators can be defrosted at the same time. It is no more necessary to interrupt the refrigerating mode to defrost all the iced evaporators as it has been the case with other defrosting methods.

[0039] According to another exemplary embodiment, the control unit is configured to switch the desuperheating device inactive at the beginning of the defrosting mode. This effects a higher temperature of the pressurized gaseous refrigerant in the pressure line after the first compressor unit and improves the efficiency of the defrosting.

[0040] According to another exemplary embodiment, a pressure side temperature sensor is disposed at the pressure side of the first compressor unit or at the pressure line after the first compressor unit and the control unit is configured to switch the desuperheating device active if the temperature sensed by the temperature sensor exceeds a predetermined temperature value. By this embodiment it is reliably avoided that the temperature of the gaseous pressurized refrigerant gets too high.

[0041] According to the invention, the control unit is configured to reduce the end pressure value of the first compressor unit at the beginning or during the defrosting mode in order to reduce the pressure of the second compressor unit of the freezing branch and to raise the performance of the second compressor unit. By this embodiment the total refrigerant flow is increased without having to employ additional compressors of the compressor unit of the freezing branch. By reducing the end pressure value of the first compressor unit, the refrigeration of the evaporators that are not defrosted, but operated further in the refrigeration mode is ensured. The pressure difference being available for the defrosting in the freezing branch is raised at the same time.

[0042] According to a further exemplary embodiment, the defrosting line connects the pressure line after the first compressor unit to at least one attaching point between the expansion device and the evaporator of a cold consumer of the freezing branch. As a matter of cause, the defrosting line can connect the pressure line to a plurality of attaching points between the expansion device and the evaporator of a plurality of respective cold consumers of the freezing branch that are to be defrosted. The evaporators of the cold consumers of the freezing branch are subject to icing and need to be defrosted quite

often.

[0043] According to another exemplary embodiment of the invention, the defrosting line connects the pressure line after the first compressor unit to at least one attaching point between the expansion device and the evaporator of a cold consumer of the normal refrigeration branch. Although the evaporators of the normal refrigeration branch are less subject to icing than the evaporators of the freezing branch, they can also be defrosted selectively and reliably by the defrosting line according to this embodiment.

[0044] According to another exemplary embodiment, a safety valve is provided in the defrosting line that closes the defrosting line when the pressure in the defrosting line exceeds a predetermined upper value, what can be the case for example if there is a malfunction of other valves.

[0045] According to a further exemplary embodiment, at least one solenoid valve is arranged in the defrosting line, and the control unit is configured to open the solenoid valve for the defrosting mode. By such solenoid valve(s), the defrosting line can be opened and closed quickly and reliably.

[0046] According to another exemplary embodiment, solenoid valves are arranged in the entry portion and in the end portion(s) of the defrosting line, and the control unit is configured to open, at the beginning of the defrosting mode, the solenoid valve in the entry portion of the defrosting line and the respective solenoid valve(s) in the end portion(s) of the defrosting line for the evaporator(s) to be switched into the defrosting mode. By this embodiment, a reliable and selective defrosting of the particular evaporators to be defrosted is attained. Likewise, the solenoid valve(s) can be closed again at the end of the defrosting mode.

[0047] According to another exemplary embodiment, a temperature sensor is disposed at at least one evaporator and the control unit is configured to finish the defrosting mode for that evaporator if the temperature sensed by the temperature sensor reaches a predetermined temperature value. This embodiment allows the defrosting to be tailored to each evaporator to be defrosted. The refrigerating circuit can be switched back from the defrosting mode into the refrigerating mode, if the last evaporator has been defrosted.

[0048] In another exemplary embodiment, the control unit is configured to finish the defrosting mode after a predetermined safety interval, providing an easy and standardized defrosting.

[0049] According to another exemplary embodiment, the control unit is configured, when finishing the defrosting mode, to close the solenoid valve at the entry portion of the defrosting line first and to close the solenoid valve(s) at the end portion(s) of the defrosting line thereafter in order to suck off the remaining refrigerant in the defrosting line portion between the solenoid valves and to bring it to the pressure of the evaporator level.

[0050] According to another exemplary embodiment

of the invention, a subcooling device is arranged in the line after the collecting container for subcooling the liquid refrigerant against refrigerant that is led to the subcooling device from the gas space of the collected container and that is subsequently led to the suction side of the first compressor unit. By such subcooling device, the refrigeration efficiency of the refrigerating circuit can be further improved.

[0051] All the advantages and the embodiments that have been described with respect to the refrigerating circuit also hold true for the corresponding method for selectively defrosting cold consumers of a refrigerating circuit. These advantages and embodiments are herewith explicitly disclosed also in terms of corresponding method steps, however without repeating them again.

[0052] While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt the particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore it is intended that the invention not be limited to the particular embodiments disclosed, but that the invention will include all embodiments falling within the scope of the appended claims.

List of Reference Numerals

[0053]

2	refrigerating circuit
4	compressor unit
6	pressure line
8	return line
10	collecting container
12	heat exchanger
14	liquid line to cold consumer units
16	first expansion device
18	cold consumer of normal refrigeration branch
20	suction line of normal refrigeration branch
22	second expansion device
24	cold consumer of freezing branch
26	suction line of freezing branch
28	compressor unit of freezing branch
30	pressure line
32	desuperheater
34	flash gas line
36	defrosting line
38	pressure reduction valve
40	solenoid valve
42	safety valve
44	first defrosting line branch
46	solenoid valve
48	second defrosting line branch
50	solenoid valve

Claims

1. Refrigerating circuit (2), comprising:

a first compressor unit (4), a condenser/gas cooler, and a collecting container (10),
 a normal refrigeration branch coupled between the collecting container (10) and the suction side of the at least one first compressor unit (4), the normal refrigeration branch comprising at least one cold consumer having an evaporator (18) with an expansion device (16) arranged before it; and
 a freezing branch coupled between the collecting container (10) and the suction side of the first compressor unit (4), the freezing branch comprising at least one cold consumer having an evaporator (24) with an expansion device (22) arranged before it, a second compressor unit (28) and a desuperheating device (32),
 the refrigerant circuit (2) further comprising refrigerant conduits for connecting said elements and for circulating a refrigerant therethrough,
 a defrosting line (36) connected between a branching-off point in the pressure line (6) after the first compressor unit (4) and at least one attaching point between the expansion device (16; 22) and the evaporator (18; 24) of one of the cold consumer units,
 wherein a pressure reduction valve (38) is arranged in the defrosting line (36),
characterized in that the refrigerant circuit (2) further comprises:

a control unit being configured to operate at least one of the evaporators (18, 24) in a defrosting mode, in which a partial flow of the pressurized gaseous refrigerant leaving the first compressor unit (4) is led to the respective evaporator (18, 24) through the defrosting line (36), wherein the pressure of the refrigerant is reduced by the pressure reduction valve (38) and the refrigerant defrosts the respective evaporator (18, 24) while maintaining its gaseous state and flows back to the respective compressor unit (4, 28);
 wherein the control unit is configured to reduce the end pressure value of the first compressor unit (4) during the defrosting mode in order to reduce the pressure of the second compressor unit (28) and raise the performance of the second compressor unit (28).

2. Refrigerating circuit according to claim 1, wherein the control unit is configured to operate at least one of the evaporators (18, 24) in a defrosting mode,

whereas the other evaporator(s) (18, 24) are operated in a refrigerating mode.

3. Refrigerating circuit according to claim 1 or 2, wherein the control unit is configured to switch the desuperheating device (32) inactive at the beginning of the defrosting mode.
4. Refrigerating circuit according to claim 3, wherein a pressure side temperature sensor is disposed at the pressure side of the first compressor unit (4) and wherein the control unit is configured to switch the desuperheating device (32) active if the temperature sensed by the pressure side temperature sensor exceeds a predetermined temperature value.
5. Refrigerating circuit according to any of the preceding claims, wherein the defrosting line (36) connects the pressure line (6) after the first compressor unit (4) to at least one attaching point between the expansion device (22) and the evaporator (22) of a cold consumer of the freezing branch.
6. Refrigerating circuit according to any of the preceding claims, wherein the defrosting line (36) connects the pressure line (6) after the first compressor unit (4) to at least one attaching point between the expansion device (16) and the evaporator (18) of a cold consumer of the normal refrigeration branch.
7. Refrigerating circuit according to any of the preceding claims, wherein a safety valve (42) is provided in the defrosting line (36), said safety valve (42) being configured to close the defrosting line (36) when the pressure in the defrosting line (36) exceeds a predetermined value.
8. Refrigerating circuit according to any of the preceding claims, wherein at least one solenoid valve (40; 46, 50) is arranged in the defrosting line (36), wherein the control unit is configured to open the solenoid valve (40; 46, 50) for the defrosting mode.
9. Refrigerating circuit according to claim 8, wherein in the entry portion and in the end portion of the defrosting line (36) solenoid valves (40; 46, 50) are arranged, wherein the control unit is configured to open, at the beginning of the defrosting mode, the solenoid valve (40) in the entry portion of the defrosting line (36) and the respective solenoid valve(s) (40; 46, 50) in the end portion of the defrosting line (36) for the evaporator(s) to be switched into the defrosting mode.
10. Refrigerating circuit according to claim 9, wherein the control unit is configured, when finishing the defrosting mode, to close the solenoid valve (40) at the entry portion of the defrosting line (36) first and to

close the solenoid valve(s) (46, 50) at the end portion of the defrosting line (36) thereafter in order to bring the defrosting line portion between the solenoid valves (40; 46, 50) to the pressure of the evaporator level.

11. Refrigerating circuit according to any of the preceding claims, wherein a temperature sensor is disposed at at least one evaporator (18, 24) and wherein the control unit is configured to finish the defrosting mode if the temperature sensed by the temperature sensor reaches a predetermined temperature value.
12. Refrigerating circuit according to any of the preceding claims, wherein the control unit is configured to finish the defrosting mode after a predetermined safety interval.
13. Refrigerating circuit according to any of the preceding claims, wherein a subcooling device (12) is arranged in the line after the collecting container (10) for subcooling the liquid refrigerant against refrigerant that is led to the subcooling device (12) from the gas space of the collecting container (10) and that is subsequently led to the suction side of the first compressor unit (4).
14. Method for selectively defrosting cold consumers (18, 24) of a refrigerating circuit (2) according to any of the preceding claims, comprising the following steps:

reducing the pressure in the defrosting line (36) by the pressure reduction valve (38) and opening the at least one solenoid valve (40; 46, 50) in the defrosting line (36);
leading a partial flow of the pressurized gaseous refrigerant leaving the first compressor unit (4) to the respective evaporator(s) (18, 24) to be defrosted through the defrosting line (36), wherein the pressure of the refrigerant is reduced by the pressure reduction valve (38) and the refrigerant defrosts the respective evaporator(s) (18, 24) while maintaining its gaseous state and flows back to the respective compressor unit (4, 28) and
reducing the end pressure value of the first compressor unit (4) in order to reduce the pressure of the second compressor unit (28) and raise the performance of the second compressor unit (28).

Patentansprüche

1. Kühlkreislauf (2), umfassend:

eine erste Verdichtereinheit (4), einen Konden-

sator/Gaskühler und einen Sammelbehälter (10),

einen Normalkühlungsweig, der zwischen dem Sammelbehälter (10) und der Saugseite der mindestens einen ersten Verdichtereinheit (4) gekoppelt ist, wobei der Normalkühlungsweig mindestens einen Kälteverbraucher mit einem Verdampfer (18) mit einer davor angeordneten Expansionseinrichtung (16) umfasst; und einen zwischen dem Sammelbehälter (10) und der Saugseite der ersten Verdichtereinheit (4) gekoppelten Gefrierweig, wobei der Gefrierweig mindestens einen Kälteverbraucher mit einem Verdampfer (24) mit einer davor angeordneten Expansionseinrichtung (22), eine zweite Verdichtereinheit (28) und eine Enthitzungseinrichtung (32) umfasst, wobei der Kältemittelkreislauf (2) ferner Kältemittelteilungen zum Verbinden dieser Elemente und zum Zirkulieren eines Kältemittels durch diese umfasst, eine Abtauleitung (36), die zwischen einem Abzweigpunkt in der Druckleitung (6) nach der ersten Verdichtereinheit (4) und mindestens einem Ansetzpunkt zwischen der Expansionseinrichtung (16; 22) und dem Verdampfer (18; 24) von einer der Kälteverbraucher-einheiten angeschlossen ist, wobei in der Abtauleitung (36) ein Druckreduktionsventil (38) angeordnet ist, **dadurch gekennzeichnet, dass** der Kältemittelkreislauf (2) ferner Folgendes umfasst:

eine Steuereinheit, die konfiguriert ist, um mindestens einen der Verdampfer (18, 24) in einem Abtaumodus zu betreiben, bei dem ein Teilstrom des unter Druck stehenden gasförmigen Kältemittels, das die erste Verdichtereinheit (4) verlässt, durch die Abtauleitung (36) zum jeweiligen Verdampfer (18, 24) geleitet wird, wobei der Druck des Kältemittels durch das Druckreduktionsventil (38) reduziert wird und das Kältemittel den jeweiligen Verdampfer (18, 24) unter Beibehaltung seines Gaszustandes abtaut und zu der jeweiligen Verdichtereinheit (4, 28) zurückströmt; wobei die Steuereinheit konfiguriert ist, den Enddruckwert der ersten Verdichtereinheit (4) während des Abtaumodus zu reduzieren, um den Druck der zweiten Verdichtereinheit (28) zu reduzieren und die Leistung der zweiten Verdichtereinheit (28) zu erhöhen.

2. Kühlkreislauf nach Anspruch 1, wobei die Steuereinheit so konfiguriert ist, dass sie mindestens einen der Verdampfer (18, 24) in einem Abtaumodus betreibt, während die anderen Verdampfer (18, 24) in

einem Kühlmodus betrieben werden.

3. Kühlkreislauf nach Anspruch 1 oder 2, wobei die Steuereinheit so konfiguriert ist, dass sie die Enthitzungseinrichtung (32) zu Beginn des Abtaumodus inaktiv schaltet.
4. Kühlkreislauf nach Anspruch 3, wobei ein druckseitiger Temperatursensor an der Druckseite der ersten Verdichtereinheit (4) angeordnet ist und wobei die Steuereinheit so konfiguriert ist, dass sie die Enthitzungseinrichtung (32) aktiv schaltet, wenn die vom druckseitigen Temperatursensor erfasste Temperatur einen vorgegebenen Temperaturwert überschreitet.
5. Kühlkreislauf nach einem der vorstehenden Ansprüche, wobei die Abtauleitung (36) die Druckleitung (6) nach der ersten Verdichtereinheit (4) mit mindestens einem Befestigungspunkt zwischen der Expansionseinrichtung (22) und dem Verdampfer (22) eines Kälteverbrauchers des Gefrierzweiges verbindet.
6. Kühlkreislauf nach einem der vorstehenden Ansprüche, wobei die Abtauleitung (36) die Druckleitung (6) nach der ersten Verdichtereinheit (4) mit mindestens einem Ansetzpunkt zwischen der Expansionseinrichtung (16) und dem Verdampfer (18) eines Kälteverbrauchers des Normalkühlungszweigs verbindet.
7. Kühlkreislauf nach einem der vorstehenden Ansprüche, wobei ein Sicherheitsventil (42) in der Abtauleitung (36) vorgesehen ist, wobei das Sicherheitsventil (42) zum Schließen der Abtauleitung (36) konfiguriert ist, wenn der Druck in der Abtauleitung (36) einen vorbestimmten Wert überschreitet.
8. Kühlkreislauf nach einem der vorstehenden Ansprüche, wobei mindestens ein Solenoidventil (40; 46, 50) in der Abtauleitung (36) angeordnet ist, wobei die Steuereinheit zum Öffnen des Solenoidventils (40; 46, 50) für den Abtaumodus konfiguriert ist.
9. Kühlkreislauf nach Anspruch 8, wobei im Eintrittsteil und im Endteil der Abtauleitung (36) Solenoidventile (40; 46, 50) angeordnet sind, wobei die Steuereinheit dazu konfiguriert ist, am Anfang des Abtaumodus, das Solenoidventil (40) im Eintrittsteil der Abtauleitung (36) zu öffnen und dass das oder die jeweiligen Solenoidventile (40; 46, 50) im Endteil der Abtauleitung (36) für den oder die Verdampfer in den Abtaubetrieb geschaltet wird/werden.
10. Kühlkreislauf nach Anspruch 9, wobei die Steuereinheit konfiguriert ist, bei Beendigung des Abtaumodus das Solenoidventil (40) zuerst am Eintrittsteil der Abtauleitung (36) zu schließen und danach das (die) Solenoidventil(e) (46, 50) am Endteil der Abtaulei-

tung (36) zu schließen, um den Abtauleitungsteil zwischen den Solenoidventilen (40; 46, 50) auf den Druck des Levels des/der Verdampfer(s) zu bringen.

11. Kühlkreislauf nach einem der vorstehenden Ansprüche, wobei ein Temperatursensor an mindestens einem Verdampfer (18, 24) angeordnet ist und wobei die Steuereinheit so konfiguriert ist, dass sie den Abtaumodus beendet, wenn die vom Temperatursensor erfasste Temperatur einen vorbestimmten Temperaturwert erreicht.
12. Kühlkreislauf nach einem der vorstehenden Ansprüche, wobei die Steuereinheit so konfiguriert ist, dass sie den Abtaumodus nach einem vorbestimmten Sicherheitsintervall beendet.
13. Kühlkreislauf nach einem der vorstehenden Ansprüche, wobei in der Leitung nach dem Sammelbehälter (10) eine Unterkühleinrichtung (12) zur Unterkühlung des flüssigen Kältemittels gegen Kältemittel angeordnet ist, das aus dem Gasraum des Sammelbehälters (10) zu der Unterkühleinrichtung (12) geführt und anschließend zur Saugseite der ersten Verdichtereinheit (4) geführt wird.
14. Verfahren zum selektiven Abtauen von Kälteverbrauchern (18, 24) eines Kühlkreislaufes (2) nach einem der vorstehenden Ansprüche, umfassend die folgenden Schritte:

 Reduzieren des Drucks in der Abtauleitung (36) durch das Druckreduktionsventil (38) und Öffnen des mindestens einen Solenoidventils (40; 46, 50) in der Abtauleitung (36) ;
 Leiten eines Teilstroms des unter Druck stehenden gasförmigen Kältemittels, das die erste Verdichtereinheit (4) verlässt, durch die Abtauleitung (36) zu den jeweiligen abzutauenden Verdampfern (18, 24), wobei der Druck des Kältemittels durch das Druckreduktionsventil (38) reduziert wird und das Kältemittel die jeweiligen Verdampfer (18, 24) unter Beibehaltung seines Gaszustandes abtaut und zu der jeweiligen Verdichtereinheit (4, 28) zurückströmt; und
 Reduzieren des Enddruckwertes der ersten Verdichtereinheit (4), um den Druck der zweiten Verdichtereinheit (28) zu reduzieren und die Leistung der zweiten Verdichtereinheit (28) zu erhöhen.

Revendications

1. Circuit de réfrigération (2) comprenant :

 un premier groupe compresseur (4), un condenseur/refroidisseur de gaz et un récipient collec-

teur (10),
 un branchement de réfrigération normale couplé entre le récipient collecteur (10) et le côté aspiration de l'au moins un premier groupe compresseur (4), le branchement de réfrigération normale comprenant au moins un consommateur de froid ayant un évaporateur (18) avec un dispositif de détente (16) disposé avant celui-ci ; et
 un branchement de congélation couplé entre le récipient collecteur (10) et le côté aspiration du premier groupe compresseur (4), le branchement de congélation comprenant au moins un consommateur de froid ayant un évaporateur (24) avec un dispositif de détente (22) disposé avant celui-ci, un second groupe compresseur (28) et un dispositif de désurchauffe (32),
 le circuit de frigorigène (2) comprenant en outre des conduits de frigorigène pour raccorder lesdits éléments et pour faire circuler un frigorigène à travers ces derniers,
 une conduite de dégivrage (36) raccordée entre un point de bifurcation dans la conduite de pression (6) après le premier groupe compresseur (4) et au moins un point de fixation entre le dispositif de détente (16 ; 22) et l'évaporateur (18 ; 24) de l'une des unités de consommateur de froid,
 une soupape de réduction de pression (38) étant agencée dans la conduite de dégivrage (36),
caractérisé en ce que le circuit de frigorigène (2) comprend en outre :

une unité de commande configurée pour faire fonctionner au moins l'un des évaporateurs (18, 24) dans un mode de dégivrage, dans lequel un écoulement partiel du frigorigène gazeux sous pression quittant le premier groupe compresseur (4) est conduit à l'évaporateur respectif (18, 24) à travers la conduite de dégivrage (36), la pression du frigorigène étant réduite par la soupape de réduction de pression (38) et le frigorigène dégivrant l'évaporateur respectif (18, 24) tout en maintenant son état gazeux et retournant au groupe compresseur respectif (4, 28) ;
 l'unité de commande étant configurée pour réduire la valeur de pression de fin du premier groupe compresseur (4) pendant le mode de dégivrage afin de réduire la pression du second groupe compresseur (28) et d'augmenter les performances du second groupe compresseur (28).

2. Circuit de réfrigération selon la revendication 1, dans lequel l'unité de commande est configurée pour faire fonctionner au moins l'un des évaporateurs (18, 24) dans un mode de dégivrage, tandis que le ou les

autres évaporateurs (18, 24) fonctionnent dans un mode de réfrigération.

3. Circuit de réfrigération selon la revendication 1 ou 2, dans lequel l'unité de commande est configurée pour commuter le dispositif de désurchauffe (32) inactif au début du mode de dégivrage.
4. Circuit de réfrigération selon la revendication 3, dans lequel une sonde de température côté pression est disposée du côté pression du premier groupe compresseur (4) et dans lequel l'unité de commande est configurée pour commuter le dispositif de désurchauffe (32) actif si la température détectée par la sonde de température côté pression dépasse une valeur de température prédéterminée.
5. Circuit de réfrigération selon l'une quelconque des revendications précédentes, dans lequel la conduite de dégivrage (36) raccorde la conduite de pression (6) après le premier groupe compresseur (4) à au moins un point de fixation entre le dispositif de détente (22) et l'évaporateur (22) d'un consommateur de froid du branchement de congélation.
6. Circuit de réfrigération selon l'une quelconque des revendications précédentes, dans lequel la conduite de dégivrage (36) raccorde la conduite de pression (6) après le premier groupe compresseur (4) à au moins un point de fixation entre le dispositif de détente (16) et l'évaporateur (18) d'un consommateur de froid du branchement de réfrigération normale.
7. Circuit de réfrigération selon l'une quelconque des revendications précédentes, dans lequel une soupape de sécurité (42) est prévue dans la conduite de dégivrage (36), ladite soupape de sécurité (42) étant configurée pour fermer la conduite de dégivrage (36) lorsque la pression dans la conduite de dégivrage (36) dépasse une valeur prédéterminée.
8. Circuit de réfrigération selon l'une quelconque des revendications précédentes, dans lequel au moins une électrovanne (40 ; 46, 50) est agencée dans la conduite de dégivrage (36), l'unité de commande étant configurée pour ouvrir l'électrovanne (40 ; 46, 50) pour le mode de dégivrage.
9. Circuit de réfrigération selon la revendication 8, dans lequel dans la partie d'entrée et dans la partie d'extrémité de la conduite de dégivrage (36), des électrovannes (40 ; 46, 50) sont agencées, l'unité de commande étant configurée pour ouvrir, au début du mode de dégivrage, l'électrovanne (40) dans la partie d'entrée de la conduite de dégivrage (36) et la ou les électrovannes respectives (40 ; 46, 50) dans la partie d'extrémité de la conduite de dégivrage (36) pour le ou les évaporateurs pour passer en

mode dégivrage.

10. Circuit de réfrigération selon la revendication 9, dans lequel l'unité de commande est configurée, lors de la fin du mode de dégivrage, pour fermer en premier l'électrovanne (40) à la partie d'entrée de la conduite de dégivrage (36) et pour fermer ensuite la ou les électrovannes (46, 50) à la partie d'extrémité de la conduite de dégivrage (36) afin d'amener la partie de la conduite de dégivrage entre les électrovannes (40 ; 46, 50) à la pression du niveau de l'évaporateur. 5
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11. Circuit de réfrigération selon l'une quelconque des revendications précédentes, dans lequel une sonde de température est disposée sur au moins un évaporateur (18, 24) et dans lequel l'unité de commande est configurée pour terminer le mode de dégivrage si la température détectée par la sonde de température atteint une valeur de température prédéterminée. 15
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12. Circuit de réfrigération selon l'une quelconque des revendications précédentes, dans lequel l'unité de commande est configurée pour terminer le mode de dégivrage après un intervalle de sécurité prédéterminé. 25
13. Circuit de réfrigération selon l'une quelconque des revendications précédentes, dans lequel un dispositif de sous-refroidissement (12) est agencée dans la conduite après le récipient collecteur (10) destiné à sous-refroidir le frigorigène liquide contre le frigorigène qui est conduit dans le dispositif de sous-refroidissement (12) à partir de l'espace gazeux du récipient collecteur (10) et qui est ensuite dirigé vers le côté aspiration du premier groupe compresseur (4). 30
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14. Procédé de dégivrage sélectif de consommateurs de froid (18, 24) d'un circuit de réfrigération (2) selon l'une quelconque des revendications précédentes, comprenant les étapes suivantes : 40

réduire la pression dans la conduite de dégivrage (36) par la soupape de réduction de pression (38) et ouvrir la au moins une électrovanne (40 ; 46, 50) dans la conduite de dégivrage (36) ;
conduire un écoulement partiel du frigorigène gazeux sous pression quittant le premier groupe compresseur (4) à l'évaporateur ou aux évaporateurs respectifs (18, 24) pour être dégivré par la conduite de dégivrage (36), la pression du frigorigène étant réduite par la soupape de réduction de pression (38) et le frigorigène dégivrant le ou les évaporateurs respectifs (18, 24) tout en maintenant son état gazeux et retournant vers le groupe compresseur respectif (4, 28) et réduire la valeur de pression de fin du premier 45
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groupe compresseur (4) afin de réduire la pression du second groupe compresseur (28) et d'augmenter les performances du second groupe compresseur (28).

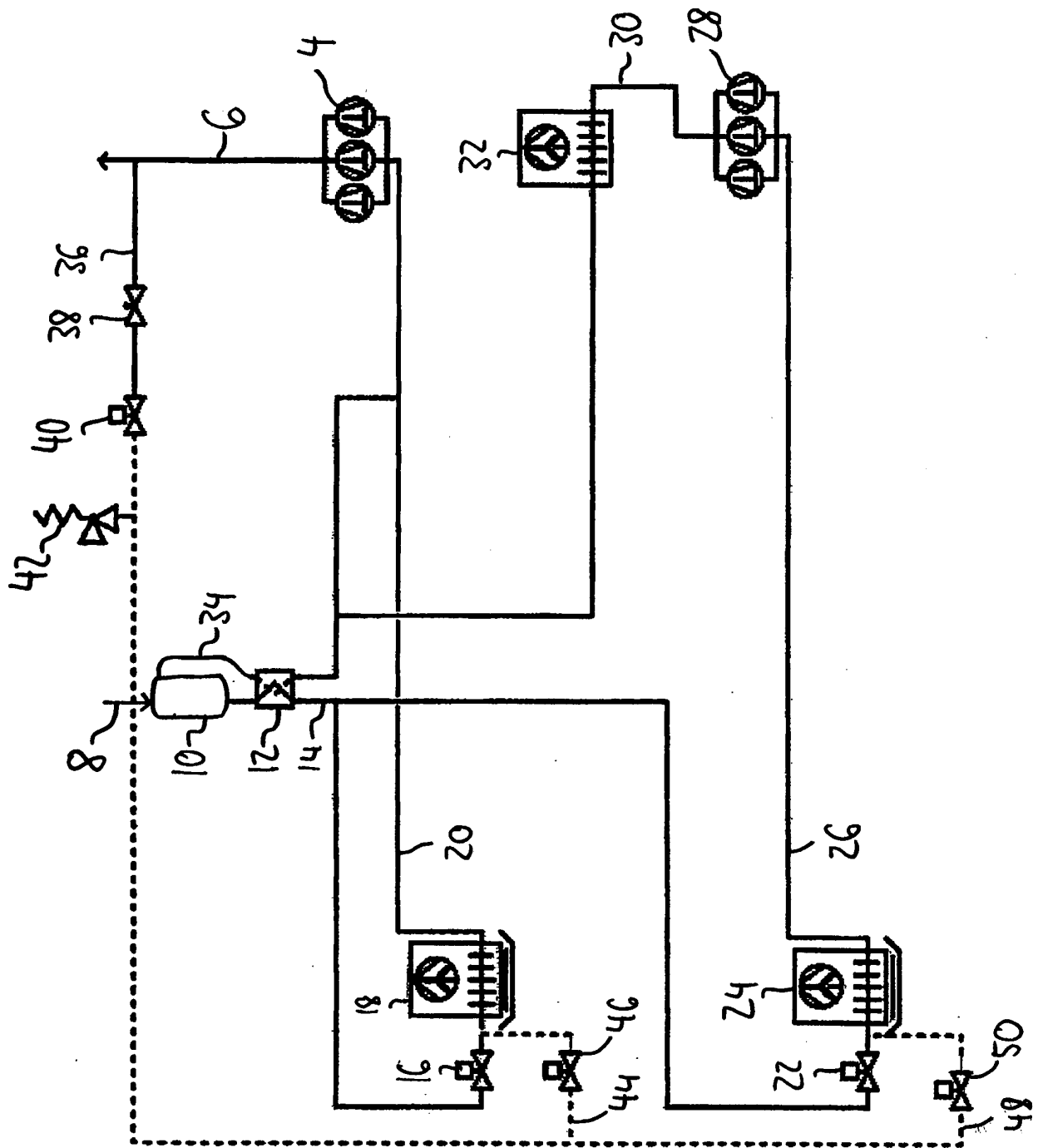


Fig. 1

REFERENCES CITED IN THE DESCRIPTION

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