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(54) **A MULTI-EVAPORATOR REFRIGERATION CIRCUIT**

KÄLTEKREISLAUF MIT MEHREREN VERDAMPFERN

CIRCUIT DE RÉFRIGÉRATION À MULTIPLES ÉVAPORATEURS

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EP 2 718 642 B1

Description

Field of the Invention

[0001] The present invention relates to a multi-evaporator refrigeration circuit, deployed both in low pressure and intermediate pressure receiver versions, adapted to use carbon dioxide as a refrigerant. The refrigeration circuit comprises at least a compressor; a condenser/gas cooler; a high pressure regulating valve; a liquid/vapour separator; a pressure limiting valve; a liquid level sensing device; two or more evaporators; and a suction receiver, wherein the refrigeration circuit is adapted to feed the liquid refrigerant to the two or more evaporators from said separator through a throttling device. The present invention also relates to the extension of the above circuit to a booster concept, where two different evaporation levels are made available, comprising the booster concept, beside the above components, at least a low temperature compressor; two or more evaporators; and a regenerative heat exchanger; wherein the method comprises feeding the liquid refrigerant to the two or more evaporators from said separator through the regenerative heat exchanger and a throttling device.

Background of the Invention

[0002] In many refrigeration systems of direct expansion, even among those using carbon dioxide (R744) as refrigerant, it is desirable to control the flow of refrigerant through the evaporator(s) in order to obtain a circulation ratio RC, i.e. the ratio between the flow rate through evaporators and the amount evaporated, slightly higher than the unit value. In this way it may be possible to obtain both the maximum use of the heat transfer surface and a smaller difference in temperature between the refrigerant and the fluid or object to be cooled and therefore a higher overall efficiency of the system. The above is possible, for example with forced circulation by a pump. The method is however expensive and complex. Italian patent applications no. TV2011A000077 and no. TV2011A000141 present a mode of embodiment of a refrigeration system of this type that is characterized by a degree of overfeeding of the evaporators, but without the use of a circulation pump and without direct control of the superheating, that is the difference between refrigerant temperature at evaporator outlet and saturated temperature at evaporating pressure. It can thus obtain a greater efficiency of heat transfer in the evaporators without the complication of using a circulation pump, as well as a higher saturated suction temperature for a given temperature of fluid or body to be cooled, and consequently a higher efficiency of the whole system.

[0003] One of the key points of the invention as described in the aforementioned patent applications is a circuit arrangement such as to allow the transfer of excess of liquid, i.e. the flow rate circulated in evaporators, but not evaporated, from the low pressure receiver into

the liquid / vapour separator at medium pressure.

[0004] The refrigeration system described in the two patent applications mentioned above provides for use of a single cold temperature. In many applications, for example in supermarkets, usage of both medium temperatures MT, i.e. temperatures in the neighborhood of 0 ° C, and low temperatures BT, i.e. temperatures in the neighborhood of -30 ° C, are present. It is therefore appropriate to extend the scope of the previously described refrigeration system also to the case where two temperature levels are present, possibly with the most economical and efficient way available when using CO₂ as a refrigerant, i.e. the configuration called "booster". This configuration using the two levels of evaporation temperatures is made with two different compressors or groups of compressors. The suction from the lower pressure compressor or group of compressors compress(es) the vapour to the suction pressure of the compressor or the group compressor to the upper level which coincides with the evaporation temperature of the medium temperature. Said compressor at a higher level of pressure then will provide both the removal of the vapour produced in evaporators for medium temperature and also compression to the higher pressure of the cycle of the fluid evaporated at the lower temperature level and compressed by the low pressure stage compressors. Such embodiment is the object of the Italian patent application TV2012A000010.

[0005] A patent application US 2010/0199707 discloses a refrigerating system which comprises a compressor, a heat rejection device, an expansion device, an evaporator and a receiver, capable of operating with the compressor discharge higher than the critical pressure of the refrigerant. The compressor pumps refrigerant gas to a high pressure condition at which it can reject heat to atmosphere or some other cooling medium. The gas is conducted from the compressor through pipes to the heat rejection device. From the heat rejection device the cooled refrigerant passes through pipes to a heat exchanger located in the receiver and from there through pipes to the evaporator. The flow outlet from the heat rejection device is regulated by a pressure control valve, the pressure downstream of the pressure control valve is regulated by a gas vent valve, the refrigerant flow to the evaporator is further regulated by an automatic control device at the inlet to the evaporator, and the automatic control device being set to permit intermittent flow of liquid refrigerant to the receiver during normal operation of the system. The refrigerant may be carbon dioxide, which may operate under transcritical pressures e.g. 80 to 120 bar absolute. The receiver acts as a trap for any liquid from the evaporator.

Summary of the invention

[0006] In the following there is described a system-type refrigeration booster, which allows operation with excess of mass flow in the evaporators of both of low temperature

and of medium-temperature, describing in detail some embodiments of a safe and simple refrigerator circuit and a method in a refrigerator circuit.

[0007] According to a first aspect of the present invention there is provided a refrigeration circuit according to claim 1 which is adapted to use carbon dioxide as a liquid refrigerant. The refrigeration circuit is primarily characterized in that the refrigeration circuit further comprises at least one ejector comprising a suction port, in parallel to the high pressure regulating valve; and that the refrigeration circuit is adapted to drive cold liquid from the suction receiver to the suction port of said at least one ejector, being activated for direct charge transfer, for maintaining a sufficient liquid level in the liquid/vapour separator even if the mass flow circulating in the two or more evaporators is higher than the mass flow evaporated, through an opening of a first control valve in the line from the suction receiver to the suction port of the at least one ejector, based on a maximum level signal generated by the liquid level sensing device, whenever the level of liquid refrigerant in said suction receiver is above a set maximum level.

[0008] According to a second aspect of the present invention there is provided a method in a multi-evaporator refrigeration circuit according to claim 5 which is adapted to use carbon dioxide as a liquid refrigerant. The method is primarily characterized in that the refrigeration circuit further comprises at least one ejector comprising a suction port included in parallel to the high pressure regulating valve; wherein the method further comprises direct driving of cold liquid from the suction receiver to the suction port of said at least one ejector for maintaining a sufficient liquid level in the liquid/vapour separator even if the mass flow circulating in the two or more evaporators is higher than the mass flow evaporated, through an opening of one valve in the line from the low pressure receiver to the suction port of the ejector, based on a maximum level signal generated by the liquid level sensing device, whenever the level of liquid in said suction receiver is above a set maximum level.

[0009] According to a third aspect of the present invention there is provided a refrigeration circuit of low pressure receiver type according to claim 6 which is primarily characterized in that the refrigeration circuit further comprises at least one ejector, comprising a suction port, in parallel to the high pressure regulating valve; and that the refrigeration circuit is adapted to drive cold liquid from the suction receiver to the suction port of said at least one ejector, being activated for the charge transfer for maintaining a sufficient liquid level in the liquid/vapour separator even if the mass flow circulating in the two or more evaporators is higher than the mass flow evaporated, through an opening of a first control valve in the line from the suction receiver to the suction port of the at least one ejector, based on a minimum level signal generated by the liquid level sensing device, whenever the level of liquid refrigerant in said liquid vapour separator is below a set minimum level.

[0010] According to a fourth aspect of the present invention there is provided a method according to claim 14 which is primarily characterized in that the refrigeration circuit further comprises at least one ejector comprising a suction port included in parallel to the high pressure regulating valve; wherein the method further comprises direct driving of cold liquid from the suction receiver to the suction port of said at least one ejector for maintaining a sufficient liquid level in the liquid/vapour separator even if the mass flow circulating in the two or more evaporators is higher than the mass flow evaporated, through an opening of a first control valve in the line from the low pressure receiver to the suction port of the at least one ejector, based on a minimum level signal generated by the liquid level sensing device, whenever the level of liquid refrigerant in said liquid vapour separator is below a set minimum level.

[0011] A further mean of a charge transfer between the suction receiver and the liquid/vapour separator, of indirect type, is considered.

Description of the Drawings

[0012] In the following the present invention will be described in more detail with reference to the appended drawings, in which

- Fig. 1 illustrates a diagram of a refrigeration system for medium temperature with recirculation flow according to an example embodiment using an indirect charge transfer method;
- Fig. 2 illustrates a diagram of a refrigeration system for medium temperature with recirculation flow according to an example embodiment using a direct charge transfer method;
- Fig. 3 illustrates another example embodiment of a refrigeration system for medium temperature with recirculation flow comprising a charge transfer device;
- Fig. 4 illustrates another example embodiment of a refrigeration system for medium temperature with recirculation flow comprising a charge transfer device;
- Fig. 5 shows a diagram of a system booster type according to an example embodiment;
- Fig. 6 illustrates an example of connection and control means of an evaporator with relative supply valve and its control device;
- Fig. 7 is an example of a control algorithm of a feeding valve to the evaporator referred to in Fig. 6;
- Fig. 8a illustrates an example of the algorithm for ad-

justing the valve to control the pressure difference with a level switch as a level detection device on the suction receiver;

Fig. 8b illustrates an example of the algorithm for adjusting the valve to control the pressure difference with a level detection device on the suction receiver comprising a continuous level measurement and analog output; and

Fig. 8c illustrates an example of the algorithm for adjusting the valve to control the pressure difference with a level detection device on the liquid/vapour separator comprising a continuous level measurement and analog output.

Nomenclature and abbreviations

[0013] The numbering used in this patent application is as follows:

- MT: medium temperature
- BT: low temperature
- RC: circulation ratio (actual mass flow through evaporators / mass flow evaporated)
- X: a regulating and charge transfer device
- 1: a medium temperature compressor or compressors
- 2: a condenser / gas cooler
- 3: a medium temperature regenerative exchanger
- 4: a high pressure regulating valve / 1st stage throttling valve
- 5: a liquid / vapour separator
- 6: a medium temperature throttling valves to evaporators
- 7: a medium temperature evaporators
- 8: a suction receiver
- 9: a pressure-regulating valve in the separator 5
- 10: a first control valve for starting of charge transfer
- 13: a second control valve for liquid discharge from the liquid/vapour separator 5
- 16: a low temperature regenerative heat exchanger
- 17: a low temperature throttling valves to evaporators
- 18: a low temperature evaporators
- 19: a low temperature compressor or compressors
- 22: a refrigerant level detection device on suction receiver 8
- 23: a refrigerant level detection device on liquid / vapour separator 5

Detailed Description of the Invention

[0014] The above mentioned Italian patent applications TV2011A000077 and TV2011A000141 describe some circuit solutions that allow to obtain a degree of recirculation RC in the evaporators and one of these solutions is shown, by way of example, in fig. 1. With ref-

erence to fig. 1, the compressor (compressors) 1 suck(s) refrigerant vapour from the suction receiver 8 and compresses it to the higher pressure of the cycle in the heat exchanger condenser / gas cooler 2, in which the refrigerant is cooled with the external air or other fluid used for cooling said condenser / gas cooler 2. The pressure in condenser / gas cooler 2 is controlled indirectly by both flow rate and temperature of the cooling fluid either directly through a high pressure-regulating valve 4 located on the pipe downstream of the heat exchanger 2, according to a known technique.

[0015] Downstream of the valve 4 is present a liquid / vapour separator 5 having the function of separating the flash vapour, produced by the first expansion through the valve 4, from the liquid intended to supply the evaporators.

[0016] The refrigerant leaving the condenser / gas cooler 2 is entered, prior to entry to the valve 4, in a regenerative exchanger 3 in which the refrigerant is cooled by heat exchange with the fluid contained in the suction receiver 8. A certain flow rate of refrigerant liquid contained in said receiver 8 will circulate due to the density difference in the primary heat exchanger 3, connected for thermosiphon-like circulation, and return to the form of vapour at the top of the suction receiver 8 itself. The resulting cooling of the fluid in one circuit of heat exchanger 3 will produce a reduction of the amount of injected vapour in the liquid / vapour separator 5 and, at the same flow rate m1 output from the liquid / vapour separator 5 will result in an increase of the liquid fraction in the separator 5 itself. A virtual transfer of charge from the receiver 8 to the liquid/vapour separator 5 is obtained in this way. A pressure-regulating valve 9 will limit the absolute or differential pressure in the separator 5 by draining a vapour flow rate in the suction receiver 8, and the difference in pressure between the liquid/vapour separator 5 and the suction receiver 8 will be adjusted so as to have a pressure differential sufficient to circulate the refrigerant in the evaporators.

[0017] In a further embodiment shown in fig.2 the refrigerant leaving the condenser / gas cooler 2 is entered to the valve 4 and to at least one ejector 14, these components being installed in parallel. Downstream of the valve 4 and ejector 14 is present the liquid / vapour separator 5 having the function of separating the flash vapour, produced by the first expansion through the valve 4, from the liquid intended to feed the evaporators.

[0018] The pressure-regulating valve 9 will limit the absolute or differential pressure in the liquid/vapour separator 5 by draining a vapour flow rate in the suction receiver 8, and the difference in pressure between the liquid/vapour separator 5 and the suction receiver 8 will be adjusted so as to have a pressure differential sufficient to circulate the refrigerant in the evaporators. A certain flow rate of liquid contained in said suction receiver 8 will return into the liquid/vapour separator 5 through a port 15 of an ejector 14. A direct transfer of charge from the suction receiver 8 to the liquid/vapour separator 5 is ob-

tained in this way.

[0019] Similarly, other configurations may be used functionally equivalent, as described in Italian patent applications no. TV2011A000077 and no. TV2011A000141.

[0020] All the circuit solutions described in the patent applications mentioned above are due to regulating and charge transfer device indicated by X in fig. 3 and fig. 4, imagining to delimit the object of the invention described in the applications mentioned with the control surface indicated by dashed lines in figs. 3 and 4.

[0021] The interface of the regulating and charge transfer device of X, for all the configurations described, can be traced to a single module of a block diagram with three inputs and two outputs, as shown in fig. 3. With reference to the regulating and charge transfer device X of fig. 3 and Fig. 4, the three input pipes are identified as inlet pipe of the fluid coming from the heat exchanger 2 and indicated with a), the inlet pipe of the flash vapour from the liquid/vapour separator 5 and indicated with b), the inlet pipe of the liquid from the suction receiver 8 and denoted by c) while the outlet pipes are those of release of the fluid to the separator 5 and the input of the flash vapour to the suction receiver 8, respectively indicated with d) and e).

[0022] A possible configuration of the booster according to an embodiment of the invention is shown in Figure 5.

[0023] With reference to Fig. 5, the medium temperature compressor (compressors) 1 sucks refrigerant vapour from the suction receiver 8 and compress it to the high pressure of the cycle in the heat exchanger condenser / gas cooler 2, in which the refrigerant is cooled with the external air or other fluid. The pressure in this heat exchanger 2 is either directly or indirectly controlled by both the flow rate and the temperature of the cooling fluid and via a regulating valve 4 located on the pipe downstream of the heat exchanger 2 and included in the regulating and charge transfer device X. Said device X also performs the fine adjustment of the high pressure, the control of pressure in the liquid/vapour separator 5 and the transfer of the flow rate of refrigerant not evaporated from the suction receiver 8 into the liquid/vapour separator 5 according to the technique described above.

[0024] Downstream of the liquid/vapour separator 5 is installed a low temperature regenerative heat exchanger 16, one circuit of which, defined as the primary circuit, is configured for the circulation of the entire liquid flow m_1 , intended to supply both the medium temperature evaporators 7, m_{1_MT} , and the low temperature evaporators 18, m_{1_BT} . The adjustment of the flow rate through the evaporators will be made, for example but not exclusively with a controller R_p that regulates the opening of valves 6 and 17 according to the temperature T_A of air or fluid to be cooled, always as an example, as shown in Fig. 5 and 6, relating to a generic group feeding valve / evaporator MT indicated with 6_n and 7_n . The flow of fluid in the liquid phase at the entrance is indicated by m_{1_n} , and

the flow rate at the exit, obviously the same, will be partly liquid, m_{L_n} , and partly in the vapour phase, m_{V_n} . In the graph of Figure 7 are reported respectively in abscissa and in ordinate the time τ and the air temperature T of the medium to be cooled. According to this method a probe for measuring the temperature T is connected to a suitable controller R_p , which adjusts the time of ON / OFF, on a time cycle D , of the valve 6_n feeding refrigerant to the evaporator 7_n , according to a technique PWM - Pulse Width Modulation. The controller R_p adjust the ratio Time ON/Time cycle D to maintain it proportional to the offset of T compared to set S_0 of the medium. A larger deviation of the value $T-S_0$, provided $T>S_0$, will give a higher ratio Time ON/Time cycle D . The generic valve 6 will be sized according to the flow coefficient k_v , for example according to the formula $m = k_v \cdot \sqrt{\Delta p}$, in which m is the mass flow rate, k_v is the coefficient of discharge of the valve 6 and Δp is the difference in pressure between upstream and downstream of the same, so that it is possible to achieve a required flow rate of the flow through the valve 6 under conditions of maximum thermal load and the conditions of pressure difference regulated by the regulating and charge transfer device X. This technique is mentioned for the sole purpose of allowing a complete understanding of the principle of operation of the system described herein. Other adjustment techniques may be employed, such as feeding valves 6 and 17 can simply be adjusted in ON / OFF and a balancing valve located downstream of said valves 6 and 17 can be used to limit the maximum flow rate.

[0025] The refrigerant leaving the primary circuit of the low temperature regenerative heat exchanger 16 is partially directed in the liquid line of supply of the medium temperature evaporators 7 through the valves 6, and indicated with m_{1_MT} , and in part is placed in the liquid line of the evaporators 18 through the BT supply valves of the low temperature evaporators 17, and indicated with m_{1_BT} . Both in the medium temperature evaporators 7 and in the low temperature evaporators 18 a fraction of the fluid, if not all, will evaporate extracting heat from substance or fluid to be cooled. The fluid flow which may not have been evaporated in the medium temperature evaporators, m_{L_MT} , will be drained together with the vapour flow rate m_{V_MT} in the receiver 8 through the suction pipe. With reference to fig. 5, $m_{1_MT} = m_{L_MT} + m_{V_MT}$. The fluid flow which may not have been evaporated in the low temperature evaporators 18, m_{L_BT} , will be drained together with the vapour flow rate m_{V_BT} in the secondary circuit of the heat exchanger 16 toward the suction of the low temperature compressor or compressors 19. With reference to fig. 5, $m_{1_BT} = m_{L_BT} + m_{V_BT}$. Since in a system of the booster type the ratio between the flow rate m_{1_BT} circulating in the low temperature evaporators 18 and the total flow of liquid leaving the liquid/vapour separator 5, $m_1 = m_{1_MT} + m_{1_BT}$, is generally of the order of 0.3 or lower the ability of the said low temperature heat exchanger 16 to evaporate the scope m_{L_BT} is high. If also the total flow rate of liquid

circulating in the primary side of the low temperature heat exchanger 16 was equal to the flow rate of liquid intended to circulate in the low temperature evaporators 18, or $m1_BT$, the ability to evaporate the amount mL_BT would be at any event sufficient due to the high temperature difference, of the order of 30K, between the liquid in the primary circuit of the exchanger 16 and the mixture liquid / vapour in the secondary circuit of the same and said temperature difference makes it possible, without risk of suction of liquid into the low temperature compressor 19, a circulation ratio RC in the evaporators of BT section of about 1.25. The low temperature compressor 19 will send the flow of refrigerant compressed in the suction receiver 8.

[0026] A further problem to be solved with the present invention is to define a method of protection to prevent an excessive amount of liquid to flow through the medium temperature evaporators 7 in the case where the flow rate regulation in these medium temperature evaporators 7 is not optimized due to inaccurate setting of the control system of the valves 6, or due to other unforeseen situations.

[0027] There may be two options for doing that, depending on the concept used for system design, that is depending on which vessel, suction receiver 8 or liquid/vapour separator 5, is used for containment of liquid charge not active in the refrigeration circuit.

[0028] In case the refrigerating circuit is designed for containment of the liquid charge in the liquid/vapour separator 5, a level switch 22 or other device is installed on the suction receiver 8 which allows to detect an excessive accumulation of liquid refrigerant. If the refrigerant level detection device 22, e.g. a switch detects an excess of refrigerant in said suction receiver 8, an indication of an unsuitable flow regulation in the evaporators 7 is provided, wherein the pressure regulating valve 9, as shown in fig. 4, said pressure regulating valve 9 being included in the charge transfer device X and shown in both fig. 8a and fig. 8b, limits the differential pressure between the liquid/vapour separator 5 and the suction receiver 8 to a value lower than that normally regulated. The flow rate through the valves 6 and the medium temperature evaporators 7 depends on the degree of opening of the valves 6, but also on the pressure difference between upstream and downstream of the same, being such difference in pressure, disregarding the pressure drop in pipes, equal to the difference in pressure between the liquid/vapour separator 5 and the suction receiver 8. According to the ideal relationship already introduced $m = kv \cdot \sqrt{Dp}$ decreasing the pressure difference between upstream and downstream of the valve 6 reduces the flow rate through all evaporators 7, and therefore, given the same thermal load, a lower flow rate of fluid mL_MT not evaporated at the exit is achieved. At the limit, equalizing the pressure in the separator 5 to that in the suction receiver 8 will stop the flow of refrigerant to the evaporators 7. With reference to Fig. 4, fig. 8a and fig. 8b, when the switch or the signal level 22 on the suction receiver 8 detects the presence

of excess liquid the valve 9 will act directly or indirectly on the relevant signal. The pressure regulating valve 9 may either be mechanically or electrically operated. The pressure regulating valve 9, through a proper control system, shown schematically in Fig. 8a and 8b, reduces to a predetermined value the pressure difference between the pipes b) and e) of the regulating and charge transfer device X for adjusting pressure and charge transfer, and then between the liquid/vapour separator 5 and the suction receiver 8, thereby causing, for a given heat load, both reduction of flow rate $m1_MT$ and a reduction in the fraction of liquid mL_MT and then allowing a proportional increase in the fraction of the vapour mass flow mV_MT at the exit of the medium temperature evaporators 7. With reference to fig. 8a an increase in liquid level in the suction receiver 8 is detected by the refrigerant level detection device 22 and via a regulator RL will control the opening degree of the valve 9 to decrease the pressure difference between the suction receiver 8 and the liquid/vapour separator 5 from the value $\Delta P1$ to the value $\Delta P2$.

[0029] With reference to Fig. 8b, which refers to an alternative to the previous embodiment, an increase in the level of liquid in the suction receiver 8 is detected by the refrigerant level detection device 22, which will send a signal proportional to the level to the controller RL which will control the opening degree of the valve 9 so as to vary the pressure difference between the suction receiver 8 and the liquid/vapour separator 5, for example but not exclusively, according to the function represented in fig. 8b which graphically shows a proportional correspondence of differential pressure between upstream and downstream of the valve 9 with liquid level in the suction receiver 8, the upper limit of differential pressure $\Delta P1$ obtained with liquid level less than or equal to L_{MIN} , and with the lower limit of differential pressure $\Delta P2$, obtained with a level equal to or greater than L_{MAX} .

[0030] Merely by way of example, in normal operating conditions in a refrigerator system for use at 0°C, the pressure in the liquid/vapour separator 5 is adjusted approximately to approximately 34 bar while the suction pressure, and then the pressure existing in the suction receiver 8 is of about 29 bar.

[0031] The pressure difference between the liquid/vapour separator 5 and the suction receiver 8, $\Delta P1$, is therefore of 5 bar, and on the basis of this design value are calculated by the valve 6 is selected to provide 100% of the maximum required flow.

[0032] Reducing said pressure differential to a value $\Delta P2 = 2.5$ bar the valve 6 will be able to drain, when it is fully to (100%) open, a flow rate 30% less than the previous one. In the example in question it is possible to estimate the percentage change of flow rate to be approximately as $\Delta m = (\sqrt{5} - \sqrt{2.5}) / \sqrt{5} \times 100$.

[0033] As another example, reducing the pressure differential to the value $\Delta P2 = 1$ bar the valve 6 will be able to flow out, always with opening degree of 100%, approximately 45% of flow, and consequently a flow rate 55% less than the original condition with $\Delta P=5$ bar. The re-

duction of flow rate can be estimated as $\Delta m = (\sqrt{5} - \sqrt{1})/\sqrt{5} \times 100$.

[0034] In case the refrigerating circuit is designed for containment of the liquid charge in the suction receiver 8, a level switch 23 or other device will be on the liquid/vapour separator 5 which allows to detect a too low level of liquid refrigerant which may bring to starving of the system. If the refrigerant level detection device 23, e.g. a switch detects a shortage of refrigerant in said liquid/vapour separator 5, which is an indication of excess of mass flow through evaporators 7, the valve 9 will reduce the pressure difference using a control logic reversed to that previously described, in the sense that a lower level will bring to a lower pressure difference between the liquid/vapour separator 5 and the suction receiver 8. The above logic is shown in fig. 8c.

[0035] As for economic reasons it might be desirable to reduce the size of the liquid/vapour separator 5 to a minimum. One valve 10 can be used to stop the charge transfer in case both Δp and liquid level in the liquid/vapour separator 5 are at their maximum, and a valve 13 can be arranged to open as a further protection means.

[0036] An example embodiment comprising valve 13 is shown in fig. 1.

[0037] In the following some examples are provided.

[0038] A according to a first example there is provided a multi-evaporator refrigeration circuit adapted to use carbon dioxide as a liquid refrigerant, comprising at least:

- a compressor 1;
- a condenser/gas cooler 2;
- a high pressure regulating valve 4;
- a liquid/vapour separator 5;
- a valve 9 controlling pressure in the liquid/vapour separator 5;
- a liquid level sensing device 22, 23;
- two or more evaporators 7, 18; and
- a suction receiver 8;

wherein the refrigeration circuit is adapted to feed the liquid refrigerant to the two or more evaporators 7 from said liquid/vapour separator 5 through a throttling device 6,

characterized in that the refrigeration circuit further comprises at least one ejector 14 comprising a suction port 15 in parallel to the high pressure regulating valve 4; and that the refrigeration circuit is adapted to drive cold liquid from the suction receiver 8 to the suction port 15 of said at least one ejector 14, being activated for direct charge, for maintaining a sufficient liquid level in the liquid/vapour separator 5 even if the mass flow circulating in the two or more evaporators 7 is higher than the mass flow evaporated, through an opening of a first control valve 10 in the line from the suction receiver 8 to the suction port 15 of the at least one ejector 14, based on a maximum level signal generated by the liquid level sensing device 22, whenever the level of liquid refrigerant in said suction receiver 8 is above a set maximum level.

[0039] In some embodiments the refrigeration circuit further comprises a first heat exchanger 3 having at least a primary circuit and a secondary circuit, wherein one circuit of the first heat exchanger 3 is adapted to circulate cold liquid from the suction receiver 8 by gravity to exchange heat with the high pressure fluid from the condenser/gas cooler 2 adapted to circulate in another circuit of the heat exchanger 3.

[0040] In some embodiments of the refrigeration circuit the at least one ejector 14 is installed in a separate piping line between an exit of the condenser/gas cooler 2 and the liquid/vapour separator 5, said piping line being connected in parallel with the piping line connecting the exit of the condenser/gas cooler 2 through the heat exchanger 3 with an inlet of the high pressure regulating valve 4.

[0041] In some embodiments the refrigeration circuit further comprises at least one low temperature compressor 19 and a second heat exchanger 16, and the refrigeration circuit is further configured for supplying the two or more evaporators 18 having an exit configured for entering one circuit of the second heat exchanger 16 exchanging heat with the main liquid line exiting the liquid/vapour separator 5 circulating in the other side of said second heat exchanger 16.

[0042] In some embodiments of the refrigeration circuit the liquid level sensing device 22 is installed in the suction receiver 8.

[0043] In some embodiments of the refrigeration circuit the liquid level sensing device 23 is installed in the liquid/vapour separator 5.

[0044] In some embodiments of the refrigeration circuit the liquid level sensing device 22 or 23 is a level switch.

[0045] In some embodiments of the refrigeration circuit the suction receiver 8 is a low pressure suction receiver.

[0046] According to a second example there is provided a refrigeration system using the arrangement refrigeration circuit according to any of the examples presented above.

[0047] According to a third example there is provided a method in a multi-evaporator refrigeration circuit of low pressure receiver type adapted to use carbon dioxide as a liquid refrigerant, the multi-evaporator refrigeration circuit comprising at least:

- a compressor 1;
- a condenser/gas cooler 2;
- a high pressure regulating valve 4;
- a liquid/vapour separator 5;
- a pressure limiting valve 9;
- a liquid level sensing device 22, 23;
- two or more evaporators 7; and
- a suction receiver 8;

wherein the method comprises feeding the liquid refrigerant to the two or more evaporators 7 from said liquid/vapour separator 5 through a throttling device 6,

characterized in that the refrigeration circuit further comprises at least one ejector 14 comprising a suction port

15 included in parallel to the high pressure regulating valve 4; wherein the method further comprises direct driving of cold liquid from the suction receiver 8 to the suction port 15 of said at least one ejector 14 for maintaining a sufficient liquid level in the liquid/vapour separator 5 even if the mass flow circulating in the two or more evaporators 7 is higher than the mass flow evaporated, through an opening of a first control valve 10 in the line from the low pressure receiver 8 to the suction port 15 of the at least one ejector 14, based on a maximum level signal generated by the liquid level sensing device 22, whenever the level of liquid in said suction receiver 8 is above a set maximum level.

[0048] According to a fourth example there is provided a multi-evaporator refrigeration circuit adapted to use carbon dioxide as a liquid refrigerant, comprising at least:

- a compressor 1;
- a condenser/gas cooler 2;
- a high pressure regulating valve 4;
- a liquid/vapour separator 5;
- a valve 9 controlling pressure in the liquid/vapour separator 5;
- a liquid level sensing device 22, 23;
- two or more evaporators 7, 18; and
- a suction receiver 8;

wherein the refrigeration circuit is adapted to feed the liquid refrigerant to the two or more evaporators 7 from said liquid/vapour separator 5 through a throttling device 6,

characterized in that the refrigeration circuit further comprises at least one ejector 14 comprising a suction port 15 in parallel to the high pressure regulating valve 4; and that the refrigeration circuit is adapted to drive cold liquid from the suction receiver 8 to the suction port 15 of said at least one ejector 14, being activated for the charge transfer for maintaining a sufficient liquid level in the liquid/vapour separator 5 even if the mass flow circulating in the two or more evaporators 7 is higher than the mass flow evaporated, through an opening of a first control valve 10 in the line from the suction receiver 8 to the suction port 15 of the at least one ejector 14, based on a minimum level signal generated by the liquid level sensing device 23, whenever the level of liquid refrigerant in said liquid/vapour separator 5 is below a set minimum level.

[0049] In some embodiments the refrigeration circuit further comprises a first heat exchanger 3 having at least a primary circuit and a secondary circuit, wherein one circuit of the first heat exchanger 3 is adapted to circulate cold liquid from the suction receiver 8 by gravity to exchange heat with the high pressure fluid from the condenser/gas cooler 2 adapted to circulate in another circuit of the heat exchanger 3.

[0050] In some embodiments of the refrigeration circuit the at least one ejector 14 is installed in a separate piping line between an exit of the condenser/gas cooler 2 and

the liquid/vapour separator 5, said piping line being connected in parallel with the piping line connecting the exit of the condenser/gas cooler 2 through the heat exchanger 3 with an inlet of the high pressure regulating valve 4.

[0051] In some embodiments the refrigeration circuit further comprises at least one low temperature compressor 19 and a second heat exchanger 16, and the refrigeration circuit is further configured for supplying the two or more evaporators 18 having an exit configured for entering one circuit of the second heat exchanger 16 exchanging heat with the main liquid line exiting the liquid/vapour separator 5 circulating in the other side of said second heat exchanger 16.

[0052] In some embodiments of the refrigeration circuit the liquid level sensing device 22 is installed in the suction receiver 8.

[0053] In some embodiments of the refrigeration circuit the liquid level sensing device 23 is installed in the liquid/vapour separator 5.

[0054] In some embodiments of the refrigeration circuit the liquid level sensing device 22 or 23 is a level switch.

[0055] In some embodiments of the refrigeration circuit the suction receiver 8 is a low pressure suction receiver.

[0056] According to a fifth example there is provided a refrigeration system using the arrangement refrigeration circuit according to any of the examples presented above.

[0057] According to a fifth example there is provided a method in a multi-evaporator refrigeration circuit of low pressure receiver type adapted to use carbon dioxide as a liquid refrigerant, the multi-evaporator refrigeration circuit comprising at least:

- a compressor 1;
- a condenser/gas cooler 2;
- a high pressure regulating valve 4;
- a liquid/vapour separator 5;
- a pressure limiting valve 9;
- a liquid level sensing device 22, 23;
- two or more evaporators 7; and
- a suction receiver 8;

wherein the method comprises feeding the liquid refrigerant to the two or more evaporators 7 from said liquid/vapour separator 5 through a throttling device 6,

characterized in that the refrigeration circuit further comprises at least one ejector 14 comprising a suction port 15 included in parallel to the high pressure regulating valve 4; wherein the method further comprises direct driving of cold liquid from the suction receiver 8 to the suction port 15 of said at least one ejector 14 for maintaining a sufficient liquid level in the liquid/vapour separator 5 even if the mass flow circulating in the two or more evaporators 7 is higher than the mass flow evaporated, through an opening of a first control valve 10 in the line from the low pressure receiver 8 to the suction port 15 of the at least one ejector 14, based on a minimum level signal generated by the liquid level sensing device 23, whenever the

level of liquid refrigerant in said liquid/vapour separator 5 is below a set minimum level.

[0058] The present invention is not limited solely to the above described embodiments but it can be varied within the scope of the appended claims.

Claims

1. A multi-evaporator refrigeration circuit adapted to use carbon dioxide as a liquid refrigerant, comprising at least:

- a compressor (1);
- a condenser/gas cooler (2);
- a high pressure regulating valve (4);
- a liquid/vapour separator (5);
- a valve (9) controlling pressure in the liquid/vapour separator (5);
- a liquid level sensing device (22, 23);
- two or more evaporators (7, 18); and
- a suction receiver (8);

wherein the refrigeration circuit is adapted to feed the liquid refrigerant to the two or more evaporators (7) from said liquid/vapour separator (5) through a throttling device (6),

characterized in that the refrigeration circuit further comprises at least one ejector (14) comprising a suction port (15) in parallel to the high pressure regulating valve (4); and that the refrigeration circuit is adapted to drive cold liquid from the suction receiver (8) to the suction port (15) of said at least one ejector (14), being activated for direct charge, for maintaining a sufficient liquid level in the liquid/vapour separator (5) even if the mass flow circulating in the two or more evaporators (7) is higher than the mass flow evaporated, through an opening of a first control valve (10) in the line from the suction receiver (8) to the suction port (15) of the at least one ejector (14), based on a maximum level signal generated by the liquid level sensing device (22), whenever the level of liquid refrigerant in said suction receiver (8) is above a set maximum level.

2. The refrigeration circuit according to claim 1, **characterized in that** the refrigeration circuit further comprises a first heat exchanger (3) having at least a primary circuit and a secondary circuit, wherein one circuit of the first heat exchanger (3) is adapted to circulate cold liquid from the suction receiver (8) by gravity to exchange heat with the high pressure fluid from the condenser/gas cooler (2) adapted to circulate in another circuit of the heat exchanger (3).

3. The refrigeration circuit according to claim 2, **characterized in that** the at least one ejector (14) is installed in a separate piping line between an exit of

the condenser/gas cooler (2) and the liquid/vapour separator (5), said piping line being connected in parallel with the piping line connecting the exit of the condenser/gas cooler (2) through the heat exchanger (3) with an inlet of the high pressure regulating valve (4).

4. The refrigeration circuit according to claim 1, 2 or 3 **characterized in that** the refrigeration circuit further comprises at least one low temperature compressor (19) and a second heat exchanger (16), and the refrigeration circuit is further configured for supplying the two or more evaporators (18) having an exit configured for entering one circuit of the second heat exchanger (16) exchanging heat with the main liquid line exiting the liquid/vapour separator (5) circulating in the other side of said second heat exchanger (16).

5. A method in a multi-evaporator refrigeration circuit of low pressure receiver type adapted to use carbon dioxide as a liquid refrigerant, the multi-evaporator refrigeration circuit comprising at least:

- a compressor (1);
- a condenser/gas cooler (2);
- a high pressure regulating valve (4);
- a liquid/vapour separator (5);
- a pressure limiting valve (9);
- a liquid level sensing device (22, 23);
- two or more evaporators (7); and
- a suction receiver (8);

wherein the method comprises feeding the liquid refrigerant to the two or more evaporators (7) from said liquid/vapour separator (5) through a throttling device (6),

characterized in that the refrigeration circuit further comprises at least one ejector (14) comprising a suction port (15) included in parallel to the high pressure regulating valve (4); wherein the method further comprises direct driving of cold liquid from the suction receiver (8) to the suction port (15) of said at least one ejector (14) for maintaining a sufficient liquid level in the liquid/vapour separator (5) even if the mass flow circulating in the two or more evaporators (7) is higher than the mass flow evaporated, through an opening of a first control valve (10) in the line from the low pressure receiver (8) to the suction port (15) of the at least one ejector (14), based on a maximum level signal generated by the liquid level sensing device (22), whenever the level of liquid in said suction receiver (8) is above a set maximum level.

6. A multi-evaporator refrigeration circuit adapted to use carbon dioxide as a liquid refrigerant, comprising at least:

- a compressor (1);

- a condenser/gas cooler (2);
- a high pressure regulating valve (4);
- a liquid/vapour separator (5);
- a valve (9) controlling pressure in the liquid/vapour separator (5);
- a liquid level sensing device (22, 23);
- two or more evaporators (7, 18); and
- a suction receiver (8);

wherein the refrigeration circuit is adapted to feed the liquid refrigerant to the two or more evaporators (7) from said liquid/vapour separator (5) through a throttling device (6),

characterized in that the refrigeration circuit further comprises at least one ejector (14) comprising a suction port (15) in parallel to the high pressure regulating valve (4); and that the refrigeration circuit is adapted to drive cold liquid from the suction receiver (8) to the suction port (15) of said at least one ejector (14), being activated for the charge transfer for maintaining a sufficient liquid level in the liquid/vapour separator (5) even if the mass flow circulating in the two or more evaporators (7) is higher than the mass flow evaporated, through an opening of a first control valve (10) in the line from the suction receiver (8) to the suction port (15) of the at least one ejector (14), based on a minimum level signal generated by the liquid level sensing device (23), whenever the level of liquid refrigerant in said liquid/vapour separator (5) is below a set minimum level.

7. The refrigeration circuit according to claim 6, **characterized in that** the refrigeration circuit further comprises a first heat exchanger (3) having at least a primary circuit and a secondary circuit, wherein one circuit of the first heat exchanger (3) is adapted to circulate cold liquid from the suction receiver (8) by gravity to exchange heat with the high pressure fluid from the condenser/gas cooler (2) adapted to circulate in another circuit of the heat exchanger (3).
8. The refrigeration circuit according to claim 7, **characterized in that** the at least one ejector (14) is installed in a separate piping line between an exit of the condenser/gas cooler (2) and the liquid/vapour separator (5), said piping line being connected in parallel with the piping line connecting the exit of the condenser/gas cooler (2) through the heat exchanger (3) with an inlet of the high pressure regulating valve (4).
9. The refrigeration circuit according to claim 6, 7 or 8 **characterized in that** the refrigeration circuit further comprises at least one low temperature compressor (19) and a second heat exchanger (16), and the refrigeration circuit is further configured for supplying the two or more evaporators (18) having an exit configured for entering one circuit of the second heat

exchanger (16) exchanging heat with the main liquid line exiting the liquid/vapour separator (5) circulating in the other side of said second heat exchanger (16).

10. The refrigeration circuit according to any of the claims 1 to 4 or 6 to 9, **characterized in that** the liquid level sensing device (22) is installed in one or the following:

- the suction receiver (8);
- the liquid/vapour separator (5).

11. The refrigeration circuit according to any of the claims 1 to 4 or 6 to 10, **characterized in that** the liquid level sensing device (22) or (23) is a level switch.

12. The refrigeration circuit according to any of the claims 1 to 4 or 6 to 11, **characterized in that** the suction receiver (8) is a low pressure suction receiver.

13. A refrigeration system using the arrangement refrigeration circuit according to any of the claims 1 to 4 or 6 to 12.

14. A method in a multi-evaporator refrigeration circuit of low pressure receiver type adapted to use carbon dioxide as a liquid refrigerant, the multi-evaporator refrigeration circuit comprising at least:

- a compressor (1);
- a condenser/gas cooler (2);
- a high pressure regulating valve (4);
- a liquid/vapour separator (5);
- a pressure limiting valve (9);
- a liquid level sensing device (22, 23);
- two or more evaporators (7); and
- a suction receiver (8);

wherein the method comprises feeding the liquid refrigerant to the two or more evaporators (7) from said liquid/vapour separator (5) through a throttling device (6),

characterized in that the refrigeration circuit further comprises at least one ejector (14) comprising a suction port (15) included in parallel to the high pressure regulating valve (4); wherein the method further comprises direct driving of cold liquid from the suction receiver (8) to the suction port (15) of said at least one ejector (14) for maintaining a sufficient liquid level in the liquid/vapour separator (5) even if the mass flow circulating in the two or more evaporators (7) is higher than the mass flow evaporated, through an opening of a first control valve (10) in the line from the low pressure receiver (8) to the suction port (15) of the at least one ejector (14), based on a minimum level signal generated by the liquid level sensing de-

vice (23), whenever the level of liquid refrigerant in said liquid/vapour separator (5) is below a set minimum level.

Patentansprüche

1. Kältekreislauf mit mehreren Verdampfern, der ausgelegt ist, Kohlendioxid als flüssiges Kältemittel zu verwenden, und der mindestens Folgendes aufweist:

- einen Kompressor (1);
- einen Kondensator/Gaskühler (2);
- ein Hochdruckregelventil (4);
- einen Flüssigkeits-/Dampfabscheider (5);
- ein Ventil (9), das Druck in dem Flüssigkeits-/Dampfabscheider (5) steuert;
- einen Füllstandfühler (22, 23);
- zwei oder mehr Verdampfer (7, 18); und
- einen Saugempfangner (8);

wobei der Kältekreislauf ausgelegt ist, das flüssige Kältemittel von dem Flüssigkeits-/Dampfabscheider (5) über eine Drosseleinrichtung (6) an zwei oder mehr Verdampfer (7) zu führen,

dadurch gekennzeichnet, dass der Kältekreislauf darüber hinaus mindestens einen Ejektor (14) aufweist, der eine Saugöffnung (15) parallel zum Hochdruckregelventil (4) aufweist; und dass der Kältekreislauf ausgelegt ist, kalte Flüssigkeit von dem Saugempfangner (8) zur Saugöffnung (15) des mindestens einen Ejektors (14) zu leiten, der für eine direkte Beschickung aktiviert wird, um einen ausreichenden Füllstand in dem Flüssigkeits-/Dampfabscheider (5) auch dann beizubehalten, wenn der Mengendurchfluss, der in den zwei oder mehr Verdampfern (7) zirkuliert, höher als der Mengendurchfluss ist, der durch eine Öffnung eines ersten Steuerventils (10) in der Leitung vom Saugempfangner (8) zur Saugöffnung (15) des mindestens einen Ejektors (14) verdampft, basierend auf einem maximalen Füllstandsignal, das durch den Füllstandfühler (22) erzeugt wird, wenn Füllstand des flüssigen Kältemittels in dem Saugempfangner (8) über dem eingestellten maximalen Füllstand liegt.

2. Kältekreislauf gemäß Anspruch 1, **dadurch gekennzeichnet, dass** der Kältekreislauf ferner einen ersten Wärmetauscher (3) mit mindestens einem Primärkreislauf und einem Sekundärkreislauf aufweist, wobei ein Kreislauf des ersten Wärmetauschers (3) ausgelegt ist, kalte Flüssigkeit von dem Saugempfangner (8) durch Schwerkraft zu zirkulieren, um Wärme mit der Hochdruckflüssigkeit aus dem Kondensator/Gaskühler (2), welcher ausgelegt ist, in einem anderen Kreislauf des Wärmetauschers (3) zu zirkulieren, auszutauschen.

3. Kältekreislauf gemäß Anspruch 2, **dadurch gekennzeichnet, dass** der mindestens eine Ejektor (14) in einer separaten Rohrleitung zwischen einem Ausgang des Kondensators/Gaskühlers (2) und dem Flüssigkeits-/Dampfabscheider (5) installiert ist, wobei die Rohrleitung parallel mit der Rohrleitung verbunden ist, die den Ausgang des Kondensators/Gaskühlers (2) durch den Wärmetauscher (3) mit einem Einlass des Hochdruckregelventils (4) verbindet.

4. Kältekreislauf gemäß Anspruch 1, 2 oder 3, **dadurch gekennzeichnet, dass** der Kältekreislauf ferner mindestens einen Niedertemperatur-Kompressor (19) und einen zweiten Wärmetauscher (16) aufweist, und der Kältekreislauf ferner konfiguriert ist, die zwei oder mehr Verdampfer (18) zu versorgen, die einen Ausgang haben, der konfiguriert ist, in einen Kreislauf des zweiten Wärmetauschers (16) einzutreten, der Wärme mit der Hauptflüssigkeitsleitung austauscht, welche aus dem Flüssigkeits-/Dampfabscheider (5) austritt, der in der anderen Seite des zweiten Wärmetauschers (16) zirkuliert.

5. Ein Verfahren in einem Kältekreislauf mit mehreren Verdampfern der Niederdruckempfänger-Bauart, das ausgelegt ist, Kohlendioxid als flüssiges Kältemittel zu verwenden, wobei der Kältekreislauf mit mehreren Verdampfern mindestens Folgendes aufweist:

- einen Kompressor (1);
- einen Kondensator/Gaskühler (2);
- ein Hochdruckregelventil (4);
- einen Flüssigkeits-/Dampfabscheider (5);
- ein Druckbegrenzungsventil (9);
- einen Füllstandfühler (22, 23);
- zwei oder mehr Verdampfer (7); und
- einen Saugempfangner (8);

wobei das Verfahren das Zuführen des flüssigen Kältemittels von dem Flüssigkeits-/Dampfabscheider (5) über eine Drosseleinrichtung (6) an die zwei oder mehr Verdampfer (7) umfasst,

dadurch gekennzeichnet, dass der Kältekreislauf darüber hinaus mindestens einen Ejektor (14) aufweist, der eine Saugöffnung (15) parallel zum Hochdruckregelventil (4) aufweist; wobei das Verfahren ferner den direkten Antrieb der kalten Flüssigkeit von dem Saugempfangner (8) zur Saugöffnung (15) des mindestens einen Ejektors (14) umfasst, um einen ausreichenden Füllstand in dem Flüssigkeits-/Dampfabscheider (5) auch dann beizubehalten, wenn der Mengendurchfluss, der in den zwei oder mehr Verdampfern (7) zirkuliert, höher als der Mengendurchfluss ist, der durch eine Öffnung eines ersten Steuerventils (10) in der Leitung von dem Niederdruckempfänger (8) zur Saugöffnung (15)

des mindestens einen Ejektors (14) verdampft, basierend auf einem maximalen Füllstandsignal, das durch den Füllstandfühler (22) erzeugt wird, wenn der Füllstand des flüssigen Kältemittels in dem Saugempfangner (8) über dem eingestellten maximalen Füllstand liegt.

6. Kältekreislauf mit mehreren Verdampfern, der ausgelegt ist, Kohlendioxid als flüssiges Kältemittel zu verwenden, und der mindestens Folgendes aufweist:

- einen Kompressor (1);
- einen Kondensator/Gaskühler (2);
- ein Hochdruckregelventil (4);
- einen Flüssigkeits-/Dampfabscheider (5);
- ein Ventil (9), das Druck in dem Flüssigkeits-/Dampfabscheider (5) steuert;
- einen Füllstandfühler (22, 23);
- zwei oder mehr Verdampfer (7, 18); und
- einen Saugempfangner (8);

wobei der Kältekreislauf ausgelegt ist, das flüssige Kältemittel von dem Flüssigkeits-/Dampfabscheider (5) über eine Drosseleinrichtung (6) an die zwei oder mehr Verdampfer (7) zu führen,

dadurch gekennzeichnet, dass der Kältekreislauf darüber hinaus mindestens einen Ejektor (14) aufweist, der eine Saugöffnung (15) parallel zum Hochdruckregelventil (4) aufweist; und dass der Kältekreislauf ausgelegt ist, kalte Flüssigkeit von dem Saugempfangner (8) zur Saugöffnung (15) des mindestens einen Ejektors (14) zu leiten, wobei er für den Beschickungstransport zum Beibehalten eines ausreichenden Füllstands in dem Flüssigkeits-/Dampfabscheider (5) auch dann aktiviert wird, wenn der Mengendurchfluss, der in den zwei oder mehr Verdampfern (7) zirkuliert, höher als der Mengendurchfluss ist, der durch eine Öffnung eines ersten Steuerventils (10) in der Leitung von dem Saugempfangner (8) zur Saugöffnung (15) des mindestens einen Ejektors (14) verdampft, basierend auf einem minimalen Füllstandsignal, das durch den Füllstandfühler (23) erzeugt wird, wenn der Füllstand des flüssigen Kältemittels in dem Flüssigkeits-/Dampfabscheider (5) unter dem eingestellten minimalen Füllstand liegt.

7. Kältekreislauf gemäß Anspruch 6, **dadurch gekennzeichnet, dass** der Kältekreislauf ferner einen ersten Wärmetauscher (3) mit mindestens einem Primärkreis und einem Sekundärkreis aufweist, wobei ein Kreislauf des ersten Wärmetauschers (3) ausgelegt ist, kalte Flüssigkeit von dem Saugempfangner (8) durch Schwerkraft zu zirkulieren, um Wärme mit der Hochdruckflüssigkeit aus dem Kondensator/Gaskühler (2), welcher ausgelegt ist, in einem anderen Kreislauf des Wärmetauschers (3) zu zirkulieren, auszutauschen.

kulieren, auszutauschen.

8. Kältekreislauf gemäß Anspruch 7, **dadurch gekennzeichnet, dass** der mindestens eine Ejektor (14) in einer separaten Rohrleitung zwischen einem Ausgang des Kondensators/Gaskühlers (2) und dem Flüssigkeits-/Dampfabscheider (5) installiert ist, wobei die Rohrleitung parallel mit der Rohrleitung verbunden ist, die den Ausgang des Kondensators/Gaskühlers (2) durch den Wärmetauscher (3) mit einem Einlass des Hochdruckregelventils (4) verbindet.

9. Kältekreislauf gemäß Anspruch 6, 7 oder 8, **dadurch gekennzeichnet, dass** der Kältekreislauf ferner mindestens einen Niedertemperatur-Kompressor (19) und einen zweiten Wärmetauscher (16) aufweist, und der Kältekreislauf ferner konfiguriert ist, die zwei oder mehr Verdampfer (18) zu versorgen, der einen Ausgang hat, der konfiguriert ist, in einen Kreislauf des zweiten Wärmetauschers (16) einzutreten, der Wärme mit der Hauptflüssigkeitsleitung austauscht, welche aus dem Flüssigkeits-/Dampfabscheider (5) austritt, der in der anderen Seite des zweiten Wärmetauschers (16) zirkuliert.

10. Kältekreislauf gemäß einem der Ansprüche 1 bis 4 oder 6 bis 9, **dadurch gekennzeichnet, dass** der Füllstandfühler (22) in einem der Folgenden installiert ist:

dem Saugempfangner (8);
dem Flüssigkeit-/Dampfabscheider (5).

11. Kältekreislauf gemäß einem der Ansprüche 1 bis 4 oder 6 bis 10, **dadurch gekennzeichnet, dass** der Füllstandfühler (22) oder (23) ein Niveauschalter ist.

12. Kältekreislauf gemäß einem der Ansprüche 1 bis 4 oder 6 bis 11, **dadurch gekennzeichnet, dass** der Saugempfangner (8) ein Niederdrucksaugempfangner ist.

13. Ein Kühlsystem, das die Kältekreislaufanordnung gemäß einem der Ansprüche 1 bis 4 oder 6 bis 12 verwendet.

14. Ein Verfahren in einem Kältekreislauf mit mehreren Verdampfern der Niederdruckempfangner-Bauart, das ausgelegt ist, Kohlendioxid als flüssiges Kältemittel zu verwenden, wobei der Kältekreislauf mit mehreren Verdampfern mindestens Folgendes aufweist:

- einen Kompressor (1);
- einen Kondensator/Gaskühler (2);
- ein Hochdruckregelventil (4);
- einen Flüssigkeits-/Dampfabscheider (5);

- ein Druckbegrenzungsventil (9);
- einen Füllstandfühler (22, 23);
- zwei oder mehr Verdampfer (7); und
- einen Saugempfangner (8);

wobei das Verfahren das Zuführen des flüssigen Kältemittels von dem Flüssigkeits-Dampfabscheider (5) über eine Drosseleinrichtung (6) zu den zwei oder mehr Verdampfern (7) umfasst,

dadurch gekennzeichnet, dass der Kältekreislauf darüber hinaus mindestens einen Ejektor (14) aufweist, der eine Saugöffnung (15) parallel zum Hochdruckregelventil (4) aufweist; wobei das Verfahren ferner den direkten Antrieb der kalten Flüssigkeit von dem Saugempfangner (8) zur Saugöffnung (15) des mindestens einen Ejektors (14) umfasst, um einen ausreichenden Füllstand in dem Flüssigkeits-/Dampfabscheider (5) auch dann beizubehalten, wenn der Mengendurchfluss, der in den zwei oder mehr Verdampfern (7) zirkuliert, höher als der Mengendurchfluss ist, der durch eine Öffnung eines ersten Steuerventils (10) in der Leitung von dem Niederdruckempfangner (8) zur Saugöffnung (15) des mindestens einen Ejektors (14) verdampft, basierend auf einem minimalen Füllstandssignal, das durch den Füllstandfühler (23) erzeugt wird, wenn der Füllstand des flüssigen Kältemittels in dem Flüssigkeits-/Dampfabscheider (5) unter dem eingestellten minimalen Füllstand liegt.

Revendications

1. Circuit à réfrigération à multiples évaporateurs adapté pour utiliser du dioxyde de carbone comme liquide frigorigène, comprenant au moins :

- un compresseur (1) ;
- un condenseur/refroidisseur de gaz (2) ;
- une vanne de réglage haute pression (4) ;
- un séparateur liquide/vapeur (5) ;
- une vanne (9) commandant la pression dans le séparateur liquide/vapeur (5) ;
- un appareil de détection de niveau de liquide (22, 23) ;
- deux évaporateurs ou plus (7, 18) ; et
- un récepteur d'aspiration (8) ;

dans lequel le circuit à réfrigération est adapté pour alimenter le liquide frigorigène vers les deux évaporateurs ou plus (7) depuis ledit séparateur liquide/vapeur (5) par l'intermédiaire d'un appareil d'étranglement (6),

caractérisé en ce que le circuit à réfrigération comprend en outre au moins un éjecteur (14) comprenant un orifice d'aspiration (15) parallèlement à la vanne de réglage haute pression (4) ; et **en ce que** le circuit à réfrigération est adapté pour entraîner le

liquide froid depuis le récepteur d'aspiration (8) jusqu'à l'orifice d'aspiration (15) dudit au moins un éjecteur (14), étant activé pour une charge directe, afin de maintenir un niveau de liquide suffisant dans le séparateur liquide/vapeur (5) même si le débit massique circulant dans les deux évaporateurs ou plus (7) est plus élevé que le débit massique évaporé, par l'intermédiaire d'une ouverture d'une première vanne de commande (10) dans la ligne depuis le récepteur d'aspiration (8) jusqu'à l'orifice d'aspiration (15) de l'au moins un éjecteur (14), en fonction d'un signal de niveau maximum généré par l'appareil de détection de niveau de liquide (22), à chaque fois que le niveau de liquide frigorigène dans ledit récepteur d'aspiration (8) est supérieur à un niveau maximum défini.

2. Circuit à réfrigération selon la revendication 1, **caractérisé en ce que** le circuit à réfrigération comprend en outre un premier échangeur de chaleur (3) présentant au moins un circuit primaire et un circuit secondaire, dans lequel un circuit du premier échangeur de chaleur (3) est adapté pour faire circuler le liquide froid provenant du récepteur d'aspiration (8) par gravité pour échanger la chaleur avec le fluide haute pression provenant du condenseur/refroidisseur de gaz (2) adapté pour circuler dans un autre circuit de l'échangeur de chaleur (3).

3. Circuit à réfrigération selon la revendication 2, **caractérisé en ce que** l'au moins un éjecteur (14) est installé dans une canalisation séparée entre une sortie du condenseur/refroidisseur de gaz (2) et du séparateur liquide/vapeur (5), ladite canalisation étant reliée en parallèle à la canalisation reliant la sortie du condenseur/refroidisseur de gaz (2) par l'intermédiaire de l'échangeur de chaleur (3) à une entrée de la vanne de réglage haute pression (4).

4. Circuit à réfrigération selon la revendication 1, 2 ou 3, **caractérisé en ce que** le circuit à réfrigération comprend en outre au moins un compresseur basse température (19) et un second échangeur de chaleur (16), et le circuit à réfrigération est en outre configuré pour alimenter les deux évaporateurs ou plus (18) présentant une sortie configurée pour entrer dans un circuit du second échangeur de chaleur (16) qui échange la chaleur avec la conduite de liquide principale sortant du séparateur liquide/vapeur (5) circulant de l'autre côté dudit second échangeur de chaleur (16).

5. Procédé dans un circuit à réfrigération à multiples évaporateurs de type récepteur basse pression adapté pour utiliser du dioxyde de carbone comme liquide frigorigène, le circuit à réfrigération à multiples évaporateurs comprenant au moins :

- un compresseur (1) ;
- un condenseur/refroidisseur de gaz (2) ;
- une vanne de réglage haute pression (4) ;
- un séparateur liquide/vapeur (5) ;
- une vanne de limitation de pression (9) ;
- un appareil de détection de niveau de liquide (22, 23) ;
- deux évaporateurs ou plus (7) ; et
- un récepteur d'aspiration (8) ;

dans lequel le procédé consiste à alimenter le liquide frigorigène vers les deux évaporateurs ou plus (7) depuis ledit séparateur liquide/vapeur (5) par l'intermédiaire d'un appareil d'étranglement (6),

caractérisé en ce que le circuit à réfrigération comprend en outre au moins un éjecteur (14) comprenant un orifice d'aspiration (15) compris parallèlement à la vanne de réglage haute pression (4) ; dans lequel le procédé consiste en outre à entraîner directement le liquide froid depuis le récepteur d'aspiration (8) jusqu'à l'orifice d'aspiration (15) dudit au moins un éjecteur (14) afin de maintenir un niveau de liquide suffisant dans le séparateur liquide/vapeur (5) même si le débit massique circulant dans les deux évaporateurs ou plus (7) est plus élevé que le débit massique évaporé, par l'intermédiaire d'une ouverture d'une première vanne de commande (10) dans la ligne depuis le récepteur basse pression (8) jusqu'à l'orifice d'aspiration (15) de l'au moins un éjecteur (14), en fonction d'un signal de niveau maximum généré par l'appareil de détection de niveau de liquide (22), à chaque fois que le niveau de liquide dans ledit récepteur d'aspiration (8) est supérieur à un niveau maximum défini.

6. Circuit à réfrigération à multiples évaporateurs adapté pour utiliser du dioxyde de carbone comme liquide frigorigène, comprenant au moins :

- un compresseur (1) ;
- un condenseur/refroidisseur de gaz (2) ;
- une vanne de réglage haute pression (4) ;
- un séparateur liquide/vapeur (5) ;
- une vanne (9) commandant la pression dans le séparateur liquide/vapeur (5) ;
- un appareil de détection de niveau de liquide (22, 23) ;
- deux évaporateurs ou plus (7, 18) ; et
- un récepteur d'aspiration (8) ;

dans lequel le circuit à réfrigération est adapté pour alimenter le liquide frigorigène vers les deux évaporateurs ou plus (7) depuis ledit séparateur liquide/vapeur (5) par l'intermédiaire d'un appareil d'étranglement (6),

caractérisé en ce que le circuit à réfrigération comprend en outre au moins un éjecteur (14) comprenant un orifice d'aspiration (15) parallèlement à la

vanne de réglage haute pression (4) ; et **en ce que** le circuit à réfrigération est adapté pour entraîner le liquide froid depuis le récepteur d'aspiration (8) jusqu'à l'orifice d'aspiration (15) dudit au moins un éjecteur (14), étant activé pour le transfert de charge afin de maintenir un niveau de liquide suffisant dans le séparateur liquide/vapeur (5) même si le débit massique circulant dans les deux évaporateurs ou plus (7) est plus élevé que le débit massique évaporé, par l'intermédiaire d'une ouverture d'une première vanne de commande (10) dans la ligne depuis le récepteur d'aspiration (8) jusqu'à l'orifice d'aspiration (15) de l'au moins un éjecteur (14), en fonction d'un signal de niveau minimum généré par l'appareil de détection de niveau de liquide (23), à chaque fois que le niveau de liquide frigorigène dans ledit séparateur liquide/vapeur (5) est inférieur à un niveau minimum défini.

7. Circuit à réfrigération selon la revendication 6, **caractérisé en ce que** le circuit à réfrigération comprend en outre un premier échangeur de chaleur (3) présentant au moins un circuit primaire et un circuit secondaire, dans lequel un circuit du premier échangeur de chaleur (3) est adapté pour faire circuler le liquide froid provenant du récepteur d'aspiration (8) par gravité pour échanger la chaleur avec le fluide haute pression provenant du condenseur/refroidisseur de gaz (2) adapté pour circuler dans un autre circuit de l'échangeur de chaleur (3).
8. Circuit à réfrigération selon la revendication 7, **caractérisé en ce que** l'au moins un éjecteur (14) est installé dans une canalisation séparée entre une sortie du condenseur/refroidisseur de gaz (2) et du séparateur liquide/vapeur (5), ladite canalisation étant reliée en parallèle à la canalisation reliant la sortie du condenseur/refroidisseur de gaz (2) par l'intermédiaire de l'échangeur de chaleur (3) à une entrée de la vanne de réglage haute pression (4).
9. Circuit à réfrigération selon la revendication 6, 7 ou 8 **caractérisé en ce que** le circuit à réfrigération comprend en outre au moins un compresseur basse température (19) et un second échangeur de chaleur (16), et le circuit à réfrigération est en outre configuré pour alimenter les deux évaporateurs ou plus (18) présentant une sortie configurée pour entrer dans un circuit du second échangeur de chaleur (16) qui échange la chaleur avec la conduite de liquide principale sortant du séparateur liquide/vapeur (5) circulant de l'autre côté dudit second échangeur de chaleur (16).
10. Circuit à réfrigération selon une quelconque des revendications 1 à 4 ou 6 à 9, **caractérisé en ce que** l'appareil de détection de niveau de liquide (22) est installé dans l'un des appareils suivants :

le récepteur d'aspiration (8) ;
le séparateur liquide/vapeur (5).

11. Circuit à réfrigération selon une quelconque des revendications 1 à 4 ou 6 à 10, **caractérisé en ce que** l'appareil de détection de niveau de liquide (22) ou (23) est un contacteur de niveau. 5
12. Circuit à réfrigération selon une quelconque des revendications 1 à 4 ou 6 à 11, **caractérisé en ce que** le récepteur d'aspiration (8) est un récepteur d'aspiration basse pression. 10
13. Système à réfrigération qui utilise l'agencement du circuit à réfrigération selon une quelconque des revendications 1 à 4 ou 6 à 12. 15
14. Procédé dans un circuit à réfrigération à multiples évaporateurs de type récepteur basse pression adapté pour utiliser du dioxyde de carbone comme liquide frigorigène, le circuit à réfrigération à multiples évaporateurs comprenant au moins : 20
- un compresseur (1) ;
 - un condenseur/refroidisseur de gaz (2) ; 25
 - une vanne de réglage haute pression (4) ;
 - un séparateur liquide/vapeur (5) ;
 - une vanne de limitation de pression (9) ;
 - un appareil de détection de niveau de liquide (22, 23) ; 30
 - deux évaporateurs ou plus (7) ; et
 - un récepteur d'aspiration (8) ;

dans lequel le procédé consiste à alimenter le liquide frigorigène vers les deux évaporateurs ou plus (7) depuis ledit séparateur liquide/vapeur (5) par l'intermédiaire d'un appareil d'étranglement (6), 35

caractérisé en ce que le circuit à réfrigération comprend en outre au moins un éjecteur (14) comprenant un orifice d'aspiration (15) compris parallèlement à la vanne de réglage haute pression (4) ; dans lequel le procédé consiste en outre à entraîner directement le liquide froid depuis le récepteur d'aspiration (8) jusqu'à l'orifice d'aspiration (15) dudit au moins un éjecteur (14) afin de maintenir un niveau de liquide suffisant dans le séparateur liquide/vapeur (5) même si le débit massique circulant dans les deux évaporateurs ou plus (7) est plus élevé que le débit massique évaporé, par l'intermédiaire d'une ouverture d'une première vanne de commande (10) dans la ligne depuis le récepteur basse pression (8) jusqu'à l'orifice d'aspiration (15) de l'au moins un éjecteur (14), en fonction d'un signal de niveau minimum généré par l'appareil de détection de niveau de liquide (23), à chaque fois que le niveau de liquide frigorigène dans ledit séparateur liquide/vapeur (5) est inférieur à un niveau minimum défini. 40 45 50 55

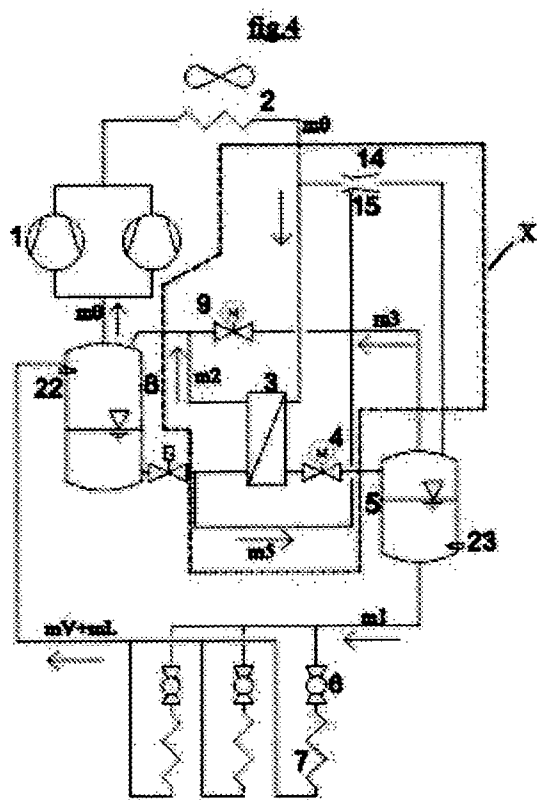
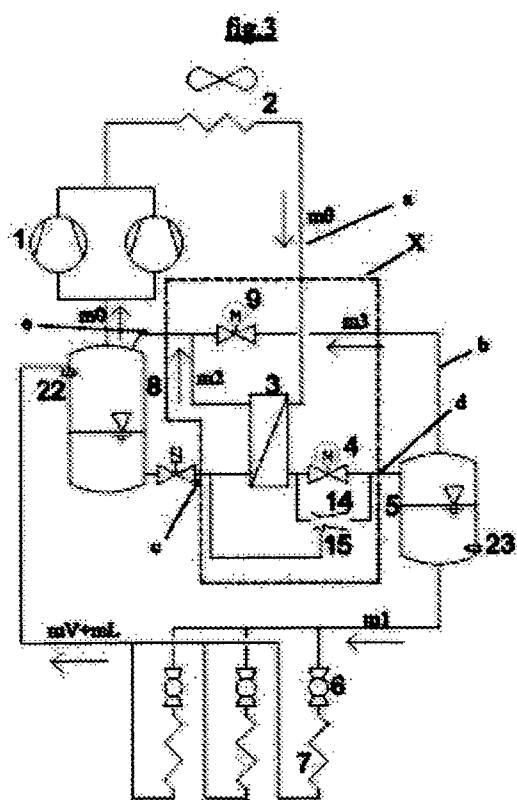
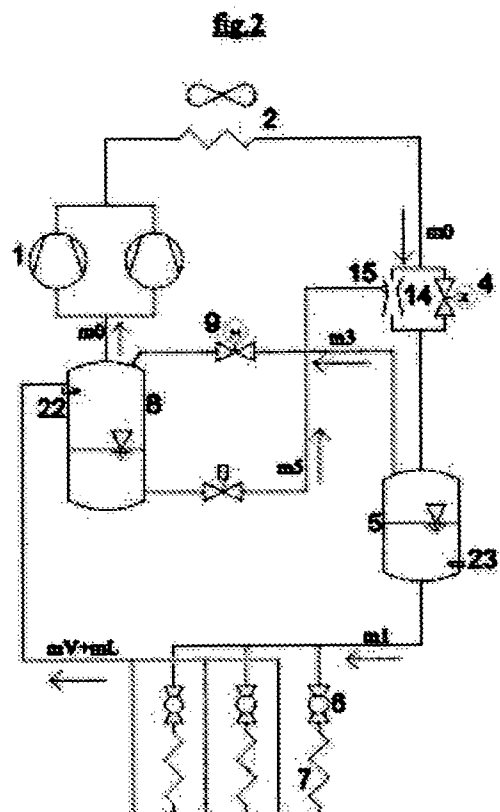
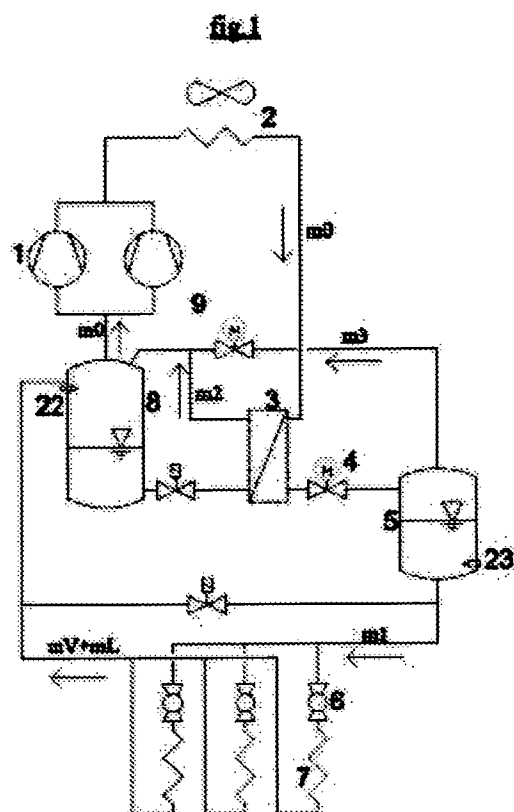


fig.5

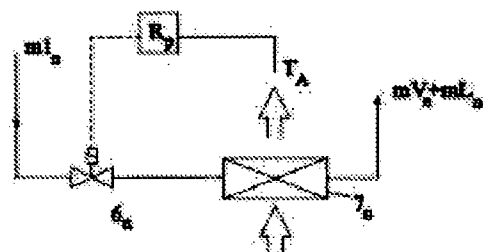
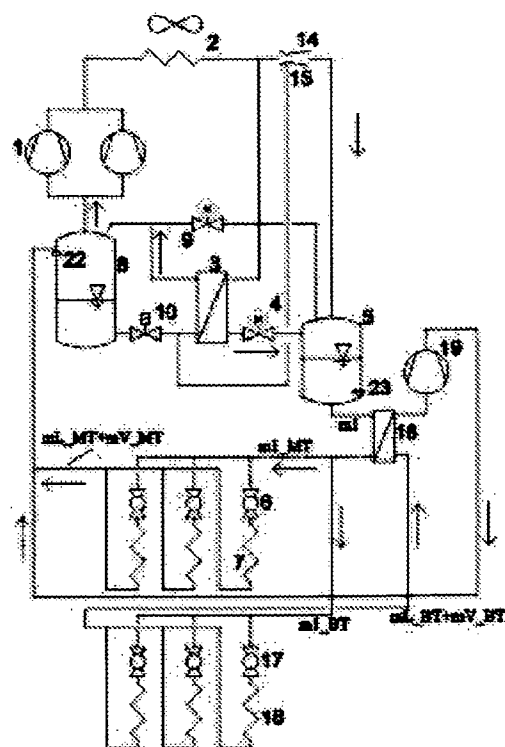


fig.6

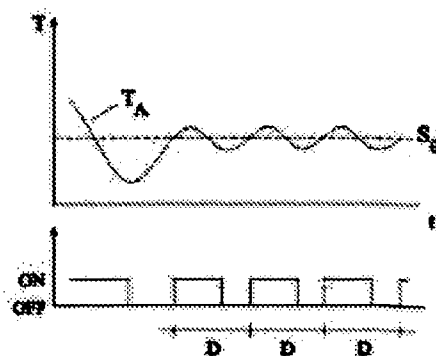


fig.7

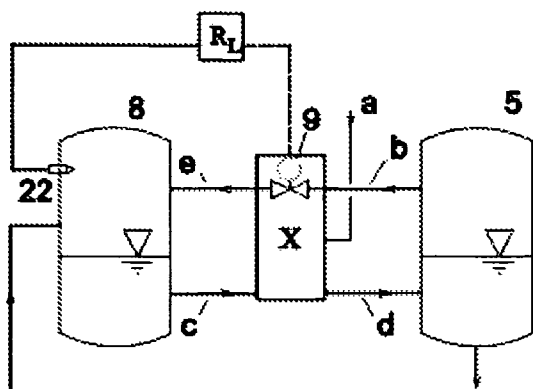


fig. 8a

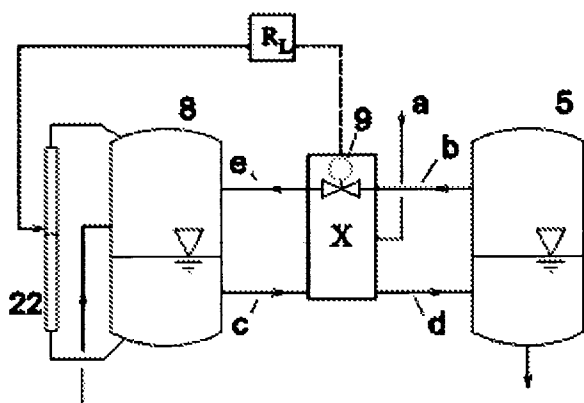
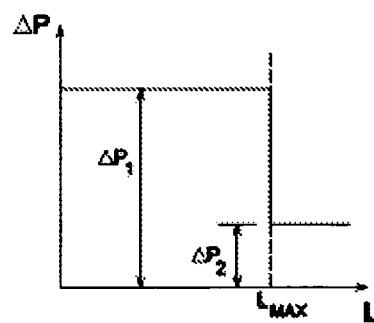


fig. 8b

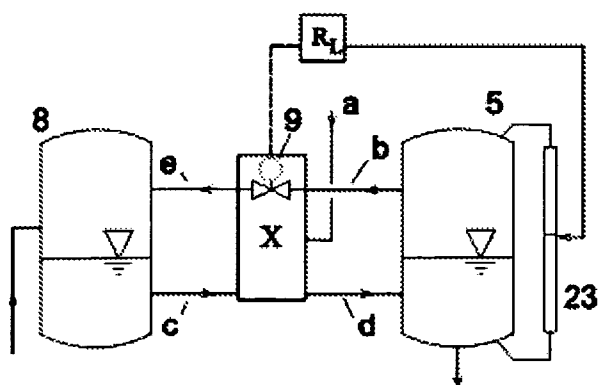
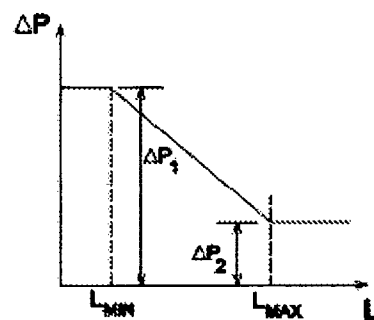
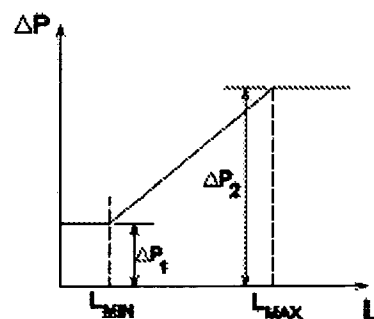


fig. 8c



REFERENCES CITED IN THE DESCRIPTION

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TÖBBPÁROLOGTATÓS HŰTŐKÖR

Szabadalmi igénypontok

1. Többpárologtatós hűtőkör, amely folyékony hűtőközegként szén-dioxid használatára alkalmasan van kiképezve, a hűtőkör tartalmaz legalább

- 5 - kompresszort (1);
- kondenzátort/gázhűtőt (2);
- nagynyomású szabályozószelepet (4);
- folyadék/gőz szeparátort (5);
- szelepet (9) a folyadék/gőz szeparátorban (5) uralkodó nyomás szabályozására;
- 10 - folyadékszint-érzékelő eszközt (22, 23);
- legalább két párologtatót (7, 18); és
- szívótartályt (8);

ahol a hűtőkör a folyékony hűtőközeget a folyadék/gőz szeparátorból (5) a legalább két párologtatóba (7) fojtóeszközhöz (6) át betáplálón van kiképezve,

- 15 **azzal jellemezve**, hogy a hűtőkör tartalmaz továbbá a nagynyomású szabályozószeleppel (4) párhuzamosan beiktatott szívónyílással (15) rendelkező legalább egy ejektort (14); és a hűtőkör arra alkalmasan van kialakítva, hogy a folyadékszint-érzékelő eszköz (22) által minden olyan esetben előállított maximumszint-jel alapján, amikor a folyékony hűtőközeg szívótartálybeli (8) szintje egy beállított maximumszint felett van, a szívótartályból (8) a – közvetlen töltéshez aktivált – legalább egy ejektor
- 20 (14) szívónyílásához (15) egy a szívótartály (8) és a legalább egy ejektor (14) szívónyílása (15) közötti vezetékbe iktatott első vezérlőszelep (10) nyílásán át hideg folyadékot vezet a folyadék/gőz szeparátorban (5) még azon esetben is elégséges folyadékszint fenntartásához, amikor a két vagy több párologtatóban (7) keringő tömegáram az elpárologtatott tömegáramot meghaladja.

2. Az 1. igénypont szerinti hűtőkör, **azzal jellemezve**, hogy a hűtőkör tartalmaz továbbá első hőcserélőt (3), melynek legalább egy primer köre és szekunder köre van, ahol az első hőcserélő (3) egyik köre a kondenzátorból/gázhűtőből (2) származó, a hőcserélő (3) egy másik körében történő keringtetésre alkalmas nagynyomású fluidummal való hőcseréhez a szívótartályból (8) hideg folyadék gravitációs keringtetésére alkalmasan van kiképezve.

3. A 2. igénypont szerinti hűtőkör, **azzal jellemezve**, hogy a legalább egy ejektor (14) egy a kondenzátor/gázhűtő (2) kiömlését és a folyadék/gőz szeparátort (5) összekötő különálló csővezetékbe van beiktatva, amely csővezeték a kondenzátor/gázhűtő (2) kiömlését a hőcserélőn (3) át a nagynyomású szabályozószelep (4) beömlésével összekötő csővezetékkel párhuzamosan van kapcsolva.

4. Az 1., a 2. vagy a 3. igénypont szerinti hűtőkör, **azzal jellemezve**, hogy a hűtőkör tartalmaz továbbá legalább egy alacsony hőmérsékletű kompresszort (19) és második hőcserélőt (16), továbbá a hűtőkör a
- 35 legalább két párologtató (18) táplálására alkalmasan van kiképezve, a legalább két párologtatónak (18)

egy a második hőcserélő (16) egyik körébe belépőn kiképzett kiömlése van, ahol a második hőcserélő (16) a folyadék/gőz szeparátorból (5) kilépő és a második hőcserélő (16) másik oldalán keringtető fő folyadékvezetékkel van hőcserélő kapcsolatban.

5. Eljárás alacsonynyomású tartályos, többpárolgató, hűtőközegként szén-dioxid használatára al-

5 alkalmasan kiképzett hűtőkörben, a többpárolgató hűtőkör tartalmaz legalább

- kompresszort (1);
- kondenzátort/gázhűtőt (2);
- nagynyomású szabályozószelepet (4);
- nyomáskorlátozó szelepet (9);
- 10 - folyadék/gőz szeparátort (5);
- folyadékszint-érzékelő eszközt (22, 23);
- legalább két párolgatót (7); és
- szívótartályt (8);

ahol az eljárás során a folyékony hűtőközeget a folyadék/gőz szeparátorból (5) fojtóeszközön (6) ke-
15 resztül a legalább két párolgatóba (7) tápláljuk,

azzal jellemezve, hogy a hűtőkör tartalmaz továbbá a nagynyomású szabályozószeleppel (4) párhuzamosan beiktatott szívónyílással (15) rendelkező legalább egy ejektort (14); ahol az eljárás során a folyadékszint-érzékelő eszköz (22) által minden olyan esetben előállított maximumszint-jel alapján, amikor a folyadék szintje a szívótartályban (8) egy beállított maximumszint felett van, a szívótartály
20 (8) és a legalább egy ejektor (14) szívónyílása (15) közötti vezetékbe iktatott első vezérlőszelep (10) nyílásán át a szívótartályból (8) a legalább egy ejektor (14) szívónyílásához (15) közvetlenül hideg folyadékot vezetünk, hogy a folyadék/gőz szeparátorban (5) még azon esetben is elégséges folyadékszintet tartsunk fenn, amikor a két vagy több párolgatóban (7) keringő tömegáram az elpárolgatózott tömegáramot meghaladja.

25 6. Többpárolgató hűtőkör, amely folyékony hűtőközegként szén-dioxid használatára alkalmasan van kiképezve, a hűtőkör tartalmaz legalább

- kompresszort (1);
- kondenzátort/gázhűtőt (2);
- nagynyomású szabályozószelepet (4);
- 30 - folyadék/gőz szeparátort (5);
- szelepet (9) a folyadék/gőz szeparátorban (5) uralkodó nyomás szabályozására;
- folyadékszint-érzékelő eszközt (22, 23);
- legalább két párolgatót (7, 18); és
- szívótartályt (8);

35 ahol a hűtőkör a folyékony hűtőközeget a folyadék/gőz szeparátorból (5) a legalább két párolgatóba (7) fojtóeszközön (6) át betáplálón van kiképezve,

- azzal jellemezve**, hogy a hűtőkör tartalmaz továbbá a nagynyomású szabályozószeleppel (4) párhuzamosan beiktatott szívónyílással (15) rendelkező legalább egy ejektort (14); és a hűtőkör arra alkalmasan van kialakítva, hogy a folyadékszint-érzékelő eszköz (23) által minden olyan esetben előállított minimumszint-jel alapján, amikor a folyékony hűtőközeg folyadék/gőz szeparátorbeli (5) szintje egy beállított minimumszint alatt van, a szívótartályból (8) a – töltet továbbításához aktivált – legalább egy ejektor (14) szívónyílásához (15) egy a szívótartály (8) és a legalább egy ejektor (14) szívónyílása (15) közötti vezetékbe iktatott első vezérlőszelep (10) nyílásán át hideg folyadékot vezet a folyadék/gőz szeparátorban (5) még azon esetben is elégséges folyadékszint fenntartásához, amikor a két vagy több párologtatóban (7) keringő tömegáram az elpárologtatott tömegáramot meghaladja.
7. A 6. igénypont szerinti hűtőkör, **azzal jellemezve**, hogy a hűtőkör tartalmaz továbbá első hőcserélőt (3), melynek legalább egy primer köre és szekunder köre van, ahol az első hőcserélő (3) egyik köre a kondenzátorból/gázhűtőből (2) származó, a hőcserélő (3) egy másik körében történő keringtetésre alkalmas nagynyomású fluidummal való hőcseréhez a szívótartályból (8) hideg folyadék gravitációs keringtetésére alkalmasan van kiképezve.
8. A 7. igénypont szerinti hűtőkör, **azzal jellemezve**, hogy a legalább egy ejektor (14) egy a kondenzátor/gázhűtő (2) kiömlését és a folyadék/gőz szeparátort (5) összekötő különálló csővezetékbe van beiktatva, amely csővezeték a kondenzátor/gázhűtő (2) kiömlését a hőcserélőn (3) át a nagynyomású szabályozószelep (4) beömlésével összekötő csővezetékkel párhuzamosan van kapcsolva.
9. A 6., a 7. vagy a 8. igénypont szerinti hűtőkör, **azzal jellemezve**, hogy a hűtőkör tartalmaz továbbá legalább egy alacsony hőmérsékletű kompresszort (19) és második hőcserélőt (16), továbbá a hűtőkör a legalább két párologtató (18) táplálására alkalmasan van kiképezve, a legalább két párologtatónak (18) egy a második hőcserélő (16) egyik körébe belépőn kiképzett kiömlése van, ahol a második hőcserélő (16) a folyadék/gőz szeparátorból (5) kilépő és a második hőcserélő (16) másik oldalán keringtető fő folyadékvezetékkel van hőcserélő kapcsolatban.
10. Az 1-4. vagy a 6-9. igénypontok bármelyike szerinti hűtőkör, **azzal jellemezve**, hogy a folyadékszint-érzékelő eszköz (22) a
- szívótartály (8); és
- a folyadék/gőz szeparátor (5)
- egyikébe van beépítve.
11. Az 1-4. vagy a 6-10. igénypontok bármelyike szerinti hűtőkör, **azzal jellemezve**, hogy a folyadékszint-érzékelő eszközt (22, 23) szintkapcsoló képezi.
12. Az 1-4. vagy a 6-11. igénypontok bármelyike szerinti hűtőkör, **azzal jellemezve**, hogy a szívótartályt (8) alacsonynyomású szívótartály képezi.

13. Hűtőrendszer, amely az 1-4. vagy a 6-12. igénypontok bármelyike szerinti hűtőkör-elrendezést használja.

14. Eljárás alacsonynyomású tartályos, többpárolgató, hűtőközegként szén-dioxid használatára alkalmasan kiképzett hűtőkörben, a többpárolgató hűtőkör tartalmaz legalább

- 5 - kompresszort (1);
- kondenzátort/gázhűtőt (2);
- nagynyomású szabályozószelepet (4);
- nyomáskorlátozó szelepet (9);
- folyadék/gőz szeparátort (5);
- 10 - folyadékszint-érzékelő eszközt (22, 23);
- legalább két párolgatót (7); és
- szivótartályt (8);

ahol az eljárás során a folyékony hűtőközeget a folyadék/gőz szeparátorból (5) fojtóeszközzön (6) keresztül a legalább két párolgatóba (7) tápláljuk,

- 15 **azzal jellemezve**, hogy a hűtőkör tartalmaz továbbá a nagynyomású szabályozószeleppel (4) párhuzamosan beiktatott szivónyílással (15) rendelkező legalább egy ejektort (14); ahol az eljárás során a folyadékszint-érzékelő eszköz (23) által minden olyan esetben előállított minimumszint-jel alapján, amikor a folyadék szintje a folyadék/gőz szeparátorban (5) egy beállított minimumszint alatt van, a szivótartály (8) és a legalább egy ejektor (14) szivónyílása (15) közötti vezetékebe iktatott első vezérlő-
- 20 szelep (10) nyílásán át a szivótartályból (8) a legalább egy ejektor (14) szivónyílásához (15) közvetlenül hideg folyadékot vezetünk, hogy a folyadék/gőz szeparátorban (5) még azon esetben is elégséges folyadékszintet tartsunk fenn, amikor a két vagy több párolgatóban (7) keringő tömegáram az elpárolgatózott tömegáramot meghaladja.