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(54) **REFRIGERATING SYSTEM AND METHOD FOR OPERATING THE SAME**

KÜHLSYSTEM UND BETRIEBSVERFAHREN DAFÜR

SYSTÈME DE RÉFRIGÉRATION ET SON PROCÉDÉ DE FONCTIONNEMENT

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Description

[0001] The invention is directed to a refrigerating system, and to a method for operating a refrigerating system.

[0002] Conventional refrigerating systems include a refrigerating cycle having a compressor, a condenser, a collecting container, an expansion valve, an evaporator and refrigerating circuits circulating a refrigerant like fluorocarbon or chlorofluorocarbon therethrough. Such refrigerants are often harmful to the environment, and thus it has become obligatory to monitor the amount of such refrigerants in refrigerating systems in predetermined intervals in order to document the leak tightness of such refrigerating systems and to detect existing leaks at an early stage.

[0003] With some conventional refrigerating systems the amount of refrigerant contained in the collecting container can be measured, but such measurements are often inaccurate, and the deviation of the measured amount of refrigerant from the actual amount is often about 3% - 6% which is much too less having regard that according to the so-called "F-Gase Verordnung" leakage ratios of 2% per year may not exceeded.

[0004] US 2003/0 159 449 discloses a refrigerating system according to the preamble of claim 1 and claim 2.

[0005] It is therefore an object of the invention to provide a refrigerating system that allows for a more precise measurement of the amount of refrigerant contained therein, and to provide a method for operating a such refrigerating system.

[0006] This is achieved by a system having the features of claim 1, which system has among other features a liquefying set comprising an additional condenser, connected in parallel to the condenser, and a control unit that in operation allows switching between normal operation of the refrigerating cycle and refrigerant collecting operation in which the remaining refrigerant is sucked off from the condenser, is liquefied by the additional condenser and collects in the collecting container.

[0007] This is also achieved by a system having the features of claim 2, which system has among other features an additional condenser arranged between the collecting container and the expansion device, and a control unit that in operation allows switching between normal operation of the refrigerating cycle in which the additional condenser works as subcooling unit and refrigerant collecting operation in which the remaining refrigerant is sucked off from the condenser, is liquefied by the additional condenser and collects in the collecting container.

[0008] The invention includes also a method according to claim 10 for operating a refrigerating system in a refrigerant collecting operation. The invention includes also a method according to claim 13 for operating a refrigerating system in a refrigerant collecting operation.

[0009] The invention includes also a method according to claim 14 for operating a refrigerating system, the refrigerating system comprising a refrigerating cycle having a compressor, a condenser, a collecting container, an

expansion device, an evaporator and refrigerating circuits circulating a refrigerant therethrough, and a liquefying set comprising an additional compressor and an additional condenser, connected in parallel to the condenser, the method comprising the steps of operating the refrigerating cycle, and operating the liquefying set as sub-cooling unit by branching off refrigerant behind the collecting container, by expanding the branched-off refrigerant, by effecting heat exchange between the branched-off, expanded refrigerant and the refrigerant flowing between the collecting container and the expansion device in a heat exchanger, by compressing the branched-off, evaporated refrigerant by the additional compressor, by condensing the compressed refrigerant in the additional condenser and by flowing the condensed refrigerant to the collecting container. Embodiments of the invention are described in greater detail below with reference to the figures, wherein:

Figure 1 shows a schematic diagram of a first refrigerating system according to a first embodiment of the invention;

Figure 2 shows a second refrigerating system according to a second embodiment of the invention;

Figure 3 shows a third refrigerating system according to a third embodiment of the invention;

Figure 4 shows a fourth refrigerating system according to a fourth embodiment of the invention; and

Figure 5 shows a fifth refrigerating system according to a fifth embodiment of the invention.

[0010] Figure 1 shows a first refrigerating system 2 comprising a main refrigerating cycle and a liquefying set.

[0011] The main refrigerating cycle comprises, in flowing direction of the refrigerant, a compressor 4, a condenser 6, a nonreturn valve 8, a collecting container 10 provided with a capacitive refrigerant fill level measuring unit 12, a solenoid valve 14, an expansion valve 16, an evaporator 18 and refrigerating circuits connecting these elements and circulating a refrigerant therethrough.

[0012] In the exemplary embodiment of Fig. 1, the condenser 6 is provided with two fans flowing air over the surface of the condenser for effecting heat exchange between the air and the refrigerant flowing through the condenser 6. Generally, the condenser 6 can be supplied with at least one fan or an arbitrary number of fans.

[0013] In particular, the air flowing over the surface of the condenser 6 is heated, wherein the refrigerant flowing through the condenser 6 is condensed/liquefied.

[0014] Likewise, in the exemplary embodiment of Fig. 1 the evaporator 18 is provided with a fan for effecting heat exchange between the refrigerant flowing through the evaporator 18 and the air flowing over the surface of

the evaporator 18. Generally, the evaporator 18 can be supplied with at least one fan or an arbitrary number of fans. In particular, the air flowing over the surface of the evaporator 18 is cooled whereas the refrigerant flowing through the evaporator 18 is heated and evaporated.

[0015] The liquefying set comprises a solenoid valve 20, an additional compressor 22, an additional condenser 24 and a nonreturn valve 26, said elements connected in parallel to the condenser 6 and the nonreturn valve 8. In this exemplary embodiment, where no subcooling unit is provided, the solenoid valve 20 is optional and can also be omitted. In this exemplary embodiment, the valve 8 is formed as a nonreturn valve 8. However, the valve 8 can also be formed as a solenoid valve or any other valve having an arbitrary control or drive.

[0016] In particular, the input line of the liquefying set is branched-off from the pressure line at a position between the compressor 4 and the condenser 6 and it discharges into the refrigerant conduit at a position between the nonreturn valve 8 and the collecting container 10.

[0017] The additional condenser 24 is provided with a fan flowing air over the surface of the additional condenser 24 for effecting heat exchange between the air and the refrigerant flowing through the additional condenser 24. In particular, the air flowing over the surface of the additional condenser 24 is heated, wherein the refrigerant flowing through the additional condenser 24 is condensed/liquefied. The compressor 4, the additional compressor 22, the solenoid valves 14 and 20 and preferably also the fans of the condenser 6, the additional condenser 24 and the evaporator 18 are controlled by a control unit (not shown).

[0018] The size and performance of the additional compressor 22 and the additional condenser 24 can be considerably lower than the size and performance of the compressor 4 and the condenser 6, respectively.

[0019] In normal operation of the first refrigerating system 2, the solenoid valve 14 is open, the solenoid valve 20 is closed, and the compressor 4, the condenser 6 and the evaporator 18 are running, whereas the additional compressor 22 and the additional condenser 24 stand still.

[0020] In order to perform a precise measurement of the refrigerant contained in the first refrigerating system 2 the control unit switches the refrigerating system 2 from normal operation to refrigerant collecting operation as follows:

At first, the solenoid valve 14 is closed and the compressor 4 sucks off the refrigerant remaining in the portion of the refrigerating cycle between solenoid valve 14 and the compressor 4, especially in the expansion valve 16, in the evaporator 18 and in the refrigerant conduits between the solenoid valve 14 and the compressor 4, until no liquid refrigerant remains in this portion.

[0021] Subsequently, the compressor 4 and the con-

denser 6 are stopped, the solenoid valve 20 is opened and the additional compressor 22 as well as the additional condenser 24 are started.

[0022] Alternatively to switching off the compressor 4, its performance can be reduced or the pressure line between the compressor 4 and the condenser 6 can be interrupted e.g. by means of an additional solenoid valve (not shown). Alternatively to switching off the condenser 6, its performance can be reduced.

[0023] Now the condenser 6 is connected to the suction line of the additional compressor 22, and the refrigerant contained in the condenser 6, in the refrigerant line between the compressor 4 and the condenser 6 and in the remaining line portion between the compressor 4 and the input line of the liquefying set is sucked off by the additional compressor 22, is led through the additional condenser 24 where it is liquefied and is then collected in the collecting container 10.

[0024] The refrigerant remaining in the condenser 6 and the refrigerant conduits is now in gaseous form. By these exemplary embodiments of the invention, it is ensured that no liquid remains in some portions of the refrigerating cycle, thereby improving the preciseness of the measuring method significantly.

[0025] Having sucked off the remaining refrigerant from the condenser 6 and the refrigerant lines this way, substantially all refrigerant contained in the refrigerating system 2 is collected in the collecting container 10, and it is in liquid phase.

[0026] Now the fill level of the refrigerant in the collecting container 10 can be measured by the capacitive refrigerant fill level measuring unit 12, and such measurement produces a very precise and reliable result. The capacitive refrigerant fill level measuring unit 12 is especially pressure and temperature compensated. Alternatively, the collecting container 10 could be set to a defined pressure or temperature as well.

[0027] In this exemplary embodiment the refrigerant fill level measuring unit 12 is of capacitive kind. As a matter of course, other methods and devices for measuring the refrigerant fill level within the collecting container 10 can also be provided. The deviation of the actual amount of refrigerant contained in the first refrigerating system 2 from the measured amount of refrigerant collected in the collecting container 10, especially the amount of refrigerant that remains in the refrigerant conduits and in the additional condenser 24, is negligible.

[0028] By means of the nonreturn valve 8 a backflow of refrigerant into the condenser 6 is avoided when performing the refrigerant collecting operation.

[0029] Having measured the amount of refrigerant in the collecting container 10 the control unit switches the first refrigerating system 2 into the normal operation mode again by closing the solenoid valve 20, by starting the compressor 4, the condenser 6, and the evaporator 18 and by opening the solenoid valve 14 again.

[0030] By means of the nonreturn valve 26 a backflow of refrigerant into the liquefying set during normal oper-

ation is prevented. The nonreturn valve 26 is optional and can also be omitted. In this exemplary embodiment, the valve 26 is formed as a nonreturn valve 26. However, the valve 26 can also be formed as a solenoid valve or any other valve having an arbitrary control or drive.

[0031] In the exemplary embodiment of figure 1 only one compressor 4, one condenser 6, and one evaporator 18 are depicted. As a matter of course, also a set of compressors, a plurality of condensers, a plurality of expansion valves and a plurality of evaporators can be provided.

[0032] Figure 2 shows a schematic diagram of a second refrigerating system 28 comprising the main refrigerating cycle and the liquefying set according to the first refrigerating system 2 and further comprising a refrigerant branch-off line extending between a position between the collecting container 10 and the solenoid valve 14 and a position between the solenoid valve 20/suction pressure regulator and the additional compressor 22.

[0033] In the refrigerant branch-off line a solenoid valve 30, an expansion valve 32, a heat exchanger 34 and a further solenoid valve 36 are arranged. The solenoid valve 36 is optional, the solenoid valve 30 is sufficient for attaining the described function. The heat exchanger 34 effects in operation heat exchange between the liquid refrigerant flowing between the collecting container 10 and the expansion device 16 and the branched-off, expanded and thus cooled refrigerant flowing in the refrigerant branch-off line. In particular, the refrigerant flowing in the main line of the refrigerating cycle between the collecting container 10 and the expansion valve 16 is refrigerated against the branched-off, expanded and thus cooled refrigerant flowing in the refrigerant branch-off line, which on the other hand is heated and evaporated.

[0034] The control unit (not shown) of the second refrigerating system 28 controls the compressor 4, the additional compressor 22, the solenoid valves 14, 20, 30 and 36 and preferably also the fans of the condenser 6, the additional condenser 24 and the evaporator 18.

[0035] In normal operation, the main refrigerating cycle is running, i.e. the compressor 4, the condenser 6 and the evaporator 18 are running, the solenoid valve 14 is open and the solenoid valve 20 is closed, and the refrigerant branch-off line with the expansion valve 32 and the heat exchanger 34 and the additional compressor 22 as well as the additional condenser 24 of the liquefying set are operated as sub-cooling unit. In particular, the branched-off, expanded and thus cooled refrigerant evaporates against the refrigerant flowing in the main line of the refrigerant cycle between the collecting container 10 and the expansion valve 16, and is sucked in by the additional compressor 22, liquefied in the additional condenser 24 and fed again to the collecting container 10. In order to enable such sub-cooling operation, the solenoid valves 30 and 36 are opened.

[0036] In order to allow refrigerant collecting operation for measuring the amount of refrigerant contained in the second refrigerating system 28 the control unit switches

the second refrigerating system 28 into the refrigerant collecting operation as follows.

[0037] In one exemplary embodiment, the solenoid valve 30 is closed at first and the refrigerant remaining in the refrigerant branch-off line including the expansion valve 32 and the heat exchanger 34 is sucked off by the additional compressor 22, liquefied by the additional condenser and collected in the collecting container 10. Subsequently the solenoid valve 36 and the solenoid valve 14 are closed and the refrigerant remaining in the portion of the refrigerating cycle between the solenoid valve 14 and the compressor 4 is sucked off by the compressor 4. The order of the closing action of solenoid valves 30 and 14 is arbitrary, they could also close at the same time. The solenoid valve 36 is optional. Afterwards the compressor 4 is stopped and the solenoid valve 20 is opened such that the particularly gaseous refrigerant is sucked from the refrigerant lines and the condenser 6 by the additional compressor 22, is liquefied by the additional condenser 24 and collected in the collecting container 10. At this state of procedure nearly all refrigerant contained in the second refrigerating system 28 is collected in the container 10, and it is measured by means of the capacitive refrigerant fill level measuring unit 12.

[0038] Having measured the amount of refrigerant contained in the second refrigerating system 28, it is switched back to normal operation by the control unit again as follows. At first the solenoid valve 20 is closed, then the solenoid valve 14 is opened and the compressor 4 is started again. Subsequently, the solenoid valves 30 and 36 are opened again. The switching operation of the valves can be carried out in a different order or also at the same time.

[0039] The second refrigerating system 28 allows for the same precise measurement of the amount of refrigerant contained in the refrigerating system 28 as it is possible with the first refrigerating 2 depicted in figure 1. Differently from the first refrigerating system 2 however, the second refrigerating system 28 does not need to stop the additional compressor 22, and particularly also the additional condenser 24 from running, but rather uses the additional compressor 22 and the additional condenser 24 in combination with the expansion valve 32 and the heat exchanger 34 as sub-cooling unit in the normal operation, thereby further improving the refrigerating performance and the efficiency of the refrigerating system 28. The costly additional elements 22 and 24 are also utilized in the normal operation but not only in the refrigerant collecting operation.

[0040] Figure 3 shows a schematic diagram of a third refrigerating system 38 mainly corresponding to the second refrigerating system 28 of figure 2 but further comprising an additional heat exchanger 40.

[0041] The additional heat exchanger 40 effects heat exchange between the branched-off refrigerant entering the refrigerant branch-off line and the branched-off refrigerant having been evaporated by the heat exchanger 34.

[0042] By the provision of this additional heat exchanger 40 the refrigerating performance and the efficiency of the third refrigerating system 38 is further improved. The normal operation, the refrigerant collecting operation and the switching therebetween correspond to those already described with respect to figure 2.

[0043] In the exemplary embodiments of Figs. 1 to 3 an additional valve can be arranged before the additional compressor 22. By such an additional valve a suction pressure regulation can be attained, and a too high suction pressure (liquefying pressure of the refrigerating operation) at the additional compressor 22 at the beginning of the suction operation can be avoided.

[0044] According to an alternative method for improving the preciseness, the suction operation is carried out in a first step by the compressor 4 and in a second step by the additional compressor 22 until a defined suction pressure is reached. By this method, the density of the gas and thus the amount of refrigerant remaining in the gaseous phase can be determined by the temperature.

[0045] Figure 4 shows a schematic diagram of a fourth refrigerating system 42.

[0046] The fourth refrigerating system 42 comprises the elements of the main refrigerating cycle as already described with respect to figure 1 which are designated with the same reference numerals. In the main refrigerating cycle there is arranged an additional element, namely the solenoid valve 44 in the pressure line between the compressor 4 and the condenser 6.

[0047] The liquefying set branches off before this solenoid valve 44, it comprises an optional solenoid valve 20, an additional condenser 24 and a solenoid valve 26, and it discharges into the refrigerant conduit at a position between the nonreturn valve 8 and the collecting container 10. Between the solenoid valve 44 and the condenser 6, a connection line branches off to the suction line of the compressor 4, and a solenoid valve 46 is provided in this connection line.

[0048] The solenoid valves 44 and 46 can also be formed as a combined three way valve.

[0049] The compressor 4, the condenser 6, the additional condenser 24, the evaporator 18 and the solenoid valves 14, 20, 44 and 46 are controlled by a control unit (not shown).

[0050] In normal operation of the fourth refrigerating system 42, the compressor 4, the condenser 6 and the evaporator 18 are running, the solenoid valves 14 and 44 are open, the solenoid valves 20 and 46 are closed and the additional condenser 24 is not working.

[0051] In order to allow for a precise measurement of the refrigerant contained in the fourth refrigerating system 42, the control unit switches the fourth refrigerating system 42 from the normal operation into the refrigerant collection operation as follows.

[0052] At first the solenoid valve 14 is closed and the compressor 4 sucks off the remaining refrigerant from the portion between the solenoid valve 14 and the compressor 4, especially from the expansion valve 16 the

evaporator 18 and the refrigerant conduits extending therebetween. Then the condenser 6 is connected to the suction line of the compressor 4 by closing the solenoid valve 44 and opening the solenoid valve 46, and the pressure line of the compressor 4 is switched to the additional condenser 24, which is started, by opening the solenoid valve 20. Recapitulating, the solenoid valve 44 acts for disconnecting the condenser 6 from the pressure line of the compressor 4 and in combination with the solenoid valve 46 for connecting the condenser 6 to the suction line of the compressor 4.

[0053] In this refrigerant collecting operation the refrigerant remaining in the condenser 6 and in the former pressure line before the condenser 6 now forming the suction line, is sucked off from the compressor 4, is liquefied by the additional condenser 24 and collected in the collecting container 10.

[0054] Having performed this refrigerant collecting operation, nearly all the refrigerant contained in the fourth refrigerating system 42 is collected in the collecting container 10 and the amount of this refrigerant can be measured by means of the capacitive refrigerant fill level measuring unit 12. The amount of refrigerant remaining in the refrigerant lines and in the additional condenser 24 is negligible.

[0055] Having measured the amount of refrigerant contained in the fourth refrigerating system 42, the control unit switches it back to normal operation as follows. The additional condenser 24 is switched off and disconnected by closing the solenoid valve 20, the condenser 6 is reconnected to the pressure line of the compressor 4 by closing the solenoid valve 46 and opening the solenoid valve 44, and the solenoid valve 14 is opened again.

[0056] By the fourth refrigerating system 42, a precise and reliable measurement of the refrigerant contained can be effected without having to provide an additional compressor. On the other hand two more solenoid valves 44 and 46 and one additional connection line connecting the condenser 6 to the suction line of the compressor 4 have to be provided, as compared with the first refrigerating system 2. The existing main compressor 4 is switched such that in normal operation its pressure line is connected to the condenser 6 and in refrigerant collecting operation its suction line is connected thereto. During refrigerant collecting operation, the performance of the compressor 4 can be temporarily reduced.

[0057] Figure 5 shows a schematic diagram of a fifth refrigerating system 48.

[0058] The fifth refrigerating system 48 comprises the elements of the main refrigerating cycle as already described with respect to figure 1 which are designated with the same reference numerals. In the main refrigerating cycle there are arranged two additional elements, namely the solenoid valve 44 in the pressure line between the compressor 4 and the condenser 6 and an additional condenser 50 between the collecting container 10 and the solenoid valve 14.

[0059] A connecting line branches off before this solenoid valve 44 and connects to a position between the additional condenser 50 and the solenoid valve 14. Between the solenoid valve 44 and the condenser 6, a connection line branches off to the suction line of the compressor 4, and a solenoid valve 46 is provided in this connection line.

[0060] During normal operation of the fifth refrigerating system 48, solenoid valves 14 and 44 are open, solenoid valves 46 and 20 are closed, and the additional condenser 50 works as a subcooling unit in the liquid refrigerant line between the collecting container 10 and the solenoid valve 14. In particular, the additional condenser 50 cools the liquid refrigerant against ambient air.

[0061] During refrigerant collecting operation, the solenoid valves 46 and 20 are open and the solenoid valves 14 and 44 are closed. The condenser is connected to the suction line of the compressor 4, and the additional condenser 50 is connected to the pressure line of the compressor 4, and the refrigerant flows through the additional condenser 50 in a reverse direction such that it works as a liquefier. During the measurement, the additional condenser 50 is always filled with liquid refrigerant and does not effect the preciseness of the measuring method. The collecting container 10 can be made considerably smaller, since it does not have to contain the complete liquid refrigerant for the measurement. Instead, part of the liquid refrigerant is contained in the additional condenser 50.

[0062] In the refrigerant collecting operation of all five described refrigerating systems 2, 28, 38, 42 and 48, the condenser 6 can particularly be stopped. Alternatively it can be operated further or its performance can be reduced.

[0063] Exemplary embodiment of the invention, as described above, allow for a precise measurement of the refrigerant actually contained in the refrigerating system by connecting the condenser to the suction line of the existing or an additional compressor. The refrigerating system according to embodiments of the invention, as described above, are suitable for use with any refrigerant, especially with fluorocarbon or chlorofluorocarbon refrigerants. The automated monitoring can be effected easily and reliably by the refrigerating system according to the embodiments of the invention, as described above, the efforts needed for such monitoring are substantially reduced, and leakages in the refrigerating cycle can be detected at an early stage. The switching between normal operation and refrigerant collecting operation and the actual measurement can be effected very fast.

[0064] The prescribed deviation of the actual amount of refrigerant to the measured amount of refrigerant of less than 2% can reliably be detected. Even much higher preciseness is attained. Consequently, by the refrigerant system according to exemplary embodiments of the invention, as described above, the requirements of the so-called F-Gase Verordnung can be matched.

[0065] Existing refrigeration cycles can easily be re-

rofitted with the elements needed for the refrigerant collecting operation, as described above.

[0066] Although the elements of the refrigerating system may be positioned in an arbitrary environment, in one embodiment of the invention, the collecting container can be positioned near the condenser, especially outdoor.

[0067] The control unit can be any kind of control or computer being capable of controlling the above mentioned elements.

[0068] According to an embodiment of the invention, the collecting container is provided with a refrigerant fill level measuring unit, which can be formed as capacitive measuring unit measuring a floaters swimming at the surface of the liquid refrigerant collecting in the collecting container. Other refrigerant fill level measuring units can be employed as well.

[0069] In an embodiment of the invention, as described above, the remaining refrigerant is sucked off by the existing compressor of the refrigerating cycle. For doing so, the condenser can be connected to the suction line of the compressor during refrigerant collecting operation such that the remaining refrigerant is sucked off. By this embodiment the existing compressor can be used for the refrigerant collecting operation, and no additional compressor needs to be provided.

[0070] For switching between normal operation and refrigerant collecting operation at least one shut off valve, especially a solenoid valve can be provided. Such shut off valves can be solenoid valves or any other valves having an arbitrary control or drive. One shut off valve can be arranged in flowing direction before the expansion device. At least one shut off valve can be provided for connecting the condenser between the pressure line of the compressor for normal operation and the suction line of the compressor for refrigerant collecting operation. At least one shut off valve can be provided for connecting the pressure line of the compressor to the additional condenser. The switching operation of at least one shut off valve is controlled by the control unit. Particularly such control unit controls all existing shut off valves. The shut off valves can be solenoid valves or any other kind of valves being capable of interrupting and reassuming refrigerant flow within a refrigerant conduit.

[0071] According to an alternative embodiment of the invention the liquefying set comprises an additional compressor and an additional condenser, said elements connected in parallel to the existing condenser, and during refrigerant collecting operation the remaining refrigerant is sucked off from the condenser by the additional compressor.

[0072] Again, at least one shut off valve is provided for allowing switching between normal operation and refrigerant collecting operation. One shut off valve can be arranged in flowing direction before the expansion device. One shut off valve can be arranged in the connection line between the condenser and the additional compressor.

[0073] By providing a liquefying set comprising an ad-

ditional compressor and an additional condenser, highly precise measurement results can be effected.

[0074] In a further embodiment of the invention, a non-return valve is arranged between the additional condenser preventing backflow of the refrigerant into the condenser.

[0075] In a further embodiment of the invention, a suction pressure regulating valve is arranged before the additional compressor for avoiding a too high suction pressure at the additional compressor at the beginning of the suction operation.

[0076] In a further embodiment of the invention, a refrigerant branch-off line extends between the position behind the collecting container and the position before the additional compressor of the liquefying set. In the refrigerant branch-off line, an additional expansion device and a heat exchanger are arranged, wherein said heat exchanger effects in operation heat exchange between the liquid refrigerant flowing between the collecting container and the expansion device and the branched-off, expanded refrigerant flowing in the refrigerant branch-off line. By this embodiment it becomes possible to use the additional compressor and the additional condenser not only during the refrigerant collecting operation but also during normal operation, in combination with the heat exchanger and the additional expansion device, as a sub-cooling unit, thereby improving the refrigerating performance and the efficiency of the refrigerating system and utilizing the additional compressor and the additional condenser in a more comprehensive manner.

[0077] According to a further embodiment at least one shut off valve is provided for allowing refrigerant flow through the refrigerant branch-off line and interrupting said refrigerant flow.

[0078] Particularly, a first shut off valve can be arranged before the additional expansion device and a second shut off valve can be arranged behind the heat exchanger. Such shut off valves can be solenoid valves or any other valves having an arbitrary control or drive.

[0079] According to a further embodiment of the invention a further heat exchanger can be provided in the refrigerant branch-off line said further heat exchanger effecting in operation heat exchange between the branched-off refrigerant entering the refrigerant branch-off line and the branched-off refrigerant having passed the heat exchanger. By the provision of such further heat exchanger the refrigerating performance and efficiency of the refrigerating system can further be improved.

[0080] By providing a nonreturn valve behind the condenser, a backflow of refrigerant into the condenser during the refrigerant collecting operation can be prevented.

[0081] In a further embodiment of the invention, at least one of the condenser, the additional condenser and the evaporator can be provided with a fan, thereby attaining particularly efficient heat exchange therein.

[0082] Exemplary embodiments of the method for operating a refrigerant system in a refrigerant collecting operation using the existing compressor and comprising an

additional condenser, a reliable collection of nearly the whole amount of refrigerant in the collecting container and a precise measurement can be attained with a quite simple construction without having to install an additional compressor.

[0083] Exemplary embodiments of the method for operating a refrigerating system in a refrigerant collecting operation using a liquefying set comprising an additional compressor and an additional condenser, a particularly complete collection of the refrigerant in the collecting container and a particularly precise measurement of the amount of refrigerant contained in the refrigerating system can be effected.

[0084] Before connecting the liquefying set to the condenser, a shut off valve positioned in flowing direction before the expansion device is closed and the refrigerant remaining between the shut off valve and the compressor is sucked off by the compressor. By doing so, the preciseness can be improved even further. Before connecting the liquefying set in parallel to the condenser, the compressor can either be switched off, its performance can be reduced or the connection between the compressor and the condenser can be interrupted.

[0085] Having collected the refrigerant in the collecting container its fill level is measured by appropriate means.

[0086] Exemplary embodiments of the method for operating a refrigerating system, as described above, in the normal operation by operating the liquefying set as a sub-cooling unit enhance on the one hand the refrigerating performance and the efficiency of the operation and allow on the other hand for a complete collection of the refrigerant contained in the refrigerating system within the collecting container and for a highly precise measurement of the amount of such refrigerant. The heat exchange is effected in a further heat exchanger between the branched-off refrigerant entering the refrigerant branch-off line and the branched-off refrigerant having passed the heat exchanger. By such embodiments, the refrigerating performance and efficiency can be improved even further.

[0087] The refrigerating system and the method for its operation according to embodiments of the invention, as described above, are suitable in combination with any compression cycle effecting refrigeration of the evaporator/cold consumers at temperatures of above 0 degrees Celsius and freezing temperatures of below 0 degrees Celsius.

[0088] 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 elements may be substituted for equivalents thereof without departing from the scope the invention. In addition, many modifications may be made to adapt a 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 invention will include all embodiments falling within the

scope of the appended claims.

Claims

1. Refrigerating system (2) comprising:

a refrigerating cycle having a compressor (4), a condenser (6), a collecting container (10), an expansion device (16), an evaporator (18) and refrigerating circuits circulating a refrigerant therethrough; **characterized by** a liquefying set comprising an additional compressor (22) and an additional condenser (24), connected in parallel to the condenser (6); and a control unit that in operation allows switching between normal operation of the refrigerating cycle and refrigerant collecting operation in which the remaining refrigerant is sucked off from the condenser (6), is liquefied by the additional condenser (24) and collects in the collecting container (10); wherein at least one shut-off valve is provided for allowing switching between normal operation and refrigerant collecting operation, wherein, in the refrigerant collecting operation, the condenser (6) is connected to the suction line of the compressor (4) such that the remaining refrigerant is sucked off from the condenser (6) by the additional compressor (10); and wherein the collecting container (10) is provided with a refrigerant fill level measuring unit (12).

2. Refrigerating system (48) comprising:

a refrigerating cycle having a compressor (4), a condenser (6), a collecting container (10), an expansion device (16), an evaporator (18) and refrigerating circuits circulating a refrigerant therethrough; **characterised by** an additional condenser (50) arranged between the collecting container (10) and the expansion device (16), and a control unit that in operation allows switching between normal operation of the refrigerating cycle in which the additional condenser (50) works as sub-cooling unit and refrigerant collecting operation in which the remaining refrigerant is sucked off from the condenser (6), is liquefied by the additional condenser (50) and collects in the collecting container (10); wherein at least one shut-off valve is provided for allowing switching between normal operation and refrigerant collecting operation, wherein, in the refrigerant collecting operation, the condenser (6) is connected to the suction line of the compressor (4) such that the remaining refrigerant is sucked off from the condenser (6) by

the compressor (4); and wherein the collecting container (10) is provided with a refrigerant fill level measuring unit (12).

- 5 3. Refrigerating system (42; 48) of any of the preceding claims, wherein a shut-off valve (14) is arranged in flowing direction before the expansion device (16).
- 10 4. Refrigerating system (42; 48) of any of claims 2 or 3, wherein at least one shut-off valve (44, 46) is provided for connecting the condenser (6) between the pressure line of the compressor (4) for normal operation and the suction line of the compressor (4) for refrigerant collecting operation.
- 15 5. Refrigerating system (42; 48) of any of claims 2 to 4, wherein at least one shut-off valve (20) is provided for connecting the pressure line of the compressor (4) to the additional condenser (24; 50).
- 20 6. Refrigerating system (2) of any of claims 1 to 5, wherein a shut-off valve (20) is arranged in the connection line between the condenser (6) and the additional compressor (22).
- 25 7. Refrigerating system (2) of any of claims 1 or 6, wherein a valve (26) is arranged behind the additional condenser (24).
- 30 8. Refrigerating system (28) of any of claims 1, 8 or 9, wherein a refrigerant branch-off line extends between a position behind the collecting container (10) and a position before the additional compressor (22) of the liquefying set; wherein, in the refrigerant branch-off line, an additional expansion device (32) and a heat exchanger (34) are arranged, said heat exchanger (34) effecting in operation heat exchange between the liquid refrigerant flowing between the collecting container (10) and the expansion device (16) and the branched-off, expanded refrigerant flowing in the refrigerant branch-off line.
- 35 9. Refrigerating system (2; 28; 38; 42; 48) of any of the preceding claims, wherein a valve (8) is arranged behind the condenser (6).
- 40 10. Method for operating a refrigerating system (42) in a refrigerant collecting operation, the refrigerating system (2) comprising a refrigerating cycle having a compressor (4), a condenser (6), a collecting container (10), an expansion device (16), an evaporator (18) and refrigerating circuits circulating a refrigerant therethrough, the method **characterised by** the steps of:
- 45 50 55

connecting the condenser (6) to the suction line of the compressor (4), and connecting a liquefying set comprising an additional condenser (24, 50) to the pressure line of the compressor (4) by at least one shut-off valve; and
 effecting refrigerant collecting operation by running the compressor (4) such that the remaining refrigerant is sucked off from the condenser (6), is liquefied by the additional condenser (24, 50) and collects in the collecting container (10), and measuring the amount of refrigerant in the collecting container (10) by a refrigerant fill level measuring unit (12).

11. Method for operating a refrigerating system (42) according to claim 10, wherein the additional condenser (24) is connected in parallel to the condenser (6).

12. Method for operating a refrigerating system (48) according to claim 10, wherein the additional condenser (50) is arranged between the collecting container (10) and the expansion device (16)).

13. Method for operating a refrigerating system (2) in a refrigerant collecting operation, the refrigerating system (2) comprising a refrigerating cycle having a compressor (4), a condenser (6), a collecting container (10), an expansion device (16), an evaporator (18) and refrigerating circuits circulating a refrigerant therethrough, the method **characterised by** the steps of:

connecting a liquefying set comprising an additional compressor (22) and an additional condenser (24) in parallel to the condenser (6) by at least one shut-off valve; and
 effecting refrigerant collecting operation by running the additional compressor (24) such that the remaining refrigerant is sucked off from the condenser (6), is liquefied by the additional condenser (24) and collects in the collecting container (10), and measuring the amount of refrigerant in the collecting container (10) by a refrigerant fill level measuring unit (12).

14. Method for operating a refrigerating system (38), the refrigerating system (38) comprising a refrigerating cycle having a compressor (4), a condenser (6), a collecting container (10), an expansion device (16), an evaporator (18) and refrigerating circuits circulating a refrigerant therethrough, and a liquefying set comprising an additional compressor (22) and an additional condenser (24), connected in parallel to the condenser (6), the method **characterised by** the steps of:

operating the refrigerating cycle;
 operating the liquefying set as subcooling unit

by branching off refrigerant behind the collecting container (10), by expanding the branched-off refrigerant, by effecting heat exchange between the branched-off, expanded refrigerant and the refrigerant flowing between the collecting container (10) and the expansion device (16) in a heat exchanger (34), by compressing the branched-off, warmed refrigerant by the additional compressor (22), by condensing the compressed refrigerant in the additional condenser (24) and by flowing the condensed refrigerant to the collecting container (10), and measuring the amount of refrigerant in the collecting container (10) by a refrigerant fill level measuring unit (12).

Patentansprüche

1. Kühleystem (2), umfassend:

einen Kühleislauf mit einem Kompressor (4), einem Kondensator (6), einem Sammelbehälter (10), einer Expansionseinrichtung (16), einem Verdampfer (18) und Kühleisleitungen, durch die ein Kältemittel zirkuliert; **gekennzeichnet durch**

einen Verflüssigungssatz, der einen zusätzlichen Kompressor (22) und einen zusätzlichen Kondensator (24) umfasst, der parallel zu dem Kondensator (6) angeschlossen ist; und
 eine Steuereinheit, die im Betrieb ein Umschalten zwischen einem Normalbetrieb des Kühleislaufs und einem Kältemittelsammelbetrieb ermöglicht, in dem das verbleibende Kältemittel vom Kondensator (6) abgesaugt wird, **durch** den zusätzlichen Kondensator (24) verflüssigt wird und sich im Sammelbehälter (10) sammelt; wobei wenigstens ein Absperrventil zum Umschalten zwischen Normalbetrieb und Kältemittelsammelbetrieb vorgesehen ist, wobei der Kondensator (6) im Kältemittelsammelbetrieb mit der Saugleitung des Kompressors (4) verbunden ist, sodass das verbleibende Kältemittel **durch** den zusätzlichen Kompressor (10) von dem Kondensator (6) abgesaugt wird; und
 wobei der Sammelbehälter (10) mit einer Kältemittelfüllpegelmesseinheit (12) versehen ist.

2. Kühleystem (48), umfassend:

einen Kühleislauf mit einem Kompressor (4), einem Kondensator (6), einem Sammelbehälter (10), einer Expansionseinrichtung (16), einem Verdampfer (18) und Kühleisleitungen, durch die ein Kältemittel zirkuliert; **gekennzeichnet durch**
 einen zusätzlichen Kondensator (50), der zwi-

- schen dem Sammelbehälter (10) und der Expansionseinrichtung (16) angeordnet ist, und eine Steuereinheit, die im Betrieb ein Umschalten zwischen einem Normalbetrieb des Kühlkreislaufs, in dem der zusätzliche Kondensator (50) als Unterkühlungseinheit arbeitet, und einem Kältemittelsammelbetrieb ermöglicht, in dem das verbleibende Kältemittel vom Kondensator (6) abgesaugt wird, **durch** den zusätzlichen Kondensator (50) verflüssigt wird und sich im Sammelbehälter (10) sammelt; wobei wenigstens ein Absperrventil zum Umschalten zwischen Normalbetrieb und Kältemittelsammelbetrieb vorgesehen ist, wobei der Kondensator (6) im Kältemittelsammelbetrieb mit der Saugleitung des Kompressors (4) verbunden ist, sodass das verbleibende Kältemittel **durch** den Kompressor (4) von dem Kondensator (6) abgesaugt wird; und wobei der Sammelbehälter (10) mit einer Kältemittelfüllpegelmesseinheit (12) versehen ist.
3. Kühltssystem (42; 48) nach einem der vorangehenden Ansprüche, wobei ein Absperrventil (14) in Strömungsrichtung vor der Expansionseinrichtung (16) angeordnet ist.
4. Kühltssystem (42; 48) nach einem der Ansprüche 2 oder 3, wobei wenigstens ein Absperrventil (44, 46) zum Verbinden des Kondensators (6) zwischen der Druckleitung des Kompressors (4) für den Normalbetrieb und der Saugleitung des Kompressors (4) für den Kältemittelsammelbetrieb vorgesehen ist.
5. Kühltssystem (42; 48) nach einem der Ansprüche 2 bis 4, wobei wenigstens ein Absperrventil (20) zum Verbinden der Druckleitung des Kompressors (4) mit dem zusätzlichen Kondensator (24; 50) vorgesehen ist.
6. Kühltssystem (2) nach einem der Ansprüche 1 bis 5, wobei ein Absperrventil (20) in der Verbindungsleitung zwischen dem Kondensator (6) und dem zusätzlichen Kompressor (22) vorgesehen ist.
7. Kühltssystem (2) nach einem der Ansprüche 1 oder 6, wobei ein Ventil (26) hinter dem zusätzlichen Kondensator (24) angeordnet ist.
8. Kühltssystem (28) nach einem der Ansprüche 1, 8 oder 9, wobei sich eine Kältemittelabzwegleitung zwischen einer Position hinter dem Sammelbehälter (10) und einer Position vor dem zusätzlichen Kompressor (22) des Verflüssigungssatzes erstreckt; wobei in der Kältemittelabzwegleitung eine zusätzliche Expansionseinrichtung (32) und ein Wärmetauscher (34) angeordnet sind, wobei der Wärmetauscher (34) im Betrieb einen Wärmeaustausch zwischen dem flüssigen Kältemittel, das zwischen dem Sammelbehälter (10) und der Expansionseinrichtung (16) strömt, und dem abgezweigten expandierten Kältemittel bewirkt, das in der Kältemittelabzwegleitung strömt.
9. Kühltssystem (2; 28; 38; 42; 48) nach einem der vorangehenden Ansprüche, wobei ein Ventil (8) hinter dem Kondensator (6) angeordnet ist.
10. Verfahren zum Betreiben eines Kühltssystems (42) in einem Kältemittelsammelbetrieb, wobei das Kühltssystem (2) einen Kühlkreislauf mit einem Kompressor (4), einem Kondensator (6), einem Sammelbehälter (10), einer Expansionseinrichtung (16), einem Verdampfer (18) und Kühlkreisleitungen umfasst, durch die ein Kältemittel zirkuliert, wobei das Verfahren durch folgende Schritte gekennzeichnet ist:
- Verbinden des Kondensators (6) mit der Saugleitung des Kompressors (4), und Verbinden eines Verflüssigungssatzes, der einen zusätzlichen Kondensator (24, 50) umfasst, mit der Druckleitung des Kompressors (4) durch wenigstens ein Absperrventil; und Bewirken des Kältemittelsammelbetriebs durch Betreiben des Kompressors (4), sodass das verbleibende Kältemittel vom Kondensator (6) abgesaugt wird, durch den zusätzlichen Kondensator (24, 50) verflüssigt wird und sich im Sammelbehälter (10) sammelt, und Messen der Menge an Kältemittel im Sammelbehälter (10) durch eine Kältemittelfüllpegelmesseinheit (12).
11. Verfahren zum Betreiben eines Kühltssystems (42) nach Anspruch 10, wobei der zusätzliche Kondensator (24) parallel zu dem Kondensator (6) angeschlossen ist.
12. Verfahren zum Betreiben eines Kühltssystems (48) nach Anspruch 10, wobei der zusätzliche Kondensator (50) zwischen dem Sammelbehälter (10) und der Expansionseinrichtung (16) angeordnet ist.
13. Verfahren zum Betreiben eines Kühltssystems (2) in einem Kältemittelsammelbetrieb, wobei das Kühltssystem (2) einen Kühlkreislauf mit einem Kompressor (4), einem Kondensator (6), einem Sammelbehälter (10), einer Expansionseinrichtung (16), einem Verdampfer (18) und Kühlkreisleitungen umfasst, durch die ein Kältemittel zirkuliert, wobei das Verfahren durch folgende Schritte gekennzeichnet ist:
- Verbinden eines Verflüssigungssatzes, der einen zusätzlichen Kompressor (22) und einen

zusätzliche Kondensator (24) parallel zu dem Kondensator (6) umfasst, durch wenigstens ein Absperrventil; und
Bewirken eines Kältemittelsammelbetriebs durch Betreiben des zusätzlichen Kompressors (24), sodass das verbleibende Kältemittel vom Kondensator (6) abgesaugt wird, durch den zusätzliche Kondensator (24) verflüssigt wird und sich im Sammelbehälter (10) sammelt, und Messen der Menge an Kältemittel im Sammelbehälter (10) durch eine Kältemittelfüllpegelmesseinheit (12).

14. Verfahren zum Betreiben eines Kühlsystems (38), wobei das Kühlsystem (38) einen Kühlkreislauf mit einem Kompressor (4), einem Kondensator (6), einem Sammelbehälter (10), einer Expansionseinrichtung (16), einem Verdampfer (18) und Kühlkreislängen umfasst, durch die ein Kältemittel zirkuliert, und einem Verflüssigungssatz, der einen zusätzlichen Kompressor (22) und einen zusätzlichen Kondensator (24) umfasst, der parallel zu dem Kondensator (6) angeschlossen ist, wobei das Verfahren durch folgende Schritte gekennzeichnet ist:

Betreiben des Kühlkreislaufs;
Betreiben des Verflüssigungssatzes als Unterkühlungseinheit, indem das Kältemittel hinter dem Sammelbehälter (10) abgezweigt wird, indem das abgezweigte Kältemittel expandiert wird, indem ein Wärmeaustausch zwischen dem abgezweigten expandierten Kältemittel und dem Kältemittel, das zwischen dem Sammelbehälter (10) und der Expansionseinrichtung (16) strömt, in einem Wärmetauscher (34) bewirkt wird, indem das abgezweigte erwärmte Kältemittel durch den zusätzlichen Kompressor (22) verdichtet wird, indem das verdichtete Kältemittel in dem zusätzlichen Kondensator (24) kondensiert wird und indem das kondensierte Kältemittel zu dem Sammelbehälter (10) strömt, und Messen der Menge an Kältemittel im Sammelbehälter (10) durch eine Kältemittelfüllpegelmesseinheit (12).

Revendications

1. Système de réfrigération (2) comprenant :

un cycle de réfrigération présentant un compresseur (4), un condensateur (6), un contenant de collecte (10), un dispositif d'expansion (16), un évaporateur (18) et des circuits de réfrigération au travers desquels circule un réfrigérant ;
caractérisé par
un ensemble de liquéfaction comprenant un compresseur supplémentaire (22) et un conden-

sateur supplémentaire (24), relié en parallèle au condensateur (6) ; et
une unité de contrôle qui permet en fonctionnement la commutation entre le fonctionnement normal du cycle de réfrigération et le fonctionnement de collecte de réfrigérant, dans lequel le réfrigérant restant est aspiré du condensateur (6), est liquéfié par le condensateur supplémentaire (24) et est collecté dans le contenant de collecte (10) ;
dans lequel au moins une soupape d'arrêt est prévue pour permettre la commutation entre le fonctionnement normal et le fonctionnement de collecte de réfrigérant, dans lequel dans le fonctionnement de collecte de réfrigérant, le condensateur (6) est relié à la ligne d'aspiration du compresseur (4) de sorte que le réfrigérant restant soit aspiré du condensateur (6) par le compresseur supplémentaire (10) ; et
dans lequel le contenant de collecte (10) est doté d'une unité de mesure de niveau de remplissage de réfrigérant (12).

2. Système de réfrigération (48) comprenant :

un cycle de réfrigération présentant un compresseur (4), un condensateur (6), un contenant de collecte (10), un dispositif d'expansion (16), un évaporateur (18) et des circuits de réfrigération au travers desquels circule un réfrigérant ;
caractérisé par
un condensateur supplémentaire (50) agencé entre le contenant de collecte (10) et le dispositif d'expansion (16) et
une unité de contrôle qui permet en fonctionnement la commutation entre le fonctionnement normal du cycle de réfrigération, dans lequel le condensateur supplémentaire (50) travaille comme unité de sous-refroidissement et le fonctionnement de collecte de réfrigérant, dans lequel le réfrigérant restant est aspiré du condensateur (6), est liquéfié par le condensateur supplémentaire (50) et est collecté dans le contenant de collecte (10) ;
dans lequel au moins une soupape d'arrêt est prévue pour permettre la commutation entre le fonctionnement normal et le fonctionnement de collecte de réfrigérant, dans lequel dans le fonctionnement de collecte de réfrigérant, le condensateur (6) est relié à la ligne d'aspiration du compresseur (4) de sorte que le réfrigérant restant soit aspiré du condensateur (6) par le compresseur (4) ; et
dans lequel le contenant de collecte (10) est doté d'une unité de mesure de niveau de remplissage de réfrigérant (12).

3. Système de réfrigération (42 ; 48) selon l'une quel-

- conque des revendications précédentes, dans lequel une soupape d'arrêt (14) est agencée dans la direction d'écoulement avant le dispositif d'expansion (16).
4. Système de réfrigération (42 ; 48) selon l'une quelconque des revendications 2 ou 3, dans lequel au moins une soupape d'arrêt (44, 46) est prévue pour la liaison du condensateur (6) entre la ligne de pression du compresseur (4) pour le fonctionnement normal et la ligne d'aspiration du compresseur (4) pour le fonctionnement de collecte de réfrigérant. 5
 5. Système de réfrigération (42 ; 48) selon l'une quelconque des revendications 2 à 4, dans lequel au moins une soupape d'arrêt (20) est prévue pour la liaison de la ligne de pression du compresseur (4) avec le condensateur supplémentaire (24 ; 50). 10
 6. Système de réfrigération (2) selon l'une quelconque des revendications 1 à 5, dans lequel une soupape d'arrêt (20) est agencée dans la ligne de liaison entre le condensateur (6) et le compresseur supplémentaire (22). 15
 7. Système de réfrigération (2) selon l'une quelconque des revendications 1 ou 6, dans lequel une soupape (26) est agencée derrière le condensateur supplémentaire (24). 20
 8. Système de réfrigération (28) selon l'une quelconque des revendications 1, 8 ou 9, dans lequel une ligne de dérivation de réfrigérant s'étend entre une position derrière le contenant de collecte (10) et une position avant le compresseur supplémentaire (22) de l'ensemble de liquéfaction ; dans lequel dans la ligne de dérivation de réfrigérant, un dispositif d'expansion supplémentaire (32) et un échangeur de chaleur (34) sont agencés, ledit échangeur de chaleur (34) effectuant en fonctionnement un échange de chaleur entre le réfrigérant liquide s'écoulant entre le contenant de collecte (10) et le dispositif d'expansion (16) et le réfrigérant expansé dérivé s'écoulant dans la ligne de dérivation de réfrigérant. 25
 9. Système de réfrigération (2 ; 28 ; 38 ; 42 ; 48) selon l'une quelconque des revendications précédentes, dans lequel une soupape (8) est agencée derrière le condensateur (6). 30
 10. Procédé de fonctionnement d'un système de réfrigération (42) dans un fonctionnement de collecte de réfrigérant, le système de réfrigération (2) comprenant un cycle de réfrigération présentant un compresseur (4), un condensateur (6), un contenant de 35
- collecte (10), un dispositif d'expansion (16), un évaporateur (18) et des circuits de réfrigération au travers desquels un réfrigérant circule, le procédé étant **caractérisé par** la liaison du condensateur (6) à la ligne d'aspiration du compresseur (4) et la liaison d'un ensemble de liquéfaction comprenant un condensateur supplémentaire (24, 50) avec la ligne de pression du compresseur (4) par au moins une soupape d'arrêt ; et la réalisation du fonctionnement de collecte de réfrigérant en faisant fonctionner le compresseur (4) de sorte que le réfrigérant restant soit aspiré du condensateur (6), soit liquéfié par le condensateur supplémentaire (24, 50) et soit collecté dans le contenant de collecte (10), et la mesure de la quantité de réfrigérant dans le contenant de collecte (10) par une unité de mesure de niveau de remplissage de réfrigérant (12).
11. Procédé de fonctionnement d'un système de réfrigération (42) selon la revendication 10, dans lequel le condensateur supplémentaire (24) est relié en parallèle au condensateur (6). 40
 12. Procédé de fonctionnement d'un système de réfrigération (48) selon la revendication 10, dans lequel le condensateur supplémentaire (50) est agencé entre le contenant de collecte (10) et le dispositif d'expansion (16). 45
 13. Procédé de fonctionnement d'un système de réfrigération (2) dans un fonctionnement de collecte de réfrigérant, le système de réfrigération (2) comprenant un cycle de réfrigération présentant un compresseur (4), un condensateur (6), un contenant de collecte (10), un dispositif d'expansion (16), un évaporateur (18) et des circuits de réfrigération au travers desquels un réfrigérant circule, le procédé étant **caractérisé par** les étapes suivantes : 50

la liaison d'un ensemble de liquéfaction comprenant un compresseur supplémentaire (22) et un condensateur supplémentaire (24) en parallèle avec le condensateur (6) par au moins une soupape d'arrêt ; et la réalisation du fonctionnement de collecte de réfrigérant en faisant fonctionner le compresseur supplémentaire (24) de sorte que le réfrigérant restant soit aspiré du condensateur (6), soit liquéfié par le condensateur supplémentaire (24) et soit collecté dans le contenant de collecte (10), et la mesure de la quantité de réfrigérant dans le contenant de collecte (10) par une unité de mesure de niveau de remplissage de réfrigérant (12). 55
 14. Procédé de fonctionnement d'un système de réfrigération (38), le système de réfrigération (38) com-

prenant un cycle de réfrigération présentant un compresseur (4), un condensateur (6), un contenant de collecte (10), un dispositif d'expansion (16), un évaporateur (18) et des circuits de réfrigération au travers desquels un réfrigérant circule, et un ensemble de liquéfaction comprenant un compresseur supplémentaire (22) et un condensateur supplémentaire (24), relié en parallèle au condensateur (6), le procédé étant **caractérisé par** les étapes suivantes :

le fonctionnement du cycle de réfrigération ;
 le fonctionnement de l'ensemble de liquéfaction comme unité de sous-refroidissement en dérivant le réfrigérant derrière le contenant de collecte (10), en réalisant l'expansion du réfrigérant dérivé, en effectuant l'échange de chaleur entre le réfrigérant expansé dérivé et le réfrigérant s'écoulant entre le contenant de collecte (10) et le dispositif d'expansion (16) dans un échangeur de chaleur (34), en compressant le réfrigérant chauffé dérivé par le compresseur supplémentaire (22) ;
 en condensant le réfrigérant compressé dans le condensateur supplémentaire (24) et en faisant écouler le réfrigérant condensé vers le contenant de collecte (10) et en mesurant la quantité de réfrigérant dans le contenant de collecte (10) par une unité de mesure de niveau de remplissage de réfrigérant (12).

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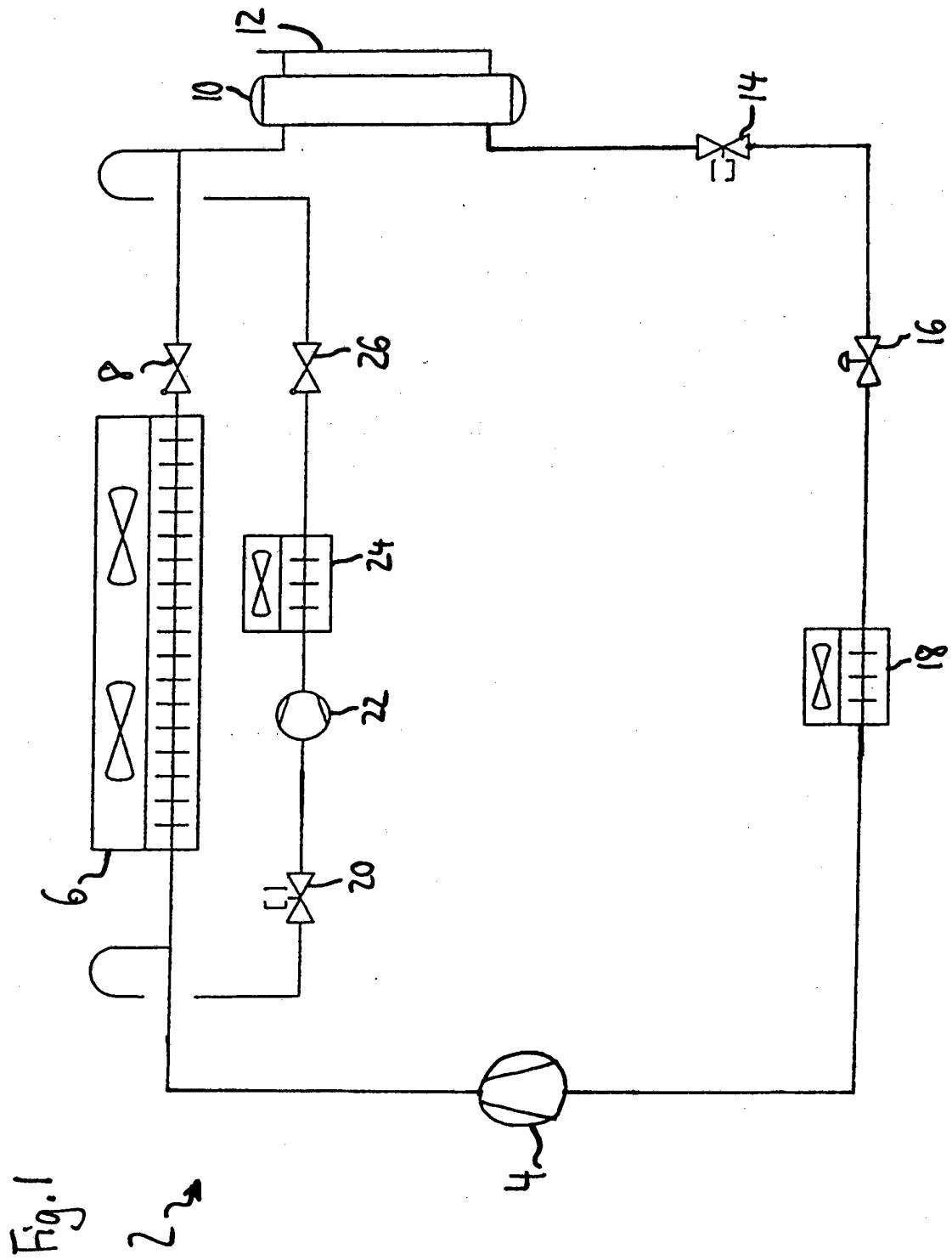
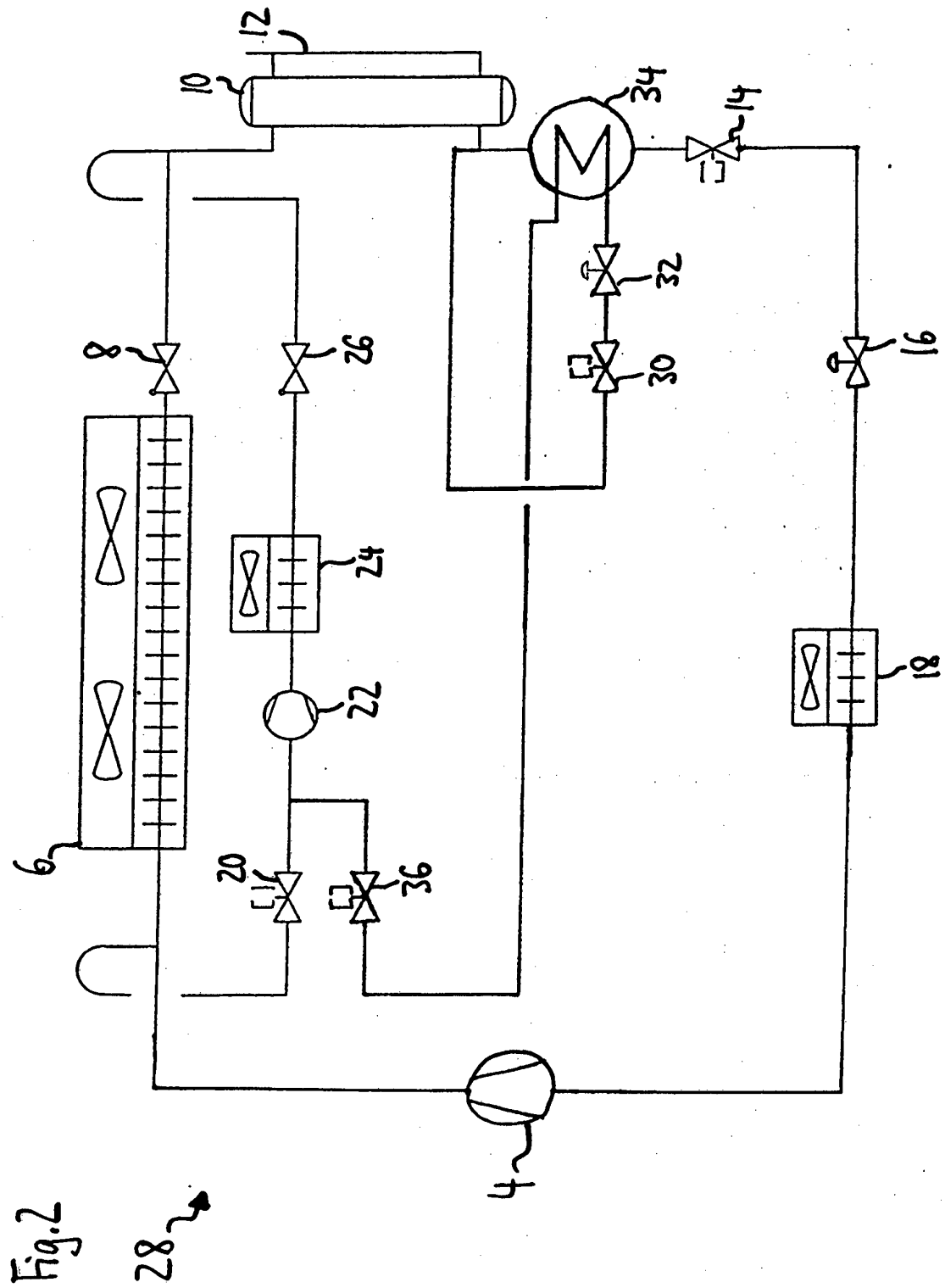
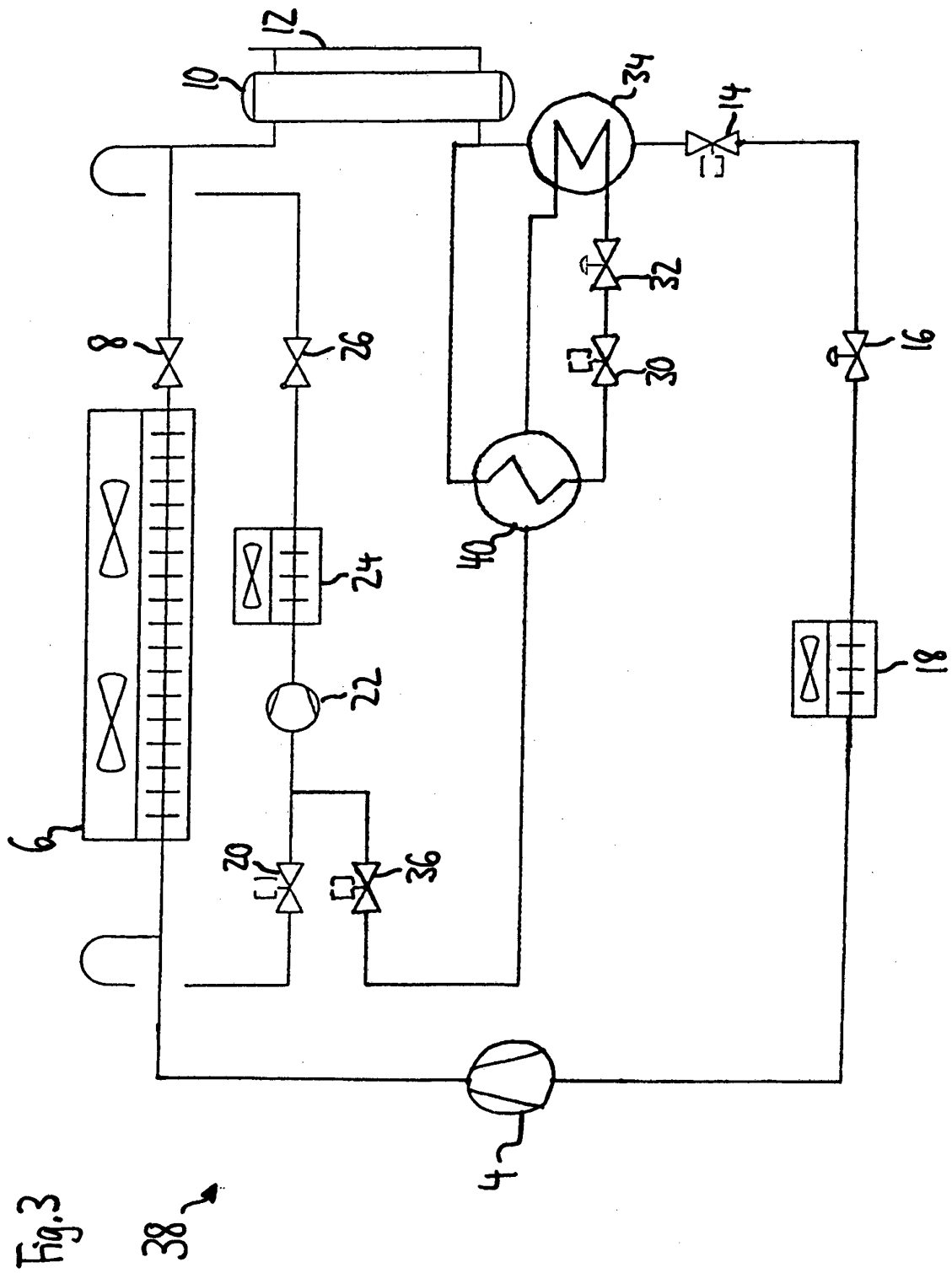


Fig. 1
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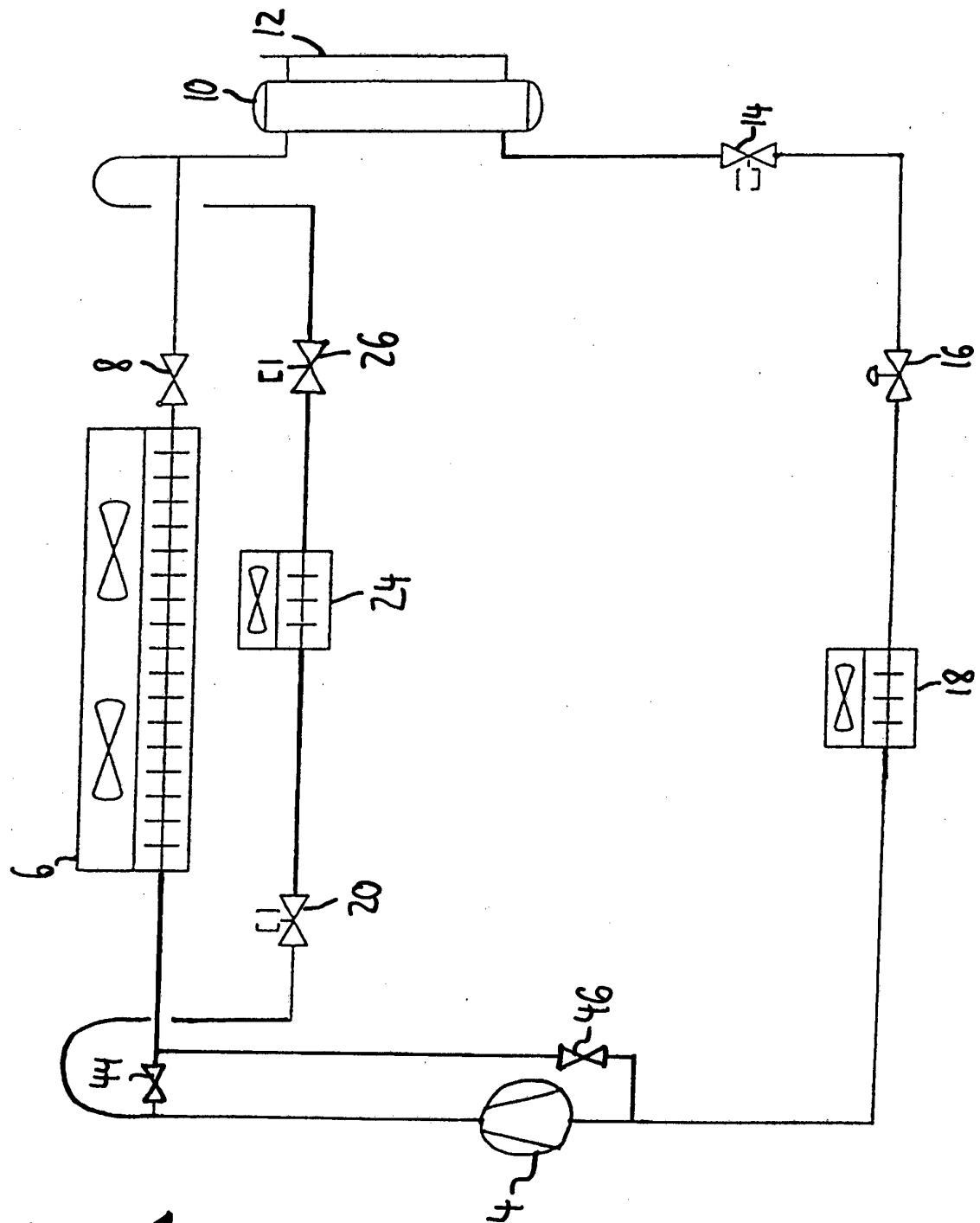


Fig. 4
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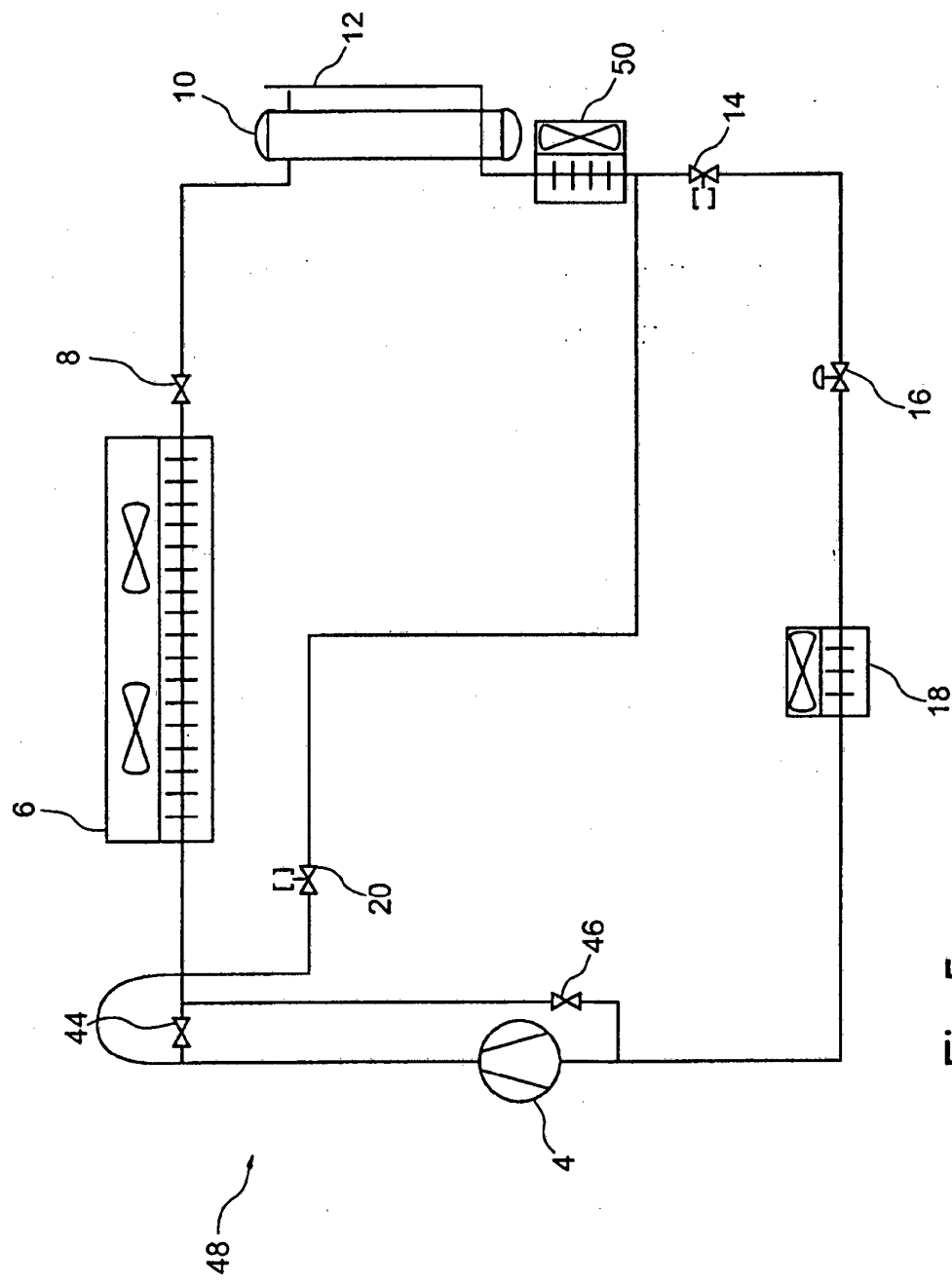


Fig.5

REFERENCES CITED IN THE DESCRIPTION

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