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(54) Title: REFRIGERATION SYSTEM

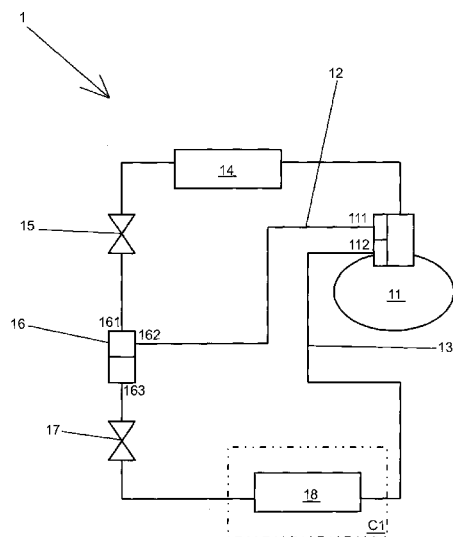


FIG. 1

(57) Abstract: The present invention refers to a refrigeration system that is based on the mechanical compression of refrigerant fluids, wherein the concept of fractionated evaporation of refrigerant fluids is combined with the concept of a double-suction compressor. For this, the refrigeration system fundamentally integrates at least one compressor (11, 21, 31) with at least two suction inlets (111, 112, 211, 212, 311, 312), and it further includes at least two independent suction lines (12, 13, 22, 23, 32, 33), wherein said independent suction line (12, 22, 32) transports a first portion of the refrigerant fluid, after a first expansion cycle, to the suction inlet (111, 211, 311) of the compressor (11, 21, 31), and the independent suction line (13, 23, 33) transports a second portion of the refrigerant fluid to the suction inlet (112, 212, 312) of the compressor (11, 21, 31). This division in portions of refrigerant fluid is achieved by at least one gas/liquid separating element (16, 26, 36), which comprises at least one fluid inlet, at least one outlet for gaseous fluids and at least one outlet for liquid fluids.



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"REFRIGERATION SYSTEM"

Field of the Invention

The present invention refers to a refrigeration system based on mechanical compression of refrigerant fluids. In special, the present invention refers to a refrigeration system based on mechanical compression and fractionated evaporation of the refrigerant fluids.

Background of the invention

As already known by the skilled in the art, refrigeration systems which are especially installed in refrigerators (or similar equipments) are entirely based on the mechanical compression of refrigerant fluids. In this context, refrigerant fluids can be defined as chemical compounds that are capable of transferring energy in a refrigeration cycle.

With reference to the functional concept of refrigeration systems, it shall be explained that refrigeration systems based on mechanical compression of refrigerant fluids provide at least one compression step, at least one condensation step, at least one expansion step, and at least one evaporation step. Thus, passing through such steps, the refrigerant fluid has its pressure and temperature modified so as to refrigerate at least one chamber or equivalent.

According to the traditional concepts (therefore, part of the prior art), a single refrigeration system can be specially sized to refrigerate two or more chambers, each of them with a different temperature. Examples of such refrigeration systems can be observed in refrigerators that comprises the integration of a refrigeration chamber with a freezing chamber. The majority of such systems operates at the lowest temperature (freezing chamber temperature) for cost reasons; however, said systems present a huge loss of energetic performance, since the evaporation pressure (which, among other aspects, defines the temperature to be reached by the refrigeration system) is oversized, resulting in a high electrical consumption (due to the operation of the compressor).

The prior art further reveals refrigeration systems (also specially sized systems to refrigerate two or more chambers) comprising the integration of duplicate components (two compressors, two condensers, two expansion mechanisms, and two evaporators) which are arranged in independent refrigeration loops. In these cases, each refrigeration loop is directed to a unique chamber, to which it is dedicated, solving, therefore, the problems related to the previously-mentioned loss of energetic performance. However, such refrigeration systems obviously present duplicate costs.

It is also already known by the skilled in the art the existence of refrigeration systems (also specially sized to refrigerate two or more chambers) comprising a single compressor, a single condenser, at least two expansion elements, and at least two evaporators. In these cases, each assemblage of evaporator/expansion element is

functionally associated with one of the chambers to be refrigerated. As each of such assemblages operates due to a single compressor, it is necessary to utilize a "directional expansion valve" (with two positions and three ways) to interconnect each assemblage of evaporator/expansion element with the compressor/condenser. Even comprising an "intermediate" refrigeration system – in comparison with the previously disclosed systems –, it is noted that the compressor is inclined to be specially sized for a single evaporator/expansion element assemblage, rendering a considerable loss of energetic performance (or inefficiency of refrigeration). Moreover, the instantly analyzed refrigeration system further presents loss of energy associated with the process of altering the evaporators, wherein such loss is related to the internal volume of the evaporators and suction pipelines (when the suction is altered between the evaporators, the compressor operates during a period of time with a refrigerant fluid presenting a "wrong" pressure). This problem further impedes that such refrigeration system utilizes different refrigerant fluids.

Document BR0802382 presents another configuration for the refrigeration system which is sized to refrigerate two or more independent chambers. Such refrigeration system is composed of a single compressor, a single condenser, at least two expansion elements and at least two evaporators. In this case, each assemblage of evaporator/expansion element is functionally associated with one of the chambers to be refrigerated. Differently from the above-mentioned technique, the configuration that is detailed in document BR0802382 provides a direct connection (without any type of directional valve) between each assemblage of evaporator/expansion element and a single compressor/condenser. However, the cited document reveals the use of a "directional suction valve" (with two positions and three ways) to interconnect the outlet of each assemblage of evaporator/expansion element to the suction pipeline of the compressor, defining, therefore, a modulated suction. Although said configuration solves a great part of the problems related to the previously cited refrigeration system (with a "directional expansion valve"), it is noted that the same is only functional when the "directional suction valve" is commutated in low speeds, otherwise, the temperature at one of the chambers may present equalization problems.

Part of the problems related to the refrigeration system that is described in document BR0802382 can be solved by the utilization of the compressor disclosed in document BR1001359.

Such compressor refers to a double-suction compressor, which is composed of two "suction valves" that are capable of being remotely and automatically controlled. Thus, one of said valves can be actuated (considering the suction of a refrigerant fluid with a certain pressure) while the other valve is deactivated. In this context, the commutation of valves can be activated by the temperature sensors that are placed in the chambers to be refrigerated.

Even if the problems related to the operation with a refrigerant fluid having a "wrong"

pressure and a high speed for the commutation of different suction lines are solved, the compressor disclosed in document BR1001359 is capable of being only installed in refrigeration systems with at least two independent chambers (each chamber being refrigerated by an assemblage of evaporator/expansion element).

5 With basis on the above-revealed context, it remains evident the need of the development of a refrigeration system being capable of improving the concept of double-suction compressor, even for refrigerators (or similar equipments) composed of at least one refrigerated chamber, said chamber being a freezing chamber or a simple refrigeration chamber.

10 Objectives of the Invention

Thus, one of the objectives of the present invention is the provision of a refrigeration system (based on a double-suction compressor) which is capable of being specially sized to refrigerate at least one refrigerated chamber.

15 It is also one of the objectives of the present invention the provision of a refrigeration system (based on a double-suction compressor) which is capable of utilizing a fractionated evaporation cycle.

Another objective of the present invention is the provision of refrigeration systems (based on a double-suction compressor) which include means of recirculating the lube oil of the compressor.

20 Summary of the Invention

These and other objectives of the instantly revealed invention are totally achieved by means of the presently revealed refrigeration system that is based on mechanical compression of refrigerant fluids.

25 According to the objectives and concepts of the present invention, the refrigeration system fundamentally integrates at least one compressor with at least two suction inlets, and it further includes at least two independent suction lines. One of the independent suction lines transports a first portion of the refrigerant fluid, after a first expansion cycle, to the suction inlet of the compressor, while the other independent suction line transports a second portion of the refrigerant fluid to the other suction inlet of the compressor.

30 The system further integrates at least one gas/liquid separating element with at least one fluid inlet and at least one outlet for gaseous fluids.

Preferably, the cited gas/liquid separating element further comprises at least one outlet for liquid fluids. Optionally, said gas/liquid separating element may further include a heat exchanger that is hydraulically isolated from the fluid inlet and outlet for gaseous fluids.

35 According to the preferable configuration of the present invention, one of the independent suction lines transports the second portion of the refrigerant fluid, after a second expansion cycle and a first evaporation cycle, to one of the suction inlets of the compressor.

In this preferable configuration, the gas/liquid separating element has the fluid inlet connected to the outlet of the first expansion element, the outlet for gaseous fluids connected to one of the suction inlets of the compressor through one of the independent suction lines, and the outlet for liquid fluids connected to the inlet of the second expansion element.

5 According to a first optional configuration of the present invention, one of the independent suction lines transports the second portion of the refrigerant fluid, after a second expansion cycle and a second evaporation cycle, to one of the suction inlets of the compressor. In this first optional configuration, the gas/liquid separating element has the fluid inlet connected to the outlet of the first evaporator, the outlet for gaseous fluids connected to
10 one of the suction inlets of the compressor through one of the independent suction lines, and the outlet for liquid fluids connected to the inlet of the second expansion element.

According to a second optional configuration of the present invention, one of the independent suction lines transports the second portion of the refrigerant fluid, after a first expansion cycle and a first evaporation cycle, to one of the suction inlets of the compressor.
15 In this second optional configuration, the gas/liquid separating element has the fluid inlet connected to the outlet of the evaporator, the outlet for gaseous fluids connected to the suction inlet of the compressor through the independent suction line, and the heat exchanger arranged in the interior of the cited gas/liquid separating element. The cited heat exchanger connects one of the pipelines derived from the evaporator to the second expansion element.

20 According to the fundamental concepts of the present invention, the instantly described refrigeration system may comprise at least two refrigeration cycles in series, or it may further comprise at least two refrigeration cycles in parallel.

Short Description of the Drawings

25 The present invention will be meticulously exemplified with basis on the figures described below.

Figure 1 illustrates a block diagram of a first configuration of the instantly defined refrigeration system;

Figure 2 illustrates a block diagram of a second configuration of the instantly defined refrigeration system; and

30 Figure 3 illustrates a block diagram of a third configuration of the instantly defined refrigeration system.

Detailed Description of the Invention

35 According to the concepts and objectives of the present invention, it is provided configurations of a refrigeration system that is capable of integrating the concepts of mechanical compression and fractionated evaporation of refrigerant fluids with the concepts of a double-suction compressor (similar to the double-suction compressor defined in document BR0802382).

Figure 1 illustrates the preferable configuration of the present invention. This preferable configuration presents a refrigeration system that is suitable for climatization (refrigeration or freezing) of a single chamber.

Consequently, this preferable configuration reveals a system 1 that is fundamentally composed of a compressor 11, a condenser 14, a first expansion element 15, a gas/liquid separating element 16, a second expansion element 17, and an evaporator 18.

As previously mentioned, the compressor 11 is a double-suction compressor, in other words, a compressor with two suction inlets 111 and 112, which are independent one from the other. Since there are two suction inlets 111 and 112, it is considered two independent suction lines 12 and 13.

Within this context, it shall be mentioned that the condenser 14, the expansion elements 15 and 17, the gas/liquid separating element 16 and the evaporator 18 comprise elements that have already been disclosed in the prior art documents, in other words, elements that are already known by the skilled in the art.

More specifically, said gas/liquid separating element 16 comprises a body with a fluid inlet 161, one outlet for gaseous fluids 162, and one outlet for liquid fluids 163. The functioning is simple: the fluid of inlet enters the cited gas/liquid separating element 16 (through the fluid inlet 161), and, due to the difference of specific mass, the fluid is separated, wherein the gaseous portion flows towards the outlet for gaseous fluids 162 and the liquid portion flows towards the outlet for liquid fluids 163.

In any case, the components that compose system 1 are associated one with the other so as to form a closed loop.

In this closed loop, the discharge outlet of the compressor 11 is connected to the inlet of the condenser 14.

On the other hand, the outlet of the condenser 14 is connected to the inlet of the first expansion element 15, wherein the outlet of the first expansion element 15 is connected to the fluid inlet 161 of the gas/liquid separating element 16.

The outlet for gaseous fluids 162 of the cited gas/liquid separating element 16 is directly connected to the suction inlet 111 of the compressor 11 through the independent suction line 12. On the other hand, the outlet for liquid fluids 163 of the same gas/liquid separating element 16 is connected to the inlet of the second expansion element 17.

On the other hand, the second expansion element 17 has its outlet connected to the inlet of the evaporator 18, which is connected to the suction inlet 112 of the compressor 11 through the independent suction line 13. It shall be further informed that the cited evaporator 18 is preferably arranged in the interior of a climatized chamber C1.

The above-mentioned closed loop enables the flow of only a portion of the refrigerant fluid (liquid portion) towards the evaporator 18. The gaseous portion of the cited

refrigerant fluid flows towards the compressor 11. Thus, it shall be specified that the gaseous and liquid portions of the refrigerant fluid are defined in accordance with the specifications of the first expansion element 15, which is predefined (together with the second expansion element 17) in accordance with the refrigeration range to be reached by the evaporator.

5 Therefore, this closed loop allows that the concept of fractionated evaporation (wherein not the entire refrigerant fluid flows towards the evaporator) is perfectly suitable for a double-suction compressor.

As an advantage of this configuration, it is noted a reduction of energy consumption by the compressor (which can operate with a portion of pre-pressurized fluid). Moreover, it is possible to guarantee that the eventual volume of the compressor crankcase oil (which is eventually compressed and mixed with the refrigerant fluid) flows towards the evaporator, through the gas/liquid separating element, and, consequently, always reintroduced into a single suction inlet of the compressor, which can be equalized with the internal volume of the compressor crankcase, enabling, thus, that this eventual volume of oil always return to its original reservoir.

Figure 2 illustrates an optional configuration of the present invention. This optional configuration presents a refrigeration system that is particularly suitable for the climatization (refrigeration or freezing) of two climatized chambers (of different temperatures) that are thermally isolated one from the other.

20 Thus, this optional configuration reveals a system 2 that is fundamentally composed of a compressor 21, a condenser 24, a first expansion element 25, a gas/liquid separating element 26, a second expansion element 27, a first evaporator 28, and a second evaporator 28'.

Thus, similar to the preferable configuration, the compressor 21 is a double-suction compressor, in other words, a compressor with two suction inlets 211 and 212, which are independent one from the other. Since there are two suction inlets 211 and 212, it is also considered two independent suction lines 22 and 23.

Within this context, it shall be mentioned that (similar to the preferable configuration) the condenser 24, the expansion elements 25 and 27, the gas/liquid separating element 26, and the evaporators 28 and 28' comprise elements that have already been disclosed in the prior art documents, in other words, elements that are already known by the skilled in the art.

In any case, the components that compose system 2 are associated one with the other so as to form a closed loop.

35 In this closed loop, the discharge outlet of the compressor 21 is connected to the inlet of the condenser 24.

On the other hand, the outlet of the condenser 24 is connected to the inlet of the first expansion element 25, wherein the outlet of the cited first expansion element 25 is

connected to the inlet of the first evaporator 28.

The outlet of the first evaporator 28 is directly connected to the fluid inlet 261 of the gas/liquid separating element 26. In this context, it is further noted that the outlet for gaseous fluids 262 of the gas/liquid separating element 26 is connected to the suction inlet 211 of the compressor 21 through the independent suction line 22, and the outlet for liquid fluids 263 of the gas/liquid separating element 26 is connected to the inlet of the second expansion element 27.

On the other hand, the second expansion element 27 has its outlet connected to the inlet of the second evaporator 28', which is connected to the suction inlet 212 of the compressor 21 through the independent suction line 23. It is further noted that, preferably, the first evaporator 28 is arranged in the interior of a climatized chamber C2, and the second evaporator 28' is arranged in the interior of another climatized chamber C3.

The above-mentioned closed loop allows the entire refrigerant fluid being firstly "applied" to the first evaporator 28, in which occurs a first heat exchange. The refrigerant fluid, in the conditions after such first heat exchange, is subjected to the gas/liquid separating element 26. Then, only a portion of the refrigerant fluid (liquid portion) flows towards the second evaporator 28'.

The gaseous portion of the cited refrigerant fluid (which is not capable of effectuating a second heat exchange in an efficient manner) flows towards the compressor 21. Thus, it shall be specified that the gaseous and liquid portions of the refrigerant fluid are defined in accordance with the specifications of the first expansion element 25 and first evaporator 28, according to the refrigeration range to be reached in such evaporator. Therefore, this closed loop allows that the concept of fractionated evaporation (wherein not the entire refrigerant fluid is subjected to a second expansion and evaporation step) is perfectly suitable for a double-suction compressor.

As the expansion elements 25 and 27 are fundamentally associated in series, and since this configuration provides two climatized chambers C2 and C3, it can be affirmed that system 2 defines two refrigeration cycles in series.

As an advantage of this configuration, it is noted a reduction of energy consumption by the compressor (which can operate with a portion of pre-pressurized fluid). Moreover, it is possible to further guarantee that the eventual volume of the compressor crankcase oil (which is eventually compressed and mixed with the refrigerant fluid) flows towards the evaporator 28' (through the gas/liquid separating element), and, consequently, always reintroduced into a single suction inlet of the compressor, which can be equalized with the internal volume of the compressor crankcase, enabling, thus, that this eventual volume of oil always return to its original reservoir.

Figure 3 illustrates a second optional configuration of the present invention. This

optional configuration presents a refrigeration system that is particularly suitable for the climatization (refrigeration or freezing) of two climatized chambers (of different temperatures) that are thermally isolated one from the other.

Thus, this optional configuration reveals a system 3 that is fundamentally composed of a compressor 31, a condenser 34, a first expansion element 35, a gas/liquid separating element 36, a second expansion element 37, a first evaporator 38, and a second evaporator FF (preferably, a fresh food evaporator).

Thus, similar to the previously disclosed configurations, the compressor 31 is a double-suction compressor, in other words, a compressor with two suction inlets 311 and 312, which are independent one from the other. Since there are two suction inlets 311 and 312, it is also considered two independent suction lines 32 and 33.

Within this context, it shall be mentioned that (similar to the previously disclosed configurations) the condenser 34, the expansion elements 35 and 37, the gas/liquid separating element 36, and the evaporators 38 and FF comprise elements that have already been disclosed in the prior art documents, in other words, elements that are already known by the skilled in the art.

In any case, the components that compose system 3 are associated one with the other so as to form a closed loop.

In this closed loop, the discharge outlet of the compressor 31 is connected to the inlet of the condenser 34, and the outlet of the condenser 34 is bifurcated, being directly connected to the evaporator FF and to the first expansion element 35, defining parallel routes for distribution. It shall be emphasized that such two connections are independent one from the other, and preferably egalitarian.

In this configuration, the gas/liquid separating element 36 and the cited evaporator FF are physically located in the interior of a climatized chamber C5, which preferably comprises a fresh food chamber. Thus, a portion of the refrigerant fluid, that derives from the condenser 34 outlet, flows towards the gas/liquid separating element 36 (through its fluid inlet 361), and a portion of the refrigerant fluid, that derives from the condenser 34 outlet, flows towards the expansion element 35.

The portion of the refrigerant fluid that flows towards the first expansion element 35 is subjected to a first expansion, flows towards the evaporator FF (thus, refrigerating the climatized chamber C5) and, then, flows towards the gas/liquid separating element 36, wherein the gaseous portion of such portion of refrigerant fluid is automatically directed to the outlet for gaseous fluids 362, and, consequently, to the suction inlet 311 of the compressor 31 through the independent suction line 32. The liquid portion of that same portion of refrigerant fluid is stored (by gravity) in the "bottom" of the cited gas/liquid separating element 36.

The cited gas/liquid separating element 36 further comprises a heat exchanger 363 placed in its interior. Such heat exchanger, preferably a coil-type heat exchanger, is hydraulically isolated from the fluid inlet 361 and outlet for gaseous fluids 362 of the gas/liquid separating element 36.

5 The heat exchanger 363, since it is placed inside the gas/liquid separating element 36 and, consequently, in the interior of the climatized chamber C5, has two distinct functions: the evaporation by "heating" – without any contact – of the liquid portion of the refrigerant fluid that is stored in the "bottom" of the gas/liquid separating element 36, and the pre-cooling of the portion of the refrigerant fluid that, without any contact with the refrigerant fluid that
10 cools the climatized chamber C5, flows towards the second expansion element 37.

The evaporation by "heating" of the liquid portion of the refrigerant fluid, that is stored in the "bottom" of the gas/liquid separating element 36, enables the conversion of such liquid portion into vapor, which is subsequently directed to the outlet for gaseous fluids 362, and, consequently, to the suction inlet 311 of the compressor 31 through the
15 independent suction line 32.

The portion of the refrigerant fluid that passes through the heat exchanger 363 is pre-cooled and flows towards the second expansion element 37, which has its outlet connected to the inlet of the evaporator 38 that is connected to the suction inlet 312 of the compressor 31 through the independent suction line 33. It shall be mentioned that the cited
20 evaporator 38 is preferably arranged in the interior of a climatized chamber C6.

As the expansion elements 35 and 37 are fundamentally associated in parallel, and since this configuration provides two climatized chambers C5 and C6, it can be affirmed that system 3 defines two refrigeration cycles in parallel.

As an advantage of this configuration, it is noted a reduction of energy consumption
25 by the compressor (which can operate with a portion of pre-pressurized fluid). Moreover, it is possible to further guarantee that the eventual volume of the compressor crankcase oil (which is eventually compressed and mixed with the refrigerant fluid) flows towards the evaporator, through the gas/liquid separating element, and, consequently, always reintroduced into a single suction inlet of the compressor, which can be equalized with the
30 internal volume of the compressor crankcase, enabling, thus, that this eventual volume of oil always return to its original reservoir.

As the configuration examples of the present invention have already been described, it shall be understood that the scope of the same includes other possible variations, which are limited by the content of the claims, therein included the equivalent
35 means.

SET OF CLAIMS

1. A refrigeration system comprising a system (1, 2, 3) composed of at least one compressor (11, 21, 31) which is integrated with at least two suction inlets (111, 112, 211, 212, 311, 312), and including at least two independent suction lines (12, 13, 22, 23, 32, 33),

5 CHARACTERIZED in that:

said independent suction line (12, 22, 32) transports a first portion of the of the refrigerant fluid, after a first expansion cycle, to the suction inlet (111, 211, 311) of the compressor (11, 21, 31);

10 said independent suction line (13, 23, 33) transports a second portion of the refrigerant fluid to the suction inlet (112, 212, 312) of the compressor (11, 21, 31); and

the system (1, 2, 3) comprises at least one gas/liquid separating element (16, 26, 36) comprising at least one fluid inlet (161, 261, 361) and at least one outlet for gaseous fluids (162, 262, 362).

2. The refrigeration system of Claim 1, CHARACTERIZED in that said gas/liquid
15 separating element (16, 26) further comprises at least one outlet for liquid fluids (163, 263).

3. The refrigeration system of Claim 1, CHARACTERIZED in that said gas/liquid separating element (36) further comprises a heat exchanger (363) that is hydraulically isolated from the fluid inlet (361) and outlet for gaseous fluids (362).

4. The refrigeration system of Claim 1, CHARACTERIZED in that said independent
20 suction line (13) transports the second portion of the refrigerant fluid, after a second expansion cycle and a first evaporation cycle, to the suction inlet (112) of the compressor.

5. The refrigeration system of Claim 1, CHARACTERIZED in that said independent suction line (23) transports the second portion of the refrigerant fluid, after a second expansion cycle and a second evaporation cycle, to the suction inlet (212) of the
25 compressor.

6. The refrigeration system of Claim 1, CHARACTERIZED in that said independent suction line (33) transports the second portion of the refrigerant fluid, after a first expansion cycle and a first evaporation cycle, to the suction inlet (312) of the compressor.

7. The refrigeration system of Claim 1 or 2, CHARACTERIZED in that said gas/liquid
30 separating element (16) provides:

the fluid inlet (161) connected to the outlet of the first expansion element (15);

the outlet for gaseous fluids (162) connected to the suction inlet (111) of the compressor (11) by a independent suction line (12); and

35 the outlet for liquid fluids (163) connected to the inlet of the second expansion element (17).

8. The refrigeration system of Claim 1 or 2, CHARACTERIZED in that said gas/liquid separating element (26) provides:

the fluid inlet (261) connected to the outlet of the first evaporator (28);

the outlet for gaseous fluids (262) connected to the suction inlet (211) of the compressor (21) by a independent suction line (22); and

5 the outlet for liquid fluids (263) connected to the inlet of the second expansion element (27).

9. The refrigeration system of Claim 1 or 3, CHARACTERIZED in that said gas/liquid separating element (36) provides:

the fluid inlet (361) connected to the outlet of the evaporator (FF);

10 the outlet for gaseous fluids (362) connected to the suction inlet (311) of the compressor (31) by an independent suction line (32);

the heat exchanger (363) arranged in the interior of the cited gas/liquid separating element (36); and

the heat exchanger (363) connected to one of the pipelines derived from the evaporator (34) of the second expansion element (37).

15 10. The refrigeration system of any of Claims 1 to 9, CHARACTERIZED in that it defines at least two refrigeration cycles in series.

11. The refrigeration system of any of Claims 1 to 9, CHARACTERIZED in that it defines at least two refrigeration cycles in parallel.

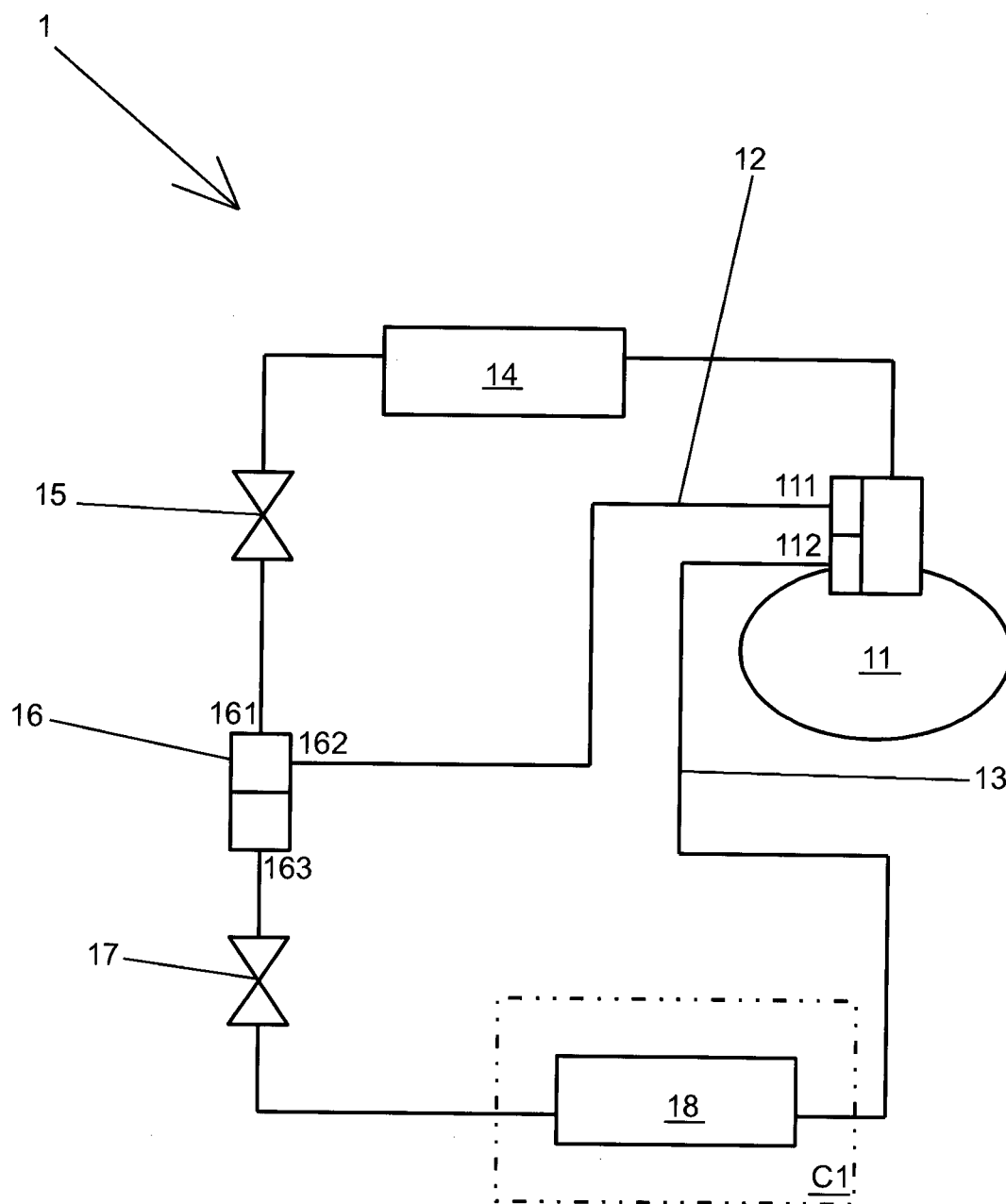


FIG. 1

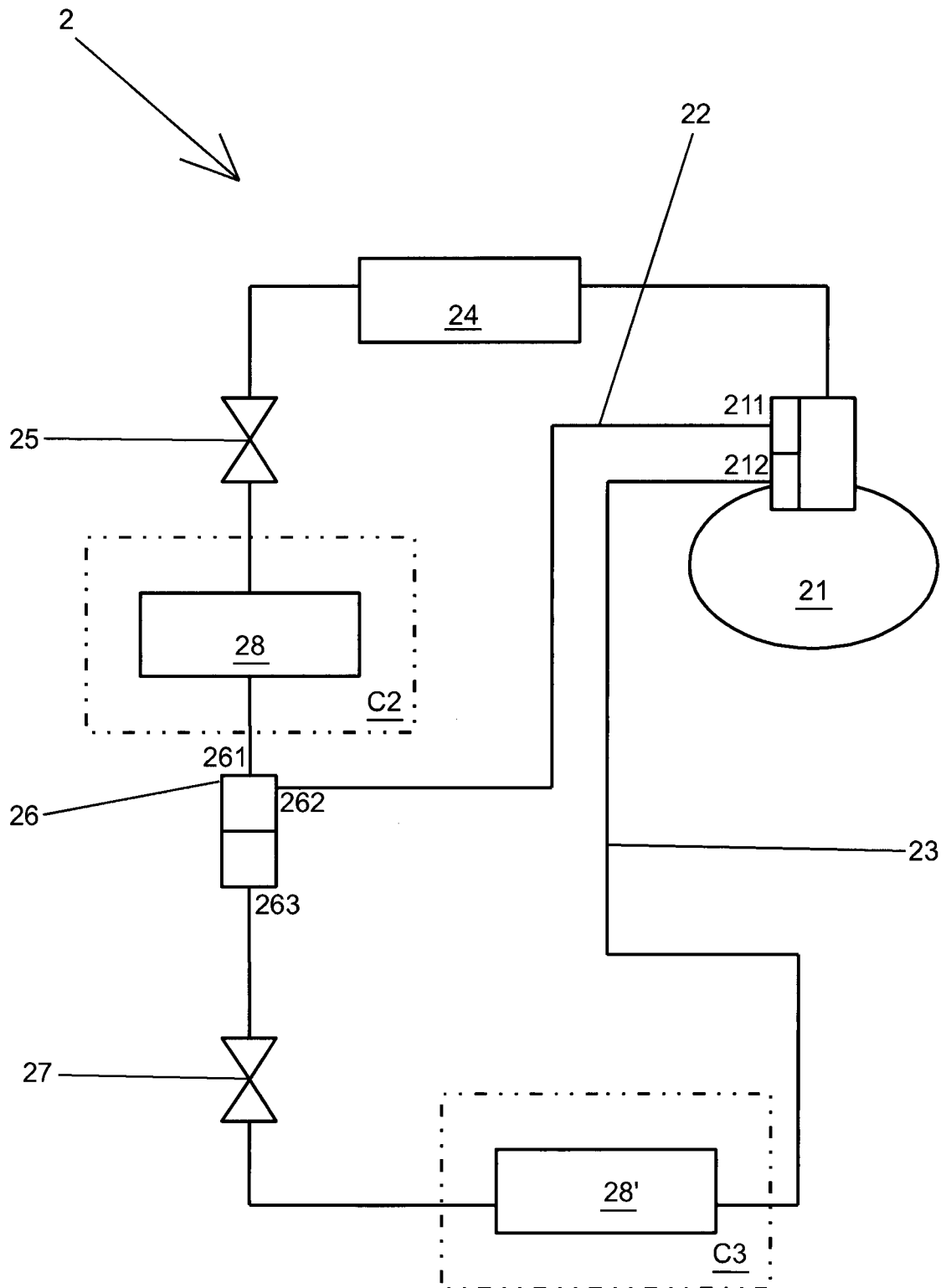


FIG. 2

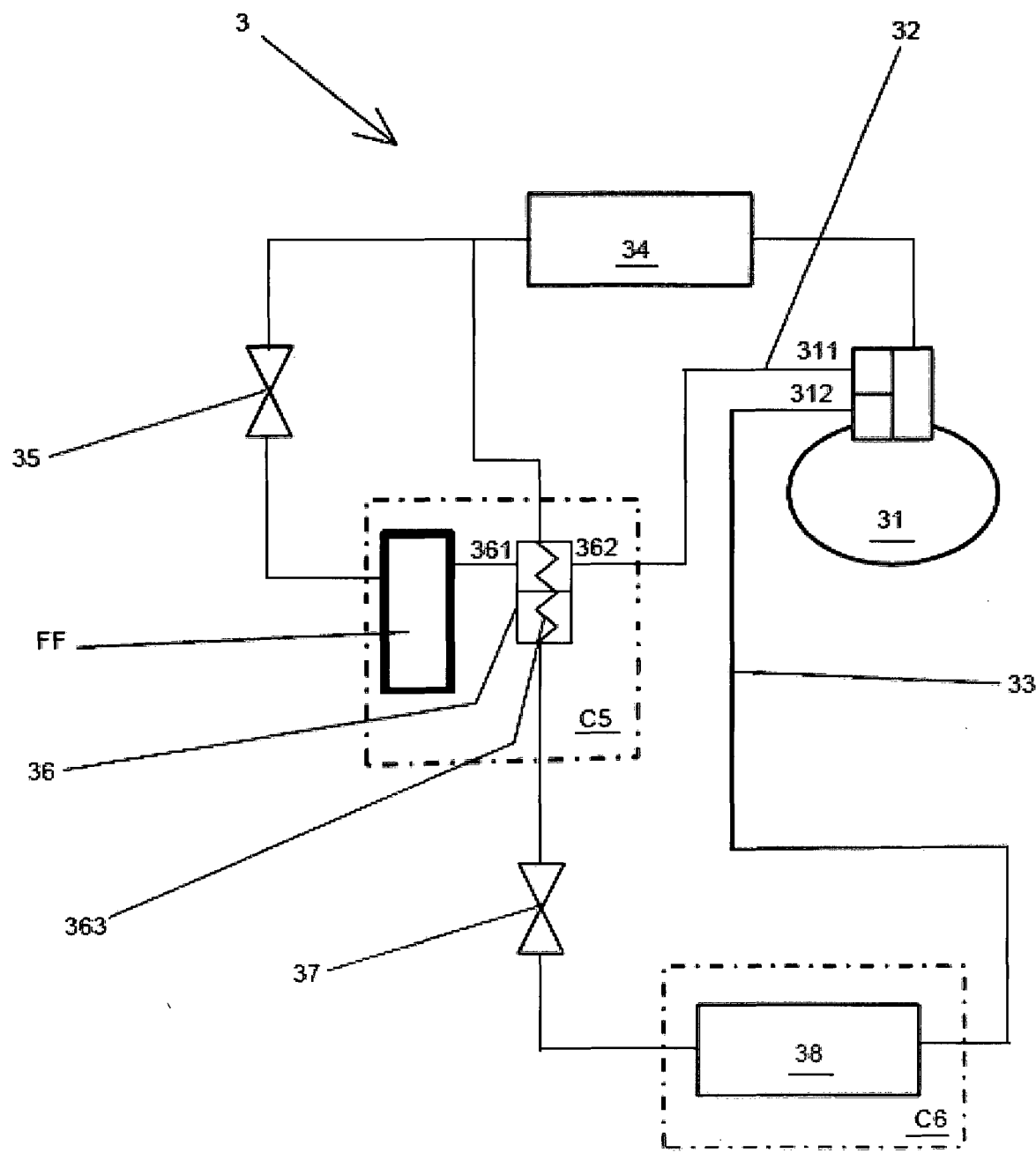


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No

PCT/BR2012/000412

A. CLASSIFICATION OF SUBJECT MATTER
 INV. F25B5/02
 ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 F25B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 924 478 A2 (CARRIER CORP [US]) 23 June 1999 (1999-06-23) paragraph [0012] - paragraph [0023]; figures 1-4	1,10,11
X	EP 2 325 577 A2 (LG ELECTRONICS INC [KR]) 25 May 2011 (2011-05-25) paragraph [0025] - paragraph [0120]; figures 1-11	1,2,7, 10,11
X	US 2003/131618 A1 (DOI TAKASHI [JP] ET AL) 17 July 2003 (2003-07-17) paragraph [0042] - paragraph [0098]; figures 1-9	1,2,7,8, 10,11
X	US 5 220 806 A (JASTER HEINZ [US] ET AL) 22 June 1993 (1993-06-22) page 3, line 52 - page 7, line 49; figures 1-6	1,2,7,8, 10,11



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search

11 March 2013

Date of mailing of the international search report

18/04/2013

Name and mailing address of the ISA/

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Authorized officer

Szilagyi, Barnabas

INTERNATIONAL SEARCH REPORT

International application No.
PCT/BR2012/000412

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☒ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

1, 2, 7, 8, 10, 11
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/BR2012/000412

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0924478	A2	23-06-1999	NONE
EP 2325577	A2	25-05-2011	CN 102062497 A 18-05-2011 EP 2325577 A2 25-05-2011 KR 20110054818 A 25-05-2011 US 2011113808 A1 19-05-2011
US 2003131618	A1	17-07-2003	CN 1432771 A 30-07-2003 JP 2003207248 A 25-07-2003 US 2003131618 A1 17-07-2003
US 5220806	A	22-06-1993	NONE

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1, 2, 7, 10, 11

Refrigeration system wherein the gas/liquid separating element further comprises at least one outlet for liquid fluids.

2. claims: 1, 3, 10, 11

Refrigeration system wherein the gas/liquid separating element further comprises a heat exchanger that is hydraulically isolated from the fluid inlet and outlet for gaseous fluids.

3. claims: 1, 4, 10, 11

Refrigeration system wherein said independent suction line transports the second portion of the refrigerant fluid, after a second expansion cycle and a first evaporation cycle, to the suction inlet of the compressor.

4. claims: 1, 5, 10, 11

Refrigeration system wherein said independent suction line transports the second portion of the refrigerant fluid after a second expansion cycle and a second evaporation cycle, to the suction inlet of the compressor.

5. claims: 1, 6, 10, 11

Refrigeration system wherein said independent suction line transports the second portion of the refrigerant fluid after a first expansion cycle and a first evaporation cycle, to the suction inlet of the compressor.

6. claims: 1, 2, 8, 10, 11

Refrigeration system wherein said gas/liquid separating element provides: the fluid inlet connected to the outlet of the first evaporator; the outlet for gaseous fluids connected to the suction inlet of the compressor by a independent suction line; and the outlet for liquid fluids connected to the inlet of the second expansion element.

7. claims: 1, 2, 9-11

Refrigeration system of wherein said gas/liquid separating

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

element provides: the fluid inlet connected to the outlet of the evaporator; the outlet for gaseous fluids connected to the suction inlet of the compressor by an independent suction line; the heat exchanger arranged in the interior of the cited gas/liquid separating element; and the heat exchanger connected to one of the pipelines derived from the evaporator of the second expansion element.

8. claims: 1, 2, 10

Refrigeration system there are connected at least two refrigeration cycles in series.

9. claims: 1, 2, 11

Refrigeration system there are connected at least two refrigeration cycles in parallel.
