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(54) **REFRIGERATION SYSTEM INCLUDING EVAPORATORS ASSOCIATED IN PARALLEL**

(57) The present invention belongs to the technological field of refrigeration systems and, more particularly refrigeration systems used in residential applications, for example, refrigeration appliances comprising at least two climate chambers at different temperatures. Conventionally, existing Refrigeration systems including evaporators connected in parallel require complex compressors comprising at least two suction paths, or alternatively functional complex arrangements unable to maintain in-

dependence between the individual evaporators. Disclosed is a refrigeration system including evaporators (51,52) connected in parallel where each of said evaporators operates through a separate feeding principle, and that this aspect makes it possible, with the aid of a liquid accumulator (6) and phase separator, maintaining the independence between the individual evaporators, besides the use of a compressor (1).

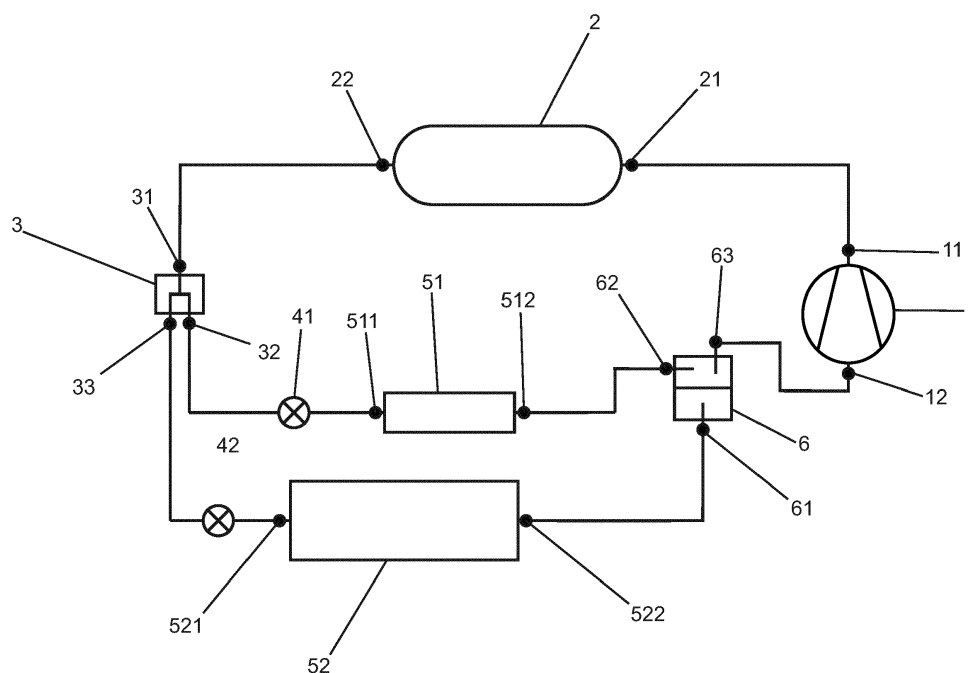


FIG. 3

Description

Field of the Invention

[0001] The invention relates to a refrigeration system including at least two evaporators connected in parallel, and more particularly, two evaporators even associated in series, has its outflows tied to the input path of an accumulator device liquids, which comprises one outflow capable of being fluidly connected to the suction path of a compressor.

Background of the Invention

[0002] As is known to the skilled technicians in the subject, the current state of the art comprises a plurality of arrangements and constructions of refrigeration systems and, in particular, refrigeration systems including at least two evaporators. Of course, this refrigeration system category - with at least two evaporators - is due to the fact that the vast majority of refrigeration appliances, the conventional refrigerator comprises at least two refrigerated compartments operating in different temperature ranges such as, for example, refrigerators comprise a freezing chamber and a cooling chamber.

[0003] Given this premise, it is highlighted that the refrigeration systems which at least two evaporators operate at different pressure ranges and temperature, which are connected in parallel.

[0004] According to the current state of the art, this type of arrangement (two evaporators operating at different pressure and temperature ranges, associated in parallel) can be achieved through the use of a single compressor.

[0005] The US2123497 and US3108453 documents illustrate rudimentary buildings of refrigeration systems that use a single compressor including at least two evaporators connected in parallel capable of operating in different pressure and temperature ranges.

[0006] Also in accordance with the current state of the art, this type of arrangement (two evaporators operating at different pressure and temperature ranges, associated in parallel) can be achieved through the use of a single compressor, provided that there are means for selecting only one of the two (or multiple) evaporators and means for connecting the outflow of the two (or multiples) evaporators through the single suction of said compressor.

[0007] In this scenario, there is the EP1087186 document, which describes and illustrates a dual evaporator refrigeration system as schematically illustrated in figure 2, comprises two evaporators operating at different temperature and pressure ranges associated in parallel. Therefore, it is pre-seen a low temperature evaporator (cooling chamber evaporator), and a very low temperature evaporator (freezing chamber evaporator). The selection of one among these two evaporators is usually performed by means of valve arranged between the outlet of the condenser and input pathways for each of the

expansion devices evaporators. As the compressor has only one suction means, the outflows of the two evaporators are connected together and to the suction path of the compressor.

[0008] However, it remains to emphasize that the outflow of the low evaporation temperature evaporator (freezer) further comprises, in a previous section for connection to the outflow of the average evaporation temperature of the evaporator (cooler), a device liquid accumulator associated in series with a one-way check valve. The series of the two components prevents the refrigerant fluid flows from the average evaporation temperature of the evaporator (higher pressure) to the evaporator very low lower evaporation temperature (smaller pressure).

[0009] While this refrigeration system is, in theory, efficient, it is noted that the same has a drawback related to the operation period in which part of the refrigerant fluid is pumped from the evaporation low temperature evaporator (freezer) to the evaporator average evaporation temperature (refrigerator), after all, all of said refrigerant tends to migrate from the average evaporation temperature of the evaporator to the evaporator low evaporation temperature during operation of the system. At the most, there is even any failure of unidirectional check valve result in compromising total system efficiency.

[0010] Based on this scenario that arises the invention in question.

Objectives of the invention

[0011] It is therefore the primary objective of the subject invention disclose a refrigeration system comprising at least two evaporators connected in parallel wherein said evaporators operate essentially independent manner, i.e. without the normal or atypical conditions of operation an evaporator influence the operation of another evaporator.

[0012] Additionally, one of the goals of the subject invention that the cooling system including at least two evaporators associated parallel disclosed herein is especially dedicated to the use of fluid compressor capable of operating without the use of internal lubricants as is the case, for example, certain types of compressors.

Summary of the Invention

[0013] The aforementioned aims are fully achieved by a refrigeration system including at least two associated evaporators in parallel wherein said evaporators connected in parallel operate in different pressure and temperature ranges; said refrigeration system comprising at least two evaporators connected in parallel, further comprising: at least one compressor, at least one condenser, at least one switch device, at least a first expansion device, at least a second expansion device, and at least one liquid accumulator; the outflow of the compressor being fluidly connected to the inlet path from the condenser; the condenser outflow being fluidly connected to

the switching device via inlet; the outflow of commutation device being fluidly connected to the first expansion device; the outflow via the switching device is fluidly connected to the second expansion device; said liquid accumulator comprising at least one via lower inlet immersed in the liquid, at least one upper inlet path, and at least one upper outflow; said refrigeration system comprising at least two evaporators connected in parallel with special and preferentially characterized in that it further comprises: at least one dry expansion evaporator acting as a high pressure evaporator and a low temperature and being fed by the first expansion device ; at least one evaporates pain flooded acting as low-pressure evaporator and very low temperature and being fed by the second expansion device; and the outlet of the cites of the dry expansion evaporator being fluidly connected via the upper inlet of the liquid accumulator; the outflow of that flooded evaporators being fluidly connected to a lower input path of the liquid accumulator; and the upper outflow of the liquid accumulator being fluidly connected to the suction path of the compressor.

[0014] In a preferred embodiment of the invention, said liquid accumulator is preferably at a higher gravitational potential relative to the flooded evaporator so as to define a siphon effect between said liquid accumulator and said flooded evaporator.

[0015] Preferably the moving parts of the compressor compression mechanism does not use oil - that is, preferably operating without lubrication liquids.

[0016] Optionally the moving parts of the compressor compression mechanism may cooperate with oil and at least one oil separator.

[0017] Also according to a preferred embodiment and an alternative, said liquid accumulator may comprise at least one additional special compartment evaporator of a refrigeration system.

Brief Description of the Drawings

[0018] The invention in question happens to be detailed in detail based on the figures listed below, including:

Figure 1 illustrates a refrigeration system including at least two evaporators connected in parallel belonging to the current state of the art;

Figure 2 illustrates another refrigeration system comprising at least two evaporators connected in parallel belonging to the current state of the art; and

Figure 3 illustrates the refrigeration system including at least two evaporators connected in parallel according to the present invention.

Detailed Description of the Invention

[0019] Preliminarily, it should be clarified that, according to specialized literature, the evaporators can be classified according to their form of "power", that is, the evaporators

can be defined as dry expansion evaporators, flooded evaporators or liquid over-feeding evaporators.

[0020] The dry expansion evaporators are often "fed" by fluid previously turbulent refrigerant (liquid and vapor), and in its outflow, all the refrigerant is in the form of superheated steam. Flooded evaporators usually are "fed" by only the refrigerant in liquid form, it being at its output, all the refrigerant is in the form of dry saturated vapor fluid.

[0021] Such arrangements are important for the fact that the refrigeration system including at least two evaporators associated in parallel now revealed is specially shaped to provide for a dry expansion evaporator associated in parallel with a flooded evaporator, and the "feeding" of an evaporator does not influence the "power" of the other evaporator.

[0022] As illustrated in Figure 3, the refrigeration system including at least two evaporators associated in parallel, according to the present invention is primarily composed of a compressor 1, a condenser 2, a switching device 3 a first expansion device 41, one second expansion device 42, a dry expansion evaporator 51, a evaporates pain flooded 52 and a liquid accumulator 6.

[0023] The compressor 1 is a compressor fundamentally conventional comprising a single outflow 11 and a single suction path 12.

[0024] The condenser 2 it is essentially a capacitor conventional comprising an inlet path 21 and an outflow 22.

[0025] The switching device 3 is any device, comprising an inlet path 31 and at least two outflows 32 and 33, is able to switch the fluid communication of its inlet path 31 with only one of the at least two outflows 32 or 33. Preferably said switching device 3 it is fundamentally a conventionally three-way valve for two positions.

[0026] Both the first expansion device 41 as the second expansion device 42 these are traditional expansion devices, and preferentially, conventional capillary tubes widely known to those skilled in the technical subject.

[0027] The dry expansion evaporator 51, which is used as evaporator of a cooling chamber (not shown), or used as high pressure and low temperature evaporator, it is a traditional dry expansion evaporator fundamentally comprising an inlet path 511 and an outflow 512.

[0028] The flooded evaporator 52, which is used as an evaporator of a freezing chamber (not shown), this is, used as low pressure and very low temperature evaporator, it is flooded evaporator conventional, comprising an inlet path 521 and outflow 522.

[0029] The liquid accumulator 6, in turn, also is a liquid accumulator conventionally used in refrigeration systems, and comprises an airtight casing provided with at least one inlet through the bottom 61, by least one upper inlet path 62 and at least one superior outflow 63.

[0030] In accordance with the subject invention, the outflow 11 to the compressor 1, is fluidly connected to the inlet path 21 to the condenser 2. The outflow 22 of the condenser 2 is fluidly connected to the inlet 31 of the switching device 3.

[0031] The outflow 32 of the switching device 3 is fluidly connected to the first expansion device 41, which is connected to the inlet path 511 to the dry expansion evaporator 51. The outflow 512 of said dry expansion evaporator 51 is fluidly connected to the upper inlet path 62 of the liquid accumulator 6.

[0032] The outflow 33 of the switching device 3 is fluidly connected to the second expansion device 42, which is connected to the input 521 via the flooded evaporator 52. The outflow 522 of the aforementioned flooded evaporator 52 is fluidly connected to a bottom inlet path 61 of the liquid accumulator 6.

[0033] The upper outflow 63 of liquid accumulator 6, in turn, is fluidly connected to the suction path 12 of the compressor 1.

[0034] It is worth mentioning that the fluid connections between the elements of the system as described above, are performed by traditional metal pipes means.

[0035] Based on the above detailed arrangement, it is verified that the liquid accumulator 6 ultimately perform two simultaneous functions, including: i) means of connection between the outflows 512 and 522 of evaporators 51 and 52 with the suction path 12 of the compressor 1; and ii) means of insulation between the evaporation line of the dry expansion evaporator 51 and the evaporation line of the flooded evaporator 52.

[0036] Once the liquid accumulator 6 acts as a link between the evaporators 51 and 52 and the compressor 1, it is clear that the invention in question facilitates the assembly of the system as a whole (see Figure 2).

[0037] Once the liquid tank 6 acts as a medium of isolation between rows of evaporation, it can be said that it is the major responsible for maintaining the independence between the evaporation lines and, in particular, maintaining the 52 always flooded evaporator flooded condition, even being the same not operating (depending on the operation of dry expansion evaporator 51).

[0038] Thus, when the dry expansion evaporator 51 is operating (according to a certain position of the switching device 3), that is, when only the dry expansion evaporator 51 is being fed, the compressor 1 tends to suck only steam superheated derived from said dry expansion evaporator 51, and the flooded evaporator 52 is still flooded with coolant in which the liquid in the tank should be at its lowest level and the lower inlet always flooded.

[0039] When the flooded evaporator 52 is operating (also due to a certain position of the switching device 3), that is, when only the flooded evaporator 52 is being fed, compressor 1 tends to suck, at first, both superheated steam arising from said dry expansion evaporator 51 as dry saturated steam coming from the flooded evaporator 52, and, in a second time, only dry saturated steam coming from the flooded evaporator 52, and the refrigerant contained in dry expansion evaporator 51 is completely drained and deposited in the accumulator at its maximum while maintaining the outflow to the compressor always with overheated steam.

[0040] That said, and that the above detailed operation

proves extremely advantageous, it is important to note that the liquid accumulator 6 has to be in a greater gravitational potential relative to the flooded evaporator 52, after all, the greatest potential gravitational ends to define a siphon effect between said liquid accumulator 6 and the aforementioned flooded evaporator 52, preventing refrigerant liquid to change position when not suctioned.

[0041] However, it remains to show that the refrigeration system including at least two evaporators connected in parallel herein disclosed is also totally capable of operating independently of the greater gravitational potential of the liquid accumulator 6 in relation to the flooded evaporator 52, after all, pressure difference between the evaporators 51 and 52, depending on the dynamics of established refrigeration, i.e., the pressure of said dry expansion evaporator 51 being greater than the pressure of the flooded evaporator 52 (depending on specific dimensioning of the expansion devices 41 and 42, of course) is sufficient to maintain the refrigerant in liquid phase only liquid in the lower region of the accumulator 6, and consequently throughout the flooded evaporator 52.

[0042] In more, remains to show that, preferentially, but not limiting, the compressor 1 is about a compressor mainly conventionally capable to operate free of lubricants. Finally, it remains to show that figure 3, and certain nomenclatures above used, are intended to illustrate the preferred embodiment of the invention in question, cannot be interpreted as limiting embodiment, after all, the scope of the invention in question must be considered as wide as the interpretation of the claims, further including the possible equivalent means.

Claims

1. Refrigeration system including at least two evaporators associated in parallel, where:

said evaporators connected in parallel operate in different pressure and temperature ranges; said refrigeration system comprising at least two evaporators connected in parallel further comprising:

at least one compressor (1), at least a condenser (2), at least a switching device (3) at least a first expansion device (41), at least a second expansion device (42), and at least one fluid accumulator (6); the outflow of the compressor being fluidly connected to the inlet path from the condenser; the condenser outflow being fluidly connected to the switching device inlet path; the switching device outflow being fluidly connected to the first expansion device; the switching device outflow is fluidly connected to the second expansion device;

said liquid accumulator (6) comprising at least one lower inlet path (61) immersed in the liquid, at least one upper inlet path (62), and at least one upper outflow (63);
 said refrigeration system comprising at least two evaporators connected in parallel being particularly **characterized in that** further comprises:

at least one dry expansion evaporator (51) acting as high pressure evaporator and low temperature and being fed by the first expansion device (41);
 at least a flooded evaporator (52) acting as a low pressure evaporator and very low temperature and being fed by the second expansion device (42); and
 the outflow (512) of said dry expansion evaporator (51) being fluidly connected to the upper inlet path (62) of the liquid accumulator (6);
 the outflow (522) of said flooded evaporator (52) being fluidly connected to a lower inlet path (61) of the liquid accumulator (6); and
 the upper outflow (63) of the liquid accumulator (6) being fluidly connected to the compressor suction path (1).

2. Refrigeration system including at least two evaporators associated in parallel, as claimed in claim 1, **characterized in that** the fluid accumulator (6) is at a higher potential gravitational in relation to the flooded evaporator (52), so as to define a siphon effect between said liquid accumulator (6) and said flooded evaporator (52).
3. Refrigeration system including at least two evaporators associated in parallel, as claimed in claim 1, **characterized by** the fact that the moving parts of the compression mechanism of compressor operate without lubrication by liquid means.
4. Refrigeration system including at least two evaporators associated in parallel, as claimed in claim 1, **characterized by** the fact that the moving parts of the compressor compression mechanism cooperate with oil and at least one oil separator.
5. Refrigeration system including at least two evaporators connected in parallel, as claimed in claim 1, **characterized by** the fact that said fluid accumulator (6) comprises at least one additional evaporator of a special compartment of the refrigeration system.

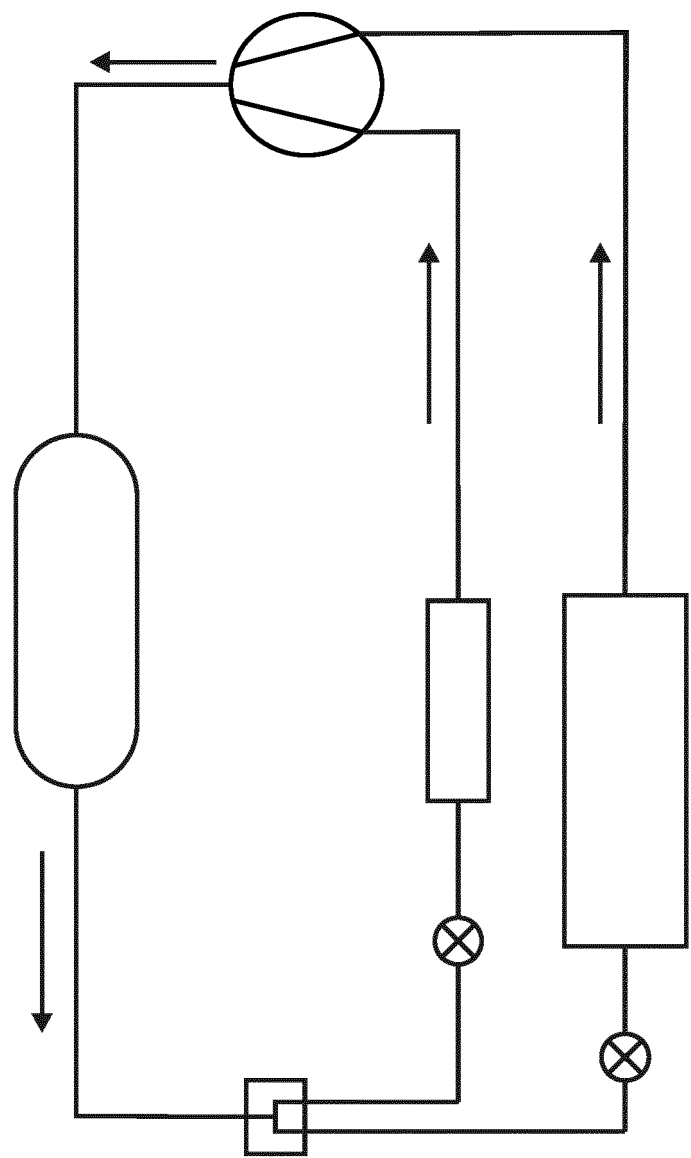


FIG. 1

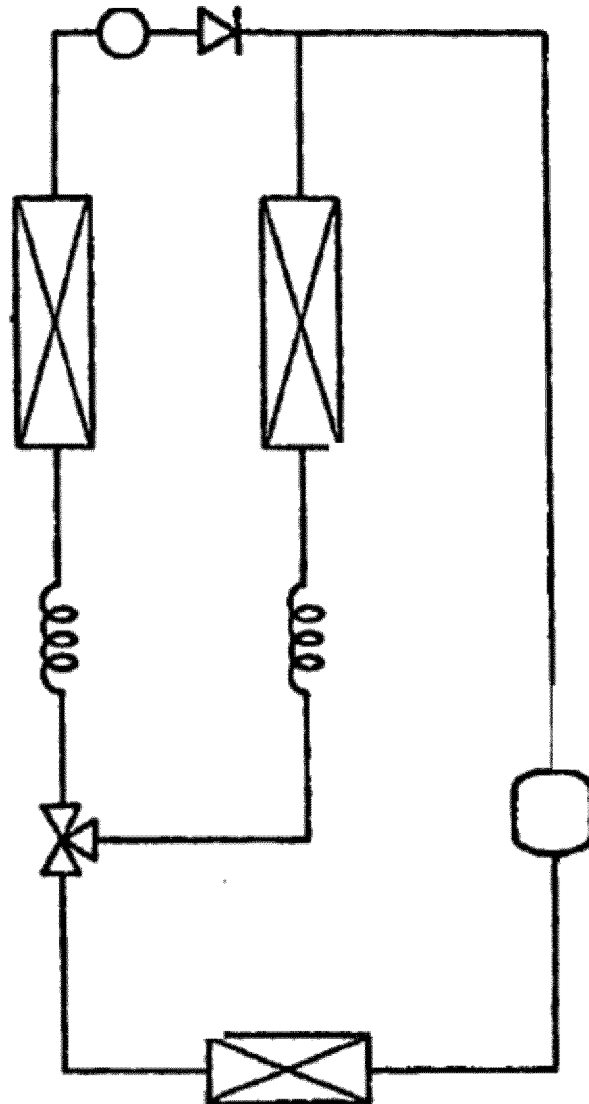


FIG. 2

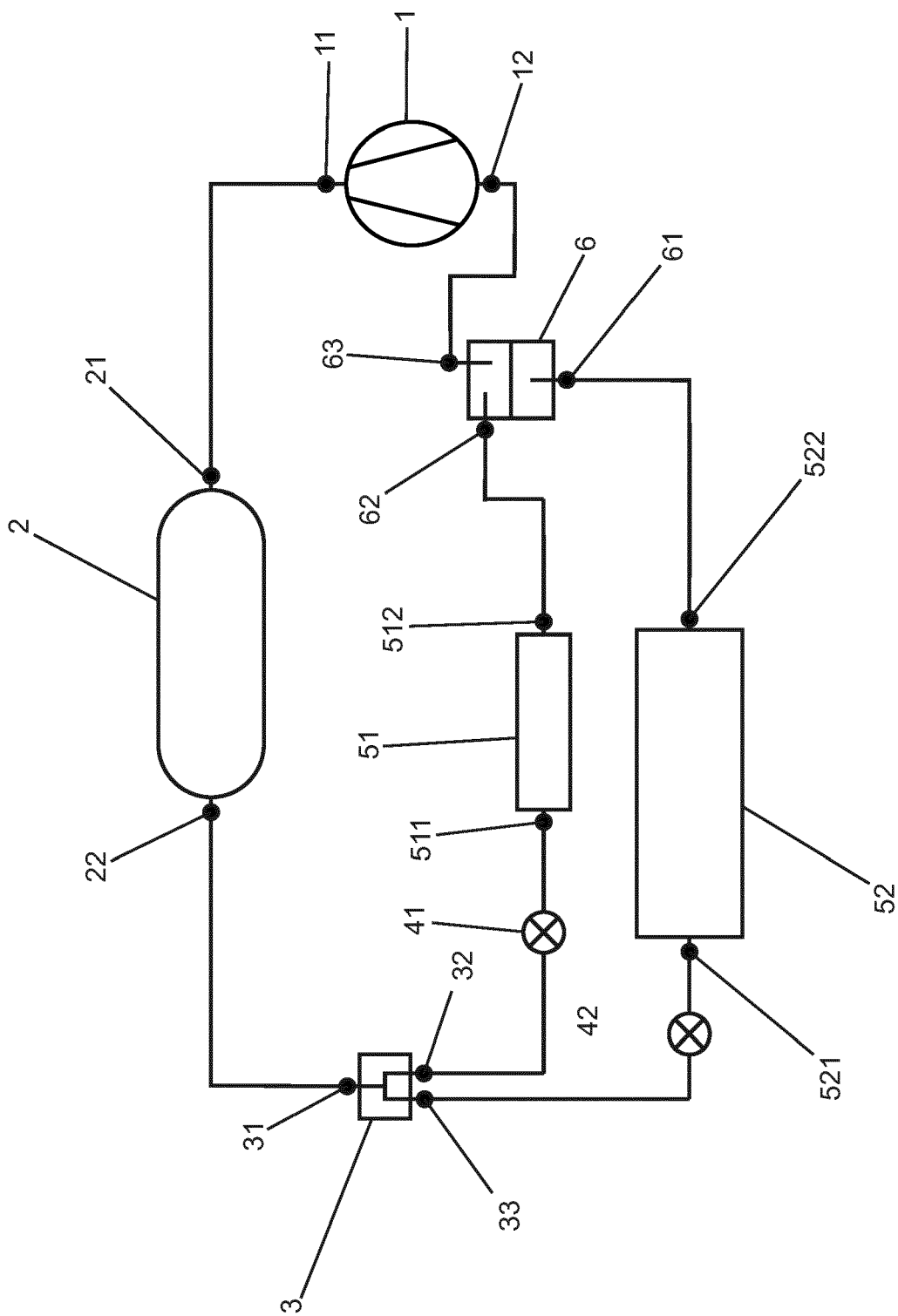


FIG. 3



EUROPEAN SEARCH REPORT

Application Number
EP 16 17 9277

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 667 699 C (SULZER AG) 18 November 1938 (1938-11-18) * page 2, column 3, line 45 - line 51; figure 1/3 *	1-5	INV. F25B5/02 F25B31/00
X	EP 2 105 686 A2 (SANYO ELECTRIC CO [JP]) 30 September 2009 (2009-09-30) * column 25, line 7, paragraph 0117; figures 13,18 * * column 33, line 9, paragraph 0141 - line 10; figure 18 *	1,3-5	
A	JP 2006 125769 A (DENSO CORP) 18 May 2006 (2006-05-18) * the whole document *	1-5	
			TECHNICAL FIELDS SEARCHED (IPC)
			F25B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 13 December 2016	Examiner Weisser, Meinrad
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 16 17 9277

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 667699 C	18-11-1938	NONE	

EP 2105686 A2	30-09-2009	EP 2105686 A2	30-09-2009
		KR 20090102709 A	30-09-2009
		US 2009241577 A1	01-10-2009

JP 2006125769 A	18-05-2006	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 2123497 A [0005]
- US 3108453 A [0005]
- EP 1087186 A [0007]