



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
09.11.2022 Bulletin 2022/45

(51) International Patent Classification (IPC):
F25B 19/00 ^(2006.01) **F25D 3/10** ^(2006.01)

(21) Application number: **22172081.6**

(52) Cooperative Patent Classification (CPC):
F25B 19/005; F25D 3/10

(22) Date of filing: **06.05.2022**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(30) Priority: **07.05.2021 IT 202100011702**

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(54) **REFRIGERATION PLANT USING A CRYOGENIC FLUID AS COLD SOURCE**

(57) Refrigeration system of an isothermal box (6) with at least one isothermal compartment (7) comprising at least one tank (1) placed externally or internally to the box (6), containing cryogenic fluid in equilibrium with its gas phase, connected, via piping (3) capable of withstanding high pressures and low temperatures, to at least one evaporator (2) placed inside said box (6), capable of releasing frigories (quantity of thermal energy subtracted from the atmosphere and absorbed by the cryogenic fluid during the change of state) in said at least one compartment (7) thanks to the liquid - gas phase transition of the cryogenic fluid;
a vent pipe (14) for emitting the exhausted refrigerant gas outside the isothermal box (6);

a plurality of fans (8) located adjacent to said at least one evaporator (2) for uniformly distributing cooled air in said at least one compartment (7);
wherein a regulation valve (11) placed downstream of said at least one evaporator (2) and upstream of said vent pipe (14) is provided, controlled by a control logic, for regulating a constant flow of refrigerant fluid through the at least one evaporator and automatic solenoid shut-off valves (4) and (5) installed on said piping (3) connecting the at least one tank (1) to the at least one evaporator (2), said solenoid valves for delivering, respectively, the gas phase and the liquid phase of the cryogenic fluid stored in the at least one tank (1).

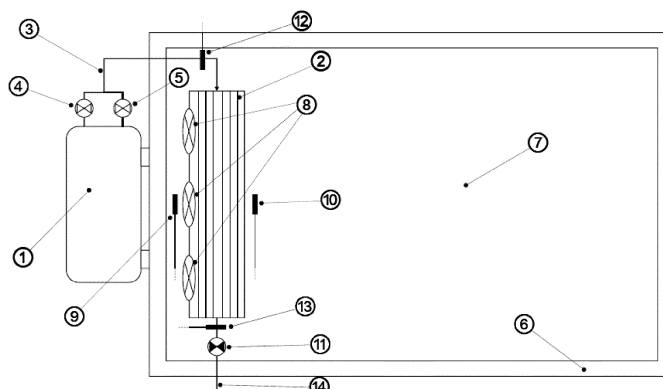


Figure 1

Description**FIELD OF THE INVENTION**

5 **[0001]** The present invention relates to a refrigeration system, in particular a mobile refrigeration system that uses a cryogenic fluid as cold source.

BACKGROUND OF THE INVENTION AND PRIOR ART

10 **[0002]** In the field of refrigerated transport, the need arises to reduce the ecological impact in terms of both emissions and noise pollution, continuously ensuring the cold chain.

[0003] These difficulties are even more marked for last-mile transport in city centres, which are increasingly difficult to access due to limitations in terms of environmental and noise pollution, vehicle mass and volume. In urban distribution, moreover, the ability to preserve the cold chain is more than ever put to the test due to the high number of deliveries - and therefore of openings of the refrigerated compartment - in a decidedly short space of time.

15 **[0004]** Perishable goods are transported by road using temperature-controlled vehicles, i.e. equipped with isothermal boxes fitted with refrigeration units.

[0005] The purpose of the isothermal box is to thermally insulate the inside environment from the outside environment. The refrigeration unit, on the other hand, has the capacity to release frigories and thus counteract the heat incoming from the walls of the isothermal box by effectively controlling the temperature.

20 **[0006]** Traditional refrigeration systems release frigories by working in a 'closed cycle'. In other words, they use a refrigerant fluid capable of changing state from liquid to gas, from gas to liquid and repeating the transformation in a cycle.

[0007] The change of state from liquid to gas takes place in an evaporator and involves a release of frigories by the fluid that causes cooling of the air circulating inside the isothermal box.

25 **[0008]** The change from gas to liquid, on the other hand, requires mechanical work, which is achieved by exploiting a compressor powered in turn by the combustion engine of the vehicle (this is always the case on small vehicles, while large vehicles may have a dedicated diesel engine). This compressor compresses the refrigerant gas, allowing it to liquefy in the downstream condenser and thus repeat the closed refrigeration cycle.

[0009] The disadvantages of the traditional configuration are numerous:

- 30
- They use refrigerant fluids that are generally harmful to the environment, flammable, explosive, toxic and expensive.
 - Increased vehicle emissions due to compressor functioning linked to the dedicated engine or to the vehicle.
 - Non-constant refrigerant capacity due to variable engine revs.
 - Noise pollution caused by functioning of the compressor.
 - 35 • Increased maintenance required and resulting downtime due to many moving parts.
 - Refrigeration not independent of the vehicle engine.
 - Insufficient temperature abatement rate for having the temperature immediately (understood as reasonable time for logistics) within the regulatory set points; therefore, it is often necessary to use electricity to operate the refrigeration units at night.

40 **[0010]** The use of cryogenic fluids can represent a solution to all the points listed above.

[0011] Current cryogenic solutions are strictly dedicated to stationary refrigeration and are therefore incompatible with mobile use on roads, or in any case completely unrelated to any type of vehicle, for which optimisation of the above parameters is required. Such systems (patent US2017/234583 A1 and US 2019/086145 A1) are in fact more similar to domestic or industrial coolers/refrigerators and in fact have control systems oriented exclusively towards measuring the temperature of the refrigeration compartment.

45 **[0012]** Current mobile cryogenic solutions, on the other hand, can inject the refrigerant directly into the isothermal box, causing however under-oxygenation and obvious safety problems.

[0013] Other solutions instead exploit a heat exchanger in which the cryogenic fluid circulates - thus avoiding its dispersion in the isothermal box (patent US 10634395) - the technology of which, however, has not been optimised. In fact, they still present several critical factors, also in terms of safety: a scale down has not been provided for use also on small vehicles in terms of weight and space occupied by the materials; moreover, a general functioning is described including also cryogenic fluids for which specific and indispensable precautions must however be implemented for the proper functioning of the system and the safety of the people and of the goods involved.

55 **[0014]** Refrigeration systems that can be mounted on vehicles are described in US 2019135159, US 2017234583, US 2019086145 and DE 10 2011014746. The systems described are not suitable for the use of carbon dioxide as a refrigerant gas and approval by transport regulatory authorities is difficult.

[0015] The present invention is therefore based on this latter type of solution to which it brings several system and

functional innovations in order to:

- improve the efficiency of the refrigeration system, reducing the consumption of cryogenic fluid and increasing autonomy;
- reduce the number of components, obtaining an overall lighter and less bulky system;
- achieve optimal temperature control, thus respecting the cold chain;
- increase the safety of the system in the event of high pressure or fluid leakage.

[0016] These and other objects are achieved by the plant according to the invention that has the features of the appended independent claim 1.

[0017] Advantageous embodiments of the invention are disclosed in the dependent claims.

SUMMARY

[0018] Substantially, the refrigeration system of an isothermal box having at least one isothermal compartment comprising:

at least one tank placed externally or internally to the box, containing cryogenic liquid in equilibrium with its gas phase, connected, by means of piping capable of withstanding high pressures and low temperatures, to at least one evaporator placed inside said box, capable of releasing frigories in said at least one compartment by means of the liquid - gas phase transition of the cryogenic fluid;

a vent pipe to emit the exhausted refrigerant gas outside the isothermal box;

a plurality of fans located adjacent to said at least one evaporator for uniformly distributing cooled air in said at least one compartment;

wherein a regulation valve is provided, placed downstream of said at least one evaporator and upstream of said vent pipe, controlled by a control logic, to regulate a constant flow of refrigerant fluid through the at least one evaporator, on the basis of inputs provided by:

- a temperature sensor, placed in output from the evaporator, air side;
- a pressure and temperature sensor, placed on the inlet of the evaporator, fluid side;
- a pressure and temperature sensor, placed at the outlet of the evaporator, fluid side,

so as to deliver a constant and specific flow of refrigerant fluid as all other parameters vary.

[0019] The refrigeration system thus includes

- one or more evaporators inside the isothermal box;
- one or more cryogenic tanks placed in front of, under or inside the isothermal box, filled with cryogenic fluid in the liquid state and connected to an evaporator by means of piping;
- a regulation valve placed downstream of the only/ of the last evaporator(s) to regulate the flow of fluid through the evaporator(s);
- fans mounted on the evaporator(s);
- a logic of control of the parameters that appropriately modulates the opening of the regulation valve and appropriately switches on a certain number of fans;
- a vent pipe to emit the exhausted refrigerant gas outside the isothermal box;
- automatic solenoid shut-off valves for delivering, respectively, the gas phase and the liquid phase of the cryogenic fluid stored in the cryogenic tank(s).

[0020] The system according to the invention has no motor or compressor. It has no moving parts with the exception of the blades of the fan.

[0021] Two temperature sensors inside the isothermal box control the temperature of the air in input and in output from the evaporator.

[0022] When the temperature measured by the sensor in input rises above the predetermined setpoint, the control system appropriately opens the regulation valve, which makes the refrigerant flow through the evaporator or the evaporators.

[0023] Actuation of the fans is modulated as a function of the DeltaT detected between the evaporator inlet and outlet, so that the quantity of air is commensurate with the availability of 'cold' and therefore maximum heat exchange efficiency is preserved and refrigerant fluid consumption is saved.

[0024] In other words, when the temperature difference between the air in input and air in output is below a certain set point, a single fan is actuated so that the temperature exchange involves a smaller quantity of air, which therefore has the possibility of cooling more. When the difference in T increases to exceed a second set point, the second fan is also active and so on.

[0025] Evaporators are heat exchangers with copper coils and aluminum fins for maximum heat transfer. They are equipped with fans so that the air movement provides an even temperature throughout the compartment.

[0026] The circulation fans and control system are powered by solar panels and/or a dedicated battery that recharges thanks to the vehicle's battery when in motion, enabling functioning thereof even when the vehicle is switched off. Thanks to the small number of components, electricity consumption is low, allowing significant autonomy even when the vehicle is switched off.

[0027] The system can be either mono-temperature (and therefore mono isothermal compartment) or multi-temperature (and therefore multi isothermal compartment). Each compartment contains a dedicated evaporator with respect to the volume to be refrigerated and to the refrigeration temperature. As a means of making the refrigeration system more efficient, the output of one compartment represents the supply for the next compartment.

[0028] In the case of a multi-temperature system, in order to obtain maximum energy efficiency, the refrigeration circuit of the various compartments is made in series, optimising the ventilation as a function of the temperature of the input fluid, so as to exploit any residual frigories thereof, in addition to the DeltaT of the output temperature already mentioned previously.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] A detailed description is provided here, taking as reference configurations of installations of the refrigeration system, which are not to be understood as the only ones possible, and therefore as limitations to the claims, but solely as representative bases.

[0030] For the description, carbon dioxide will be considered as a refrigerant fluid in that it requires additional precautions with respect to other cryogenic fluids. It will therefore be possible to fully describe all the functions of the technology in its most complex use, including in fact functioning in the case of fluids whose management is less articulated (such as nitrogen, argon, air, etc.).

[0031] In the drawings:

- Figure 1 is a view from above of a mono-temperature plant;
- Figure 2 is a side view of the mono-temperature plant of Figure 1;
- Figure 3 is a view from above of a multi-temperature plant;
- Figure 4 is a side view of the multi-temperature plant of Figure 3.

DETAILED DESCRIPTION OF THE INVENTION

[0032] Referring initially to the mono-temperature plant of Figs. 1 and 2, liquid carbon dioxide is stored in a tank 1, in equilibrium with its gas phase, at a pressure indicatively comprised between 10 - 16 bar.

[0033] Working at lower pressures is avoided in that, when 5.18 bar is reached, the carbon dioxide changes phase with the formation of dry ice, effectively making delivery impossible.

[0034] Collaterally, working at higher pressures is avoided in that the liquid-gas equilibrium involves one and only one temperature value per selected pressure value. Raising the pressure leads to an increase in fluid temperature, as shown in the table below. This would be counterproductive for the application purpose of the technology.

Pressure [bar]	5.18	8.01	10.05	15.26	19.69
Temperature [°C]	-56.6	-46	-40	-28	-20

[0035] In order to preserve the state of equilibrium of the fluid contained in the container, the cryogenic tank is thermally insulated from the outside thanks to a double wall with a vacuum cavity filled with insulating material.

[0036] The tank 1 is connected to the evaporator 2 via piping 3 capable of withstanding high pressures and low temperatures.

[0037] Two solenoid valves 4 and 5 are installed on this section, capable of

- delivering cryogenic fluid in the gaseous state when 4 is open;
- delivering cryogenic fluid in the liquid state when 5 is open;

- isolating the tank from the rest of the system when **4** and **5** are both closed.

[0038] At the first start-up of the system after a shutdown, it is in fact necessary to "pressurise the system" in order to reach the minimum delivery pressure (> 5.18 bar) and avoid the formation of dry ice in the case of delivery of liquid. Accordingly, valve **4** is preliminarily opened so as to deliver cryogenic fluid in the gaseous state and bring the pressure of the system to operating pressure.

[0039] At this point valve **4** closes and cryogenic fluid can be delivered in the liquid state by opening of the solenoid valve **5**.

[0040] During the phase of functioning, in which it is necessary to deliver cryogenic fluid in the liquid state to the system, valve **4** is always closed and valve **5** is always open.

[0041] When the system is switched off, however, in order to ensure maximum safety, the system is 'drained' and brought to ambient pressure. With the aim of preserving the contents of the tank and not 'drain' it, both valves **4** and **5** are closed during this process.

[0042] The heat exchange takes place in the evaporator **2**, placed inside the isothermal box **6** and capable of releasing frigories in the load compartment **7** thanks to the liquid - gas phase transition of the cryogenic fluid during which a large quantity of heat is absorbed from the surrounding environment.

[0043] The principle is that of providing a high surface area of heat exchange, obtained thanks to the structure of the evaporator **2** made up of a finned tube bundle, in which the passage of air is forced through the use of fans **8**. The fans are actuated consequentially according to the temperature difference recorded on the air side by the pair of temperature transmitters placed at the inlet **9** and outlet **10** of the evaporator **2**, respectively. In this way, the air flow is partialized according to the cooling that it undergoes when traversing evaporator **2**, thus guaranteeing maximum efficiency. If in fact the temperature difference on the air side is greater than a certain set point, other air will be forced through by turning on an additional fan so as to cool a larger quantity of air, and vice versa.

[0044] In fact, the aim is to maintain a certain temperature difference value on the air side constant so as to always exploit the maximum cooling capacity in relation to the quantity of recirculated air.

[0045] In output from the evaporator, the exhaust gas meets regulation valve **11**, which is the heart of the system. The valve, in fact, modulates its opening to manage the flow of refrigerant circulating through the entire system.

[0046] Its functioning, in terms of opening logic, is based on the reading of various inputs provided by:

- temperature transmitter **10**: placed in output from the evaporator, air side;
- pressure and temperature transmitter **12a** and **12b**: placed at the input of the evaporator, fluid side;
- pressure and temperature transmitter **13a** and **13b**: placed at the output of the evaporator, fluid side.

[0047] Pressure and temperature transmitters **12a** and **12b** measure the pressure and temperature of the fluid in the liquid state while pressure and temperature transmitters **13a** and **13b** measure the pressure and temperature in the gaseous state. The combination of these parameters translates into a specific percentage of opening of regulation valve **11**. This is due to the fact that the phase transition, which takes place in evaporator **2**, causes an expansion of the fluid with a consequent back-pressure effect for which it is necessary to modulate the opening of the valve according to the extent of the phenomenon.

[0048] The PLC of the system, which manages the control logic, (not shown) continuously processes the input data to return the correct opening of the regulation valve **11** on time.

[0049] In other words: the temperature transmitter **10** defines whether there is the need to cool or otherwise the air in the load compartment **7** by actuating or not actuating the regulation valve **11** and, when actuated, the pressure and temperature transmitters **12a** and **12b** provide information on the fluid input conditions in the system while the pressure and temperature transmitters **13a** and **13b** on the output conditions, which define the exact percentage of opening thereof.

[0050] The result is a regulation valve **11** with the capacity to deliver a constant and specific flow of refrigerant fluid as all other parameters vary.

[0051] The exhausted gas at this point is conveyed externally and released into the atmosphere **14**.

[0052] When the system is switched off, the operating logic provides for its securing:

- valves **4** and **5** close, so as to block the supply of further fluid;
- the regulation valve **11** opens, to allow any fluid still circulating to exit;
- the fans **8** remain active for a pre-set time, so as to completely evaporate any fluid still circulating, thus ensuring that only the gas phase exits the system.

[0053] Referring now to Figs. 3 and 4, a multi-temperature system is described, using the same reference numerals to denote elements described in the embodiment of Figs. 1 and 2, even if differently arranged.

[0054] Temperature-controlled distribution may also require the simultaneous transport of products to be handled at

different temperatures. It becomes necessary to have several isothermal compartments in which to store fresh (tends to be at 0-4°C) and/or frozen (tends to be at -20°C) and/or dry (tends to be at room temperature) goods separately. For each compartment, a special heat exchanger is installed to ensure the necessary heat exchange.

[0055] It is again emphasised that the drawings are representative and not limiting. The description on two different compartments is therefore not to be understood as the only existing one, but solely as a descriptive basis that is also valid for a larger number of compartments.

[0056] The multi-temperature system, in turn, can be understood as an extension of the features already described with reference to 1 and 2, therefore only the emblematic aspects of this configuration will be highlighted in detail.

[0057] Liquid carbon dioxide is stored in tank 1 which is connected to the first evaporator 2 via piping 3.

[0058] In order to ensure maximum efficiency, the cryogenic fluid traverses the various exchangers in series, from the isothermal compartment with lowest temperature to the one with highest temperature. In this way, the refrigerant leaving the first exchanger still has frigories for cooling the next isothermal compartment, which requires a higher temperature than the previous one, and so on. It must be remembered that, thermodynamically, the fluid cannot leave the isothermal compartment at a higher temperature than that of the compartment itself.

[0059] Two solenoid valves 4 and 5 are installed on tank 1, capable of delivering cryogenic fluid in the gas phase or liquid phase to the system and isolating the tank from the rest of the system.

[0060] The heat exchange takes place through the use of fans 8, in the evaporator 2, placed inside the isothermal box 6 and capable of releasing frigories in the load compartment 7 thanks to the liquid - gas phase transition of the cryogenic fluid during which a large quantity of heat is absorbed from the surrounding environment.

[0061] The fans 8 are actuated on the basis of the signals recorded by the temperature transmitters 9 and 10.

[0062] In output from the first evaporator 2, the cryogenic fluid enters the second evaporator 15 mounted in the isothermal compartment 16, which requires a higher temperature than that of the isothermal compartment 2.

[0063] The heat exchange takes place through the use of fans 17 exploiting the latent heat of the liquid/gas phase transition of the cryogenic fluid, in the case wherein the fans 8 have remained switched off during the supply of liquid through the evaporator 2, or by exploiting the sensible heat from the heating of the cold gas, in the opposite case.

[0064] An optional bypass 18 can be implemented in order to selectively deliver liquid to the various evaporators 2, 15.

[0065] The fans 17 are activated on the basis of the signals recorded by the temperature transmitters 19, 20 according to the operating logic already described for the fans 8.

[0066] In output from the last evaporator 15, the exhausted gas meets the regulation valve 11 which modulates its opening to manage the flow of refrigerant circulating through the whole system.

[0067] Its functioning, understood as opening logic, is similar to that described for the mono-temperature configuration. In this case, it is however necessary to maintain the temperature for both isothermal compartments 7, 16. There is therefore the additional input provided by the temperature transmitter 20, placed in output from the second evaporator, air side.

[0068] In this way, both the temperature transmitter 10 placed on the air in output from the first evaporator 2, and the temperature transmitter 20 placed on the air in output from the second evaporator 15, independently define whether or not there is the need to cool the air in the load compartment 7 and/or in the load compartment 16, respectively, with actuation of the regulation valve 11 and the respective fans 8, 17. The percentage of opening is defined by the signals of the pressure and temperature transmitters 13a and 13b, as described previously.

[0069] The result is a regulation valve 11 with the capacity for delivering a constant and specific flow of refrigerant fluid as all other parameters vary, selectively refrigerating several isothermal compartments.

[0070] The exhausted gas at this point is conveyed externally and released into the atmosphere 14.

[0071] In the shutdown phase, the logic already described is implemented while also keeping the fans 17 active.

[0072] From what is disclosed, the advantages of the system according to the invention appear clear.

[0073] However, the invention is not limited to the particular embodiment described previously and illustrated in the accompanying drawings, but various detailed changes may be made thereto within the reach of the person skilled in the art, without thereby departing from the scope of the invention itself as defined by the appended claims.

Claims

1. Refrigeration system of an isothermal box (6) with at least one isothermal compartment (7) comprising:

at least one tank (1) placed externally or internally to the box (6), containing cryogenic liquid in equilibrium with its gas phase, connected, via piping (3) capable of withstanding high pressures and low temperatures, to at least one evaporator (2) placed inside said box (6), capable of releasing frigories in said at least one compartment (7) thanks to the transition of the liquid - gas phase of the cryogenic fluid;
a vent pipe (14) for emitting the exhausted refrigerant gas outside of the isothermal box (6);

a plurality of fans (8) located adjacent to said at least one evaporator (2) for uniformly distributing cooled air in said at least one compartment (7);

characterised in that it provides:

- automatic solenoid shut-off valves (4) and (5) installed on said piping (3) connecting the at least one tank (1) to the at least one evaporator (2), said automatic solenoid shut-off valves for the delivery, respectively, of the gas phase and of the liquid phase of the cryogenic fluid stored in the at least one tank (1): the valve (4) for delivery of the gas phase is opened when the system is started up to bring the pressure to the operating pressure; the valve (5) for delivery of the liquid phase is opened during the operating phase, with the valve (4) closed;

- a regulation valve (11) placed downstream of said at least one evaporator (2) and upstream of said vent pipe (14), managed by a control logic, to regulate a constant flow of refrigerant fluid through the at least one evaporator, based on inputs provided by:

- a temperature sensor (10), placed in output from the evaporator, on the air side;
- a pressure sensor (12a) (12b), placed on the evaporator inlet, on the fluid side;
- a temperature and pressure sensor (13a) (13b), placed at the output of the evaporator, on the fluid side,

so as to deliver a constant and specific flow of refrigerant fluid when all the other parameters vary.

2. Refrigeration system according to claim 1, **characterised in that** said control logic sequentially actuates said plurality of fans (8) on the basis of the difference in air temperature between the inlet and outlet of said at least one evaporator (2), measured by a sensor (9) placed at the inlet of the evaporator, and by said sensor (10) placed at the outlet, so as to partialize the air flow according to the cooling it undergoes when traversing said at least one evaporator (2), thus ensuring maximum efficiency.

3. Refrigeration system according to any one of the preceding claims, **characterised in that** when the system is switched off, the control logic provides for:

closing the gas delivery valves (4) and liquid delivery valves (5) to block the delivery of further fluid;
opening the regulation valve (11), to allow the fluid that may still be in circulation to exit;
keeping the fans (8) active for a pre-established time, so as to completely evaporate any liquid still in circulation, guaranteeing the release of only the gas phase from the system.

4. Refrigeration system according to any one of the preceding claims, **characterised in that** said control logic blocks the supply of the cryogenic fluid if the door of the box (6) is opened or in any case a loss or a drop in pressure occurs in the box (6).

5. Refrigeration system according to any one of the preceding claims, **characterised in that** said control logic evaluates the residual autonomy of cryogenic fluid based on the opening time of the regulation valve (11) from the last supply.

6. Refrigeration system according to any one of the preceding claims, **characterised in that** said cryogenic fluid is liquid carbon dioxide stored in the at least one tank (1).

7. Refrigeration system according to claim 1 and one or more of the preceding claims, **characterised in that** said box (6) comprises a plurality of isothermal compartments (7; 16) at different temperatures, each provided with a respective evaporator (2; 15) arranged in series and equipped with respective inlet (9; 19) and outlet (10; 20) temperature sensors, as well as respective pluralities of fans (8; 17), said temperature and pressure sensors (13a) (13b) and said regulation valve (11) being placed downstream of the last evaporator of the series.

8. Refrigeration system according to claim 7, **characterised in that** an optional bypass (18) is provided in order to selectively deliver liquid to the various evaporators (2; 15).

9. Refrigeration system according to any one of the preceding claims, **characterised in that** said isothermal box (6) is the body of a light (total weight <3.5 t) or heavy commercial vehicle (total weight > 3.5 t).

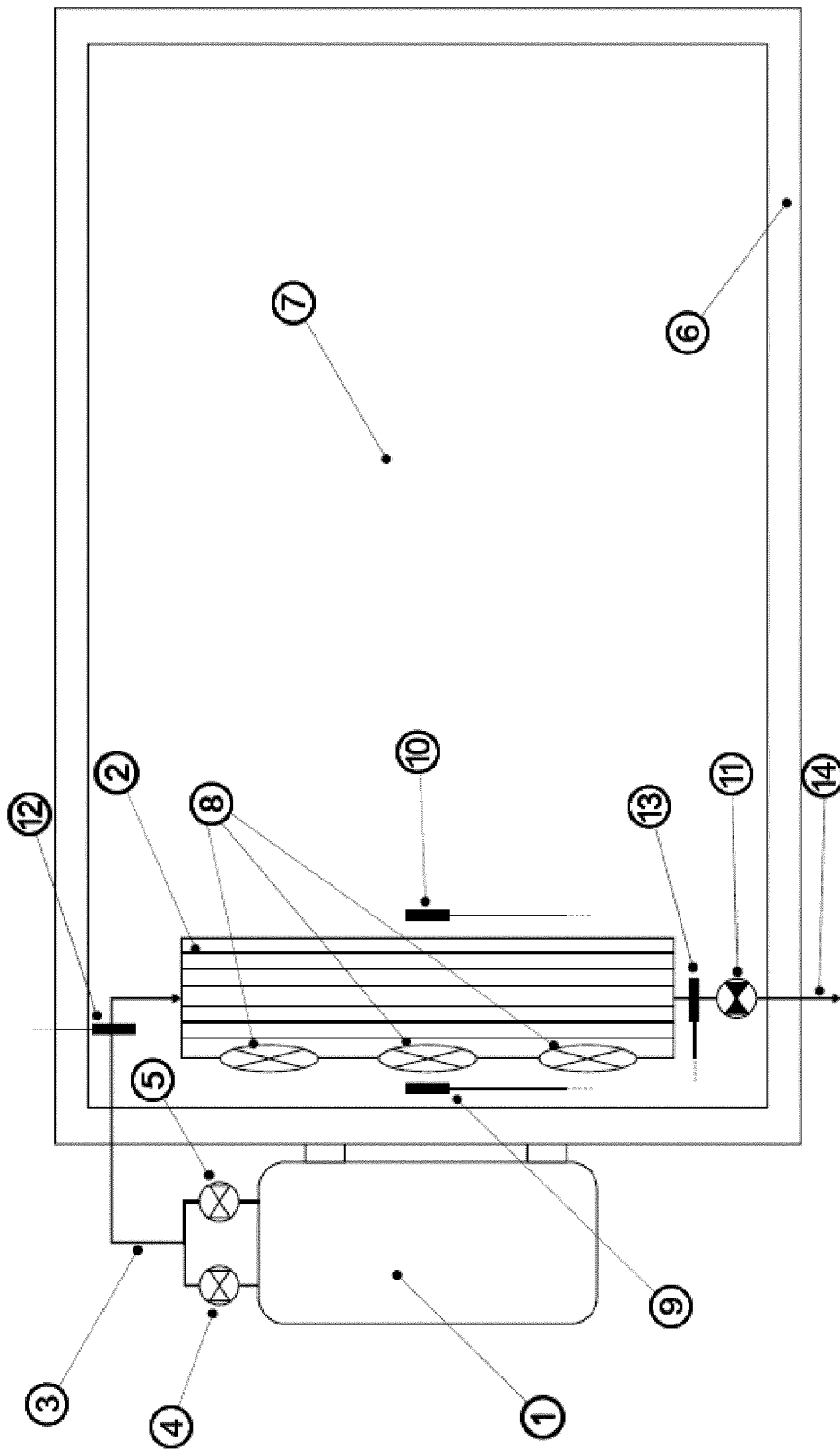


Figure 1

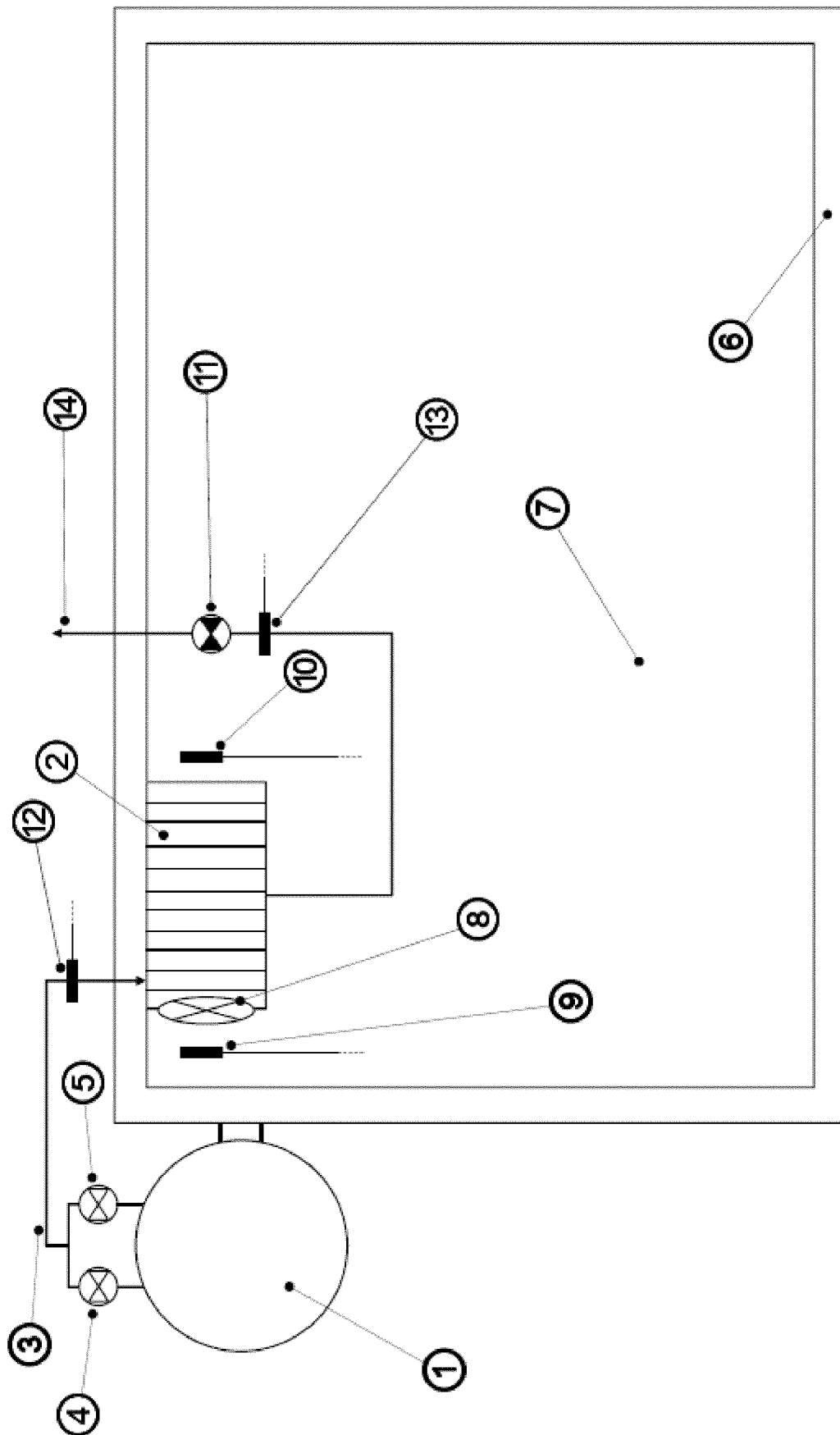


Figure 2

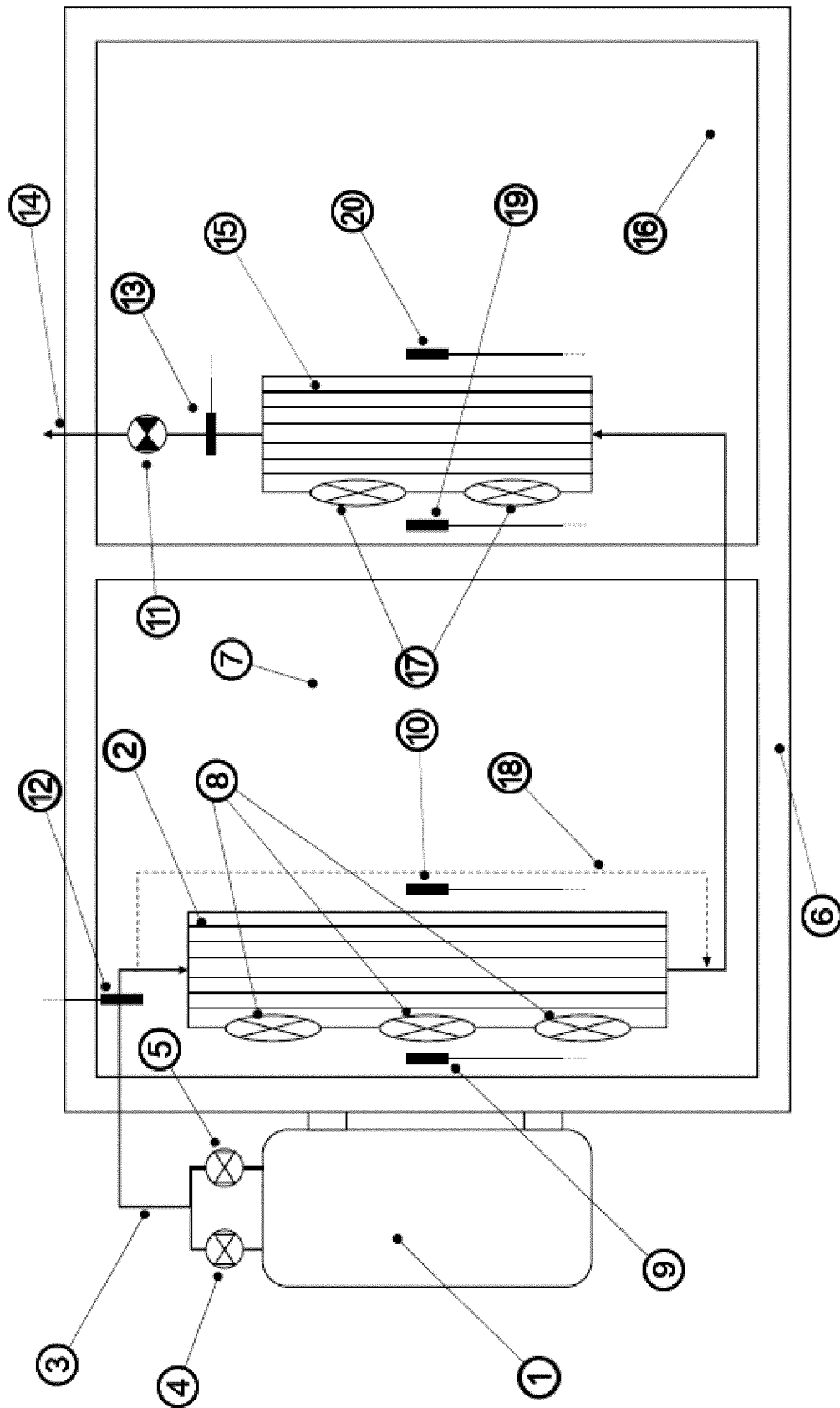


Figure 3

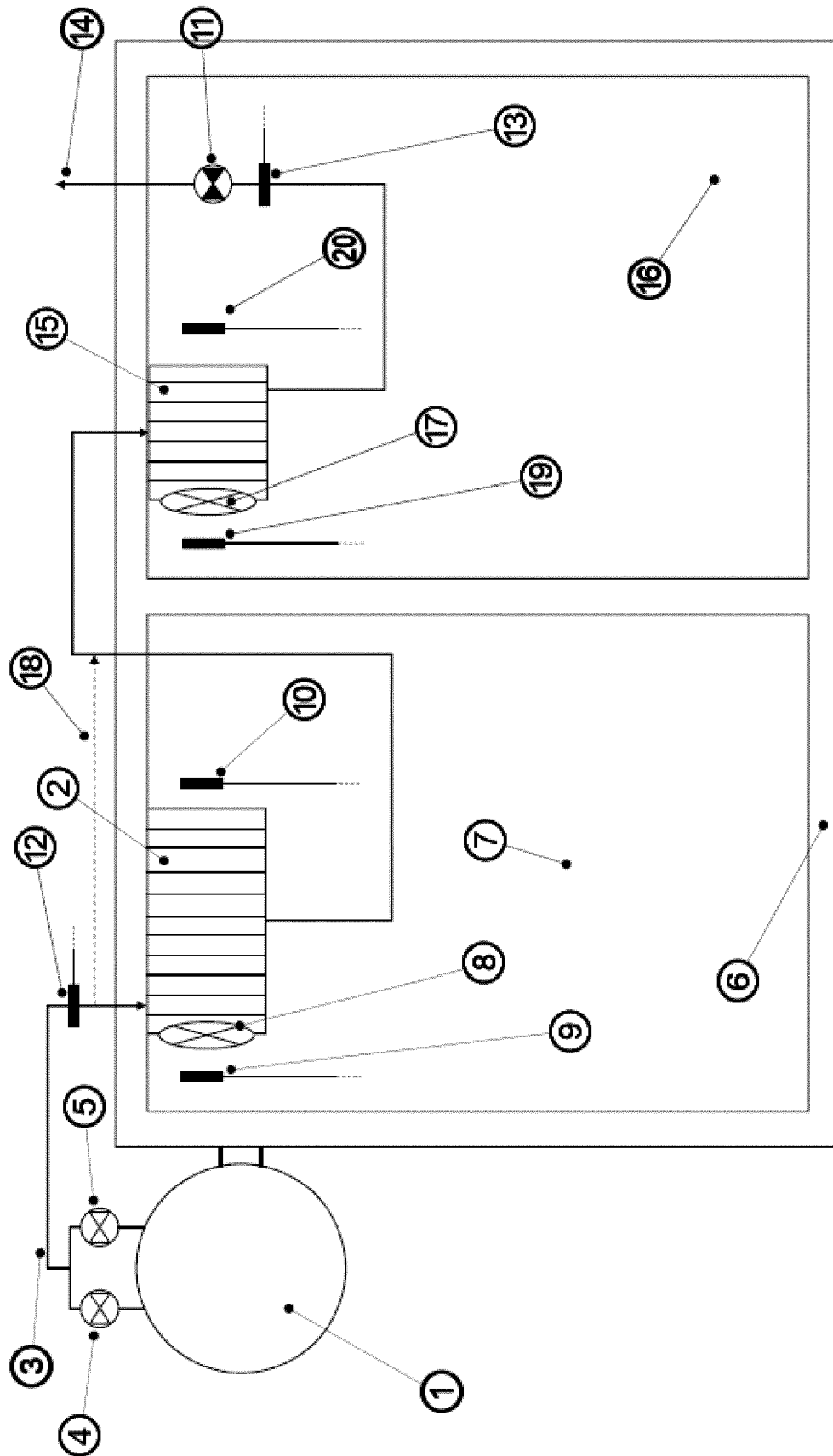


Figure 4



EUROPEAN SEARCH REPORT

Application Number

EP 22 17 2081

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EPO FORM 1503 03.82 (P04C01)

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	US 2019/086145 A1 (TRAN BAO [US] ET AL) 21 March 2019 (2019-03-21)	1, 2, 4-9	INV. F25B19/00 F25D3/10
A	* paragraph [0052] - paragraph [0152]; figures 1-9 *	3	

X	US 2017/234583 A1 (MOON WILLIAM G [US] ET AL) 17 August 2017 (2017-08-17)	1, 2, 4-9	
A	* paragraph [0014] - paragraph [0043]; figures 1-6 *	3	

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A	* paragraph [0025] - paragraph [0036]; figures 1, 2 *	3	

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A	* paragraph [0029] - paragraph [0037]; figures 1, 2 *	3	

A	EP 1 369 648 A2 (SANYO ELECTRIC CO [JP]) 10 December 2003 (2003-12-10) * figure 2 *	1	TECHNICAL FIELDS SEARCHED (IPC) F25B F25D

The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 1 September 2022	Examiner Szilagyi, Barnabas
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 22 17 2081

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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