



(11)

EP 4 155 623 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.03.2023 Bulletin 2023/13

(51) International Patent Classification (IPC):
F25B 7/00 (2006.01)

(21) Application number: **22197604.6**

(52) Cooperative Patent Classification (CPC):
**F25B 23/006; F25B 25/005; F25B 2339/047;
F25B 2400/22**

(22) Date of filing: **24.09.2022**

(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

(71) Applicant: **Arneg S.p.A.**
35010 Campo San Martino (PD) (IT)

(72) Inventor: **Lauri, Igor**
35037 Teolo (PD) (IT)

(74) Representative: **Pelanda, Paolo**
De Gaspari Osgnach s.r.l.
Via Altinate, 33
35121 Padova (IT)

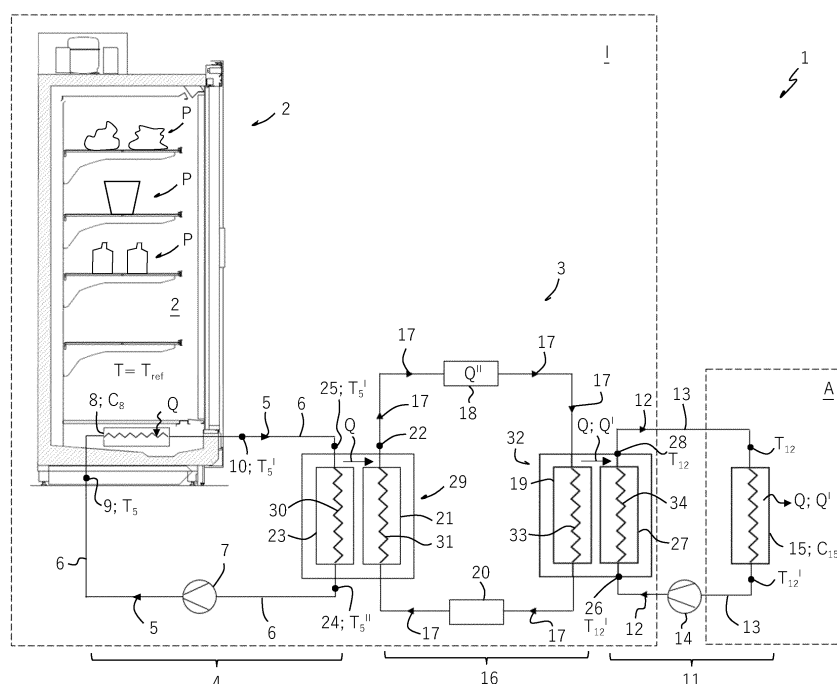
(30) Priority: **24.09.2021 IT 202100024584**

(54) **CABINET FOR REFRIGERATION AND STORAGE OF FOOD PRODUCTS**

(57) A cabinet for the refrigeration and storage of food products (P), comprising at least one refrigerated compartment (2) and a system (3) suited to cool the refrigerated compartment (2); said system (3) comprises a first circuit (4) suited to promote the circulation of a first carrier fluid (5) fluidically associated with the compartment (2) for the purpose of absorbing the heat (Q) present therein and to cool said compartment (2) to a predetermined temperature (T_{ref}), a second circuit (11) suited to promote the circulation of a second carrier fluid (12) flu-

idically associated with an external environment (A) to promote the dissipation of at least part of the heat (Q) absorbed by the first fluid (5) within the compartment (2). A third circuit (16) is provided, which is suited to promote the circulation of a third carrier fluid (17) and fluidically interposed between the first circuit (4) and the second circuit (11) in such a way as to promote the exchange of heat (Q) between said third carrier fluid (17) and the first (5) and the second carrier fluid (12).

FIG. 1



Description

Field of application of the invention

[0001] The present invention concerns the technical field of displays and, more specifically, it concerns a cabinet designed to promote the refrigeration and storage of food products.

State of the art

[0002] As is known, for the storage and sale of quickly perishable food products it is common to use refrigerated cabinets, also commonly referred to as "refrigerated cabinets" or "refrigerating cabinets", suited to contain food products intended to be stored in cold and temperature-controlled environments.

[0003] When the food products are displayed in large places (supermarkets, hypermarkets etc.), it is common to provide for the separate and remote installation of the components that make up the refrigerated cabinet.

[0004] In particular, the compartment intended for storing food products is placed in a remote position, away from other components of the refrigerator unit (for example, the compressor and the condenser).

[0005] The compressor is often installed inside a dedicated space (called "engine room"), while the condenser is placed outside the building, in such a way as to promote the heat exchange between the carrier fluid and the environment.

[0006] In this case, therefore, it is possible to use the same compressor and the same condenser (or a set comprising both of them) for a plurality of display compartments located inside the supermarket.

[0007] The main drawback of this solution lies in that the laying of the pipes that contain the refrigerant through the structure of the building is rather expensive. In addition to the above, the pipes must be installed in a fixed and predetermined position, which does not allow the original installation layout followed for all the cabinets to be modified.

[0008] Furthermore, the amount of carrier fluid used for the operation of this type of refrigerated cabinet is rather large and not negligible.

[0009] In fact, it is common to use a quantity of carrier fluid equal to several hundred kilograms, so as to promote the cooling of all the compartments located inside the supermarket.

[0010] In addition, to promote the circulation of the carrier fluid between the components of the refrigerated cabinet and the refrigerated compartment, it is necessary to provide a plurality of pipes, the construction and installation of which are very complicated.

[0011] According to an alternative configuration, refrigerated cabinets can use two different carrier fluids that circulate within separate circuits installed in the same system.

[0012] In particular, in the so-called "*remote indirect*'

version of refrigerated cabinets, there is a first remote circuit consisting of a compressor, a condenser, an expansion valve and an evaporator inside which a preferably flammable carrier fluid (propane or another similar gas) circulates.

[0013] There is also a second circuit inside which a different (preferably non-flammable) carrier fluid circulates. Said second circuit is completely separate from the first circuit but exchanges thermal energy with the latter through the evaporator.

[0014] The second circuit includes also a heat exchanger located in the refrigerated compartment. From the fluidic point of view, the carrier fluid used in the first circuit, preferably of the flammable type, serves the function of absorbing heat from the second non-flammable fluid, in such a way as to lower the temperature of the latter and promote the cooling of the refrigerated compartment.

[0015] The first circuit includes also a condenser located outside the environment where the refrigerated cabinet is installed.

[0016] The amount of carrier fluid, preferably of the flammable type, used in this type of refrigerated cabinets is significantly smaller than that used in the refrigerated cabinets described with reference to the previous case.

[0017] However, even when the installation of a plurality of refrigerated compartments is not required, the total amount of flammable carrier fluid is still considerable.

[0018] Even in a further configuration of the refrigerated cabinets, referred to as "*semi plug-in*", there are two separate circuits: a preferably flammable carrier fluid circulates in the first circuit, while a non-flammable fluid (usually water) circulates in the second circuit.

[0019] The first circuit comprises: a compressor, a condenser, an expansion valve (or a similar expansion element) and an evaporator, wherein the latter component is fluidically associated with the refrigerated compartment.

[0020] The second circuit, instead, is separate with respect to the first circuit but exchanges heat with the latter at the condenser; the heat absorbed by the fluid at this component is then dissipated outside the environment where the system is installed by means of a chiller.

[0021] The function of the chiller is to keep the water, which is the second carrier fluid, at a substantially constant temperature.

[0022] In the refrigerated cabinets having this configuration, therefore, the cooling of the compartment is obtained by means of the carrier fluid, which is preferably of the flammable type. The main drawback of this solution lies in that, in any case, the quantity of said fluid is relatively large and not negligible.

[0023] In fact, even though it requires an overall smaller quantity of flammable carrier fluid compared to the cases described above, this "*semi plug-in*" solution still requires a relatively large amount of a potentially flammable fluid, especially in the case where the compart-

ment to be cooled is large.

[0024] The documents US2007/0056312, US2015/0257548 and US2007/0056312 describe cabinets for the refrigeration, storage and sale of food products that have the above-mentioned drawbacks; in particular, the cabinets described in said documents are equipped with compartment cooling systems that do not allow for an even distribution of the refrigerated air, thus generating a considerable temperature gradient that negatively affects the efficient storage of food products.

Presentation of the invention

[0025] The present invention intends to overcome the technical drawbacks mentioned above by providing a particularly effective and efficient cabinet for the refrigeration, storage and sale of food products.

[0026] More specifically, the main object of the present invention is to provide a cabinet for the refrigeration and storage of food products that is capable of significantly reducing the amount of flammable carrier fluid used in the same cabinet.

[0027] A further object of the present invention is to provide a cabinet for the refrigeration and storage of food products that offers a higher level of safety compared to the refrigerated cabinet configurations currently known on the market.

[0028] A further object of the present invention is to provide a cabinet for the refrigeration and storage of food products whose maintenance can be carried out to a large extent by an operator who is not qualified to handle gases and flammable substances (for example, a plumber).

[0029] A further object of the present invention is to provide a cabinet for the refrigeration and storage of food products which makes it possible to minimize the assistance of an operator specialized in refrigeration systems or other skilled technicians qualified to handle gases and flammable substances.

[0030] Another object of the present invention is to provide a cabinet for the refrigeration and storage of food products which is easy to manufacture and has relatively low production and assembly costs.

[0031] A further object of the present invention is to provide a cabinet for the refrigeration and storage of food products which makes it possible to confine the circuit containing the carrier fluid of the flammable type in a self-contained and especially safe compartment, in any case positioned within the frame of the refrigerated compartment.

[0032] A further object of the present invention is to provide a cabinet for the refrigeration and storage of food products which can increase energy efficiency and improve the preservation of food products.

[0033] A further object of the present invention is to provide a cabinet for the refrigeration and storage of food products which is capable of considerably reducing the temperature gradient generated inside the compartment

in which the food products are displayed.

[0034] These objects, together with others that are clarified in greater detail below, are achieved by a cabinet for the refrigeration and storage of food products of the type according to claim 1.

[0035] Other objects that are better described below are achieved by a cabinet for the refrigeration and storage of food products according to the dependent claims.

Brief description of the drawings

[0036] The advantages and characteristics of the present invention clearly emerge from the following detailed description of some preferred but not limiting configurations of a cabinet designed to promote the refrigeration and storage of food products, with special reference to the following drawings, wherein:

- **Figure 1** shows a block diagram of a cabinet for the refrigeration and storage of food products according to the invention;
- **Figure 2** shows a simplified sectional view of a cabinet for the refrigeration and storage of food products according to the invention;
- **Figure 3** shows a side sectional view of an embodiment of the cabinet according to the invention;
- **Figure 4** shows a top view of a first detail of the cabinet represented in Figure 3;
- **Figure 5** shows a side view of the cabinet of Figure 3, in which the air flows present inside the food products storage compartment are schematically represented.

Detailed description of the invention

[0037] The present invention concerns a cabinet for the refrigeration and storage of food products. Said cabinet, hereinafter indicated by the reference number **1**, can be suited to contain and display food products **P** of various types, whether fresh, and therefore intended to be consumed in a short period of time, or long- or medium-life food products which, however, need to be constantly maintained at a temperature lower than environment temperature.

[0038] Conveniently, said cabinet **1** comprises a refrigerated compartment **2** designed to contain the food products **P**.

[0039] In particular, the cabinet **1** can comprise a supporting frame **2^I** provided with a plurality of sides **2^{II}**; **2^{III}**; **2^{IV}**; **2^V** suited to define the refrigerated compartment **2**.

[0040] One or more of said sides of the compartment **2** can be made of glass or another transparent material in such a way as to allow the food products **P** contained inside the refrigerated compartment **2** to be seen from the outside.

[0041] In addition, the compartment **2** can be delimited by a bottom side **2^I**, a top side **2^{III}**, a side **2^{IV}** and one or more sides **2^V** suited to form a mobile door in such a way

as to allow a user to access the food products **P** stored inside the compartment itself.

[0042] Conveniently, each compartment can be equipped with one or more substantially horizontal shelves designed to support the products to be refrigerated.

[0043] Furthermore, the supporting frame **2^I** can substantially be a self-supporting frame, so that it can be placed inside an installation environment **I** designed for the sale and storage of food products **P**, whether fresh or preserved under controlled temperature.

[0044] The shape of the frame **2^I** defining the cabinet **1** can be such as to allow the latter to be installed in structures intended to promote the retail sale of food products.

[0045] For example, said cabinet **1** can be installed both in particularly large places, such as supermarkets, hypermarkets etc., and in smaller places, such as small shops, delicatessens, bakeries etc.

[0046] Conveniently, a single cabinet **1** can comprise a plurality of refrigerated compartments **2** which can be fluidically communicating with each other or separate from each other, depending on the intended use of the cabinet itself.

[0047] As is better described below, in the case where more than one refrigerated compartment **2** are associated with the same cabinet **1**, the construction configuration of the latter requires a single cooling system, indicated by the reference number **3** in the **Figures**, and suited to promote the extraction of heat from each individual compartment **2** so as to maintain it at a temperature that is equal or close to the reference temperature (typically included between 0°C and 10°C).

[0048] **Figure 1** shows a block diagram of the thermal system associated with a cabinet **1** according to the present invention.

[0049] A cooling system **3** is provided, which serves the function of cooling the volume contained in the compartment **2** to a predetermined temperature, which can generally be set by a user and/or defined by the reference standards in force in the field of food preservation.

[0050] In particular, the cooling system **3** comprises a first circuit **4** suited to promote the circulation of a first carrier fluid **5**.

[0051] The first circuit **4** is fluidically associated with the refrigerated compartment **2** in order to cool it to a predetermined temperature.

[0052] The temperature inside the compartment **2** can generally be selectively set by the user; the function of the first circuit **4** is to maintain the temperature **T** inside said compartment **2** at a value equal or close to a reference value **T_{ref}** set by the operator.

[0053] As better illustrated in **Figure 1**, the first circuit **4** can comprise a series of pipes, indicated as a whole by the reference number **6**, and a pump **7** which is fluidically associated with said pipes **6** in such a way as to promote the selective circulation of the first carrier fluid **5** inside the first circuit **4**.

[0054] The first circuit **4** comprises a first heat exchanger **8** operatively associated with the compartment to be cooled **2** and arranged in series with respect to the corresponding pump **7**.

5 [0055] The first heat exchanger **8** can have predetermined sizes and overall dimensions defining a heating capacity **C_g** suited to guarantee the transfer of the heat present inside the compartment **5** towards the first carrier fluid **5** in order to maintain the compartment **2** itself at the predetermined temperature **T_{ref}**.

10 [0056] The temperature **T₅** of the first carrier fluid **5** at the inlet **9** of the first heat exchanger **8** is lower than the temperature **T₅'** of the same carrier fluid **5** at the outlet **10** of the first heat exchanger **8**.

15 [0057] The first heat exchanger **8** can be selected from the group comprising tube bundle heat exchangers or similar exchangers.

[0058] Conveniently, the first carrier fluid **5** can be selected from the group comprising non-flammable carrier fluids.

20 [0059] For example, the first carrier fluid **5** can consist of water or water and glycol.

[0060] The first carrier fluid **5** can also be different from water; however, it is understood that in the configuration of the cabinet **1** described herein said first fluid **5** is always a non-flammable fluid.

25 [0061] Therefore, the pipes **6** of the first circuit **4**, the pump **7** and the first heat exchanger **8** are designed to allow the selective circulation of a certain water flow rate during the operation of the cabinet **1**.

30 [0062] The cooling system **3** comprises a second circuit **11** suited to promote the circulation of a second carrier fluid **12**.

35 [0063] The second circuit **11** is fluidically associated with an environment **A** external to the environment **I** where the cabinet **1** is installed.

[0064] The function of the second circuit **11** is to promote the dissipation of at least part of the heat **Q** absorbed by the first carrier fluid **5** at the refrigerated compartment **2** into the external environment **A**.

40 [0065] In general, the expression "*external environment*" refers to an environment **A** that is located outside the building **I** or the structure in which the cabinet **1** is installed.

45 [0066] In fact, in this industrial sector it is common to promote the dissipation of the heat **Q** previously extracted from the refrigerated compartment(s) **2** towards the outside in such a way as to prevent said heat **Q** from heating the environment **I** where the cabinet **1** is located.

50 [0067] This aspect is particularly important in the case where several cabinets **1** are installed in the same installation environment (supermarkets, hypermarkets etc.); in this case, in fact, the heat **Q** extracted from each compartment **2** would be released inside the installation environment **I**, causing the latter to heat up relatively quickly.

[0068] The second circuit **11** can comprise a series of pipes **13** associated with a corresponding pump **14**.

55 [0069] The selective activation of the pump **14** pro-

motes the controlled circulation of the second carrier fluid **12** inside the pipes **13**.

[0070] The second circuit **11** can comprise a second heat exchanger **15**, arranged in series with respect to the corresponding pump **14** and associated with the external environment **A**.

[0071] In this case, the second heat exchanger **15** is placed directly in contact with the air outside the building or structure.

[0072] The second heat exchanger **15** is thus configured to promote the heat exchange between the second carrier fluid **12** and the air outside the installation environment **I**.

[0073] Conveniently, the size and overall dimensions of the second heat exchanger **15** are selected so as to obtain such a heating capacity C_{15} as to allow the heat Q absorbed by the second carrier fluid **12** (coming from the refrigerated compartment **2**) or the heat Q' obtained as the sum of the heat Q absorbed by the second carrier fluid **12** (coming from the refrigerated compartment **2**) and the heat Q'' developed by the other components (for example, a compressor associated with a different circuit) during the operation of the cabinet **1** ($Q' = Q + Q''$) to be dissipated towards the external environment **A**.

[0074] The temperature T_{12} of the second carrier fluid **12** at the inlet of the second heat exchanger **15** is higher than the temperature T_{12}' of the same carrier fluid **12** at the outlet of the second heat exchanger **15**.

[0075] Conveniently, the second carrier fluid **12** can be selected from the group comprising non-flammable carrier fluids.

[0076] For example, the second carrier fluid **12** can be water.

[0077] The second carrier fluid **12** can also be different from water; however, it is understood that in the configuration of the cabinet **1** described herein said fluid is always a non-flammable fluid.

[0078] In this case, the pipes **13** of the second circuit **11**, the pump **14** and the second heat exchanger **15** are designed in such a way as to allow the selective circulation of a certain water flow rate during the operation of the cabinet **1**.

[0079] According to a particular configuration of the invention, the cooling system **3** comprises a third circuit **16** intended to promote the circulation of a third carrier fluid **17**.

[0080] As better illustrated in **Figure 1**, the third circuit **16** is fluidically interposed between the first circuit **4** and the second circuit **11**.

[0081] The function of the third circuit **16** is to promote the heat exchange between the third carrier fluid **17** circulating inside the latter and, respectively, the first carrier fluid **5** and the second carrier fluid **12**, which respectively circulate inside the first circuit **4** and the second circuit **11**.

[0082] The third circuit **16** is separated from the first circuit **4** and the second circuit **11**; in substance, the third carrier fluid **17** never comes into contact with the first carrier fluid **5** and/or the second carrier fluid **12**.

[0083] Furthermore, the third circuit **16** is interposed between the first circuit **4** and the second circuit **11**; therefore, the second carrier fluid **12** does not come into contact with the third carrier fluid **17**, either.

[0084] The first circuit **4**, the second circuit **11** and the third circuit **16** are fluidically separate from each other.

[0085] However, these circuits **4**, **11**, **16** are suited to promote a heat exchange between the fluids **5**, **12**, **17** which circulate inside them.

[0086] The configuration of the first circuit **4**, the second circuit **11** and the third circuit **16** is such that they only allow heat to be transferred between the three carrier fluids **5**, **12**, **17**.

[0087] More specifically, as is better explained below, the interaction between the three circuits **4**, **11**, **16** will be such as to promote the transfer of thermal energy from the first carrier fluid **5** to the third carrier fluid **17**.

[0088] Similarly, the interaction between the circuits **4**, **11**, **16** will be such as to promote the transfer of thermal energy from the third carrier fluid **17** to the second carrier fluid **12**.

[0089] The third circuit **16** can comprise a compressor **18** positioned upstream of a condenser **19** which in turn is connected to an expansion valve **20**. If necessary, the latter can be replaced by an equivalent expansion element **20** (for example, a capillary tube) and be connected in series to an evaporator **21** whose outlet **22** is connected to the compressor **18**.

[0090] The third circuit **16** will be designed to subject the third carrier fluid **17** to a thermal cycle of the refrigeration type.

[0091] The third carrier fluid **17**, therefore, must be selected from the group of fluids suited to undergo such chemical-physical transformations as to allow a refrigeration cycle to be performed.

[0092] In particular, the operation of the compressor **18** promotes a pressure increase in the third carrier fluid **17** (in the gaseous state), thus increasing its temperature.

[0093] The compressed gas then flows through the condenser **19** so as to release heat towards the outside and, consequently, allow a change of state of the third carrier fluid **17** to the liquid phase to take place.

[0094] At this point, through the activation of the expansion valve **20** (or of another expansion element), it is possible to reduce the pressure associated with the third carrier fluid **17**, in such a way as to decrease its temperature.

[0095] A change of state of the third fluid **17**, from the gaseous/liquid phase (present downstream of the expansion valve **20**) to the gaseous phase, takes place in the evaporator **21**.

[0096] The third carrier fluid **17** flowing out of the evaporator **21** through the outlet **22** is conveyed to the compressor **18** again.

[0097] The first circuit **4** interacts fluidically with the third circuit **16** at the evaporator **21** provided in the latter.

[0098] Analogously, the second circuit **11** interacts fluidically with the third circuit **16** through the condenser **19**

present in the latter.

[0099] Therefore, there is a first transfer of heat Q from the first carrier fluid 5 (flowing out of the first heat exchanger 8 through the outlet 10) to the third carrier fluid 17; said heat transfer occurs, as mentioned, at the evaporator 21.

[0100] For this purpose, the first circuit 4 can comprise an additional heat exchanger 23 placed fluidically in contact with the evaporator 21 of the third circuit 16.

[0101] The function of the additional heat exchanger 23 is to promote the transfer of a certain amount of thermal energy Q from the first carrier fluid 5 towards the third carrier fluid 17 circulating inside the evaporator 21.

[0102] As a result of said transfer, the temperature T_5'' associated with the first carrier fluid 5 at the outlet 24 of the additional heat exchanger 23 is lower than the temperature T_5' of the same fluid at the inlet 25 of said component 23.

[0103] In substance, the thermal energy Q absorbed by the first fluid 5 during its passage through the first heat exchanger 8 is essentially dissipated towards the third carrier fluid 17 when the latter flows through the additional heat exchanger 23.

[0104] In this way, the temperature T_5 of the first fluid 5 at the inlet 9 of the first heat exchanger 8 remains substantially constant during normal operation of the cabinet 1 (with the same cooling temperature T_{ref} set in the compartment 2).

[0105] In addition, a second transfer of heat Q from the third carrier fluid 17 to the second carrier fluid 5 (exiting from the outlet 26 of the second heat exchanger 15) takes place; said heat transfer occurs, as mentioned, at the condenser 19.

[0106] For this purpose, even the second circuit 11 can comprise an additional heat exchanger 27 placed fluidically in contact with the condenser 19 associated with the third circuit 16.

[0107] The function of this additional heat exchanger 27 is to promote the transfer of a certain amount of thermal energy Q ; Q' from the third carrier fluid 17 (circulating inside the condenser 19) to the second carrier fluid 12.

[0108] Following said heat transfer, the temperature T_{12} associated with the second fluid carrier 12 at the outlet 28 of the additional heat exchanger 27 is higher than the temperature T_{12}' of the same fluid at the inlet 26 of the additional heat exchanger 27.

[0109] In substance, the thermal energy Q ; Q' dissipated by the second fluid 12 while flowing through the second heat exchanger 15 (generally located outside the installation environment I) is substantially equal to the thermal energy Q ; Q' absorbed by the same fluid 12 while flowing through the additional heat exchanger 27.

[0110] In other words, the second fluid 12 is heated due to the effect of the heat absorbed by the condenser 19 associated with the third circuit 16.

[0111] In this way, the temperature T_{12}' of the second fluid 12 at the outlet of the second heat exchanger 15 remains substantially constant during normal operation

of the cabinet 1 (with the same cooling temperature T_{ref} set in the compartment).

[0112] Conveniently, at least one among the first carrier fluid 5, the second carrier fluid 12 and the third carrier fluid 17 is different from the others.

[0113] In particular, the third carrier fluid 17 can be selected from the group comprising flammable fluids.

[0114] For example, the third carrier fluid 17 can be selected from the group comprising natural refrigerants based on ethane and/or propane and/or butane and/or based on other similar flammable gases.

[0115] In general, the third carrier fluid 17 can be of the type R90, R290, R170, R600 etc.

[0116] As already described above, in the configuration of the cabinet 1 illustrated in the diagram shown in Figure 1, the first carrier fluid 5 and second carrier fluid 12 can be water (or water-based liquids), while the third carrier fluid 17 can be of the type indicated above.

[0117] The use of a potentially flammable third carrier fluid 17 suggests that special components are used, which are suited to define both the additional heat exchangers 23, 27, respectively associated with the first circuit 4 and the second circuit 11, and the condenser 19 and the evaporator 21 associated with the third circuit 16.

[0118] The evaporator 21 associated with the third circuit 16 and the additional heat exchanger 23 associated with the first circuit 4 can both be obtained by means of a single heat exchanger component 29.

[0119] Said component 29 is provided with one pair of ducts (or set of ducts) 30, 31 which are fluidically separate but at the same time configured to promote however a heat exchange.

[0120] One of said ducts 30 is fluidically associated with the first circuit 4 so as to allow the circulation of the first carrier fluid 5. In this case, therefore, said duct 30 constitutes the additional heat exchanger 23 associated with the first circuit 4.

[0121] The other duct 31 of said heat exchanger component 29, instead, is associated with the third circuit 16 so as to allow the circulation of the third carrier fluid 17. In this case, therefore, said duct 31 is configured to define the evaporator 21.

[0122] Similarly to what has just been described, the condenser 19 associated with the third circuit 16 and the additional heat exchanger 27 associated with the second circuit 11 can both be obtained by means of a (further) single heat exchanger component 32.

[0123] Also said component 32 is provided with one pair of ducts (or set of ducts) 33, 34 which are fluidically separate but at the same time configured to allow a mutual heat exchange to take place.

[0124] One of said ducts 33 is fluidically associated with the third circuit 16 so as to allow the circulation of the third carrier fluid 17. In this case, therefore, said duct 33 is configured to define the condenser 19.

[0125] The other duct 34 of said heat exchanger component 32, instead, is associated with the second circuit 11 so as to allow the circulation of the second carrier fluid

12. In this case, therefore, said duct **34** constitutes the additional heat exchanger **27** associated with the second circuit **11**.

[0126] Conveniently, as better visible in **Figure 1**, the first circuit **4** is not equipped with any expansion element, since the first carrier fluid **5** is selected from among the fluids that do not require such an element to promote the heat exchange with the volume of air contained inside the compartment **2**.

[0127] In other words, the components used in the first circuit **4** are exclusively the pump **7**, the first heat exchanger **8** and the additional heat exchanger **23**.

[0128] The second circuit **11** is not equipped with any expansion element, either, since the second carrier fluid **12** is selected from the set of fluids that do not require such an element to promote the heat exchange with the third carrier fluid **17**.

[0129] The components used in the second circuit **11** are exclusively the pump **14**, the heat exchanger **15** and the additional heat exchanger **27**.

[0130] As already described above, the third circuit **16** is the only one among the circuits present in the cooling system **3** where a single expansion element **20** (a single expansion element means one unit of this component) is used.

[0131] From an operational point of view, the third fluid **17** can be considered a "main fluid", while the first and the second fluid can be considered "carrier fluids".

[0132] The third fluid **17**, in fact, is of the flammable type and it undergoes all the transformations required by a refrigeration cycle (that is, a reversed Carnot cycle) inside the respective circuit **16**. In this way, the third fluid **17** can absorb large quantities of heat from the first fluid **5** (at the evaporator **21** and at the additional heat exchanger **23**), allowing the latter to significantly cool down.

[0133] The relatively low temperature of the first fluid **5** is therefore suited to promote the cooling of the compartment **2** through circulation in the heat exchanger **8**.

[0134] It is therefore possible to observe how the cooling of the compartment **2** to a set temperature T_{ref} directly depends on the refrigeration cycle to which the third fluid **17** is subjected: the latter, in fact, controls the heat exchange by using the first fluid **5** as a simple carrier that extracts heat from the volume of air contained in the compartment **2**.

[0135] In the configuration of the cabinet illustrated in the **Figures**, the third circuit **16** and the third fluid **17** assume the "master" role, since with their behavior they actually control the heat exchange and the action of the cooling means **3**; the first fluid **5**, instead, can be considered a "carrier" (or "slave"), as it represents the physical medium (whose conditions depend on the behavior of the first fluid **17**) used to extract the heat present inside the compartment **2**.

[0136] In a similar manner, also the second fluid **12** behaves as a "carrier" fluid, since its conditions depend on the behavior of the first fluid **17**; the second fluid **12**, in fact, serves the function of dissipating the heat asso-

ciated with the third fluid **17** outside the installation environment.

[0137] Conveniently, the first non-flammable carrier fluid **5** circulating inside the first circuit **4** can have a temperature included between -2°C and $+1^{\circ}\text{C}$.

[0138] More specifically, at the inlet of the heat exchanger **8** the first fluid **5** can have a temperature of not less than -2°C , while at the inlet of the additional heat exchanger **23** the temperature associated with the first fluid can be close to about -1°C .

[0139] Furthermore, at the inlet of the evaporator **21** the third fluid **17** can have a temperature approximately included between -10°C and -6°C , while at the outlet of said component the third fluid can have a temperature included between 0°C and $+5^{\circ}\text{C}$.

[0140] At the outlet of the compressor **18** (and thus at the inlet of the heat exchanger **32**), the third fluid **17** can have a temperature included between 60°C and 75°C , while at the outlet of the heat exchanger **32** the third fluid **17** can have a temperature generally included between 30°C and 50°C .

[0141] Preferably, the exchanger components **29**, **32** described above can be obtained by means of one pair two-circuits plate heat exchangers of the type known per se and not described below.

[0142] Thanks to the configuration described above and to the use of the plate heat exchangers **29**, **32**, it is possible to minimize the extension of the third circuit **16**.

[0143] The substantial miniaturization of the third circuit **11** makes it possible to use a reduced amount of third carrier fluid **17** which, as already described above, is selected from the group comprising flammable fluids.

[0144] This aspect is decisive when it comes to increasing the overall safety of the refrigeration cabinet for food products that is the subject of the present invention. Furthermore, the special configuration of the cabinet described above allows the third circuit to be confined within a dedicated space **35** created in the frame.

[0145] This compartment is clearly visible in the sectional view of the cabinet shown in **Figure 2**.

[0146] This space **35** can be delimited by sides **36** specially made of metal and having a relatively high thickness (for example, 5mm - 10mm), in such a way as to define a closed, separate and safe compartment inside which the entirety of the third potentially flammable carrier fluid **17** is contained.

[0147] Thanks to the small overall dimensions of the third circuit **16**, it is possible to provide a cabinet **1** that is extremely flexible about the position of the space/compartment containing the third carrier fluid **17**.

[0148] This space/compartment, in fact, can be located above the refrigerated compartment **2** or, alternatively, next to it, so as to allow a skilled operator to easily carry out any maintenance activities involving the third circuit and/or the third carrier fluid.

[0149] In the preferred configuration of the invention, the cabinet **1** can be provided with one or more internal refrigerated compartments **2** of the type illustrated in the

sectional view shown in **Figures** from 3 to 5.

[0150] The cooling of the compartment 2 is based on the heat exchange promoted between the first carrier fluid 5 and the air present inside said compartment 2; however, in the configuration of the invention illustrated in **Figures** from 3 to 5, further technical elements (described below) are used, whose function is to promote the controlled circulation of a flow of refrigerated air inside the compartment 2.

[0151] Conveniently, the cooling system 3 can be provided with an aeraulic circuit, indicated as a whole by the reference number 37, comprising one or more ducts 38 and a plurality of fans 39.

[0152] The activation of the fans 39 makes it possible to convey a forced flow of refrigerated air into the ducts 38.

[0153] In particular, the ducts are provided with openings 40 facing towards the fans 39, in such a way as to allow the air flow generated by the activation of the latter to flow in.

[0154] Each duct 38 is provided with at least one outlet nozzle 41 placed in fluidic communication with the inner volume of the compartment 2 in order to distribute the refrigerated air flow previously conveyed into the duct 38 by the fans 39.

[0155] The outlet nozzle 41 of each duct are positioned in proximity to the door 2^V (or the movable side) and directed downwards, so that the refrigerated air flow exiting from them hits a substantially vertical portion of the inner volume of the compartment that makes contact with the doors 2^V or the movable side.

[0156] The refrigerated air flow exiting from the outlet nozzle 41 of the ducts 38 is therefore such as to define an air curtain or air knife which, when the door 2^V is open, acts as a barrier against the possible entry in the compartment 2 of relatively warm air present in the installation environment of the cabinet.

[0157] More specifically, the lower part of the frame 2^I can be configured to define a space 42 suited to house the fans 39 and the heat exchanger 8 associated with the first circuit 4.

[0158] The space 42 can be located under the bottom side 2^{II} of the compartment 2 and can be fluidically connected to the openings 40 provided in the ducts 38.

[0159] The housing space is visible in **Figure 3** and **Figure 4**, which respectively represent a side sectional view of the cabinet and a top view of the lower part of the compartment (without the bottom side 2^{II}).

[0160] Conveniently, the aeraulic circuit 37 can be provided with one or more elements suited to promote the deflection of the refrigerated air flow generated by the activation of the fans 39.

[0161] Preferably, the flow deflection element can consist of a flat and substantially vertical metal bulkhead 44 arranged inside the space 42 in the area separating two fans 39 positioned side by side. The bulkhead 44, furthermore, is provided with an edge 45 which is substantially in contact with the heat exchanger 8 associated with

the first circuit 4.

[0162] In the case where more than two fans 39 are used, it is possible to use several bulkheads 44, each located inside the space 42 in the area that separates two respective pairs of fans 39.

[0163] The function of the bulkheads 44 (and thus of the elements that promote the flow deflection) is to partially separate the air flows generated by each individual fan 39 and directed towards the heat exchanger 8. In this way, in fact, each air motion generated by a single fan 39 and suited to hit the heat exchanger 8 has a substantially uniform shape; in this way, therefore, it is possible to maximize the heat exchange that these flows undergo during their passage inside the heat exchanger 8.

[0164] In other words, the presence of the bulkheads 44 allows the flows generated by the fans 39 to be separated from each other so as to consequently reduce the risk that they can generate turbulence. In this condition, therefore, most of the flow generated by each individual fan 39 (which has a uniform shape) comes into contact with the exchanger without being modified and is therefore cooled with high thermal efficiency.

[0165] For this reason, the presence of the bulkheads 44 makes it possible to reduce the energy consumption associated with the cooling of the compartment 2 and, at the same time, makes it possible to increase the thermal efficiency of the cabinet 1.

[0166] Conveniently, each duct 38 is divided into a first portion 46 with substantially vertical extension and a second portion 47 with substantially horizontal extension.

[0167] The first portion 46 and the second portion 47 are respectively delimited by a vertical side 2^{IV} and a horizontal side 2^{III} defining, respectively, the side and the top of the compartment 2.

[0168] More specifically, the second portion 47 of the duct 38 extends above the compartment 2 and is fluidically connected to outlet nozzle 41 located in proximity to the door 2^V or the movable side.

[0169] Conveniently, the side 2^{IV} of the compartment 2 is provided with a plurality of substantially horizontal slits 48 whose function is to place the first portion 46 of the duct 38 in communication with the inner volume of the compartment 2 to be cooled.

[0170] As can be seen in greater detail in **Figure 3**, the slits 48 are distributed along respective horizontal rows 49 that extend over the entire width of the side 2^{IV} that delimits the compartment 2 (and defines the first vertical portion 46 of the duct 38).

[0171] Moreover, the horizontal rows 49 formed by the slits 48 are distributed in a substantially uniform manner along the entire vertical extension of the side 2^{IV}; said rows 49, in fact, have a substantially constant vertical pitch P_1 .

[0172] For example, the vertical pitch P_1 can be included between 30 mm and 80 mm and be preferably close to 50 mm.

[0173] Preferably, each slit 48 can have a width w_1 equal to approximately ten times its height h_1 ($w_1 =$

$10 \cdot h_1$); for example, the slits **48** can have a width w_1 of approximately 20 mm and a height h_1 of approximately 2 mm.

[0174] In addition, each row **49** consists of slits **48** arranged side by side and separated along the respective directrix with a substantially constant horizontal pitch **Z**. As better illustrated in **Figure 3**, in this context the pitch **Z** is defined as the distance that separates the front ends of two slits **48** arranged side by side.

[0175] The horizontal pitch **Z** can be selected according to the width w_1 of the slit **48** and, in particular, said pitch **Z** is selected so that it is always greater than (or at least equal to) the value of the width w_1 of the slit **48** ($Z \geq w_1$).

[0176] A portion of the refrigerated air flow passing through the first portion **46** of the duct **36** flows out through the slits **48** and hits the back of the volume of the compartment **2** (that is, the region of the space located opposite the movable side or door **2^V**).

[0177] The synergistic effect produced by the presence of the slits **48** and by their special distribution is obtained by (i) a plurality of rows of slits **48** spaced by the vertical pitch P_1 , (ii) each row formed by slits arranged side by side and separated by the horizontal pitch **Z** - makes it possible to obtain a benefit in terms of temperature distribution inside the compartment **2**.

[0178] In particular, it is possible to reduce the temperature gradient between the coldest point in the compartment **2** (in proximity to the side **2^{IV}**) and the warmest point in the compartment **2** (in proximity to the movable side or door, generally made of transparent glass).

[0179] The special arrangement/size of the slits **48**, in accordance with the foregoing, makes it possible to obtain the important technical effect consisting in the division of the refrigerated air flow circulating inside the first portion **46** of the duct **38** into i) a barrier flowing out of the outlet nozzle **41**, a plurality of small, substantially uniform sub-flows, each of which propagates from the slits **48** towards the movable side or door **2^V**.

[0180] All together, these sub-flows occupy the entire volume of the compartment and therefore each product, independently of the shelf on which it is located, is hit by a small current of refrigerated air that rapidly cools it or maintains it at the desired temperature.

[0181] In other words, the presence of the slits **48**, according to the configuration described above, makes it possible to maintain the temperature substantially constant at each point of the compartment **2**, thus allowing the products to exchange the correct amount of thermal energy with the refrigerated air present inside the volume.

[0182] More specifically, the products **P** that are displayed, and therefore also subjected to irradiation from the outside, benefit from an additional convective exchange due to the action of the front air curtain or knife.

[0183] Irradiation from the outside originates from the heat exchange with the place of installation promoted by the cabinet **1**, this phenomenon being most relevant in the areas of the compartment **2** that are close to the door

2^V.

[0184] On the contrary, the products **P** that are less subjected to radiation from the outside (typically located towards the side **2^{IV}** of the compartment **2**) are less affected than the products in view, since near the shelf there is a plurality of sub-flows of refrigerated air that are set in such a way as to keep all the products at the correct temperature with the least possible use of thermal energy.

[0185] In the embodiment of the cabinet illustrated in the **Figures**, the flow rate of the fans **39** is selected in such a way as to exploit the doors **2^V** as surfaces that rectify the air curtain.

[0186] In particular, the optimal flow rate is calculated as a compromise that makes it possible i) to obtain sufficient verticality of the air curtain or air knife by means of the doors **2^V** used as elements that rectify the flow lines, and ii) to avoid an excessive increase of the convective heat exchange action against said doors **2^{IV}** and thus of the consumption associated with the electric motor driving the fans **39**.

[0187] Preferably, with the same size of the slits **48**, it is possible to define an optimal flow rate of refrigerated air, which can be observed in the cases where the speed of the refrigerated air is included between 1.65 m/s and 2.0 m/s, the speed being measured at the intake area of the fans **39**.

[0188] For lower flow rates than the rated ones, the part of the air flow detaches from the inner surface of the door **2^V**, thus starting a "wave" motion that reduces efficiency and increases the temperature gradient inside the compartment.

[0189] When the air flow rate from the outlet nozzle of the duct is optimal, the air curtain propagates vertically in such a way as to evenly involve all the products to be refrigerated that are close to the door **2^V**. In other words, the flow of the air curtain delivered by the outlet nozzles **41** makes contact with the door **2^V** (when the latter is closed).

[0190] In this way, the swirling movements that are generated in the portion of the volume between the air curtain and the door **2^V** are eliminated, or at least reduced.

[0191] A substantially vertical curtain can be maintained also thanks to the horizontal sub-flows from the slits **48**, which all together prevent the air curtain from being directed towards the inside of the compartment **2** during its propagation from the top **2^{III}** to the bottom **2^V**.

[0192] **Figure 5** schematically illustrates the air flows that are generated inside the compartment **2**: the letter **K** indicates the air curtain that touches the door **2^V** while the letter **J** indicates the substantially horizontal sub-flows that come out of the slits and that have the function to hit the products resting on the shelves and "push" the air curtain **K** outwards so as to keep it in contact with the door **2^V**.

[0193] Conveniently, also in the configuration of the invention illustrated in **Figures** from **3** to **5** the third carrier

fluid 17 can be maintained at a temperature included between -2 °C and +1 °C. Obviously, what has been described above with reference to the operation of the first 4, the second 11 and the third circuit 16 applies also to this configuration of the cabinet 1.

[0194] In an alternative embodiment of the invention, not illustrated in the Figures, it is possible to use a single cooling system 3 (made up of the first 4, the second 11 and the third circuit 16 as described above) to condition a plurality of compartments 2 associated with different and distinct cabinets.

[0195] In this case, therefore, it is possible to at least partially centralize the configuration of the cooling system 3. In fact, there can be a single third circuit 16 installed above a cabinet 1 (in a manner similar to what is illustrated in Figure 2) and a single second circuit 11 connected to the third circuit 16 and provided with one or more heat exchangers 15 positioned outside the environment where the cabinets 1 are installed.

[0196] The single third circuit 16 can be connected to a plurality of first circuits 4, each associated with the compartment 2 of a corresponding cabinet 1; in particular, each first circuit 4 requires the use of a heat exchanger 8 fluidically connected to the compartment 2 of the cabinets 1.

[0197] In this way, several cabinets 1 can be installed in the same area, each cabinet 1 is provided with its own first circuit 4 (independent of the others) connected, however, to the same (and only) third circuit 16.

[0198] This configuration makes it possible to optimize the use of the components by employing a single third circuit 16 whose fluid 17 acts as the "master" for all the fluids 5 associated with the first circuits 4 connected to said third circuit 16.

[0199] The present invention can be carried out in other variants, all falling within the scope of the inventive features claimed and described herein; said technical features can be replaced by different technically equivalent elements and materials; the shapes and dimensions of the invention can be any, provided that they are compatible with its use.

[0200] The numbers and reference signs included in the claims and in the description are only intended to increase the clarity of the text and must not be considered as elements limiting the technical interpretation of the objects or processes identified by them.

Claims

1. A cabinet for the refrigeration and storage of food products (P), comprising:

- at least one refrigerated compartment (2);
- a system (3) suited to cool said at least one refrigerated compartment (2);

wherein said system (3) comprises:

- a first circuit (4) suited to promote the circulation of a first carrier fluid (5), said first circuit (4) being fluidically associated with said compartment (2) for the purpose of absorbing the heat (Q) present therein and cooling said compartment (2) to a predetermined temperature (T_{ref});
 - a second circuit (11) suited to promote the circulation of a second carrier fluid (12), said second circuit (11) being fluidically associated with an external environment (A) to promote the dissipation of at least part of the heat (Q) absorbed by said first fluid (5) within said compartment (2);
 - a third circuit (16) suited to promote the circulation of a third carrier fluid (17), said third circuit (16) being fluidically interposed between said first circuit (4) and said second circuit (11) in order to promote the exchange of heat (Q) between said third carrier fluid (17) and said first (5) and said second carrier fluid (12);
- wherein said system (3) comprises a single expansion element (20) associated with the third circuit (16) interposed between said first circuit (4) and said second circuit (11).

2. Cabinet according to claim 1, **characterized in that** said first carrier fluid (5) circulating within said first circuit (4) is maintained at a temperature between -2 °C and +1 °C.

3. Cabinet according to claim 1 or 2, **characterized in that** said first circuit (4), said second circuit (11) and said third circuit (16) are closed and fluidically separate from each other.

4. Cabinet according to one or more of the preceding claims, **characterized in that** said first carrier fluid (5) and/or said second carrier fluid (12) is/are different from said third carrier fluid (17).

5. Cabinet according to claim 4, **characterized in that** said first carrier fluid (5) is selected from the group comprising non-flammable carrier fluids, said second carrier fluid (12) is selected from the group comprising non-flammable carrier fluids and said third carrier fluid (17) is selected from the group comprising flammable carrier fluids.

6. Cabinet according to claim 4 or 5, **characterized in that** said first carrier fluid (5) and said second carrier fluid (12) are selected from the group comprising water and/or non-flammable glycol-based substances, said third carrier fluid (17) being selected from the group comprising propane-based natural refrigerants.

7. Cabinet according to one or more of the preceding claims, **characterized in that** said first circuit (4) and said second circuit (11) comprise respective pumps

- (7, 14) suited to promote the circulation of said first carrier fluid (5) and said second carrier fluid (12).
8. Cabinet according to claim 7, **characterized in that** said first circuit (4) comprises a first heat exchanger (8) associated with said refrigerated compartment (2), said second circuit (11) comprises a second heat exchanger (15) associated with the external environment (A), said first heat exchanger (8) and said second heat exchanger (15) being arranged fluidically in series with the respective pump (4, 17) of said first circuit (4) and of said second circuit (11).

5
10
 9. Cabinet according to one or more of the preceding claims, **characterized in that** said third circuit (16) comprises at least one compressor (18), a condenser (19), an expansion element (20) and an evaporator (21), said condenser (19) being arranged downstream of said compressor (18), said expansion element (20) being arranged downstream of said condenser (19), said evaporator (21) being arranged downstream of said expansion element (20) and upstream of said compressor (18).

15
20
 10. Cabinet according to claim 9, **characterized in that** said first circuit (4) comprises an additional heat exchanger (23) placed fluidically in contact with the evaporator (21) of said third circuit (16), said additional heat exchanger (23) being suited to promote the exchange of heat (Q) with said evaporator (21) in such a way as to cool said first carrier fluid (5) flowing out of said first heat exchanger (8) and to subsequently heat said third carrier fluid (17).

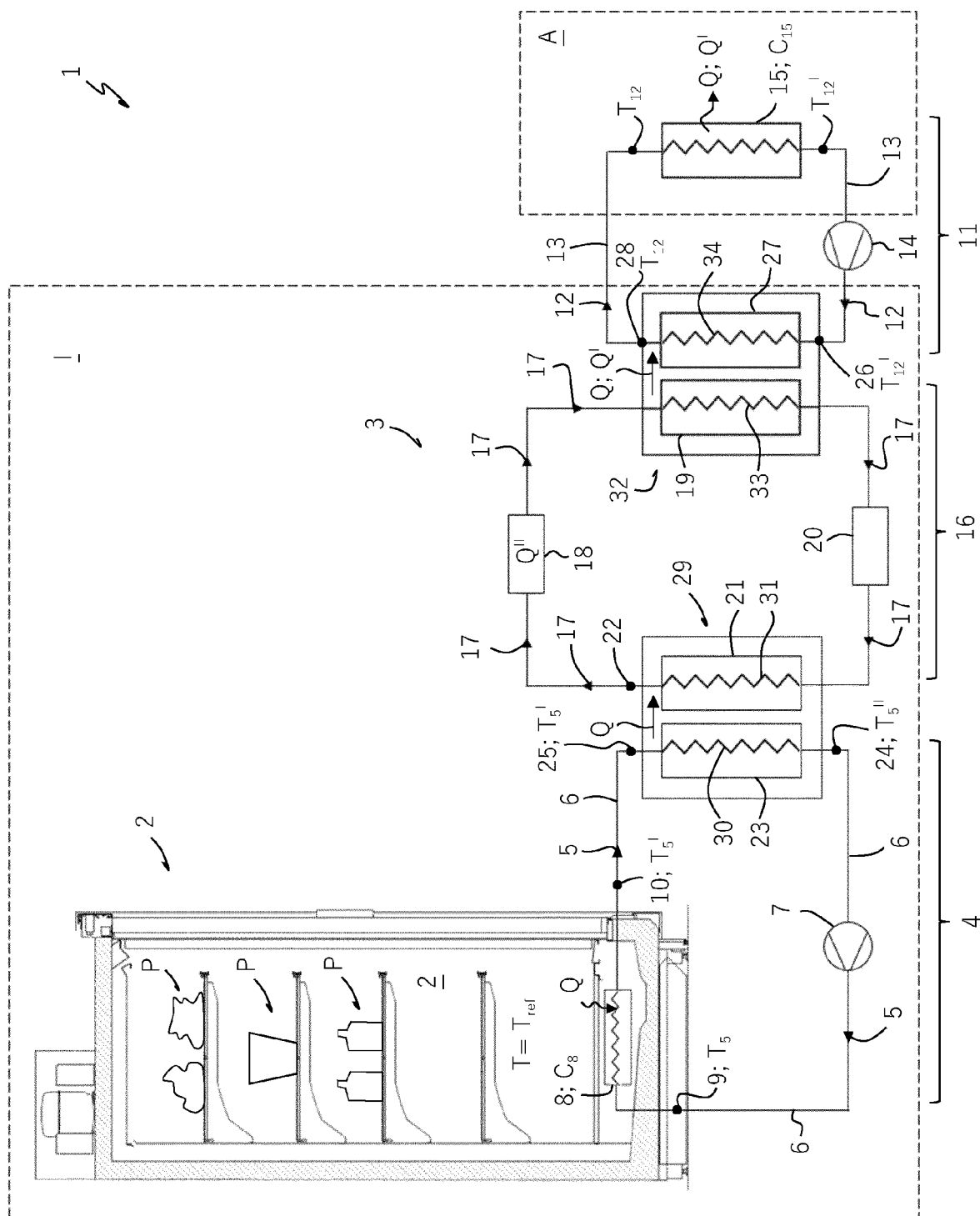
25
30
 11. Cabinet according to claim 10, **characterized in that** said evaporator (21) of said third circuit (16) and said additional heat exchanger (23) of said first circuit (4) are both made with a single heat exchanger element (29) provided with one pair of separate ducts (30, 31) between which the heat exchange is intended to take place, one of said ducts (30) being suited to promote the circulation of said first carrier fluid (5) and the other one of said ducts (31) being suited to promote the circulation of said second carrier fluid (17).

35
40
45
 12. Cabinet according to claim 10 or 11, **characterized in that** said second circuit (11) comprises an additional heat exchanger (27) placed fluidically in contact with the condenser (19) of said third circuit (16), said additional heat exchanger (27) being suited to promote the exchange of heat (Q) with said condenser (19) in such a way as to cool said third carrier fluid (17) downstream of said compressor (18) and to heat said second carrier fluid (12).

50
55
 13. Cabinet according to claim 12, **characterized in that** said condenser (19) of said third circuit (16) and said additional heat exchanger (27) of said second circuit (11) are both made with a single heat exchanger element (32) provided with one pair of separate ducts (33, 34) between which the heat exchange is intended to take place, one of said ducts (33) being suited to promote the circulation of said third carrier fluid (17) and the other one of said ducts (34) being suited to promote the circulation of said second carrier fluid (12).

5
 14. Cabinet according to claim 13, **characterized in that** said heat exchanger elements (29, 32) are selected from the group comprising plate heat exchangers or similar heat exchangers.
 15. Cabinet according to one or more of the preceding claims, **characterized in that** said system (3) comprises an aeraulic circuit (37) suited to promote forced air circulation within said refrigerated compartment (2), said aeraulic circuit (37) being fluidically associated with said first circuit (4).

FIG. 1



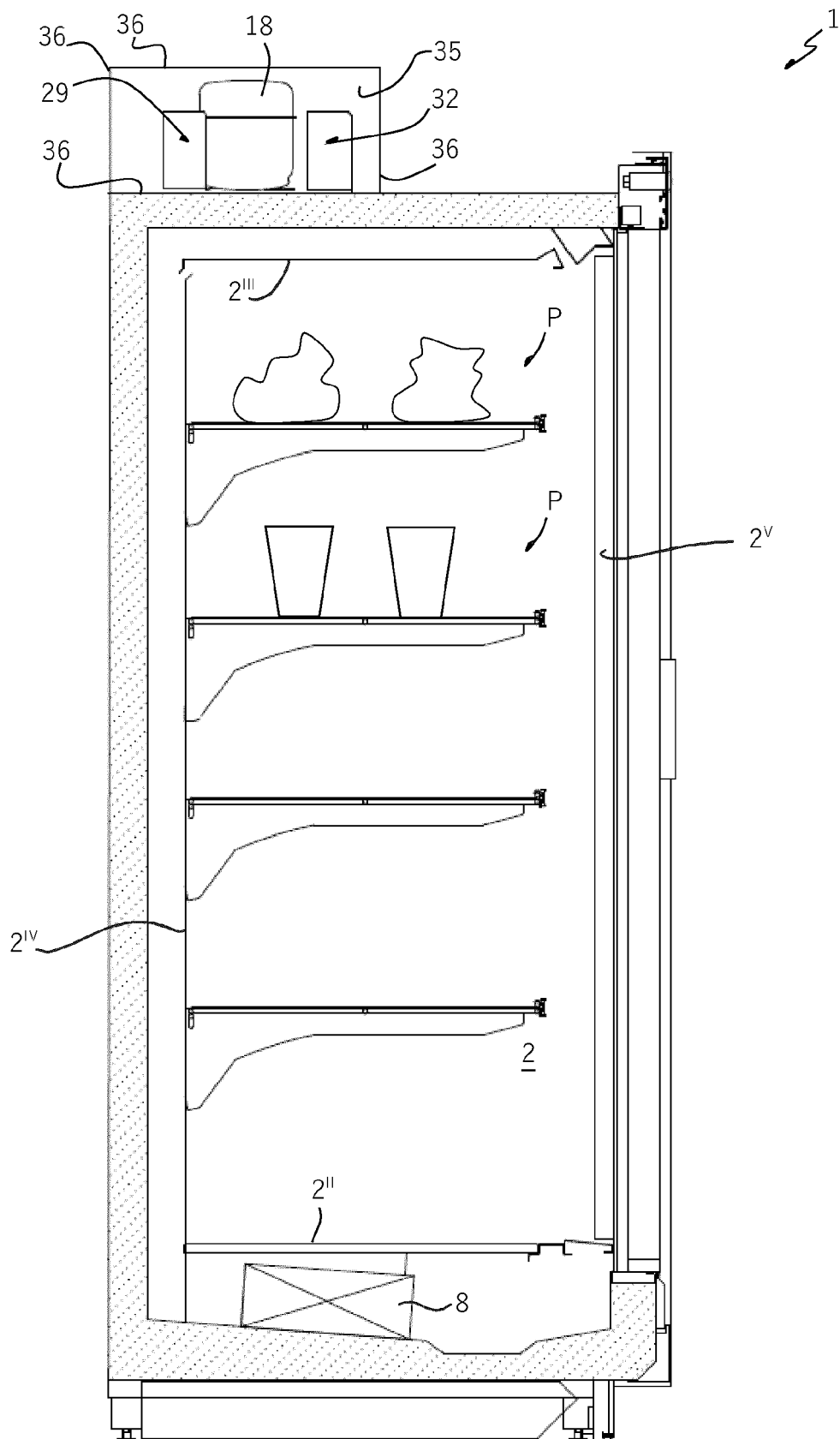


FIG. 2

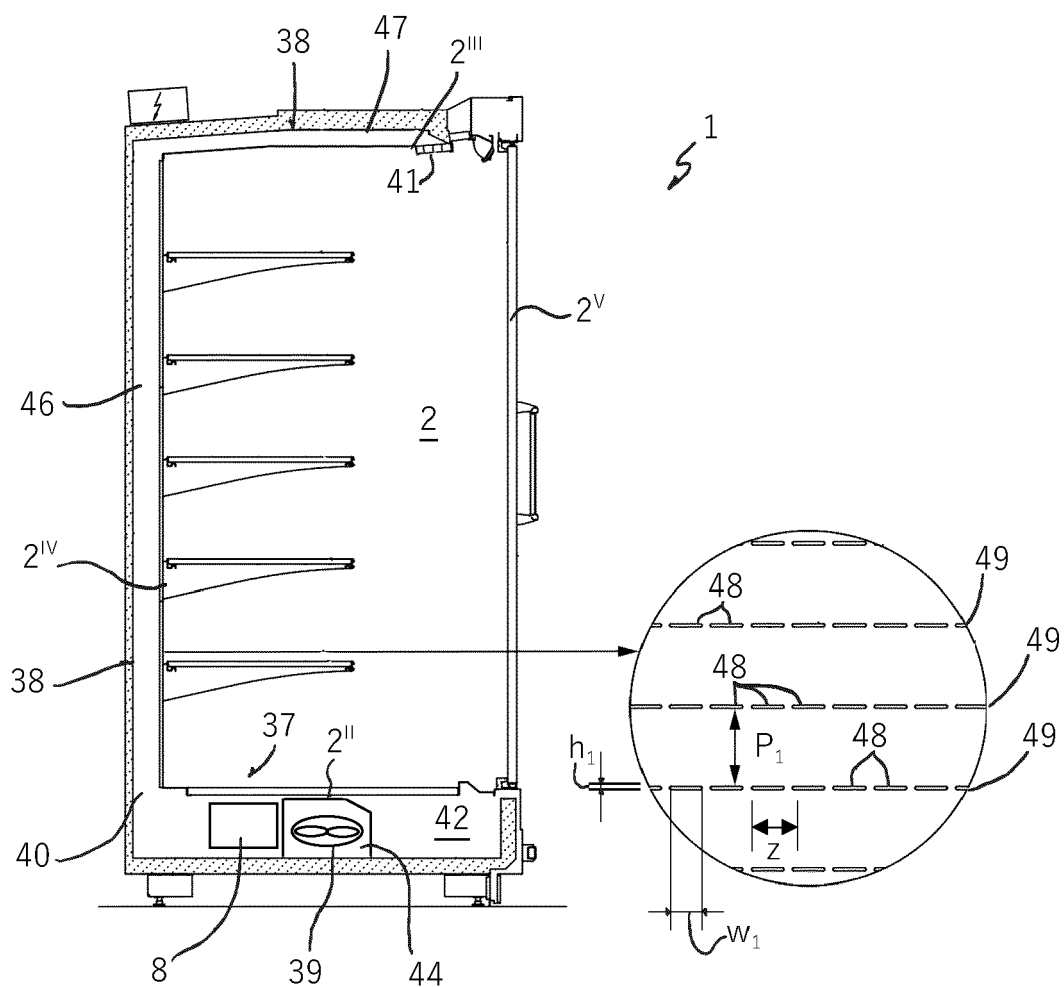


FIG. 3

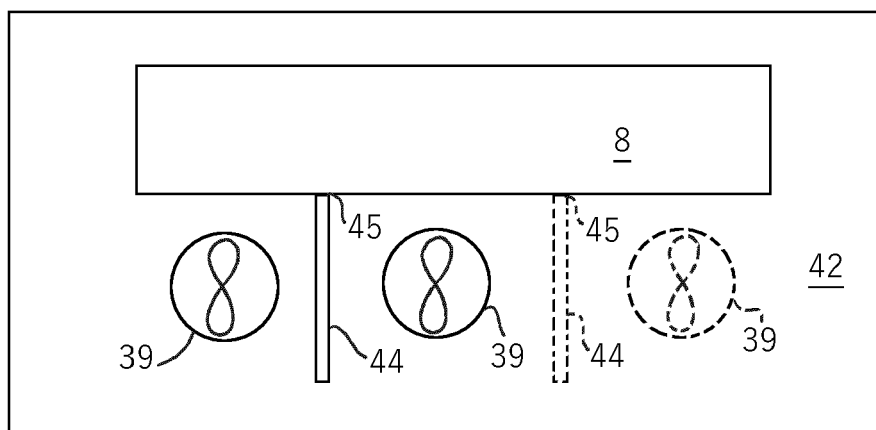


FIG. 4

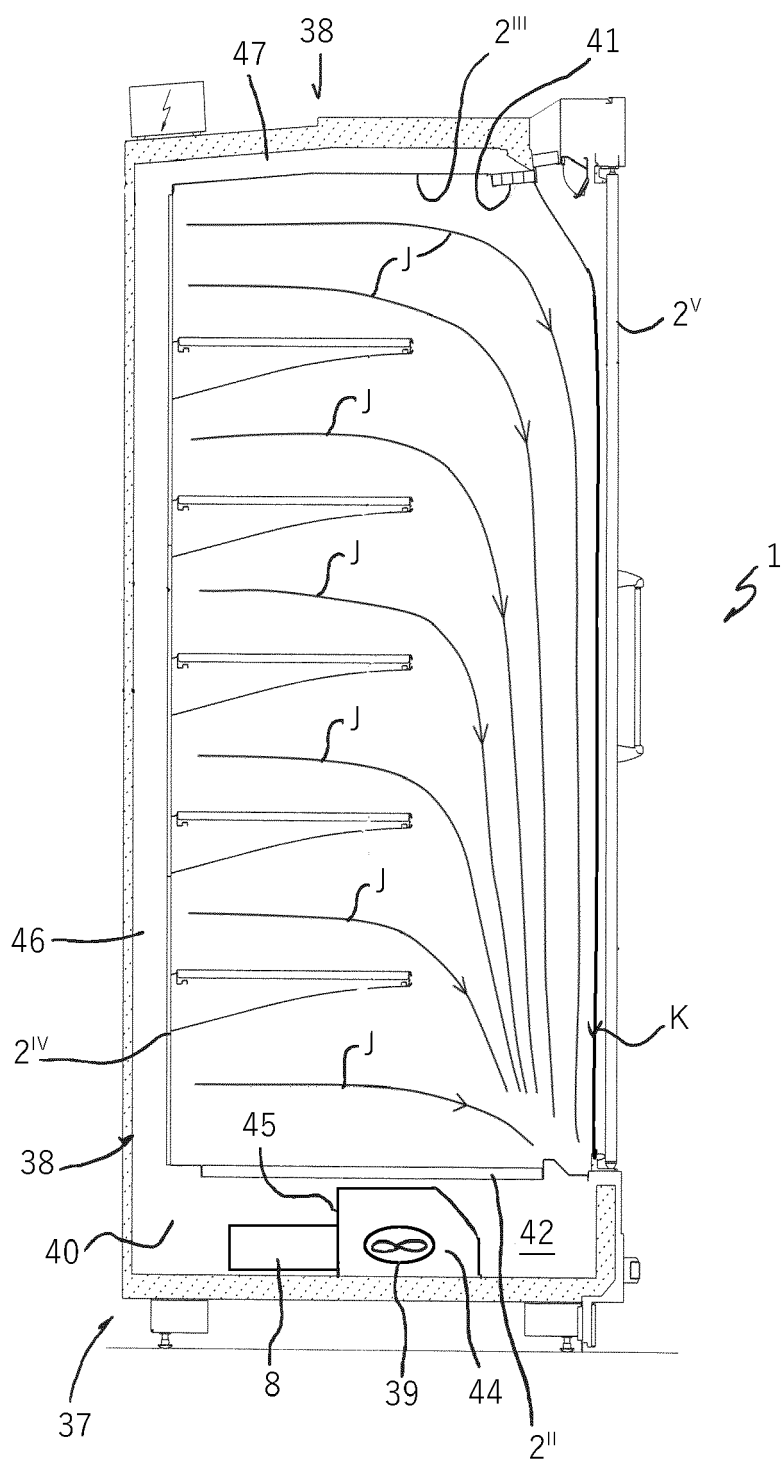


FIG. 5



EUROPEAN SEARCH REPORT

Application Number

EP 22 19 7604

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 2015/257548 A1 (SHAPIRO DORON [US] ET AL) 17 September 2015 (2015-09-17) * figure 6 * * paragraphs [0022], [0028], [0030] * -----	1-15	INV. F25B7/00
X	WO 90/14566 A1 (VP ENERGISYSTEM I PITEAA AB [SE]) 29 November 1990 (1990-11-29) * figure 2 * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			F25B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		12 January 2023	Dezso, Gabor
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			

EPO FORM 1503 03.82 (P04C01)

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

EP 22 19 7604

5

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.

12-01-2023

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
US 2015257548 A1	17-09-2015	AU	2015230002	A1		15-09-2016
		CA	2942346	A1		17-09-2015
		EP	3117161	A1		18-01-2017
		NZ	722954	A		28-06-2019
		US	2015257548	A1		17-09-2015
		WO	2015138051	A1		17-09-2015

WO 9014566 A1	29-11-1990	AT	108013	T		15-07-1994
		DE	69010337	T2		09-02-1995
		DK	0483161	T3		07-11-1994
		EP	0483161	A1		06-05-1992
		NO	174174	B		13-12-1993
		SE	463735	B		14-01-1991
		WO	9014566	A1		29-11-1990

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 20070056312 A [0024]
- US 20150257548 A [0024]