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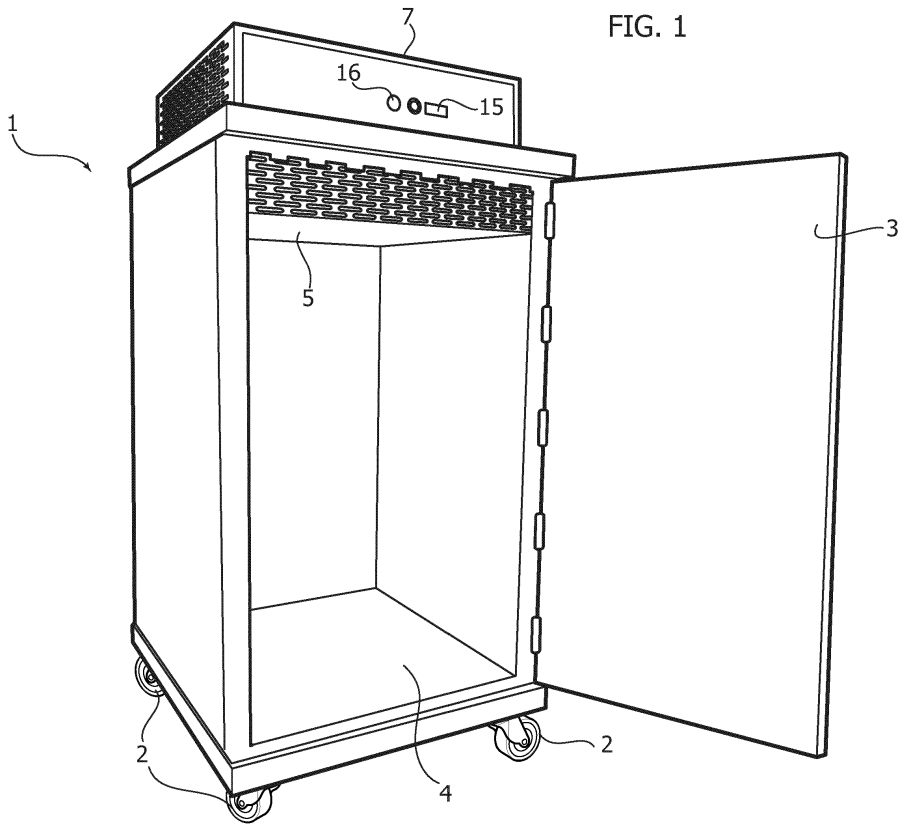
(54) ISOTHERMAL CONTAINER FOR TRANSPORTING PERISHABLE FOOD-STUFFS

(57) Isothermal container (1) for transporting perishable food-stuffs, comprising an inner compartment (4) for storing the food-stuffs and at least one vessel (17, 18; 25) containing a refrigerant substance for maintaining in the compartment (4) a cooling temperature for preserving fresh food-stuffs or a freezing temperature for preserving frozen food-stuffs. The refrigerant substance is a eutectic liquid and the isothermal container (1) is provided with a frigorific assembly (8) fixed outside the compartment (4) and designed to be connected to an electric power source, when available, for selectively and adjustably cooling the eutectic liquid.

FIG. 1



EP 3 244 144 A1

Description

Field of the invention

[0001] The present invention refers to isothermal containers for transporting perishable food-stuffs, particularly for the large-scale distribution, comprising an inner compartment for storing the food-stuffs and at least one vessel containing a refrigerant substance for maintaining a cooling temperature for preserving fresh food-stuffs or a freezing temperature for preserving frozen food-stuffs in the compartment.

State of the prior art

[0002] Isothermal containers thus made are for example known from documents EP-0337860, EP-075816, EP-0823600 and EP-0863374, according to which the refrigerant substance is made up of dry ice contained in a drawer arranged in the upper area of the compartment of the isothermal containers. Dry ice is obtained by means of specific equipment for injecting CO2 into the drawer and this entails costs, dosage difficulty as well as environmental pollution risks. The refrigerant effect that can be obtained with this solution generally has a limited duration in particular when it comes to maintaining the freezing temperature of frozen food-stuffs.

[0003] The use of refrigerant substances made up of eutectic liquids or mixtures, i.e. substances whose melting point is lower than that of the single substances they are made up of is also known in the prior art. Typically, this solution is used for small isothermal containers designed to hold a meal and kept in a store provided with an external and separate heat regulation unit, like in the case described in US-8952556, or in a household refrigerator, like in the case described in EP-1939554. In both cases, the container with the frozen eutectic liquid and the food-stuffs is removed from the store or respectively from the refrigerator so as to be preserved in an external environment for a limited period of time.

[0004] Another solution, described in document FR-3007114, provides for the use of a thermal-chemical system including a reservoir forming an evaporator and containing a liquefied gas capable of combining with a reactive product contained in a reactor, and switch valves designed to be activated to cool or heat the food-stuffs container are provided.

[0005] In a further solution, document US-7600392 describes a first cooling sub-system of the compressor type, supplied by an electric source, and a second cooling subsystem constituted by a eutectic accumulator. When power-supplied, the first cooling sub-system cools the second cooling sub-system through a first circuit, and a second circuit through which the second cooling sub-system cools the food-stuffs container in absence of electrical power supply is provided. This solution is particularly complex due to the presence of the second circuit.

[0006] Document US-2011/0067852 discloses a controlled temperature container in which providing the container with vessels i.e. plates containing different eutectic liquids, respectively one for cooling and the other for heating is provided for.

[0007] All these prior art solutions are inappropriate for transporting perishable food-stuffs for large-scale distribution, both due to their complexity and the difficulty of regulating and maintaining the required conditioning of the food-stuffs, whether fresh or frozen, at the appropriate cooling or freezing temperatures over long periods of time.

Summary of the invention

[0008] The object of the invention is to overcome the aforementioned drawbacks, and this object is attained thanks to an isothermal container for transporting perishable food-stuffs as defined in claim 1.

[0009] Thus, the isothermal container is provided with two vessels, each containing a respective cooling eutectic liquid having a different freezing temperature with respect to the other, and the frigorific assembly fixed outside the container comprises two compressors and two evaporators designed to independently cool the eutectic liquid in each vessel to a respective different selectively and adjustably pre-set temperature.

[0010] The two vessels conveniently have a differentiated volume, greater for the vessel of the eutectic liquid with lower freezing temperature.

[0011] The two vessels may be arranged adjacent to each other, or one may be contained inside the other.

[0012] The frigorific assembly conveniently comprises a single capacitor connected to two evaporators, constituted by respective coils contained in the aforementioned vessels.

[0013] Thanks to this solution idea, the isothermal container according to the invention is capable of attaining considerable advantages in terms of duration in absence of electrical power supply, the duration of the refrigerant effect, rapidity of conditioning to the desired cooling or freezing temperatures when the frigorific assembly is running, transportability on board distribution vehicles, even of the electric drive type, and easy to recycle at the end of the life cycle thereof.

Brief description of the drawings

[0014] Further characteristics and advantages of the invention will be apparent from the following detailed description, with reference to the attached drawings provided by way of non-limiting example, wherein:

- figure 1 is a schematic perspective view of an isothermal container according to the invention for transporting perishable food-stuffs,
- figure 2 is a perspective and partly broken view of a part of the frigorific assembly of the isothermal container,

- figure 3 is a perspective view showing an arrangement of the vessels containing eutectic liquid,
- figure 4 is an exploded perspective view of one of the vessels,
- figure 5 is a perspective exploded view of the other vessel,
- figure 6 is a diagram showing the circuit of the frigorific assembly, and
- figure 7 is an exploded perspective view of a variant of the eutectic liquid vessel.

Detailed description of the invention

[0015] Solely with reference to figure 1, an isothermal container of the generally conventional type, formed by a parallelepiped-shaped body obtained through rotational moulding with a monobloc structure, without corners, gaskets and welding, is indicated in its entirety with 1. The outer shell is made of polyethylene and the insulation is made of polyurethane foam enclosed in the polyethylene shell.

[0016] The container 1 is provided - at the lower part - with swivelling wheels 2 and - at the front part - with a door 3, having the same monobloc structure, for sealingly closing an inner compartment 4 for storing perishable food-stuffs to be transported for distribution.

[0017] The upper area of the inner compartment 4 has a receptacle 5, to be addressed hereinafter, provided with a front grid 6.

[0018] A box fixed permanently and stably outside the upper wall of the container 1, i.e. at the top part thereof, and containing most of the frigorific assembly 8, represented in figure 2 and whose circuit is shown in figure 6 by way of example, is indicated with 7. In the case of the illustrated example, the frigorific assembly 8 comprises a pair of motor compressors 9, 10 connected to a common capacitor 11 on one side and to a pair of coil evaporators 12, 13 - illustrated in figures 4 and 5 - on the other. The frigorific assembly 8 further comprises an electronic control unit 14 to which there are operatively associated temperature sensors and probes - not illustrated - as well as a switch 15 and a selector 16 arranged on the front wall of the box 7, as represented in figure 1.

[0019] A first and a second vessel each containing a refrigerant substance constituted by a respective eutectic liquid, are indicated with 17, 18. The vessels 17 and 18 are constituted by hermetically sealed vats, provided - at the top part - with respective release valves 19, 20 for compensating the internal pressure, and one containing the coil evaporator 12 and the other the coil evaporator 13.

[0020] The coil 12 is provided with respective inlet 21 and outlet 22 ducts projecting upwards from the vessel 17 for respectively connecting with the compressor 9 and the capacitor 11, and the coil evaporator 13 is similarly provided with respective inlet 23 and outlet 24 ducts also projecting above the vessel 18 for connecting to the compressor 10 and to the capacitor 11 of the frigorific assembly 8.

[0021] Preferably, the vessel refrigerant circuit 17 ("cooling circuit") as well as the vessel refrigerant circuit 18 (" freezing circuit") use a refrigerant gas R507.

[0022] In the case of the example described herein, the two vessels 17 and 18 are fixedly and adjacently positioned inside the receptacle 5 located at the upper part of the compartment 4, immediately beneath the upper wall of the isothermal container 1 to which the box 7 with the frigorific assembly 8, behind the grid 6, is fixed.

[0023] The vessel 17 for example measures about a third of the size of the vessel 18 and it contains about 18.5 1 of a eutectic mixture for example made up of water and a thickener, whose eutectic temperature is 0°C.

[0024] The larger vessel 18 contains about 30.5 1 of eutectic mixture for example made up of water, NaCl and thickener, whose eutectic temperature is -21°C for example. Both vessels 17 and 18 are not fully filled with the respective eutectic liquids, given that the volume increase of the eutectic mixture in the freezing stage obviously has to be taken into account.

[0025] The frigorific assembly 8 can be adjustably and selectively used, through the selector 16, for creating a cooled or frozen environment in the isothermal container 1, depending on the condition of the perishable food-stuffs introduced into the compartment 4 for transportation in use. The motor compressors 9, 10, when connected to power mains and supplied at 230 Vac and 50 Hz, are capable of cooling the eutectic liquid contained in one or the other vessel 17, 18 within eight hours approximately. Once the frigorific assembly 8 is disconnected from the power mains, the isothermal container 1 is used for transporting the perishable food-stuffs at a controlled temperature: the thermal energy accumulated by the eutectic liquid contained in the vessel 17 and 18 is released into the compartment 4 and it enables transporting fresh or frozen food-stuffs for several hours, without requiring further power supply.

[0026] The operating modes of the frigorific assembly 8 in the two different modes, designed to be set through the selector 16 respectively for transporting fresh food-stuffs and frozen food-stuffs are described below.

[0027] When conditioning the isothermal container 1 for transporting fresh goods, after connecting to the power mains and setting the selector 16 to the corresponding "fresh" position, both compressors 9, 10 are activated. The compressor 10 associated to the vessel 18 automatically stops when the eutectic mixture therein reaches the temperature of -10°C: this value can be changed by means of an electronic thermostat connected to the control unit 14. The compressor 9 associated to the vessel 17 automatically stops when the eutectic mixture therein reaches the temperature of -20°C, so as to be sure that the state of such mixture has fully changed.

[0028] The average time required for conditioning the isothermal container 1 for transporting fresh products is approximately eight hours: temperature detection in both vessels 17 and 18 is carried out by means of probes, not

illustrated, positioned therein. The end of the conditioning cycle may be signalled by means of a light warning.

[0029] It should be observed that the cooling of the vessel 18 for conditioning the isothermal container 1, even for transporting fresh products, is carried out so as to prevent the thermal energy accumulated in the vessel 17 from being absorbed by the eutectic mixture contained in the vessel 18.

[0030] The temperature inside the isothermal container 1 is conveniently displayed on the front wall of the box 7.

[0031] Experimental tests carried out by the Applicant revealed that at the end of this conditioning cycle the isothermal container 1 is capable of guaranteeing an approximately 72-hour duration for transporting fresh food-stuffs without requiring power supply (tests carried out in climatic chambers with food-stuffs equivalent to 10% of the useful capacity of the isothermal container 1 and at a 30°C room temperature).

[0032] When conditioning the isothermal container 1 for transporting frozen food-stuffs, after connecting the frigorific assembly 8 to the power mains and setting the selector 16 to the "frozen" position, both compressors 9, 10 are activated even in this case. The compressor 9 stops when the eutectic mixture contained in the vessel 18 reaches a temperature of -20°C. The compressor 10 instead stops after the eutectic mixture in the vessel 17 reaches -40°C, so as to be sure that the state of the eutectic liquid has fully changed. The average time required for conditioning the isothermal container 1 for transporting frozen food-stuffs is eight hours in this case too.

[0033] It should be observed that when conditioning the isothermal container 1 for transporting frozen products, the vessel 17 is also cooled so as to prevent the thermal energy accumulated in the vessel 18 from being absorbed by the eutectic mixture contained in the vessel 17.

[0034] Experimental tests carried out by the Applicant revealed that the isothermal container 1 has an approximately 24-hour duration for transporting frozen goods at a temperature below -18°C without requiring power supply (test carried out in climatic chambers with food-stuffs equivalent to 40% of the useful capacity of the isothermal container 1 and at a 25°C room temperature).

[0035] According to a first variant of the invention, not represented in the drawings, instead of two adjacently arranged vessels for holding two different eutectic mixtures, a solution wherein the vessel 17, possibly replaced by a flexible bag, is contained in the vessel 18 can be envisaged. In this case, when the temperature of the outer vessel 18 reaches -10°C the eutectic liquid contained in the inner bag accumulates energy and the surrounding eutectic liquid will keep it solidified. In this manner, the system will have plenty of energy to release so as to keep the temperatures positive.

[0036] When the eutectic liquid in the outer vessel 18 is cooled up to -30°C, cooling all the liquid present therein including the one contained in the inner vessel 17 to the temperature of -21°C, it solidifies accumulating energy, which will be released during transportation.

[0037] In this variant, the inner vessel 17 may be made of various materials, for example steel or plastic material.

[0038] In a second variant, also not represented in the drawings, a single motor compressor capable of supplying the two frigorific circuits, can be provided instead of two motor compressors 9, 10.

[0039] A third variant, represented in figure 7, provides for the use of one vessel 25 with capacity substantially equal to the sum of the capacities of the two vessels 17 and 18 and containing one coil evaporator 26 connected to the frigorific assembly 8, which will include one motor compressor even in this case. In this case, the vessel 25 will contain the eutectic mixture of the type appropriate to preserve fresh food-stuffs or of the type appropriate to preserve frozen food-stuffs. Obviously, with this simplified variant, the isothermal container 1 can only be used either for one or for the other type of food-stuffs.

[0040] The advantages of the isothermal container according to the invention can be summarised as follows:

- the system can be conditioned by connecting to the mains and then it can be used on transportation means without requiring connection to the mains power supply,
- the system enables conditioning the refrigerant vessels stably fixed in an isothermal container, thus enabling avoiding having to move additional eutectic plates and it enables using a freezer/chiller for conditioning the eutectic plates,
- the system enables storing food-stuffs in the isothermal container, maintaining the controlled temperature awaiting transportation,
- the system enables transporting both fresh and frozen food-stuffs depending on the daily needs,
- the system can be transported by air without any limitations,
- the vessel containing the eutectic liquid with lower freezing point stores energy at -21°C for example, and the isothermal period occurs at this temperature due to the latent heat of fusion, thus all accumulated energy is released. The vessel containing the eutectic liquid with freezing point at 0°C stores energy at this temperature, at which the isothermal period occurs due to the latent heat of fusion, thus the relative accumulated energy is released. This enables transporting frozen or fresh food-stuffs without deterioration.

[0041] Obviously, the construction details and the embodiments may widely vary with respect to what has been described and illustrated, without departing from the scope of protection of the present invention as defined in the claims that follow.

Claims

1. Isothermal container (1) for transporting perishable food-stuffs, comprising an inner compartment (4) for storing food-stuffs and at least one vessel (17, 18; 25) containing a refrigerant substance for maintaining in the compartment (4) either a cooling temperature for the preservation of fresh food-stuffs or a freezing temperature for the preservation of frozen food-stuffs, **characterised in that** it comprises two vessels (17, 18) each containing a respective refrigerant eutectic liquid with freezing temperature different from the other, and **in that** the isothermal container (1) is provided with a frigorific assembly (8) fixed outside the compartment (4) and designed to be connected to an electric power source, when available, said frigorific assembly (8) comprising at least one compressor (9, 10) and two evaporators (12, 13) designed to independently cool the eutectic liquid in each vessel (17, 18) to a respective selectively and adjustably pre-set temperature.

2. Isothermal container according to claim 1, **characterised in that** said two vessels (17, 18) have a differentiated volume, greater for the vessel (18) of the eutectic liquid with lower freezing temperature.

3. Isothermal container according to claim 2, **characterised in that** the vessel (18) of the eutectic liquid with lower freezing temperature has dimensions substantially equivalent to three times the dimensions of the vessel (17) of the eutectic liquid with less low freezing temperature.

4. Isothermal container according to one or more of claims 1 to 3, **characterised in that** said two vessels (17, 18) are arranged adjacent to each other.

5. Isothermal container according to one or more of claims 1 to 3, **characterised in that** said two vessels (17, 18) are arranged one inside the other.

6. Isothermal container according to any one of claims 1 to 5, **characterised in that** said frigorific assembly (8) can be set so as to cool said eutectic liquids according to differentiated modes.

7. Isothermal container according to one or more of claims 1 to 6, **characterised in that** the frigorific assembly (8) comprises a pair of compressors (9, 10) and a pair of coil evaporators (12, 13) fitted into said vessels (17, 18).

8. Isothermal container according to claim 7, **characterised in that** the frigorific assembly (8) comprises a single capacitor (11).

9. Isothermal container according to one or more of claims 1 to 8, **characterised in that** the eutectic liquid in one vessel (17) has a freezing temperature of about 0°C and the eutectic liquid in the other vessel (18) has a freezing temperature of about -21°C.

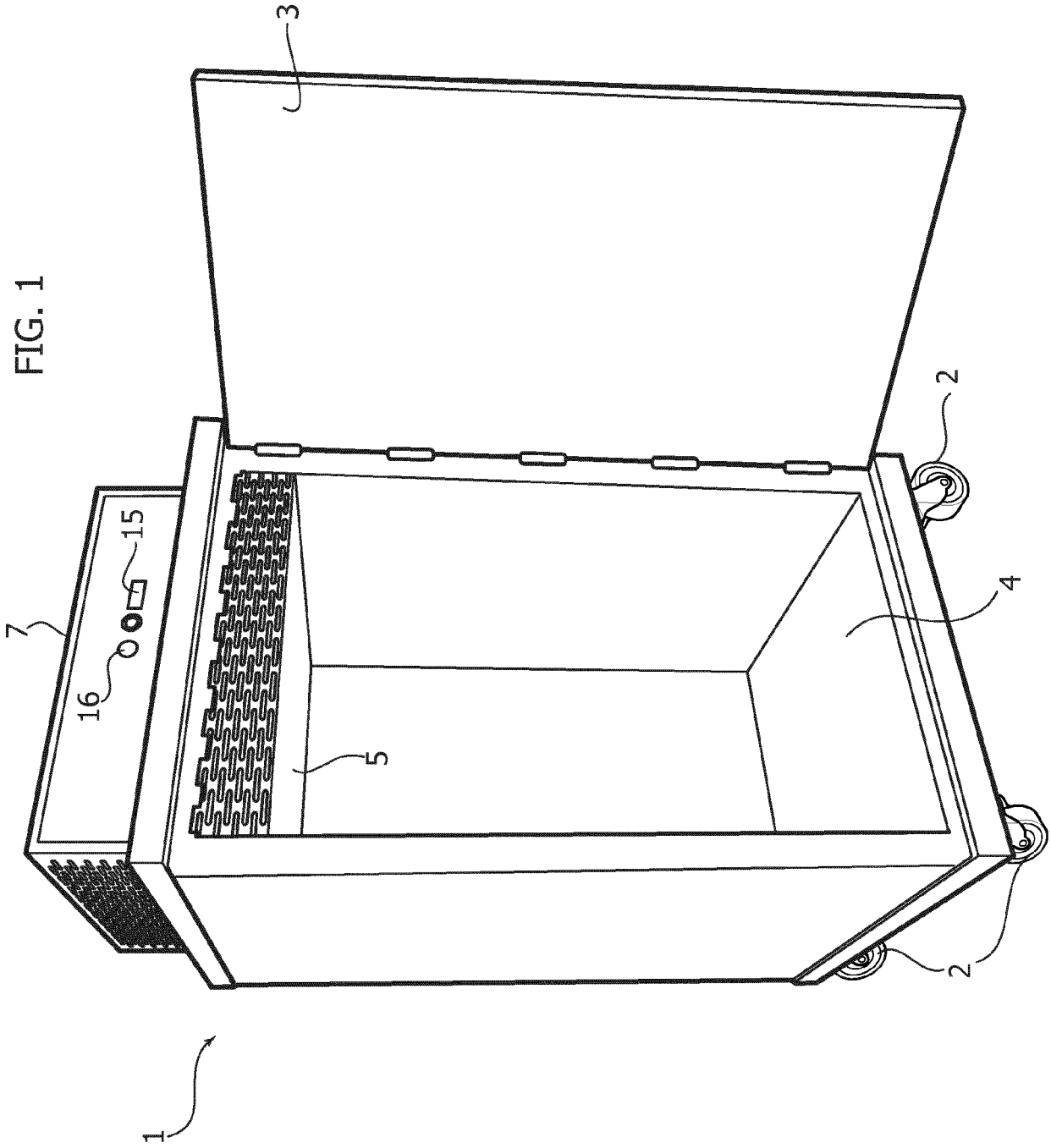
10. Isothermal container according to any one of the preceding claims, **characterised in that** the frigorific assembly (8) is fixed on top of the isothermal container (1) and the or each vessel (17, 18; 25) containing the eutectic liquid is installed in the upper area of said compartment (4).

11. Isothermal container, according to any one of claims 1 to 10, **characterised in that** for transporting fresh food-stuffs one vessel (17) is cooled to a temperature of about -20°C and the other vessel (18) is cooled to a temperature of about -10°C.

12. Isothermal container, according to any one of claims 1 to 10, **characterised in that** for transporting frozen food-stuffs one vessel (17) is cooled to a temperature of about -40°C and the other vessel (18) is cooled to a temperature of about -20°C.

13. Isothermal container according to one or more of the preceding claims, **characterised in that** each vessel (17, 18; 25) is provided with a respective release valve (19, 20).

FIG. 1



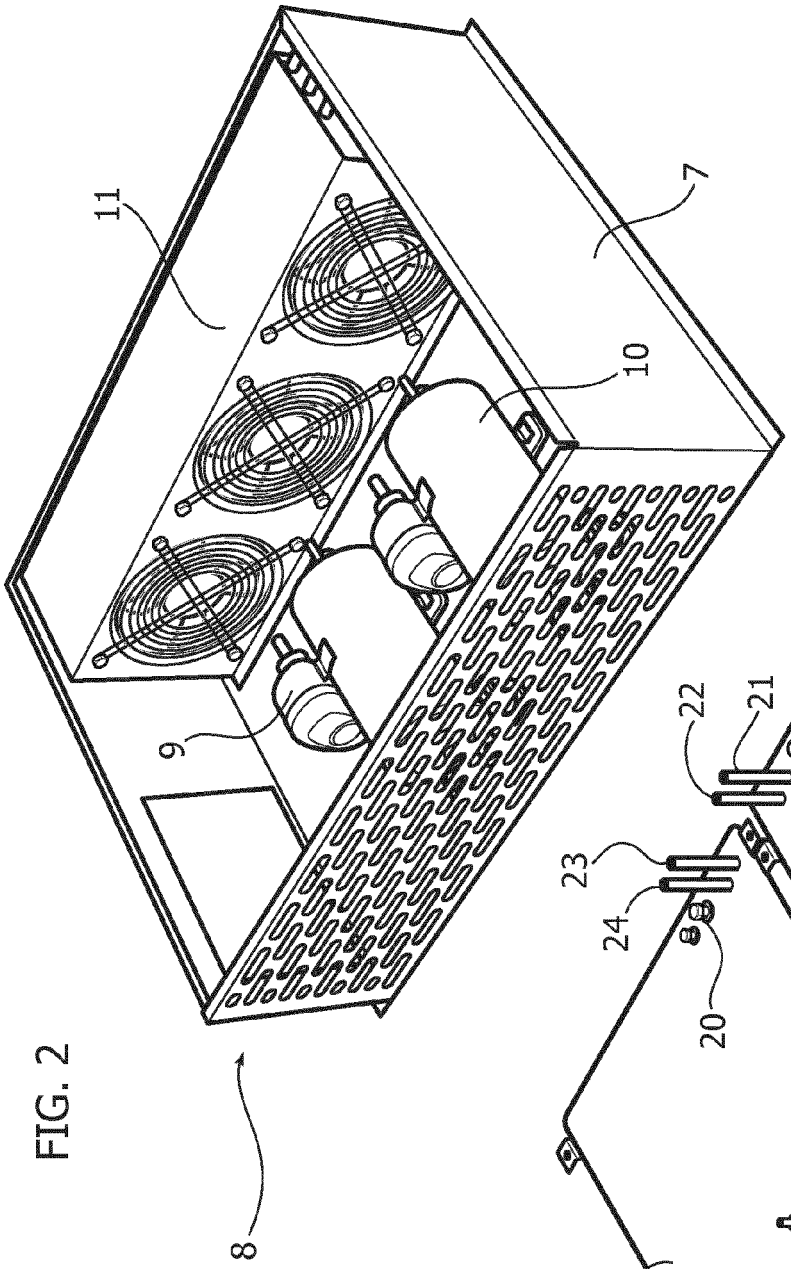


FIG. 2

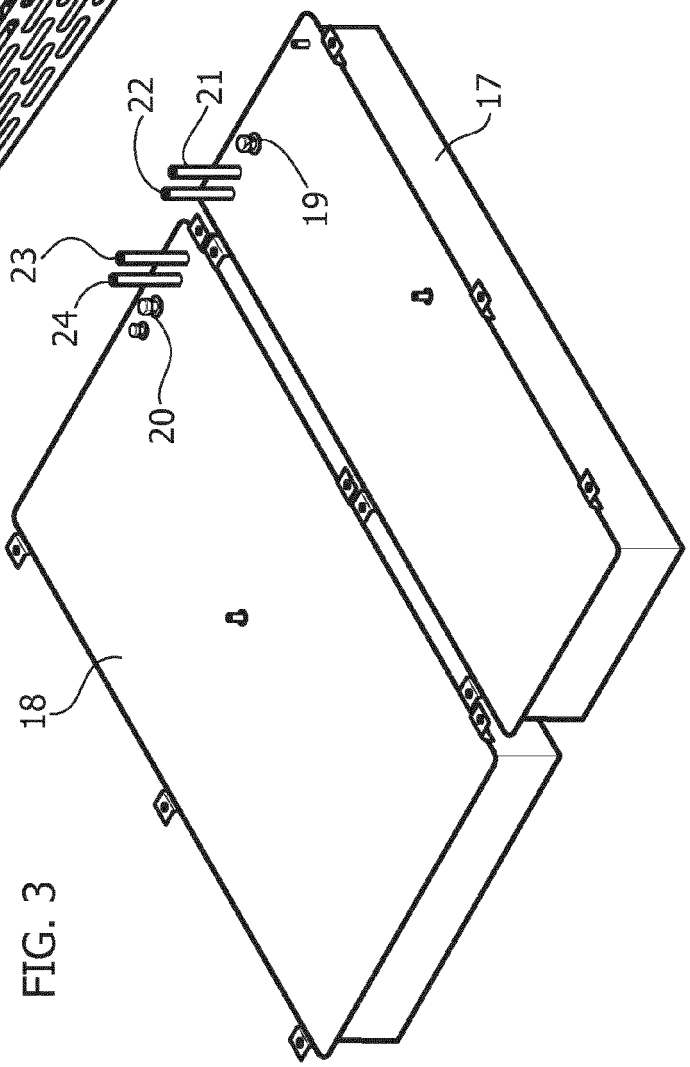


FIG. 3

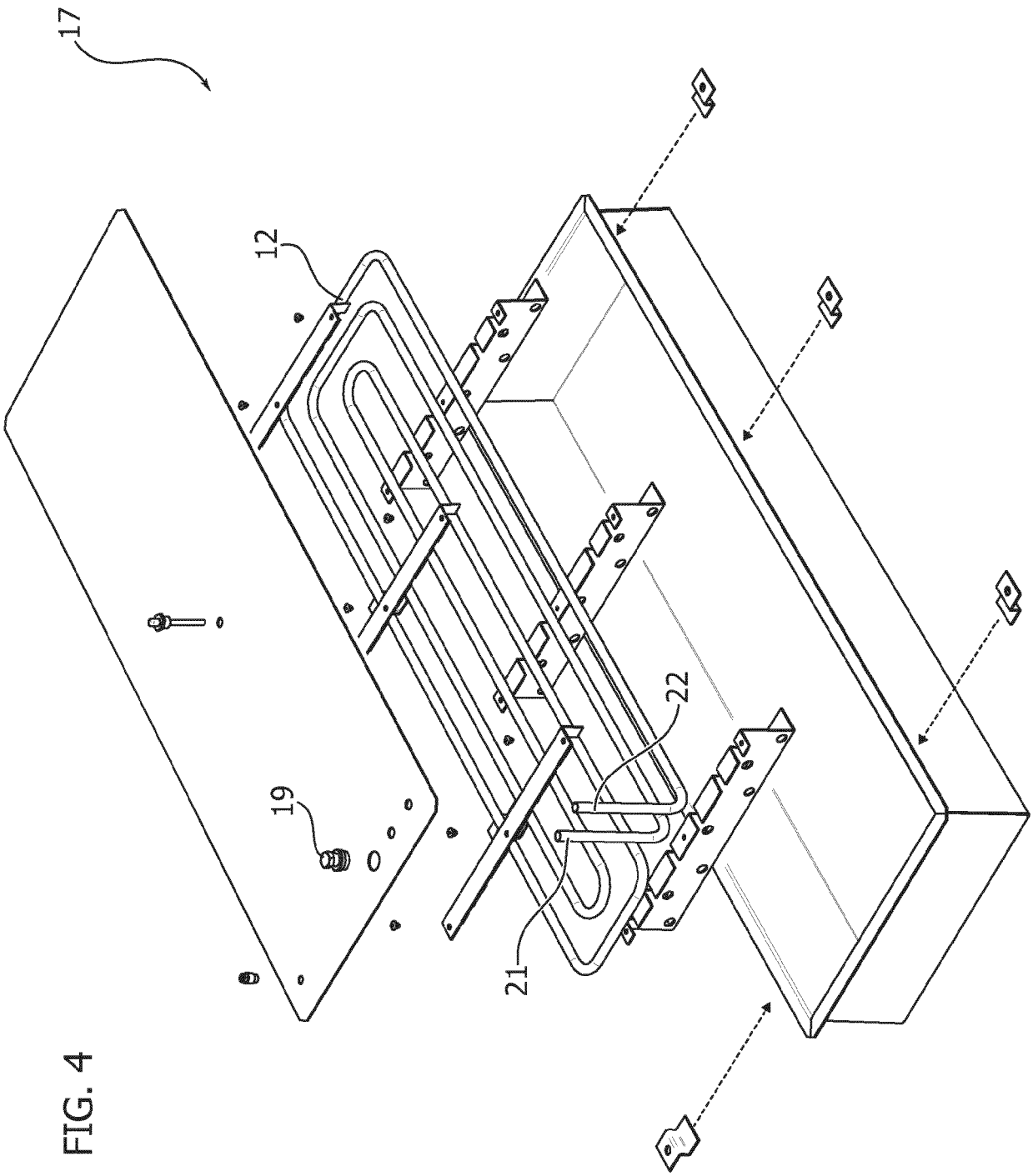


FIG. 4

FIG. 5

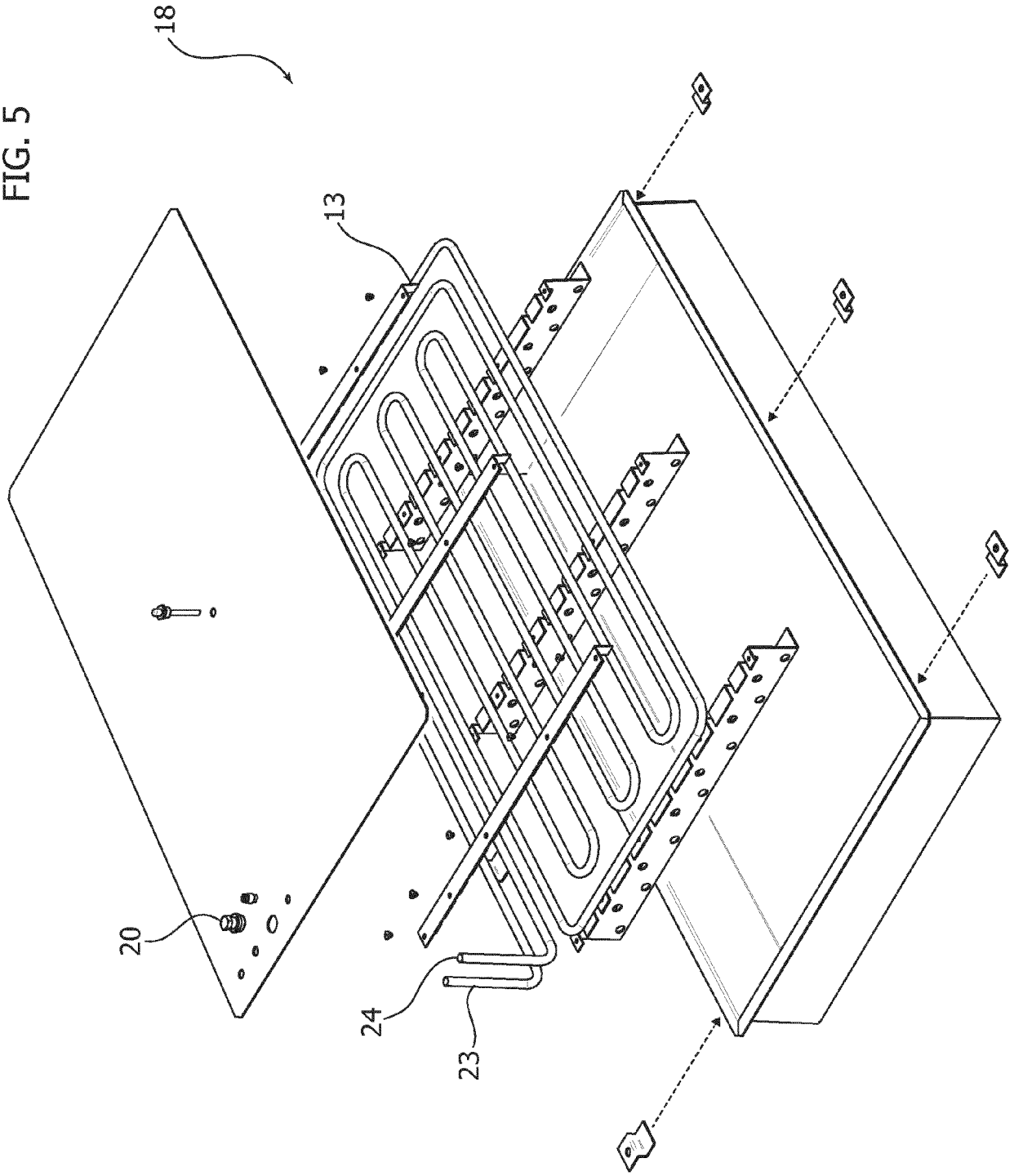


FIG. 6

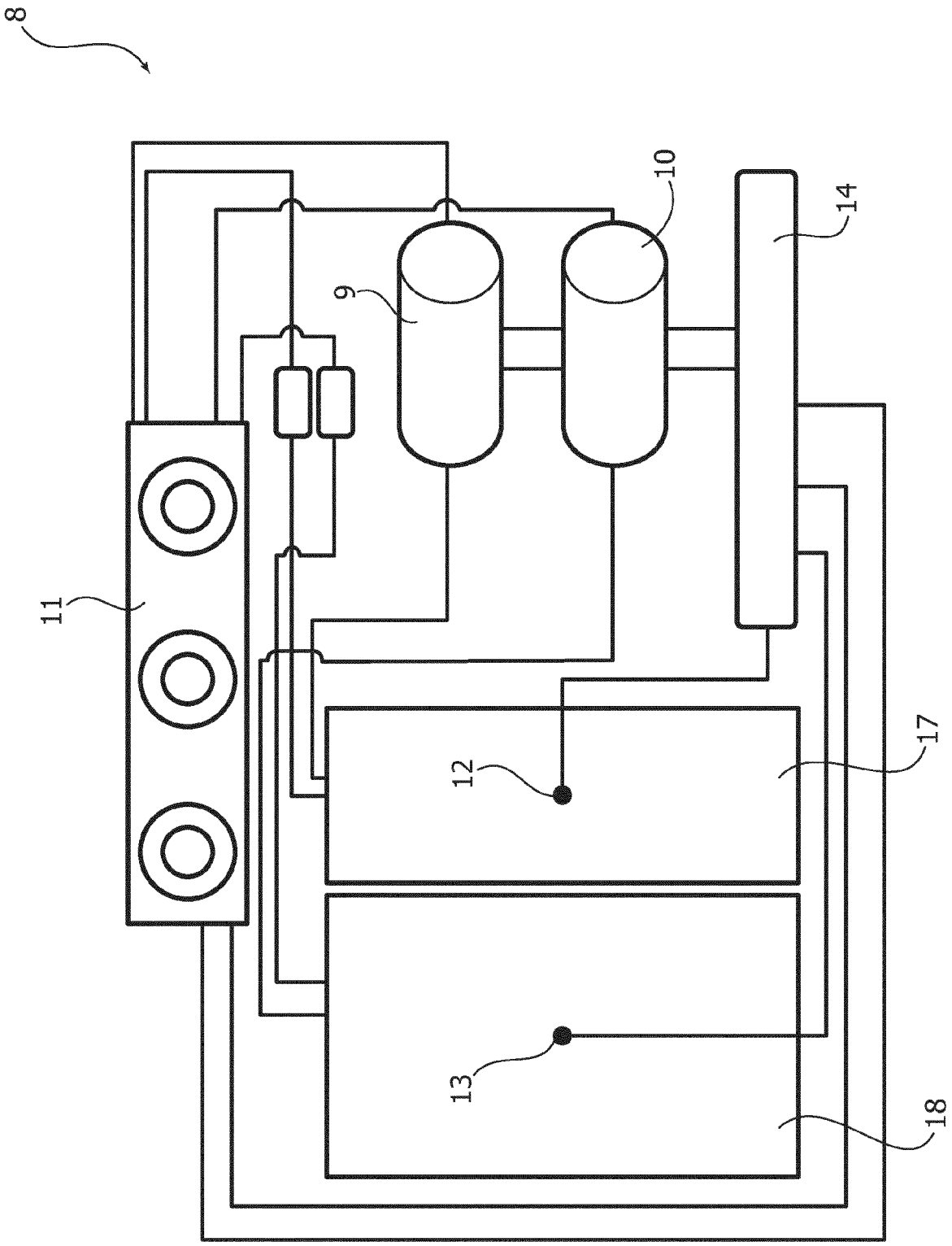
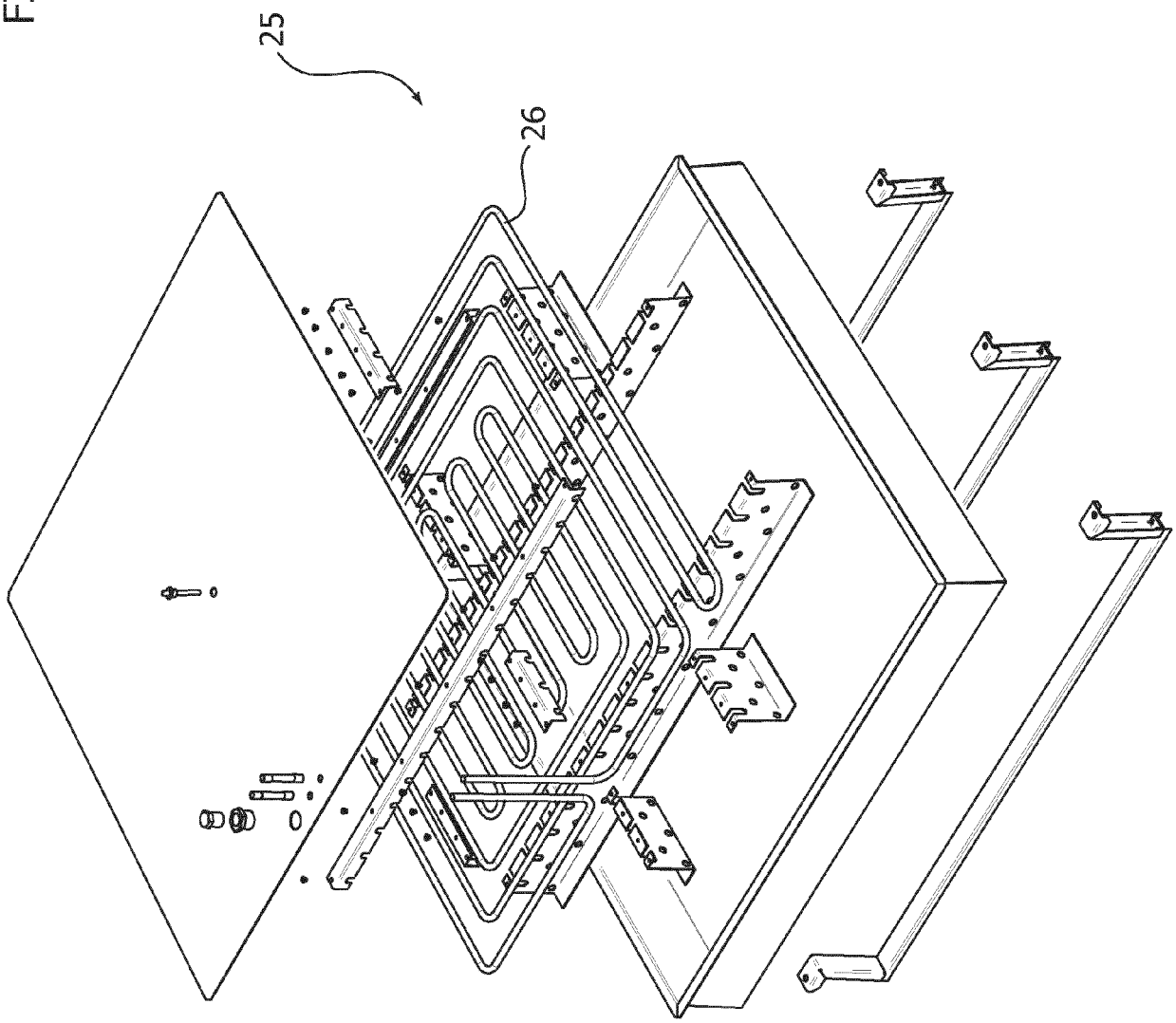


FIG. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 17 17 0355

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 Y	US 2011/067852 A1 (FARRAR DAVID SCOTT [US]) 24 March 2011 (2011-03-24) * paragraphs [0042], [0046]; figures 1,2,3,6,7 * -----	1-8 9-13	INV. F25D11/00 F25D16/00
A	WO 2006/007663 A1 (ERA ENVIRONMENTAL REFRIGERATIO [AU]; WILLIAMS THEODORE DAVID [AU]; COU) 26 January 2006 (2006-01-26) * page 1, lines 5-7 * * page 3, lines 19-28; figures * -----	1	
A	US 2015/233617 A1 (CHOU FONG-LI [US] ET AL) 20 August 2015 (2015-08-20) * paragraph [0035]; figures * -----	1	
Y	EP 1 236 960 A1 (HIGH TECHNOLOGY PARTICIPATION [LU]) 4 September 2002 (2002-09-04) * paragraph [0034]; figures * -----	9-13	
A	DE 10 2010 041951 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 5 April 2012 (2012-04-05) * paragraph [0043]; figure 3 * -----	1-13	TECHNICAL FIELDS SEARCHED (IPC) F25D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 June 2017	Vigilante, Marco

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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26-06-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011067852 A1	24-03-2011	EP 2480844 A1	01-08-2012
		US 2011067852 A1	24-03-2011
		US 2015158667 A1	11-06-2015
		US 2015166262 A1	18-06-2015
		US 2017131014 A1	11-05-2017
		US 2017131015 A1	11-05-2017
		WO 2011035102 A1	24-03-2011
WO 2006007663 A1	26-01-2006	CA 2574374 A1	26-01-2006
		CN 101002062 A	18-07-2007
		EP 1800074 A1	27-06-2007
		JP 5099503 B2	19-12-2012
		JP 2008506923 A	06-03-2008
		KR 20070047305 A	04-05-2007
		NZ 552486 A	27-11-2009
		US 2008092559 A1	24-04-2008
		WO 2006007663 A1	26-01-2006
US 2015233617 A1	20-08-2015	NONE	
EP 1236960 A1	04-09-2002	AT 295517 T	15-05-2005
		DE 60204065 D1	16-06-2005
		DE 60204065 T2	02-02-2006
		EP 1236960 A1	04-09-2002
		ES 2239693 T3	01-10-2005
		IT MI20010407 A1	28-08-2002
DE 102010041951 A1	05-04-2012	DE 102010041951 A1	05-04-2012
		EP 2625478 A2	14-08-2013
		WO 2012045574 A2	12-04-2012

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 0337860 A **[0002]**
- EP 075816 A **[0002]**
- EP 0823600 A **[0002]**
- EP 0863374 A **[0002]**
- US 8952556 B **[0003]**
- EP 1939554 A **[0003]**
- FR 3007114 **[0004]**
- US 7600392 B **[0005]**
- US 20110067852 A **[0006]**