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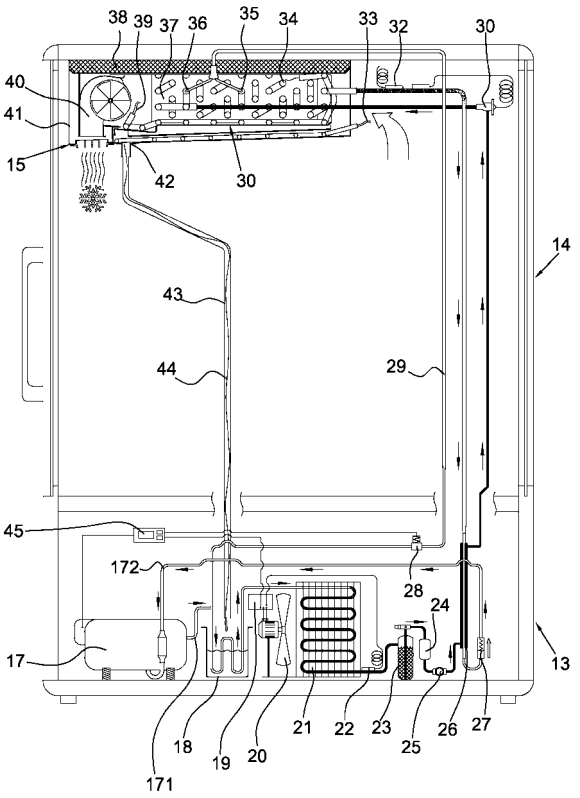
(54) **Cooling plant**

(57) Cooling plant with a vertical showcase comprising a box-shaped body (10) inside which, in a display portion (14), there is a varying number of grids or shelves (12) for the housing of products to be maintained at a controlled temperature. A cooling group (13) comprises a compressor (17) suitable for compressing the cooling gas, an air condenser (21) and at least one fan (20) suitable for subtracting heat from the compressed gas and supplying said gas, through a cooling circuit, to an evaporation group (15) which expands said gas cooling it and subtracting heat from the products housed in said display portion.

Fig. 2



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Description

[0001] The present invention relates to a cooling plant. In particular, reference is made to a cooling plant for vertical showcases optimized for reaching a high cooling and defrosting performance.

[0002] So-called "vertical showcase" cooling plants normally consist of a cabinet made up of four full-glass walls; one of the four walls usually consists of one or more doors again preferably made of glass. Inside the cabinet there is a varying number of glass grids or shelves.

[0003] The cooling or freezing group is normally, but not necessarily, situated in the lower part of the showcase, separated and isolated from the glass display part.

[0004] The cooling group normally has a piston compressor which creates considerable noise and the expansion of the gas is effected by means of capillary ducts with the consequent disadvantages. It is known that expansion through capillary is constant for the whole functioning time of the compressor, which is inappropriate when the door of the showcase is continually opened and closed to remove the products or after a defrosting phase, during which the temperature rises and the refrigerating power must be increased to bring the temperature inside the showcase back to the preservation values of the product as rapidly as possible.

[0005] An air condenser with a fan with a fixed velocity is assembled together with the compressor in cooling plants of the known type.

[0006] This solution proves to be equally precarious, considering that the showcase could be exposed to the outside and therefore subject to possible climatic changes, the fixed ventilation could create a greater or lesser condensation as a result of this, with a consequent anomalous and poor cooling performance. These plants also comprise an evaporator group which must radiate the cold and which can be positioned either in the lower part or in the upper part inside the showcase, or divided for each shelf-grid.

[0007] The cooling plants of vertical showcases are generally divided into so-called static cooling plants and ventilated cooling plants.

[0008] Static plants are defined as such when the element which irradiates the cold is not immerged in a flow of forced air but is diffused by normal air convection. Static plants normally have various very thin evaporators, for example about 10-15 mm, situated below each grid layer.

[0009] With time, the grids under the flow of damp air coming from below can become encrusted with ice and can lose their cooling efficacy. The showcase must therefore be emptied and the plant switched off every week, or at the discretion of the user, very frequently, to allow the ice to melt and when the defrosting is complete, the inside of the showcase must be to cleaned and dried, the cooling plant switched on, it is necessary to wait until the preservation temperature has been reached and then insert the products to be displayed for sale.

[0010] Ventilated cooling plants have an evaporator situated in the upper part or in the lower part of the showcase. They exploit a flow of air generated by a fan which sucks the air from a side of the evaporator making it pass through a circuit of copper tubes and through an extremely dense series of thin aluminum fins.

[0011] During this phase, the air loses its humidity, is cooled further and is then blown into the inner environment of the showcase lowering its temperature.

[0012] The air inside the showcase is contemporaneously sucked into the evaporator, creating a continuous cooling circuit.

[0013] These types of evaporators are also subject to blockage due to the ice which is formed during the passage of damp air, and consequently they also require defrosting normally time-driven by an electronic thermostat which switches off the cooling plant and activates the resistances applied on the surface of the series of fins.

[0014] Hot gas can be used in the same plant instead of resistances as defrosting element of the evaporator.

[0015] In this case, it is not necessary to remove the products from inside the showcase, even if the heating of the evaporator on the part of the resistances is not uniform and may require some time to defrost all the ice, as also with hot gas alone, with a consequent temperature rise inside the showcase and a deterioration of the products.

[0016] An objective of the present invention is to provide a cooling plant which overcomes the above drawbacks by combining an effective cooling plant for a showcase with an equally effective ultra-rapid defrosting system for cleaning the evaporator of ice encrustations formed during its normal cooling.

[0017] An object of the present invention therefore relates to a cooling plant according to the enclosed claim 1.

[0018] The characteristics and advantages of the plant according to the present invention will appear more evident from the following illustrative and nonlimiting description of an embodiment with reference to the enclosed figures, in which:

- figure 1 is a perspective view of a cooling plant for a vertical showcase;
- figure 2 illustrates the cooling circuit of the cooling plant of figure 1 during the cooling phase;
- figure 3 illustrates the cooling circuit with hot gas of the cooling plant of figure 1 during the defrosting phase;
- figures 4a and 4b illustrate an enlarged detail of the evaporation group in a view from above and a side view, respectively, according to the present invention.

[0019] With reference to the above figures, the cooling plant of the present invention comprises a cabinet or box-

shaped body 10 made up of four walls preferably made entirely of glass; one of the four walls normally consists of one or more doors 11 again preferably made of glass. A varying number of grids or shelves are generally situated inside the cabinet for housing products to be maintained at a controlled temperature; these shelves are preferably made of glass.

[0020] A cooling or freezing group 13 is normally but not necessarily situated in the lower part of the showcase, separated and isolated from the glass display portion 14, whereas an evaporation group 15 is normally situated on the upper part of the showcase or cabinet.

[0021] The cooling group is suitable for raising both the temperature and pressure of the cooling gas and consequently liquefying it and extracting heat from it. This gas is appropriately supplied to the evaporation group where, by the pressure difference existing in the suction side of the liquid, it is injected into the evaporator where it is expanded and brought to a gaseous state in order to absorb the heat from the products stored inside the cooling plant on the various shelves. The gas is then sent back to the cooling group for a new cycle.

[0022] The evaporation group and cooling group are connected to each other by means of two separate circuits, a cooling circuit and a defrosting circuit driven by a thermo-regulator.

[0023] Said cooling group comprises a compressor 17, for example of the rotational type with blades having a high cooling efficiency, and low noise.

[0024] Said compressor 17 sends the cooling gas from one of its outlet pipes 171 to an evaporation and condensation tank 18 and subsequently into a condenser 21 where, under the action of two motor-fans 20, the gas passes from a gaseous state to a liquid state.

[0025] At the outlet of the condenser 21, there is a temperature sensor 22 suitable for indicating the temperature of the gas and sending a signal to a velocity regulator 19 of the fan; depending on the preestablished temperature, the regulator increases or reduces the velocity of the motor-fans 20 thus contributing to keeping the temperature of the liquid gas leaving the condenser 21, constant.

[0026] In this way, if the temperature of the environment outside the showcase is more or less high, the motor-fans 20 will also rotate more or less rapidly to keep the temperature of the condensed gas leaving the condenser 21 and therefore the performance of the cooling plant, constant. Following the condenser, a liquid receiver 23, a filter 24 and a liquid passage indicator 25 are situated in the circuit.

[0027] The evaporation group comprises a circuit of tubes 34 for the gas coming from the cooling group arranged inside a defroster 37 situated in a casing 41, two fans 40 (for illustrative purposes one is shown) suitable for diffusing the cold inside the display chamber of the showcase 14, a discharge 42 for the condensate which collects the liquid from the evaporation group and sends it to the condensate collection tank 18.

[0028] The group also comprises a pair of defrosting resistances 33 and 39, a closed cell insulating panel 38 above the evaporator group 15 which prevents the formation of ice and frost above the evaporator group itself.

[0029] The cooling circuit comprises a heat exchanger 26 and a thermostat valve 31, for example an MOP charge thermostat valve, through which the gas is sent at a suitable temperature to the evaporation group 15.

[0030] The MOP charge thermostat valve 31 limits the injection of the gas when the compressor 17 is started up, consequently not overloading it and avoiding start-up problems.

[0031] Said thermostat valve 31 is assembled in substitution of the traditional capillary diffuser, which automatically increases or reduces the gas expansion in relation to the inlet temperature of the air in the evaporator 37, rapidly restoring the temperature inside the showcase, both after the door has been opened to remove a product and also after defrosting.

[0032] The liquid gas inside the evaporator 37 expands removing heat and returns to the gaseous state, it leaves the evaporator, passes into the exchanger 26, passes through a non-return valve 27, and returns to the compressor 17, through an inlet pipe 172 for a new cycle.

[0033] The defrosting circuit comprises a solenoid valve 28 which allows the hot gas to be sent from the compressor 17 to the evaporation group by means of a supply tube 29.

[0034] In the circuit, the hot cooling gas is removed from said compressor before it is cooled in said condenser 21 and is sent to said evaporation group by means of said supply tube 29 controlled by the valve 28 suitably driven.

[0035] Said tube is divided in its terminal portion so as to insert said gas into the evaporator 37 dividing itself into two inlets 35-36 for a better feeding to the circuit 34 and consequently defrosting and dissolving more efficiently and rapidly the ice formed on the fins of the evaporator 37. This defrosting is also supported by the resistances 33 and 39 which are activated by the thermo-regulator together with the valve 28.

[0036] The defrosting is controlled in two ways contemporaneously by the thermo-regulator 45, time regulation of about 3 minutes (which can be modified), and the other temperature regulation by means of the probe 32 which interacts with the thermo-regulator 45 and in turn stops the defrosting if the gas leaving the evaporator 37 reaches +2°, +3° before the due time (these can also be modified).

[0037] During this defrosting phase, the fans 20 are advantageously stopped, the pressure of the gas increases in the condenser 21 which acts as a "closed valve" compelling the gas to prefer the passage through the supply tube 29; this avoids adding further blockage electrovalves.

[0038] The hot gas partially cooled but not condensed (liquid) leaving the evaporator 37 returns to the compressor 17, where it is reheated and is re-pumped into the supply tube 29 to continue the defrosting cycle. The

number of defrosting cycles and their duration are established on said thermo-regulator 45.

[0039] In an alternative embodiment illustrated in figures 4a and 4b, the injection of hot gas into the evaporator 37 is effected with a single tube 46, upstream of the whole circuit 34 of the evaporator 37.

[0040] One of the resistances 39 is kept pressed against the lower part of the series of fins of the evaporator 37 by a plate 30 particularly shaped and tilted to favour the drainage of the condensation water.

[0041] As the plate 30 rests on the resistance 39, it is heated preventing the water falling onto it from freezing, favouring its flow into the drainage outlet 42.

[0042] The casing 41 made of aluminum plate covers the whole evaporator group 37 and is such that it can collect further losses of water, ice or frost channeling them towards the discharge 42.

[0043] The second resistance 33 is positioned and pressed on the inner surface of the casing 41 to facilitate the melting of the ice which could be formed on the base.

[0044] The water deriving from the defrosting flows out of the discharge outlet 42 into the discharge tube 43 which carries the water into the collection tank 18. Water is advantageously evaporated from this tank by passing it through the tube of hot gas leaving the compressor 17, so that the temperature of the gas inside the tube drops before entering the condenser 21.

[0045] A further resistance 44 suitable for preventing the water from refreezing obstructing the hole of the tube 43, is positioned inside the tube 43.

[0046] The cooling plant thus conceived does not jeopardize the product being displayed even if the door accidentally remains partially open.

[0047] The non-return valve 27 ensures that during the stoppage of the compressor 17, when the temperature has been reached, a quantity of hot gas does not return to the evaporator 37 causing condensate and misting of the glass.

Claims

1. A cooling plant with a vertical showcase comprising a box-shaped body (10) inside which, in a display portion (14), there is a varying number of grids or shelves (12) for the housing of products to be maintained at a controlled temperature,
   a cooling group (13) comprising a compressor (17) suitable for compressing the cooling gas, an air condenser (21) and at least one fan (20) suitable for subtracting heat from the compressed gas and supplying said gas, through a cooling circuit, to an evaporation group (15) which expands said gas cooling it and subtracting heat from the products housed in said display portion,
   characterized in that it comprises:

   a defrosting circuit in which the hot cooling gas is removed from said compressor before it is cooled in said condenser (21) and is sent to said evaporation group by means of a supply pipe (29) and a suitably driven valve (28).

2. The plant according to claim 1, wherein said cooling circuit comprises a heat exchanger (26) and a thermostat valve (31) through which the gas is sent at a temperature suitable for the evaporation group (15).

3. The plant according to claim 1, wherein said supply pipe (29) is divided in its terminal portion so as to insert said gas into the evaporator in two inlets (35, 36) for a better feeding of the circuit and consequently more effective and rapid defrosting and dissolving of the ice formed on the fins of the evaporator (37).

4. The plant according to claim 1, wherein said evaporation group comprises two resistances (33, 39) which are activated by the thermo-regulator (45) contemporaneously with the valve (28).

5. The plant according to claim 1, wherein the defrosting circuit comprises a double control, of the time and temperature, by means of a thermo-regulator (45), where a probe (32) interacts with the thermo-regulator (45) and stops the defrosting if the outgoing gas reaches a temperature of +2°,+3°C before time.

6. The plant according to claim 1, wherein the evaporation group is surmounted by a closed cell insulating panel (38) which prevents the formation of ice and frost above the evaporator group itself.

7. The plant according to claim 4, wherein one of said resistances (39) is kept pressed against the lower part of the series of fins of the evaporator by a shaped and tilted plate (30) to favour the drainage of the condensation water.

8. The plant according to claim 4, wherein a casing (41) made of aluminum plate covers the whole evaporator group and is produced so as to collect further losses of water, ice or frost channelling them towards a discharge outlet (42).

9. The plant according to claim 8, wherein the second resistance (33) is positioned and pressed on the inner surface of the casing (41) to facilitate the dissolving of the ice which could be formed on the base.

Fig. 1

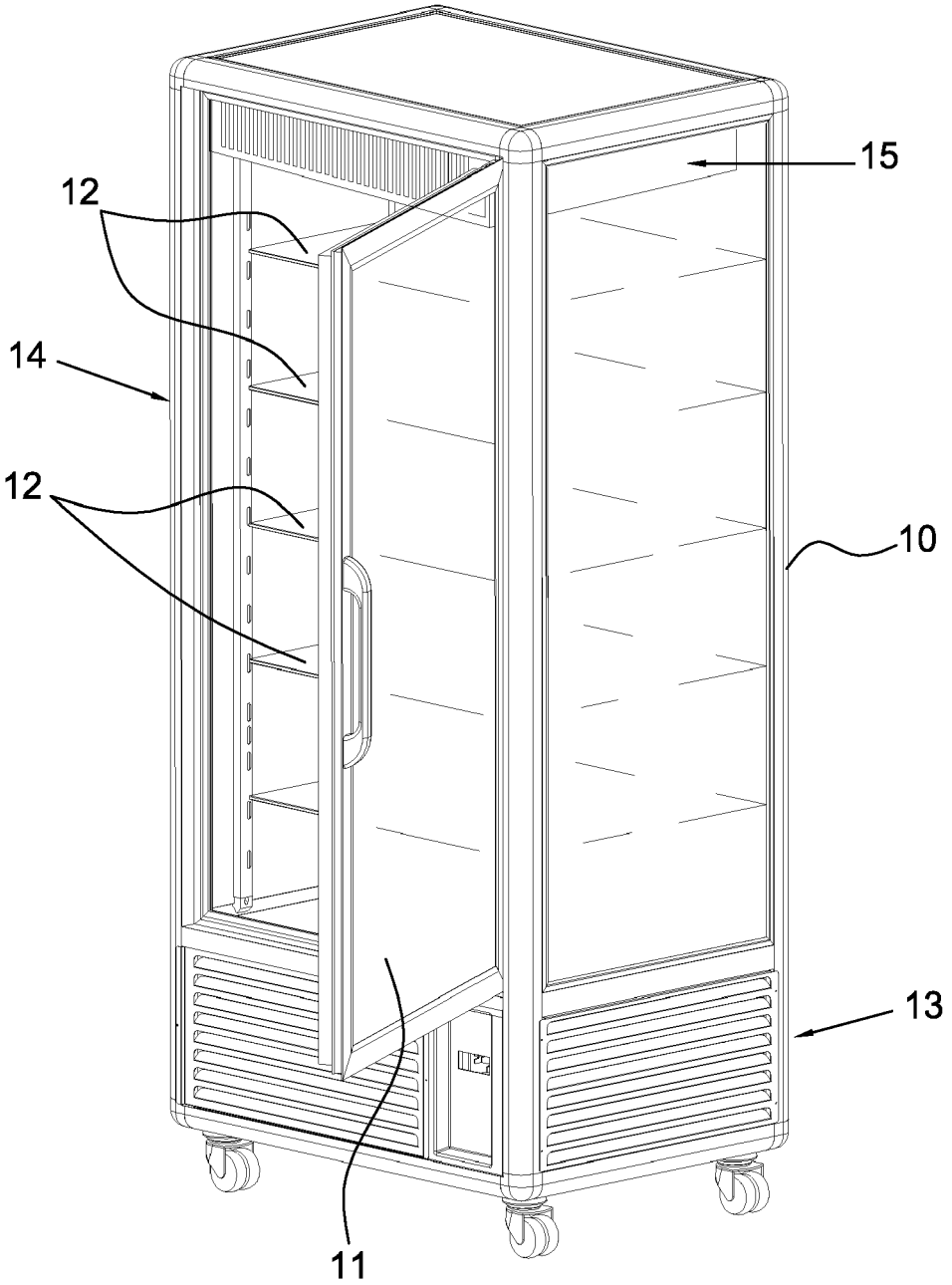

Fig. 2

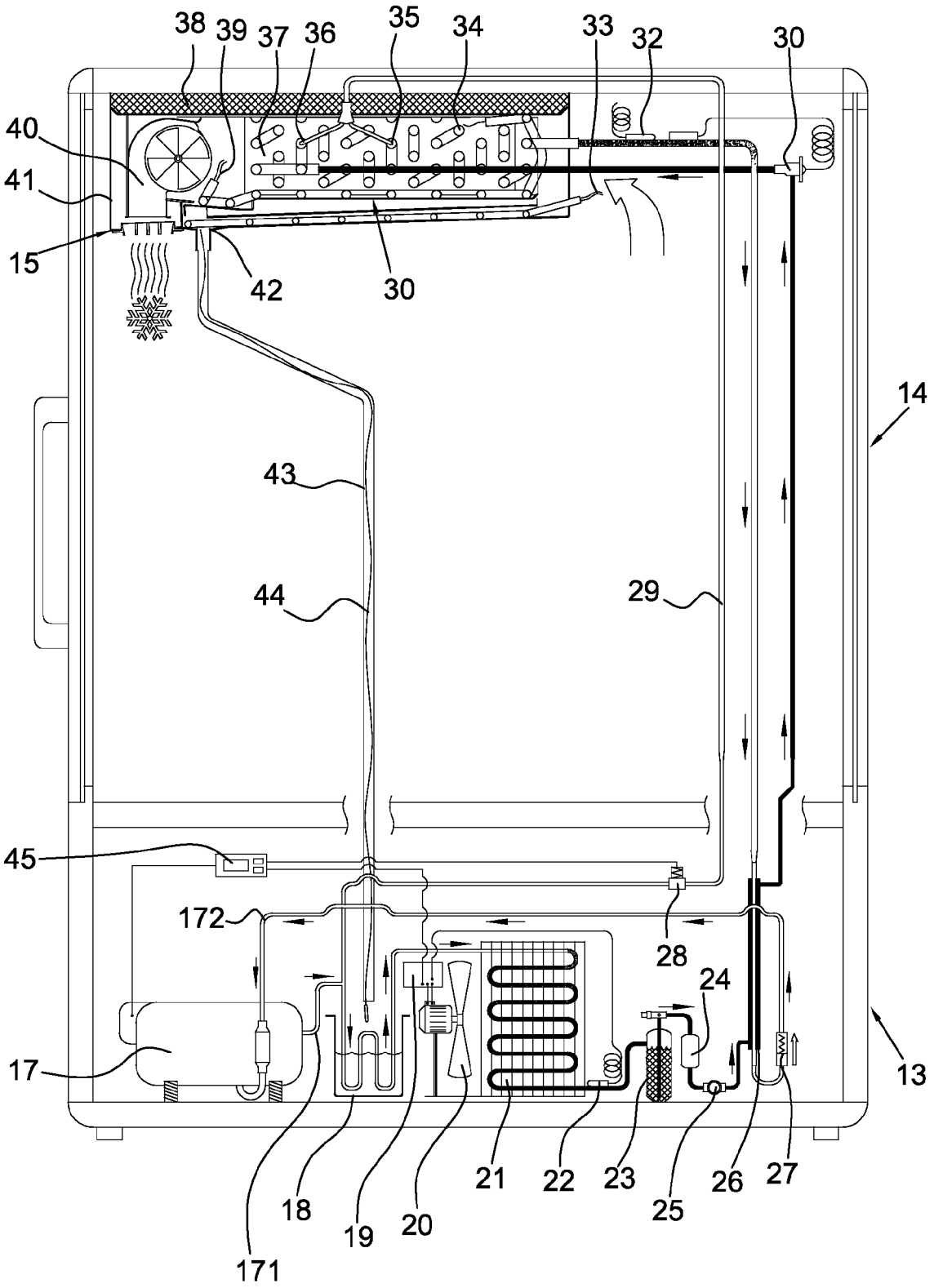
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Fig. 3

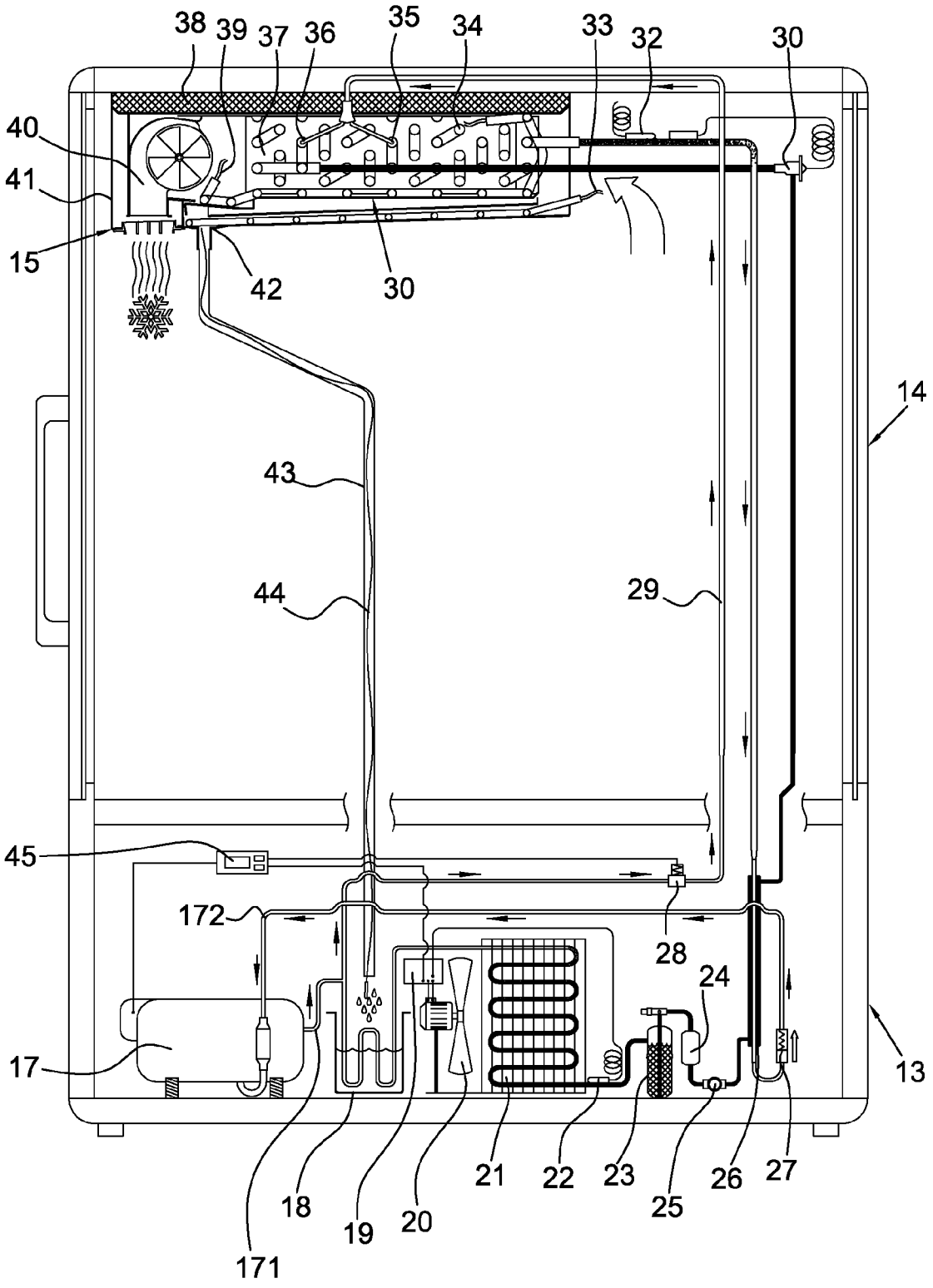
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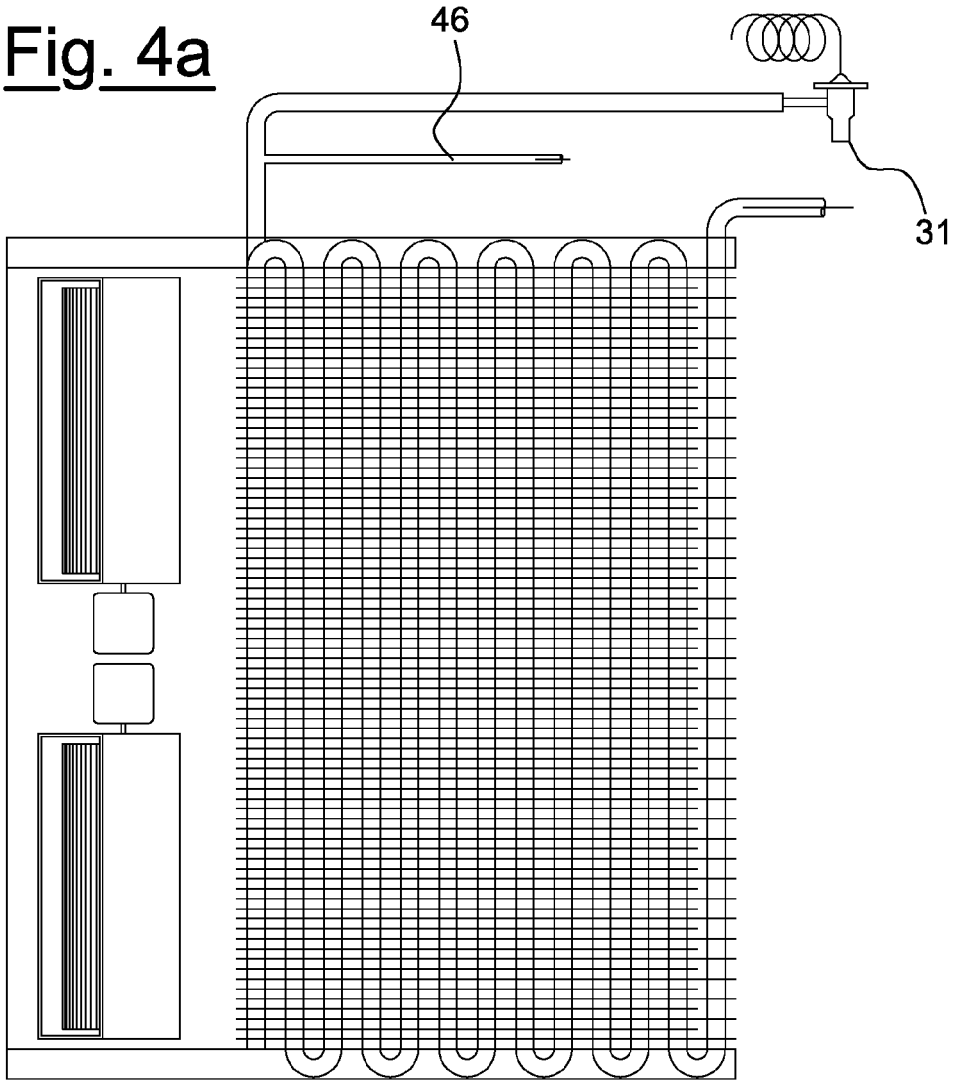
Fig. 4a



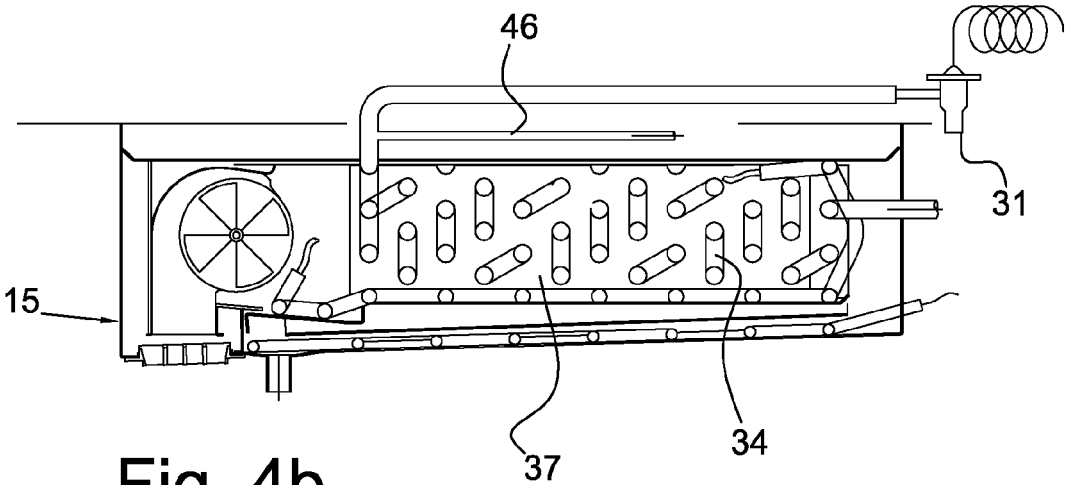


Fig. 4b

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EUROPEAN SEARCH REPORT

Application Number
EP 08 16 7081

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 3 186 185 A (BENTLY GEORGE K ET AL) 1 June 1965 (1965-06-01) * the whole document *	1-9	INV. A47F3/04
X	US 4 299 092 A (IBRAHIM FAYEZ F) 10 November 1981 (1981-11-10) * the whole document *	1-9	
X	US 2 960 844 A (QUICK LESTER K) 22 November 1960 (1960-11-22) * the whole document *	1-9	
X	AU 61026 80 A (COMMERCIAL & IND REFRIGERATION) 12 February 1981 (1981-02-12) * the whole document *	1-9	
X	GB 2 348 947 A (JTL SYSTEMS LTD [GB]) 18 October 2000 (2000-10-18) * the whole document *	1-9	
X	US 5 406 805 A (RADERMACHER K REINHARD H [US] ET AL) 18 April 1995 (1995-04-18) * the whole document *	1-9	TECHNICAL FIELDS SEARCHED (IPC) A47F
A	US 2006/207281 A1 (SUDA JUNICHI [JP] ET AL) 21 September 2006 (2006-09-21) * the whole document *	1-9	
A	US 3 585 814 A (CAUWENBERGE GABRIEL VAN) 22 June 1971 (1971-06-22) * the whole document *	1-9	
A	UA 77 925 C2 (AISBERG LTD LTD LIABILITY COMP [UA]) 15 January 2007 (2007-01-15) * the whole document *	1-9	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 February 2009	Cardan, Cosmin

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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03-02-2009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3186185 A	01-06-1965	ES 294933 A1	01-06-1964
		GB 1011175 A	24-11-1965
US 4299092 A	10-11-1981	NONE	
US 2960844 A	22-11-1960	NONE	
AU 6102680 A	12-02-1981	NONE	
GB 2348947 A	18-10-2000	NONE	
US 5406805 A	18-04-1995	AU 699381 B2	03-12-1998
		AU 1050195 A	29-05-1995
		BR 9408046 A	24-12-1996
		CA 2174949 A1	18-05-1995
		CN 1134747 A	30-10-1996
		EP 0728283 A1	28-08-1996
		JP 3185888 B2	11-07-2001
		JP 9509732 T	30-09-1997
		KR 100230170 B1	15-11-1999
		WO 9513510 A1	18-05-1995
US 2006207281 A1	21-09-2006	JP 2006258323 A	28-09-2006
		KR 20060101281 A	22-09-2006
US 3585814 A	22-06-1971	BE 704470 A	29-03-1968
		GB 1207226 A	30-09-1970
		NL 6813917 A	01-04-1969
UA 77925 C2	15-01-2007	EP 1855071 A2	14-11-2007

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