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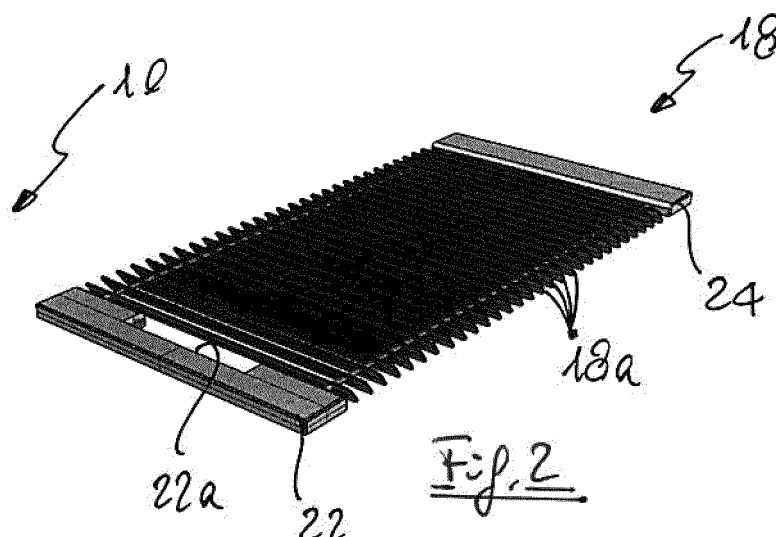
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(54) **Refrigerator**

(57) A refrigerator comprises a freezing compartment closed by a door and a member adapted to reduce the moisture content of air, said member being a flat

member placed adjacent the top of the freezing compartment and adapted to be removed by the user for eliminating frost.



Description

[0001] The present invention relates to a refrigerator comprising at least a freezing compartment closed by a door, and a member arranged to reduce the moisture content of the air.

[0002] Such a refrigerator is known from EP 0644385 A1 which discloses a no-frost refrigerator comprising a freezing compartment, a closed storage compartment and a refrigerating circuit having an evaporator and circulating air to the above compartments. In such known solution the member to reduce moisture content of the air is a partition wall arranged in the return air duct, such partition wall being provided with a heater for carrying out defrost phase.

[0003] WO2009/141125A1 discloses a no frost refrigerator comprising a pre-defrost device which is arranged adjacent to the evaporator and has the same purpose of the partition wall of EP 0644385, i.e. to have at least some humidity in the air guided by the pre-defrost device sticking to it.

[0004] The above solutions are designed for use in no-frost refrigerators, where the main quantity of frost is accumulated on the evaporator put in the air flow circuit. Therefore the benefit of having these added elements on which some frost is accumulated is quite limited. Moreover, for removing frost from such accumulation surface it is necessary to have an auxiliary heater, which increases the whole cost and complexity of the appliance.

[0005] In a direct cooled freezer, internal air is colder and therefore denser than external air. So, every time the door is opened, part of the cold dry air inside falls out (most from the lower part of the freezer) and it is replaced by external warmer and more humid air, that enters mainly on the upper part of the freezer liner. Humidity enters and remains stuck to freezer cold walls, forming a layer of frost. Frost has to be periodically manually removed by the user: this operation is quite complex because it requires switching off the appliance, removing frozen food and storing it somewhere else, wait some time for the ice to melt into water, remove water, etc.

[0006] Most direct cooled freezers do not have any device to slow down frost formation or to speed up frost removal operation. Existing solutions are (apart from "no frost" refrigerators mentioned above) low frost external flexible bags: they reduce external air inlet when freezer door is closed. Drawback is the need of external space, so this solution is used mainly for chest freezers. Another solution is to use silica gel bags inside freezer. Such bags collect humidity that enters into freezer compartment. Drawback is that this material has to be replaced periodically; furthermore it is toxic and in case of disposal it requires special treatment. Another known solution is to use a sort of frost cup that collects frost that enters when door is closed; frost is then periodically manually removed by the user by removing and cleaning the cup. Drawback is that the system requires an electrical heater that keeps air duct clean from ice: therefore it requires electrical connections and electronic control.

[0007] A solution for speeding up the process of manual defrosting of a direct cooled freezer, particularly a vertical freezer, is disclosed by DE29702740U in which the evaporator, where there is the main accumulation of frost, may be removed from the cavity thanks to automatic valves which avoid losing refrigerant fluid. The evaporator is then cleaned manually (for instance by putting it under tap water). Such solution is quite complex and expensive and does not guarantee that a lack of refrigerant fluid may occur in the process of removing and then re-installing the evaporator grid.

[0008] It's an object of the present invention to provide a refrigerator of the kind specified at the beginning of the description, and particularly a direct cooled vertical freezer or a refrigerator comprising such freezing compartment, with a solution for avoiding a too frequent manual defrosting of the cavity and evaporator.

[0009] Such object is reached thanks to the features listed in the appended claims.

[0010] According to one aspect of the invention, a metal grid made of one (single plate) or more (fins) metal surfaces supported by a frame is placed on the top part of a freezer compartment: in this way when the door is opened, most of the external humid air enters in contact with it. Of course the grid is not the coldest part of the freezer (by definition, the coldest part is the evaporator) but it is cold enough to have part of humidity stuck to its surface. Also the metal grid has to be periodically cleaned by the user, but this operation is much easier because the grid can be easily removed and then cleaned with tap water. The grid is then replaced inside freezer and the same grid can be reused every time. In this way frost formation on the freezer walls is slower. As a consequence, the complex manual defrost operation can be done less frequently. The grid is a simple mechanical component and it does not require electrical connections and/or electronic control.

[0011] By placing the flat element or grid substantially horizontal within the freezer compartment, a value of up to 20% of the total frost is accumulated on the grid only, a quite surprising value indeed particularly because the total surface of the grid is much less than 20% of the total surfaces of the freezer compartment. The applicant believes that this surprising value is due to the pattern of air flow when the door is opened, the outside air impinging the flat element first.

[0012] According to another preferred feature of the invention, the flat element presents a plurality of parallel fins arranged transversally to the front opening of the compartment. Further advantages and features of the solution according to the present invention will be clear from the following detailed description, provided by way of non-limiting example, with reference to the attached drawings in which:

- Figure 1 is a cross-section view of a refrigerator according to the present invention;

- Figure 2 is an enlarged prospective view of a component of figure 1;
- Figure 3 is plan enlarged view of the component of figure 2
- Figure 4 is a cross section of an upper part of the freezing compartment of figure 1 according to a first embodiment;
- Figure 5 is a view similar to figure 4 according to a second embodiment; and
- Figure 6 is a view similar to figures 3 and 4 according to a third embodiment.

[0013] With reference to the drawings, with 10 it is indicated a direct cooled double door refrigerator having an upper fresh food compartment 10a and a lower freezer compartment 10b. In the example of figure 1, the freezer compartment 10b is provided with two drawers 12 and a sliding shelf 14. Close to the ceiling of the compartment, indicated with reference 16 in the drawings, it is placed a flat grid 18 (figures 2, 3) comprising a plurality of parallel slanted fins 18a connected together by longitudinal beams 20 (figure 3). The fins 18a are placed transversally with reference to the direction of the opening of the compartment. The ends of each beam 20 are connected to a front piece 22 and to a rear piece 24 respectively, so as to form a single piece grid. The front piece 22 is provided centrally with an aperture 22a defining a handle for easily removing and mounting the grid 18 over rails (not shown) defined in the side walls of the liner. The applicant has tested different kinds of fins pattern; figure 4 shows a pattern ("A") in which the fins 18a are inclined in a direction different from the direction shown in figure 5 (pattern "B").

[0014] Figure 6 shows a different arrangement of the grid 18 which is slanted of about 20° to 35° with respect to the horizontal arrangement shown in figures 4 and 5 (in the example of figure 6 the fins 18a are oriented according to pattern "B", but also the pattern "A" was tested by the applicant).

[0015] The results of the tests carried out by the applicant on two different commercial double doors refrigerators (CB310 and CB304) have given the following results in terms of quantity of frost accumulated on the grid 18 and on other parts of the compartment, particularly top surface (ceiling of the cavity), drawers, shelves and other surfaces.

	Product 1- CB310 - With Drawers			
	20 fins/horizontal / A	20 fins / horizontal / B	20 fins / inclined / B	20 fins / inclined / A
Top Surface	10%	13%	15%	18%
Other Surfaces	34%	32%	36%	33%
Grid 18	20%	19%	19%	19%
Drawers + Shelves	35%	36%	31%	30%

	Product 2 - CB304 - With Drawers			
	14 fins / inclined / B	14 fins / inclined / A	14 fins /horizontal / A	14 fins / horizontal / B
Top Surface	16%	18%	24%	23%
Other Surfaces	39%	34%	30%	27%
Grid 18	12%	10%	12%	15%
Drawers + Shelves	33%	37%	34%	35%

[0016] The 20 fins used on CB310 have a width of about 350 mm, while the 14 fins tested on CB304 have a width of 300 mm.

[0017] Best results in terms of frost accumulation have been obtained by using 20 fins 18a with a width of 350 mm, positioned horizontally in the freezing compartment 10b. The influence of pattern "A" or "B" (inclination of fins) is quite low and therefore the arrangement of such fins can be chosen depending on other considerations.

[0018] Of course other number of fins 18a can be chosen, and good results may be obtained by using fins in the range from 10 to 30. Also the width of the grid 18 may vary, and it depends mainly on the dimension of the compartment. As far as the material of the grid 18 is concerned, it is only important that the material has a high thermal conductivity, for instance aluminum or stainless steel.

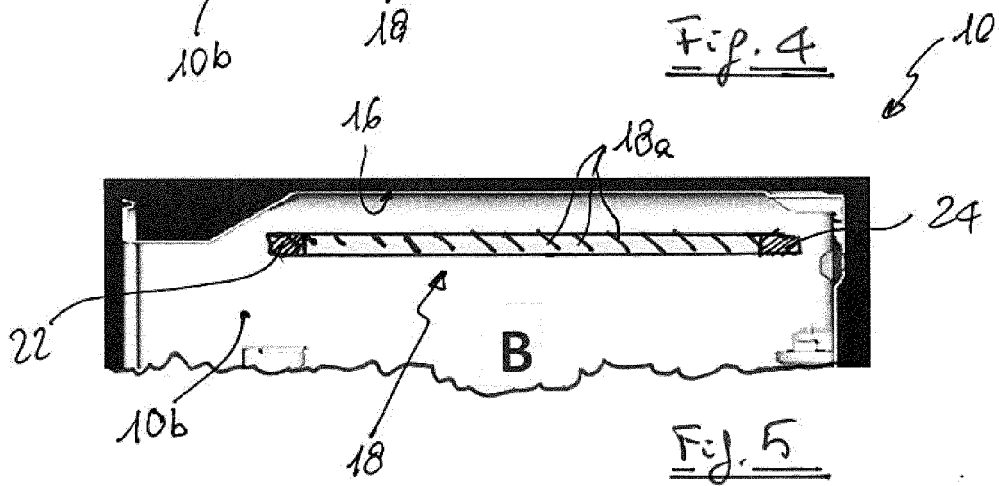
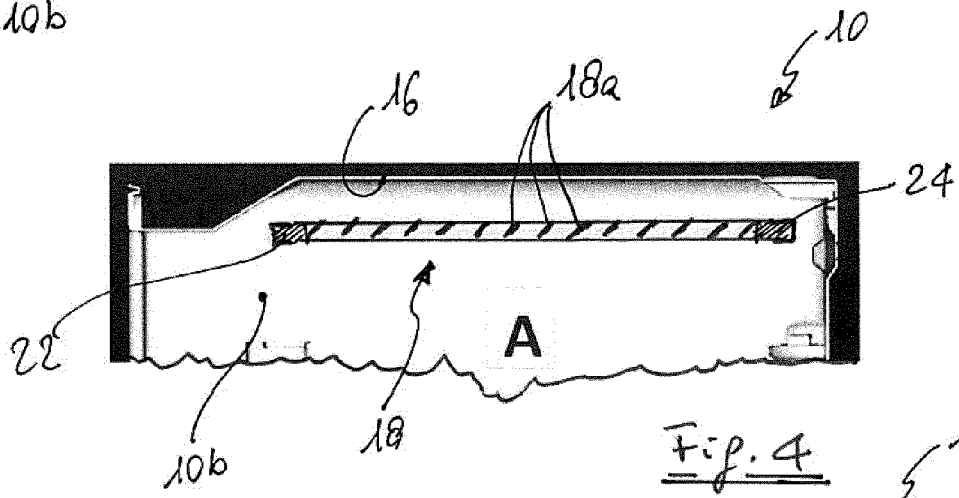
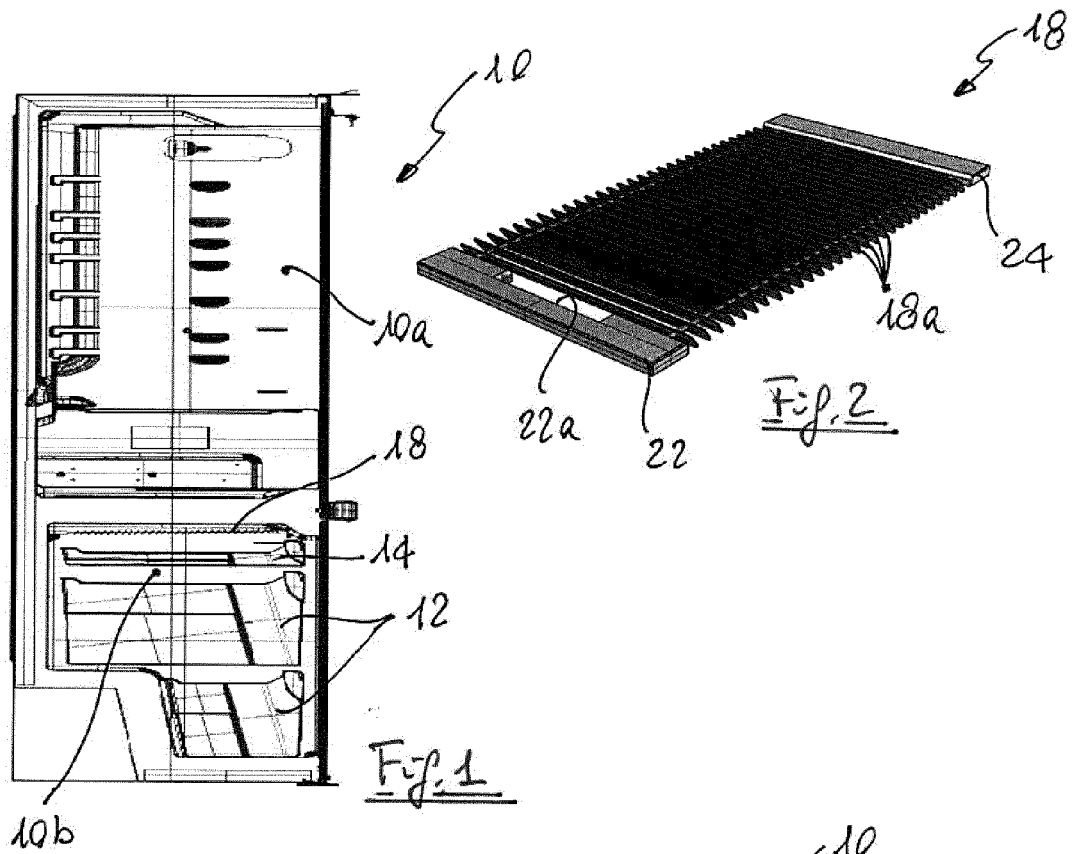
[0019] A way for moving from the present long and annoying defrost process for direct cooled freezer to a simple and faster one have been described, in which a very simple mechanical piece (metal grid with fins) acts as a humidity collection "catalyst" to collect a relevant part of humidity inside the inner-liner of the cavity. Such piece is easy to remove, to clean and to reposition in the freezer.

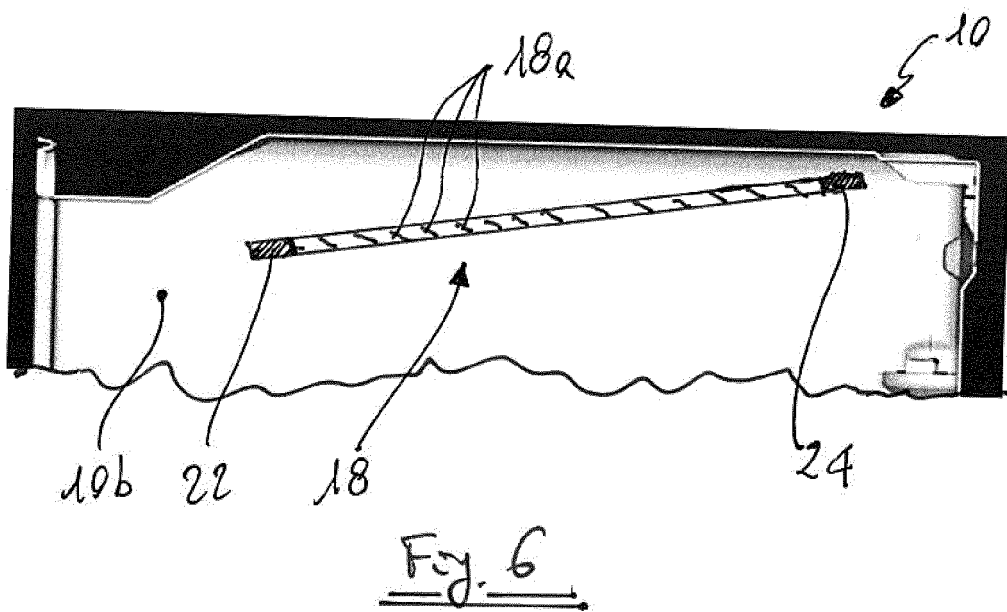
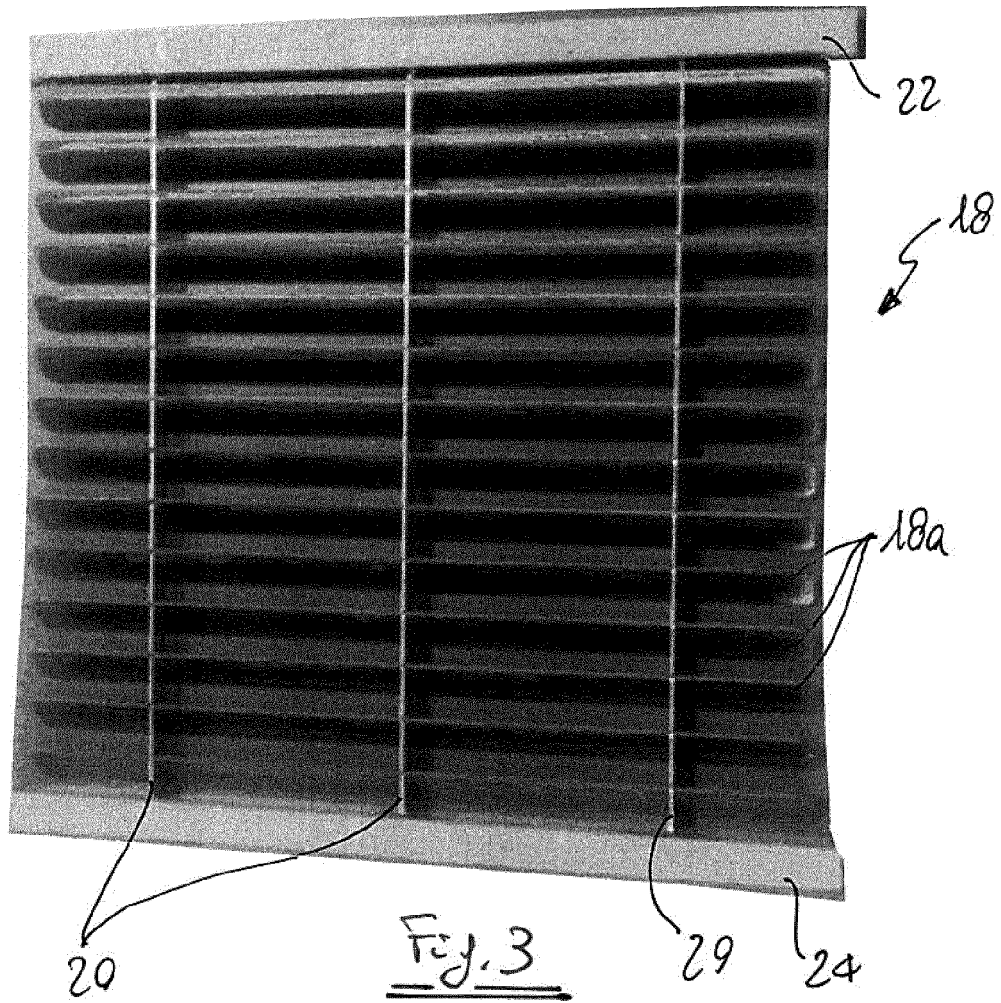
[0020] Of course even if the subject-matter of the invention has been described in details with reference to a double

door refrigerators, it can be used as well also in other kinds of refrigeration appliances, for instance side by side refrigerators.

5 **Claims**

1. A refrigerator comprising a freezing compartment (10b) closed by a door, and a member adapted to reduce the moisture content of air, **characterized in that** said member is a flat member (18) placed adjacent the top (16) of the freezing compartment (10b) and adapted to be removed by the user for eliminating frost.
2. A refrigerator according to claim 1, wherein the flat element (18) is positioned horizontally within the freezing compartment (10b).
3. S refrigerator according to claim 1, wherein the flat element (18) is positioned inclined within the freezing compartment (10b).
4. A refrigerator according to any of the preceding claims, wherein the flat element (18) presents a plurality of fins (18a) arranged transversally to the opening of the compartment (10b).
5. A refrigerator according to claim 4, wherein the fins (18a) are parallel and inclined with reference to the flat element (18).
6. A refrigerator according to claim 4 or 5, wherein the fins (18a) are comprised in a number between 10 and 30.







EUROPEAN SEARCH REPORT

Application Number
EP 13 18 3553

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X	EP 0 031 311 A2 (ELECTROLUX AB [SE]) 1 July 1981 (1981-07-01) * page 2, line 27 - page 4, line 20; figures 1-4 *	1,2	INV. F25D21/06
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A	----- US 2005/061015 A1 (INGLEY HERBERT A [US] ET AL INGLEY III HERBERT A [US] ET AL) 24 March 2005 (2005-03-24) * the whole document *	1	
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 27 November 2013	Examiner Jessen, Flemming
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			

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EPO FORM 1503 03.82 (P04C01)

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

EP 13 18 3553

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
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