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(54) **Title:** LIGHTING SYSTEM FOR REFRIGERATORS

(57) **Abstract:** The present invention describes a refrigerator (1), in particular of the no-frost type, comprising a refrigerator compartment (12) or a refrigerator compartment (12) and a freezer compartment (13) into its cabinet (11) for storing food, a lighting system (4) of at least said refrigerator compartment (12) and an evaporator unit (2; 21, 22, 23, 24, 25) in turn comprising an evaporator (22) suitable for cooling the air and a fan (21) for moving the air within said refrigerator compartment (12) and/or freezer compartment (13). The lighting system (4) consists of one or more LED (L1, L2) light bars (4), each one placed substantially in the proximity of the jointing zone between the sides (113) of said refrigerator compartment (12) and the back wall (112) thereof and extending substantially by the entire height of said refrigerator compartment (12).

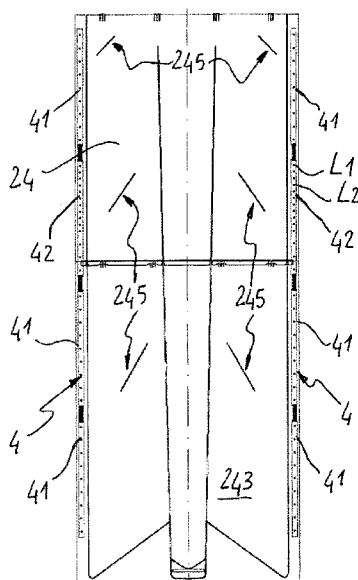


Fig. 4

ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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LIGHTING SYSTEM FOR REFRIGERATORS

DESCRIPTION

The object of the present invention is a refrigerator for household purpose, in particular of the type that does not form frost, also called no-frost.

More in particular, the object of the invention is a no-frost refrigerator capable of storing food and products of any nature therein without substantial losses of the
5 quality thereof.

The invention, therefore, relates to the field of household appliances, in particular to that of household no-frost refrigerators.

As is known, in no-frost refrigerators heat is taken from food and products to be stored by forced convection, through a circulation of cold air in the inside
10 compartment thereof; such feature differentiates no-frost refrigerators from those called "static", that is, without forced convection.

Another difference between no-frost and static refrigerators consists in the different defrosting method that takes place electronically in the first ones whereas it is generally manual in the second ones.

15 According to the prior art, refrigerators are provided with one or more inside compartments with different temperatures for storing and preserving food and products of a various nature (hereinafter, for clarity, globally indicated by the term "food"): in particular, a refrigerator compartment suitable for storing fresh food at a temperature comprised between 0°C and 10°C and a freezer
20 compartment, of smaller dimensions and volume than the first one, for storing

frozen food. According to the relative position of such compartments, said refrigerators are divided into "combined" and "dual door". Each compartment can further comprise multiple divisions, shelves and/or drawers. For clarity of description, the term (no-frost) refrigerator shall always be used in the following
5 description, irrespective of the number of inside compartments and of the type.

Ventilated no-frost refrigerators, as known, are provided with an evaporator, generally laminar, for cooling and drying the air and a fan for the movement thereof within said one or more compartments. Such components are generally set behind the back wall of at least one of the refrigerator compartments while
10 multiple holes obtained thereon allow the inlet and the subsequent circulation of the cooled air flow between the various shelves (provided that they are not obstructed by the food). Since no-frost refrigerating appliances are known, at this level it does not seem necessary to further dwell on the multiple possibilities of installation of the evaporator thereof.

15 The main drawback of no-frost refrigerators is the forming of frost on the evaporator. In fact, as is known, inside the refrigerator there usually is a considerable inlet of humidity due to both the inlet of air from the outside (for example, when the door is opened) and to the unavoidable process of transpiration of the fresh food to be cooled and stored; during the cooling of the
20 air, therefore, the collected humidity frosts, accumulating thereon as ice. The forming of ice on the laminar evaporator leads to a penalisation of the heat exchange due to the insulating properties thereof and to a fluid-dynamic inefficiency, since the air passage is increasingly hindered by the forming of frost. Therefore in general, there occurs a lower cooling of the air flow and a
25 consequent lower efficiency of the refrigerator. In the most serious cases, the forming of frost may even lead to the breakage of the evaporator, in particular impairing the coupling between the blades thereof (intended for increasing the heat exchange surface) and the coil crossed by the refrigerating fluid.

A "good" use of the refrigerator, for example avoiding frequent opening of the
30 door thereof or the introduction of hot food contributes to limiting the inlet of

heat and humidity, and thus, to limiting consumptions and forming of frost on the evaporator, but in any case such drawback cannot be eliminated as it is inbuilt in the same concept of refrigeration in environments that in any case exhibit a certain humidity level. It is generally managed by defrosting systems of the evaporator that are triggered automatically and at fixed time intervals. Known defrosting systems for example are those that provide for the reversal of the refrigerating cycle and/or the use of electrical resistors placed at the evaporator. It is clear that the energy used for transforming the humidity into frost as well as that used for melting the same frost (especially in the case of electrical resistors) represents a waste that significantly affects the energy efficiency and the consumptions of the refrigerating appliance.

A second big drawback of no-frost refrigerators relates to the risk that if the food, especially "fresh" food (vegetables, fruit and the like) is not protected by films or container, it could dry excessively losing its organoleptic and nutritional properties by the effect of the activated air circulation.

In fact, fresh food has a humidity value that is normally very high, and therefore a relative air humidity in the range of 90-95% is found on the surface thereof. A relative humidity at least equal to such value should therefore be kept in the compartment where this food is stored for preventing water from evaporating from the surface thereof, whereas since the air coming out of the evaporator has yielded the humidity thereof to it in the form of frost, it is substantially dry.

Systems for the rehumidification of the cold and dry air coming from the evaporator have long been provided in order to limit such drawback. Without loss of generality, said systems may consist in trays, obtained on the bottom of the refrigerator compartment, suitable for collecting and containing a part of the condensation water formed during the automatic defrosting process of the evaporator and subject to being lapped by the cold air flow. To this end, see document IT1 104915.

The presence of trays with stagnant water into the refrigerator compartment, however, could cause problems of an aesthetic and hygienic nature, especially if

the food inadvertently comes into contact therewith.

Moreover, all of the air flow refrigerated by the evaporator hardly laps the surface of the water contained in said tray, making it difficult to keep the ideal humidity level in the entire compartment wherein the food is stored.

- 5 The object of the present invention is to eliminate at least a part of the drawbacks outlined above.

In particular, the main object of the present invention is to provide a no-frost refrigerator provided with improved means for keeping the organoleptic properties and features of the food stored therein even for long periods.

- 10 A second object of the present invention is to provide a no-frost refrigerator characterised by a high energy efficiency and low consumption.

A further object, at least of some versions of the present invention, is to provide an improved system for lighting the compartments of the no-frost refrigerator with a reduced energy consumption and a high aesthetic and commercial value.

- 15 These objects and other advantageous results, as it will clearly appear, are achieved with a device according to the annexed main claims.

The features of the present invention will appear more clearly from the following description of some preferred embodiments thereof, according to the patent claims and illustrated, by way of a non-limiting example, in the annexed

- 20 drawings, wherein:

- figure 1 schematically shows a side cross-section view of a no-frost refrigerator according to a first embodiment of the invention and an enlargement of a detail thereof.
 - figure 2 schematically shows a side cross-section view of a no-frost refrigerator according to a second embodiment of the invention and an enlargement of a detail thereof.
 - figures 3a and 3b respectively show an axonometric and an exploded view of the evaporator unit of the no-frost refrigerator of figure 1 and/or 2.
 - figures 4 and 5 show two different views of the lighting system applied to the evaporator unit of the previous figures.
- 30

The features of the invention are now described, making use of the references contained in the annexed figures.

With reference to figures 1 and 2, reference numeral 1 indicates a no-frost refrigerator respectively of the single door and dual door types. Hereinafter, for
5 simplicity of description, the term refrigerator shall always refer to a refrigerating appliance of the no-frost type.

Cabinet 11 is shown of refrigerator 1, obtained by thermo-forming, wherein there are defined one or more compartments 12, 13 comprising a plurality of shelves 14 whereon the food to be stored may be placed.

10 As is known, the food may also be stored into sliding drawers 15 or in cells closed by flap doors (not shown in the annexed figures).

Compartments 12, 13 may be accessed from the outside through relative doors 12.a, 13.a.

More in particular, refrigerator 1 of figure 1 is provided with a single door 12.a
15 for closing the single compartment 12 wherein the fresh products and food are stored (called refrigerator compartment 12) whereas figure 2 shows a refrigerator 1 that besides said refrigerator compartment 12, comprises a second compartment 13 (called freezer compartment 13) for storing frozen and/or deep-frozen products, also provided with the relevant access door 13.a.

20 As already partially said, the preservation of the organoleptic and nutritional properties of the food stored into refrigerator 1 is carried out by the circulation of a suitably cooled air flow capable of refrigerating the food by forced convection, lapping it.

The cooling of the water flow and the circulation thereof are carried out by an
25 "evaporator unit 2".

According to the prior art, the evaporator unit 2 comprises a fan 21 (preferably centrifugal and associated to a motor, not shown) and a laminar evaporator 22 (also called finned battery) wherein the air flow to be refrigerated is forced to pass, pushed by fan 21.

30 As is clearly shown in figs. 3a and/or 3b, fan 21 and evaporator 22 are positioned

on a platform 23 where to a back 24 is jointed, the function whereof shall be explained hereinafter, lying on a vertical plane substantially orthogonal to that of the same platform 23.

More in detail, as shown in the annexed figs., the housing for the centrifugal fan 21 is obtained on platform 23 in the proximity of the front edge 231 thereof
5 whereas the laminar evaporator 22 is positioned at the opposite edge. A distributor 25 is further provided between the centrifugal fan 21 and evaporator 22 which evenly distributes the air flow drawn by fan 21 from the refrigerator compartment 12 on the entire exchanging surface of evaporator 22 for an
10 optimum cooling thereof. Distributor 25 of figure 3a and/or 3b consists of fins 251 that extend from hub 211 of fan 21 defining a plurality of distribution channels 252 thereinbetween and with said front edge 231 of platform 23.

The centrifugal fan 21 is hidden to the sight by a cover 3 fixed to the outside face 232 of platform 23 and provided with a safety grid 31 and with optional low
15 consumption light spots 32 (preferably LED).

According to the invention, the evaporator unit 2 is positioned and fixed, through known means and systems (for example by screwing), within the refrigerator compartment 12 so that platform 23 (and the components placed thereon) is close to ceiling 111 of the refrigerator compartment 12 and back 24 to the back
20 wall 112 thereof. As shown in fig. 5 in cross-section view according to a horizontal plane, width LS of back 24 is less than that LP of the back wall 112 so as to leave a passage 5 between the side edges and sides 113 of the refrigerator compartment 12 (or, which is equivalent, of cabinet 11) for the reasons that shall be explained hereinafter.

25 Back 24 and the longitudinal profiles 244 thereof form a channelling C with the back wall 112 of the refrigerator compartment 12.

During the programmed defrosting of the ice accumulated, for the reasons already seen, on evaporator 22, channelling C is suitable for conveying the water generated towards a drain 16 for the discharge thereof (generally obtained on the
30 back wall 112 of the refrigerator compartment 12 in the proximity of cavity 17

that seats the compressor and other known components of the refrigerating circuit) whereas during the steady operation of refrigerator 1 it serves as plenum suitable for receiving the cold air flow coming from evaporator 22 and wherefrom, pushed by fan 21, is subject to passing again into the refrigerator compartment 12. From said plenum C, in fact, the air flow first crosses openings 245 (see fig. 5) of the longitudinal profiles 244 and then the above passages 5 actually entering into the refrigerator compartment 12. In other words, the air circulation indicated by arrows F1 in the annexed figures is activated within the refrigerator compartment 12.

10 The surface of the inside face 243 of back 24 further has, according to the invention, such features as to allow a part of the defrosting water, conveyed by gravity towards drain 16, to be retained thereon. Such capacity of the inside face 243 of back 24 to remain wet may be obtained in various ways: by way of a non/limiting example, by providing scratches and/or streaks and/or grooves and/or embossing and/or felts and/or any other system and means on said inside face 243 suitable for making the surface of said inside face 243 of said back 24 sufficiently rough to retain the defrosting water making it wettable and/or hygroscopic.

The cold and dry air coming from evaporator 22 and that fills plenum C during the routine operation of refrigerator 1 is therefore capable of becoming charged with humidity lapping the wet surface of said inside face 243 of back 24.

By suitably acting, in the design step, on the surface dimensions of back 24 and/or on the type and of the surface features of the inside face 243 thereof, that is, on the amount of water it is capable of retaining, it is therefore possible to ensure the required humidity level in the refrigerator compartment 12 for preventing the excessive drying of the food, ensuring the proper preservation thereof.

In addition to what said, it is useful to note that according to a preferred embodiment of the invention, on the inside face 243 of back 24 there may be provided baffles 242 that direct the cold air flow towards openings 245 of the

longitudinal profiles 244. Said baffles 242 may be fixed or motor-driven, in this second case they may vary their orientation (controlled for example by the control and management unit of refrigerator 1) for directing a larger fraction of cold air towards some shelves 14 of the refrigerator compartment 12 rather than
5 in others, for example towards those wherein a faster cooling of the food is required.

Also a second important advantage is achieved with the evaporator unit 2 described above. According to the invention, in fact, the defrosting of evaporator 22, which takes place subsequent to the temporary and programmed interruption
10 of the refrigerating cycle, takes place naturally simply due to the fact that it is placed within the refrigerator compartment 12 where, as known, the temperatures for food storage are highly positive, generally comprised between 3°C and 10°C. However, it is also possible to also provide one or more electrical resistors (or similar heating devices) at evaporator 22 capable of accelerating the defrosting
15 thereof.

According to another aspect of the invention, along the sides of back 24 there are obtained special seats 241 for installing a lighting system 4 of the refrigerator compartment 12 (see figures 4 and 5).

More in particular, the lighting system 4 preferably consists of light LED or
20 SMD bars that, once installed onto seats 241, illuminate said passages 5 between back 24 and sides 113 of cabinet 11. For simplicity of description, hereinafter the term LED shall also indicate the so-called light SMD.

As shown in figure 4, multiple sectors 41, 42 may be found on the light bars 4, each one being capable of emitting light of different colours.

25 By way of a non-limiting example, the light bar 4 may be provided with first sectors 41 the LED whereof emit a light with substantially neutral or warm colours (preferably white or red) and second sectors 42 that emit cold light, preferably blue. Light bars 4 thus conceived therefore have the dual function of allowing an adequate lighting of the refrigerator compartment 12 while
30 signalling, through the colour of the emitted light, the different temperatures that

may be found therein between shelves 14.

Therefore, said first sectors 41 shall be positioned at those shelves 14 (and/or drawers 15) located in the zones of the refrigerator compartment 12 with higher temperatures whereas the second sectors 42 at those located in the zones with lower temperature (we may consider, for example, the well-known "quick cooling" compartments comprising one or more shelves 14).

Moreover, it has been seen that, according to the invention, the temperatures of said zones of the refrigerator compartment 12 may be changed, increasing or decreasing them, respectively according to the larger or smaller cold air flow rate directed by the motor-driven and adjustable baffles 242 of back 24.

For this reason, each sector 41 and/or 42 of the light bar 4 may comprise both LED L1 capable of emitting neutral/warm light and LED L2 that on the contrary emit cold light, the first one activating when the temperature of the zone of the refrigerator compartment 12 is higher than a predetermined threshold value, the second ones when it is lower. The alternate lighting of LED L1 or L2 may therefore be automatically subject (by the control and command unit of refrigerator 1) to change in orientation of the motor-driven baffles 242.

It is clear that several variants to refrigerator 1, object of the invention, are possible for those skilled in the art, without departing from the novelty scopes of the inventive idea, as well as it is clear that in the practical embodiment of the invention the various components described above may be replaced with technically equivalent ones. For example, in the case of dual door refrigerators 1, the evaporator unit 2 installed, as already widely described, in the refrigerator compartment 12 is also used for cooling an air flow intended for the freezer compartment 13. In this version, according to the usual fixed balancing methods (whereon it is not necessary to dwell as they are known to the man skilled in the art), the air flow drawn by fan 21 from the refrigerator compartment 12 and cooled by evaporator 22 is therefore partly pushed along back 24 and hereby back again to the refrigerator compartment 12 for storing fresh food and partly to the freezer compartment 13 (where much lower temperatures are required, in the

range of- 20-25°C for the storage thereof). To this end, an insulated conduit 131 is provided on wall 112 of cabinet 11, at the back of the freezer compartment 13, for conveying the air cooled by evaporator 22 to the same freezer compartment 13 whereas in the partition 114 with the refrigerator compartment 12 there is
5 provided a return conduit 132, insulated as well, which returns the refrigerated air (according to the direction of arrows F2) downstream of fan 21 for a new cooling to evaporator 22.

Of course, it is also possible to provide the freezer compartment 13 with a dedicated fan-evaporator unit which is independent of that installed in the
10 refrigerator compartment 12.

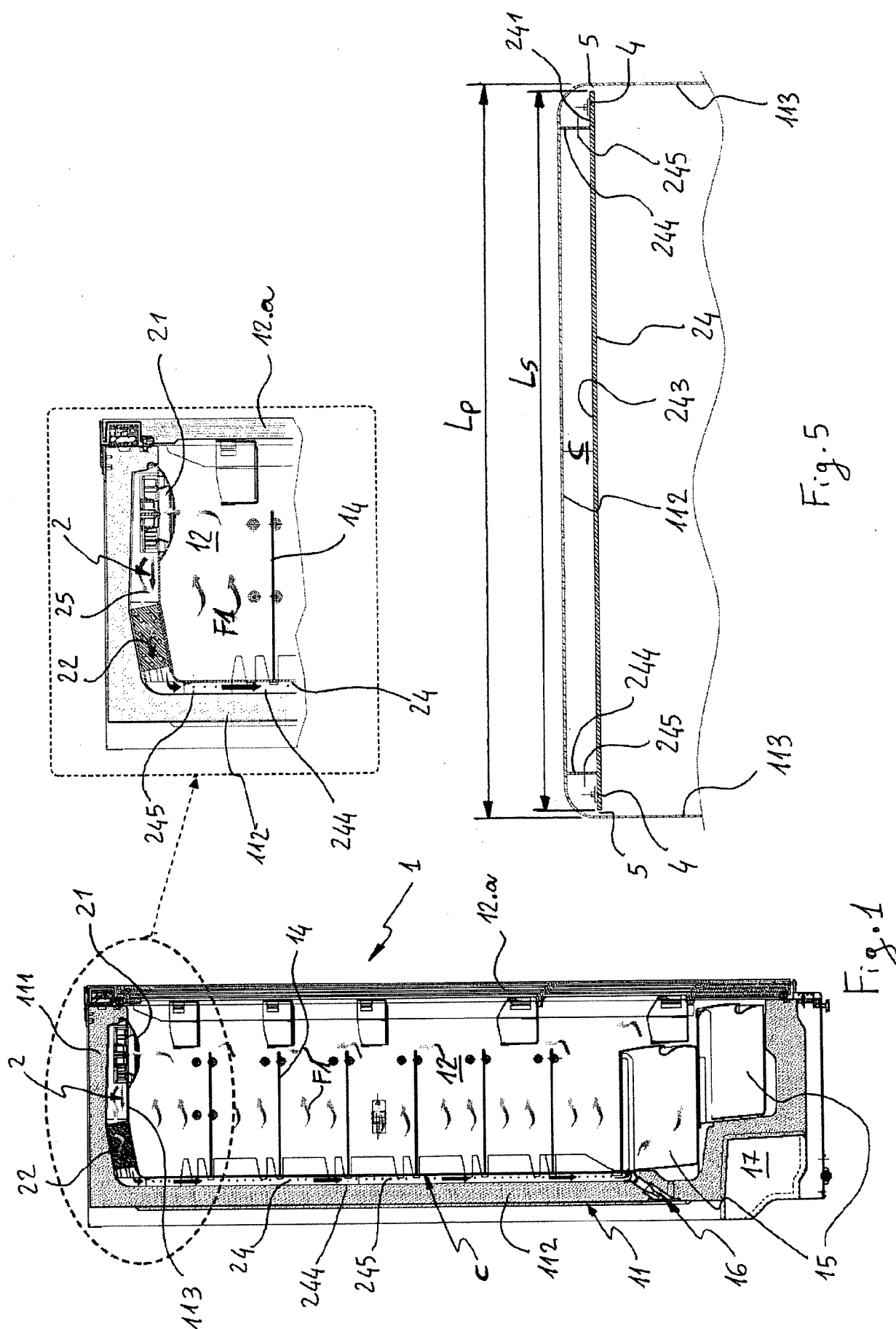
It is clear that the above objects are achieved with a no-frost refrigerator 1 like that described in its versions, in particular that of preventing an excessive "drying" of the food and of the products stored, keeping the refrigerated air flow that circulates in the refrigerator compartment 12 constantly humid by means of
15 back 24 of the invention and a considerable energy saving both for the use of a lighting system 4 with low energy consumption and for the possibility of performing the automatic and programmed defrosting of evaporator 22 without the need of additional heating elements (in particular, electrical resistors). It should be noted that the lighting system 4, which uses lighting means with a low
20 consumption, can be easily mounted in back 24 according to the invention whereas mounting it would be more difficult and expensive if such back 24 was not provided. The lighting system 4 further allows a more efficient use of refrigerator 1 signalling, with the different colours of the light emitted, the different internal temperatures so that the user can safely place the food, based
25 on the organoleptic properties and features thereof, on the proper shelf 14 or drawer 15 ensuring the optimal preservation thereof.

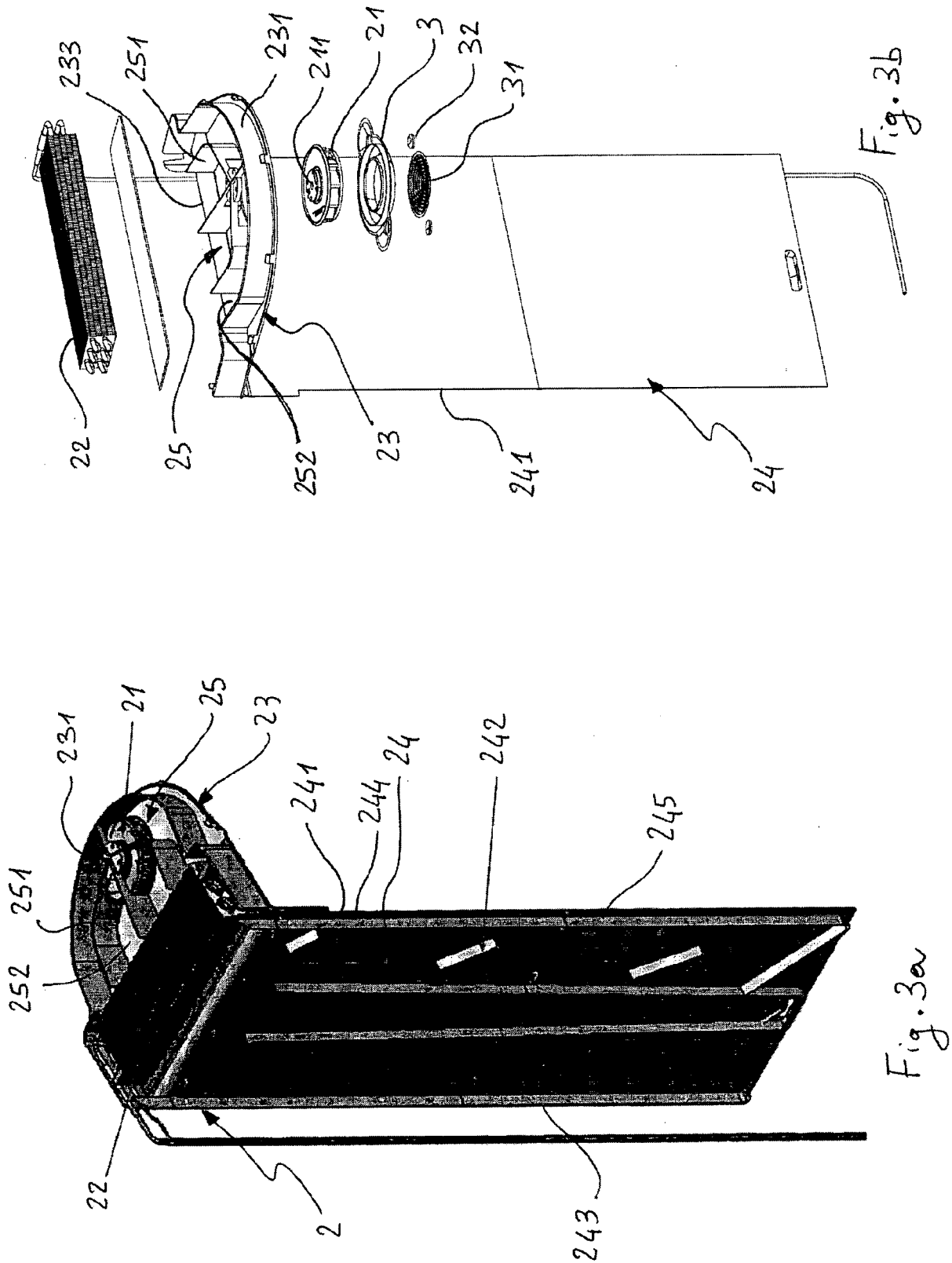
CLAIMS

1. Refrigerator (1), in particular of the no-frost type, comprising a refrigerator compartment (12) or a refrigerator compartment (12) and a freezer compartment (13) into its cabinet (11) for storing food, a lighting system (4)
5 of at least said refrigerator compartment (12) and an evaporator unit (2; 21, 22, 23, 24, 25) in turn comprising:
- an evaporator (22) suitable for cooling the air
 - a fan (21) for moving the air within said refrigerator compartment (12) and/or freezer compartment (13)
- 10 said evaporator (22) being suitable for cooling the air moved within said refrigerator compartment (12) and/or freezer compartment (13) by said fan (21)
characterised in that
said lighting system (4) consists of one or more LED (L1, L2) light bars
15 (4), each one of said light bars (4) being placed substantially in the proximity of the jointing zone between the sides (113) of said refrigerator compartment (12) and the back wall (112) thereof and extending substantially by the entire height of said refrigerator compartment (12).
2. Refrigerator (1) according to the previous claim
20 characterised in that
said light bars (4) comprise one or more first sectors (41) comprising at least LED (L1) capable of emitting neutral or warm light and one or more second sectors (42) comprising at least LED (L2) capable of emitting cold light,
said one or more first sectors (41) being placed substantially at the zones of
25 said refrigerator compartment (12) with higher temperatures whereas said one or more second sectors (42) being placed substantially at the zones of said refrigerator compartment (12) with lower temperatures.
3. Refrigerator (1) according to any previous claim
characterised in that
30 said light bars (4):

- are installed on seats (241) obtained along the sides of a back (24) close to the back wall (112) of the refrigerator compartment (12), said back (24) being connected to a platform (23) close to the ceiling (111) of said refrigerator compartment (12) for housing at least said evaporator (22) and said fan (21) and lying on a vertical plane substantially orthogonal to said platform (23)
 - illuminate the passages (5) between the side edges of said back (24) and said sides (113) of said refrigerator compartment (12).
4. Refrigerator (1) according to any previous claim
- characterised in that
- said one or more sectors (41) may comprise, in addition to said LED (L1), also LED (L2) capable of emitting cold light whereas said one or more second sectors (42) may comprise, in addition to said LED (L2), also LED (L1) capable of emitting neutral or warm light, the activation of said LED (L1) taking place when the temperature of the zone of said refrigerator compartment (12) whereat said one or more first sectors (41) or said one or more second sectors (42) are placed is higher than a predetermined threshold value whereas the activation of said second LED (L2) taking place when the temperature of the zone of said refrigerator compartment (12) whereat said one or more first sectors (41) or said one or more second sectors (42) are placed is lower than said predetermined threshold value.
5. Refrigerator (1) according to the previous claim
- characterised in that
- the alternate activation of said LED (L1, L2) is subject to the change in the orientation of baffles (242) provided on the inside face (243) of said back (24), said baffles (242) being capable of varying the amount of cold air coming from said evaporator (22), to be directed towards said zones of said refrigerator compartment (12).
6. Refrigerator (1) according to any previous claim
- characterised in that

said lighting system (4) further comprises one or more light spots (32) placed on the outside face (232) of said platform (23), said one or more light spots (32) being integrated in the cover (3) fixed on said outside face (232) of said platform (23) that hides said fan (21) to the sight.





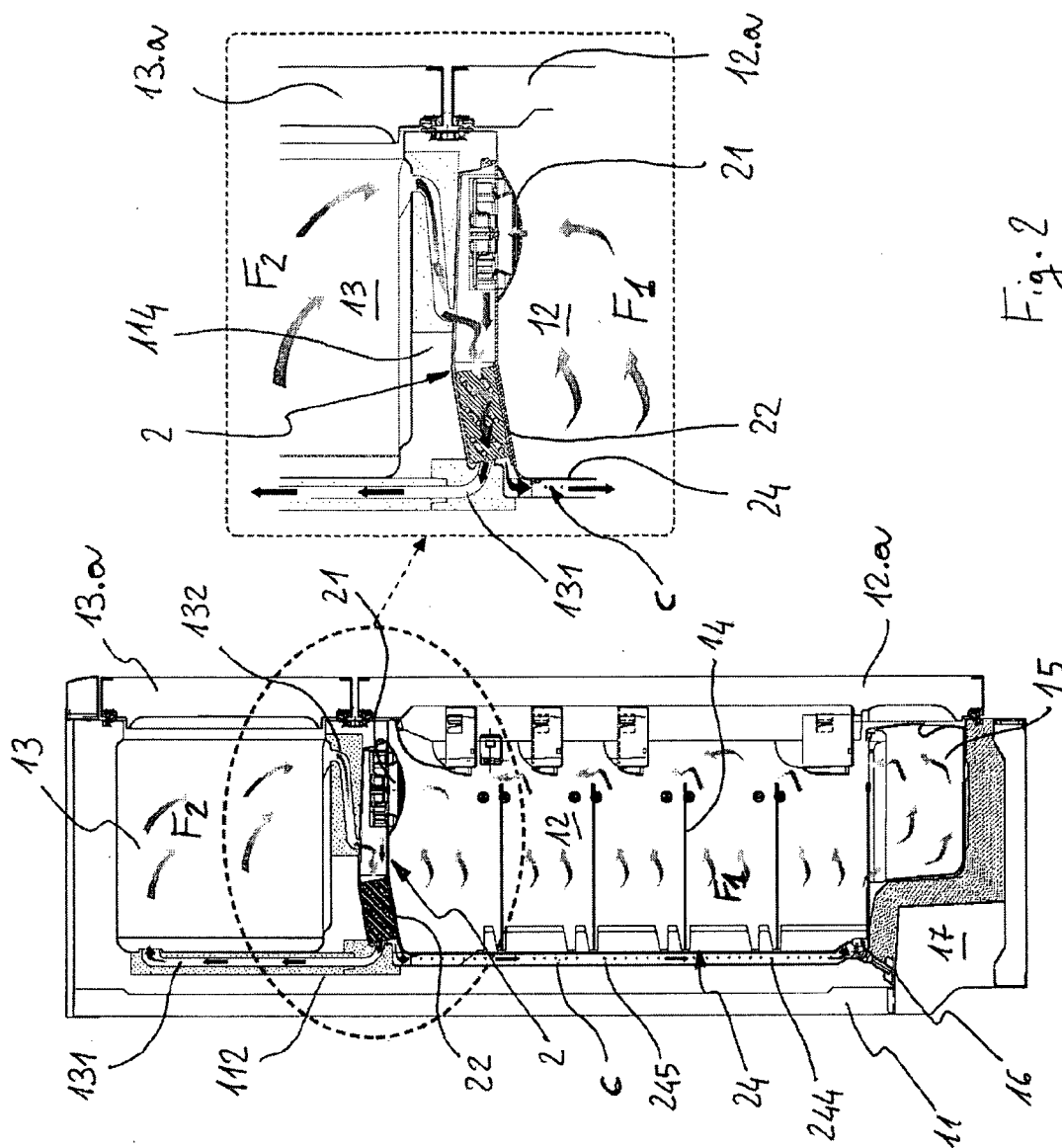


Fig. 2

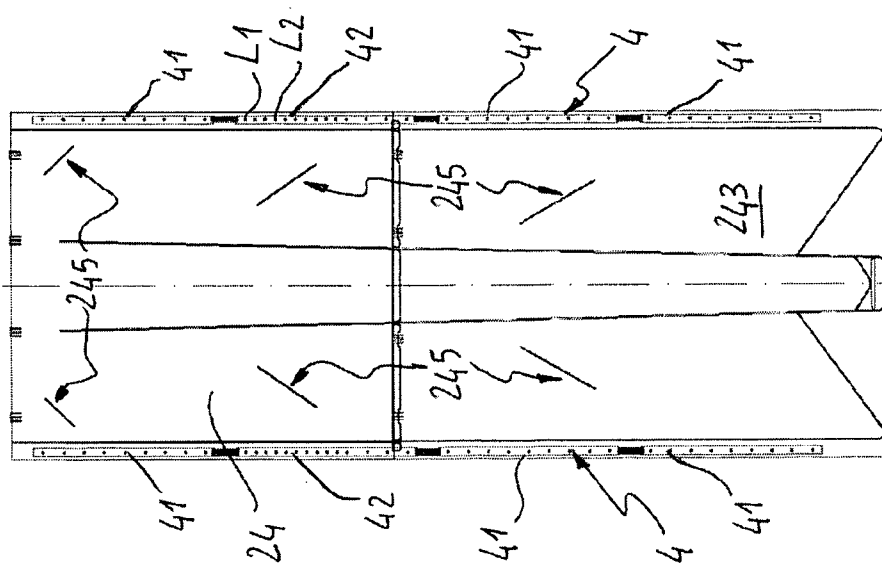


Fig. 4