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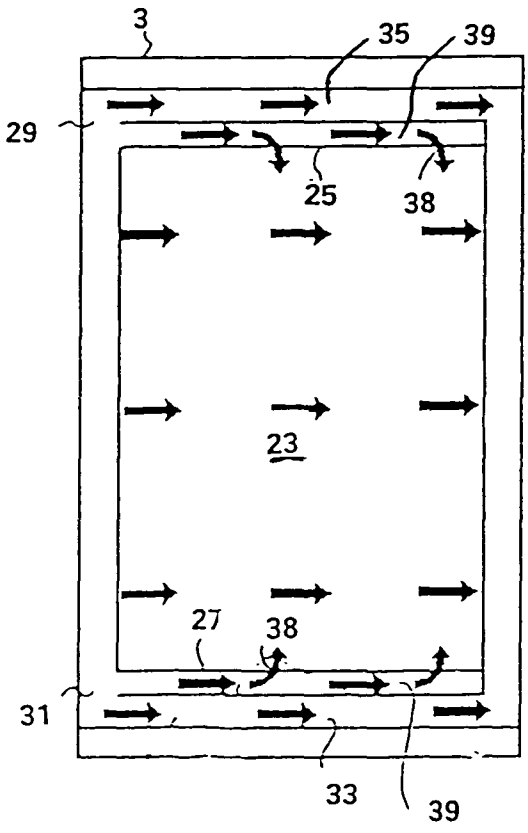
(54) **Title:** TOP-OPENING FREEZER WITH IMPROVED COOLING GAS FLOW



A-A

(57) **Abstract:** A top-opening freezer (1) is presented including an outer casing (3) and a goods compartment (5) with a bottom wall (7), a front wall (9), a rear wall (11) and two side walls (25, 27). A cooling gas curtain (13) is directed across the top opening (13) of the goods compartment. Additionally, the side walls (25, 27) of the goods compartment (5) are cooled by providing a second flow path (29, 31) arranged between the side walls (25, 27) and the outer casing (3), respectively.

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Top-opening freezer with improved cooling gas flow

The present invention is directed to a top-opening freezer having an improved cooling gas flow distribution. Particularly, the present invention is directed to a top-opening freezer including an outer casing, a goods compartment disposed within the outer casing and having a bottom wall, a front wall, a rear wall, two side walls and a top-opening. A first flow path is provided such that cooling gas is guided from an opening at an upper portion of the front wall side of the goods compartment to an opening in an upper portion of the opposite rear wall side of the goods compartment thereby providing a cooling gas curtain across the top opening.

Top-opening freezers are widely used. E.g. in supermarkets, top-opening freezers are used both for deep-freezing consumer products such as food and at the same time displaying these products to customers. In these top-opening freezers having e.g. the form of chests cold air remains in the goods compartment as the goods compartment is only open at its upper side and the cold air being heavier than the air of the surrounding environment is captured within the goods compartment.

In order to reduce the heat entry due to customers grasping into the goods compartment cold air is conventionally directed across the top opening of the goods compartment thereby creating a cooling air curtain. The flow path of the cooling air curtain usually extends from an opening in an upper portion of a front wall in the goods compartment to an upper portion of a rear wall.

However, close to the side walls of the goods compartment, i.e. at the lateral sides of the cooling air curtain, there may be regions which are not sufficiently cooled as there may be turbulences in the cooling gas flow of the gas curtain at these regions where the gas curtain is adjacent to one of the side walls. Furthermore, heat can be transferred via the side walls further increasing the temperatures in these regions.

There may be strict regulations indicating maximum temperature limits which are not allowed to be exceeded within the goods compartment. Due to such regulations regions of elevated temperature at the sides of a top-opening freezer may not be acceptable.

It is therefore an object of the present invention to prevent regions of elevated temperature especially at the sides of the goods department.

The top-opening freezer according to the present invention is characterized by a side wall cooling means cooling at least one of the side walls of the goods compartment and being positioned between a side wall of the goods compartment and the outer casing. A second flow path can be provided such that cooling gas is guided in at least one channel positioned between a side wall of the goods compartment and the outer casing.

In the inventive top-opening freezer, cooling gas can flow in a closed loop. Preferably, the cooling gas is provided by cooled air which can circulate in the closed loop. Thus, losses of cooled air to the environment can be replaced by drawing ambient air into the closed loop. Preferably a cooling gas circulation means such as a fan is provided to circulate the cooling gas. The cooling gas can flow to an entry to the second flow path being proximal to the front wall of the goods department, then flow through the second flow path and then from an exit of the second flow path back to its entry, optionally via the cooling gas circulating means.

There may be one common cooling gas circulating means circulating both the cooling gas in the first flow path and the cooling gas in the second flow path. E.g. a fan can be provided underneath the bottom wall of the goods compartment propelling a common cooling gas flow. Subsequently, this common cooling gas flow is divided into the first flow producing the cooling gas curtain from the front wall to the rear wall of the goods compartment and the second flow flowing through the channel positioned adjacent to the side wall of the goods compartment. Alternatively, two separate cooling circulation means can be provided for the first and the second flow path, respectively.

Preferably a cooling means such as a heat exchanger is provided within the closed loop. Cooling gas for the first and/or second flow path can be cooled by passing it through the cooling means. Preferably, the cooling means is located within the top opening freezer, but can also be provided remotely thereof.

The cooling gas flowing in the second flow path serves for cooling the adjacent side wall. Thereby, the heat entry across the side wall to the goods compartment can be reduced significantly.

According to one embodiment, the channel of the second flow path is defined by one of the respective side walls and the outer casing. In other words, walls defining the channel of the second flow path can be constituted by a side wall and a wall of the outer casing. The cooling gas can enter the space between the side wall and the outer casing proximal to a front wall side, then flow through the space between the side wall and the outer casing and then exit at the opposite rear wall side. No additional tubing needs to be provided between the side walls of the goods department and the outer casing.

Preferably, the second flow path is arranged such that cooling gas flows from a front wall side of the goods compartment across the entire side wall surface to a rear wall side of the goods compartment. Thereby, the side wall can be cooled along its entire length.

According to a further embodiment the channel of the second flow path is positioned laterally adjacent to an upper edge of the side wall of the goods compartment. Thereby, the side wall is especially cooled in a region adjacent to the top-opening where heat losses occur due to turbulences in the cooling gas curtain.

According to a further embodiment the channel of the second flow path includes one or more flow connections to the goods compartment. Through these flow connections cooling gas can flow from the second flow path into the goods compartment thereby providing improved cooling of the goods compartment especially in a region close to the side walls. The flow connections can be provided by holes or cut-outs in the side wall of the goods compartment. These holes or cut-outs can have any geometry allowing a gas flow between the cooling channel

and the goods compartment. Optionally, the second flow path is closed at its rear wall side such that the entire gas flow is forced through the flow connections into the goods compatment. By using special geometries for the flow connections or the holes the flow of cooling gas into the goods compartment can be enhanced, thereby providing even better cooling. E.g., the holes or cut-outs can be made larger in regions where additional cooling is especially desired, such as at a region proximal to the rear wall, compared to other regions such that more cooling gas enters at these regions. In order to both cool the space between the side walls of the goods compartment and the outer casing and allow a predetermined cooling gas flow to the goods compartment, the second flow path can be divided into a first continuous flow portion extending from a front wall side of the goods compartment to a rear wall side and a second flow portion having flow connections to the goods compartment. The first flow portion serves for better isolating the goods compartment against the surrounding environment of the top-opening freezer while the second flow portion improves the cooling within the goods compartment within the region close to the side walls. The first and second flow portions can be separated e.g. by a guide vane.

Preferably, the flow connections can be arranged at the filling limit of the goods compartment. That means that the openings for introducing cooling gas from the channel of the second flow path to the goods compartment are approximately arranged in a height of the side wall up to which the goods compartment is to be filled at maximum with goods to be stored therein. By such arrangements, the goods closest to the cooling gas curtain are especially cooled.

Furthermore, the flow connections are preferably arranged at a portion of the side wall proximal to the rear wall. Accordingly, cooling gas can specifically be introduced into the goods compartment in a region downstream of the middle of the first flow path, i.e. the middle of the cooling gas curtain. Thereby, especially the region closer to the opening in the rear wall for returning the cooling gas of the first flow back to cooling gas circulation means, i.e., the region where the cooling gas curtain is warmest and most disturbed, can be additionally cooled.

Further advantages of the present invention will be apparent to those skilled in the art from the following detailed description of preferred embodiments together with the Figures, wherein:

Figure 1 is a sectional view of a top-opening freezer;

Figure 2 is a sectional view of a conventional top-opening freezer along the plane A-A indicated in Figure 1;

Figure 3 is a sectional view of a top-opening freezer according to an embodiment of the invention along the plane A-A indicated in Figure 1;

Figure 4 is a sectional view of a prior art top-opening freezer along the plane B-B indicated in Figure 1;

Figure 5 is a sectional view of a top-opening freezer according to an embodiment of the invention along the plane B-B indicated in Figure 1.

In Figure 1, a top-opening freezer 1 includes an outer casing 3 and a goods compartment 5 disposed within the outer casing 3 and having a bottom wall 7, a front wall 9, a rear wall 11 and a top-opening 13. Beyond the bottom wall 7 of the goods compartment 5 there is a cooling gas circulating and cooling means 15 like e.g. a fan coupled with a heat exchanger. The fan propels cooling gas for flowing round a cooling gas circuit. The cooling gas first flows through a space between the bottom wall 7 and front wall 9 of the goods compartment and the outer casing 3. Then, cooling gas exits through an opening 17 in an upper portion of the front wall 9. The cooling gas flows along the top opening 13 of the goods compartment 5 thereby forming a cooling gas curtain. Subsequently, the cooling gas enters an opening 19 in an opposite upper portion of the rear wall 11 and flows back to the cooling gas circulating and cooling means 15 through the space between the rear wall 11 and bottom wall 7 of the goods compartment 5 and the outer casing 3.

The illustrated top-opening freezer 1 further includes a heat exchanger (not shown) positioned within the cooling gas circuit and connected to a cooling unit (not shown) included in a lower part 21 of the top-opening freezer 1.

Figure 2 illustrates a conventional top-opening freezer wherein a cooling gas curtain 23 (indicated as arrows) is flowing from a front wall 9, across the top-opening 13 to a rear rear wall 11 of the goods compartment 5. The side walls 25, 27 of the goods compartment 5 are not specifically cooled.

Figure 3 shows an embodiment of the top-opening freezer according to an embodiment of the invention. Additionally to the air curtain 23 additional second flow paths are provided in a space between the side walls 25, 27 and the outer casing 3, respectively. The two second flow paths are provided with a first flow portion 33, 35, respectively, extending from a front wall 9 side of the goods compartment 5 to a rear wall 11 side, and second flow portions 37, 39, respectively, having flow connections 38 to the goods compartment 5. A part of the cooling gas flows from a front side along the first flow portions 33, 35 to the rear side thereby cooling the side walls. Another part of the cooling gas flows through the second flow portions 37, 39 from the front side through the flow connections 38 into the goods compartment 5 thereby cooling the regions of the goods compartment 5 close to the side walls 25, 27.

As can be seen from Figure 4, in a prior art top-opening freezer, the cooling gas returning from the rear wall side 11 flows linearly along the surface underneath the bottom wall 7 and through a unit 41, comprising a fan and a heat exchanger extending almost along the entire width of the bottom wall 7 before again flowing to the front wall 9. In contrast hereto, as shown in Figure 5, in the top-opening freezer according to the disclosed embodiment of the present invention the cooling gas coming from the fan/evaporator unit 41 is divided by a guide vane 43 into two separate streams. The middle stream continues to form the cooling gas curtain whereas the border region streams are diverted into the direction of the second flow path in the side walls 25, 27.

Claims:

1. Top-opening freezer (1) including:
an outer casing (3);
a goods compartment (5) disposed within the outer casing (3) having a bottom wall (7), a front wall (9), a rear wall (11), two side walls (25, 27) and a top opening (13);
wherein a first flow path is provided such that cooling gas is guided from an opening (17) at an upper portion of the front wall (9) side of the goods compartment to an opening (19) in an upper portion of the opposite rear wall (11) side of the goods compartment thereby providing a cooling gas curtain across the top opening (13);
characterized by
a side wall cooling means for cooling at least one side wall of the goods compartment and being positioned between a side wall (25, 27) of the goods compartment (5) and the outer casing (3).

2. Freezer according to claim 1, wherein the side wall cooling means comprises at least one channel (29, 31) for a second flow path provided such that cooling gas is guided in the at least one channel (29, 31).

3. Freezer according to claim 2, wherein the channel (29, 31) of the second flow path is defined by a respective side wall (29, 31) of the goods compartment (5) and the outer casing (3).

4. Freezer according to claim 2 or 3, wherein the channel (29, 31) of the second flow path extends from a front wall (9) side of the goods compartment (5) to a rear wall (11) side of the goods compartment (5).

5. Freezer according to one of claims 2 to 4, wherein the channel (29, 31) of the second flow path is positioned laterally adjacent an upper edge of the side wall (29, 31) of the goods compartment (5).

6. Freezer according to one of claims 2 to 5, wherein the the channel (29, 31) of the second flow path includes flow connections (38) to the goods compartment (5).

7. Freezer according to claim 6, wherein the flow connections (38) are provided by holes in the side wall (25, 27) of the goods compartment (5).

8. Freezer according to one of claims 2 to 7, wherein the second flow path is divided into a first flow portion (33, 35) extending from a front wall (9) side of the goods compartment (5) to a rear wall (11) side of the goods compartment (5) and a second flow portion (37, 39) having flow connections to the goods compartment (5).

9. Freezer according to one of claims 6 to 8, wherein the flow connections (38) are arranged at a filling limit of the goods compartment (5).

10. Freezer according to one of claims 6 to 9, wherein the flow connections (39) are arranged at a portion of the side wall (25, 27) proximal to the rear wall (11).

11. Freezer according to one of claims 2 to 10, further comprising a cooling gas circulating means (15) for circulating a cooling gas through at least one of the first and second flow paths.

12. Freezer according to claim 11, wherein a gas flow coming from the cooling gas circulating means (15) is divided into the first and second flow path by means of a guide vane (43).

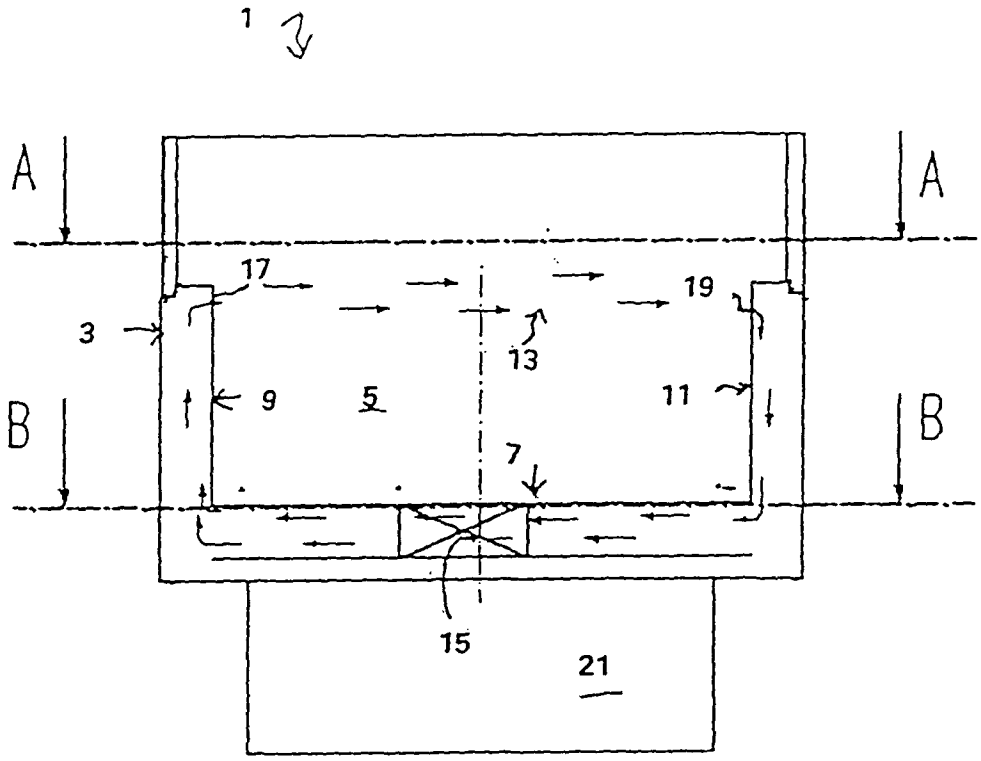

Fig. 1

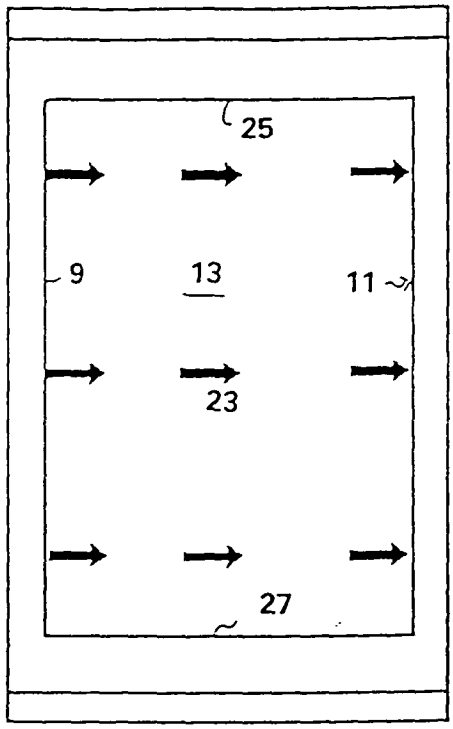

Fig. 2 (prior art)

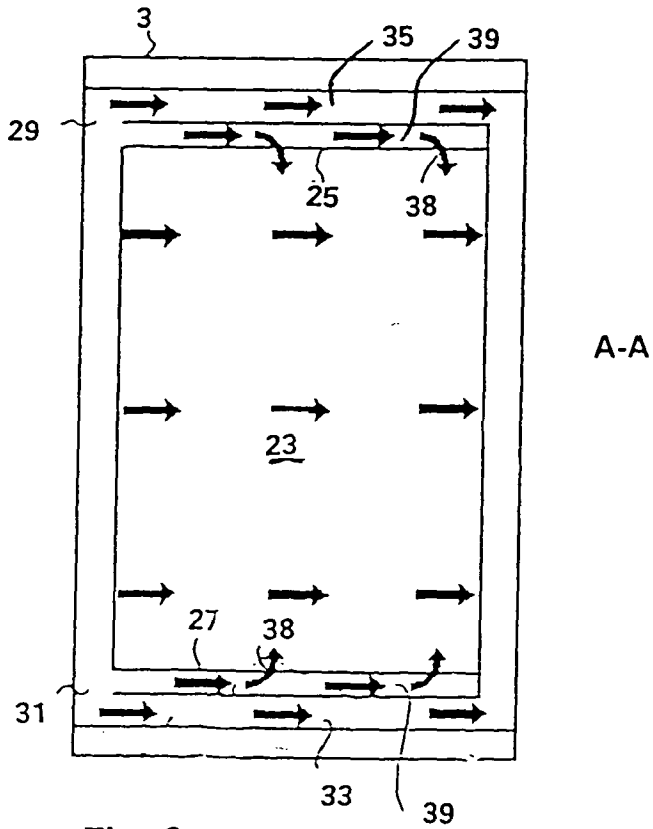

Fig. 3

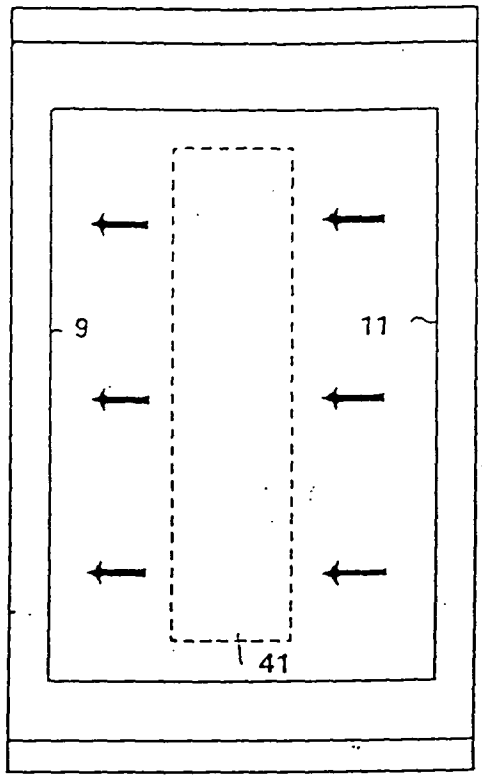

Fig. 4 (prior art)

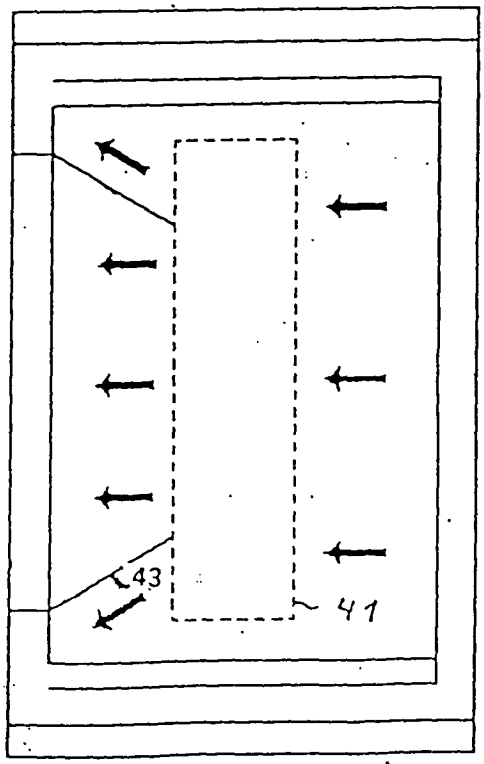

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2006/007503

A. CLASSIFICATION OF SUBJECT MATTER
INV. F25D23/02 A47F3/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F25D A47F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 23 20 208 A1 (LINDE AG) 7 November 1974 (1974-11-07) page 6; figures 2,3	1-5,11
A	US 2003/217560 A1 (KASUYA JUNICHIRO [JP] ET AL) 27 November 2003 (2003-11-27) paragraphs [0007], [0010], [0012], [0013]; figures 1,2	1-12
A	US 4 300 358 A (HINO KAZUHIKO ET AL) 17 November 1981 (1981-11-17) column 2, lines 6-37; figure 1	1-12
A	US 5 442 932 A (O'HEARNE ROBERT L [US]) 22 August 1995 (1995-08-22) abstract; figure 1	1-12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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