



(11) **EP 2 166 296 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
16.11.2011 Bulletin 2011/46

(51) Int Cl.:
F25D 23/06^(2006.01)

(21) Application number: **09179831.4**

(22) Date of filing: **28.07.2006**

(54) **Top-opening freezer with improved cooling gas flow**

Gefriertruhe mit verbessertem Kühlgasstrom

Congélateur à ouverture par le haut doté d'un flux de gaz amélioré

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR

(43) Date of publication of application:
24.03.2010 Bulletin 2010/12

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
06762884.2 / 2 047 190

(73) Proprietor: **CARRIER CORPORATION**
Farmington,
Connecticut 06034-4015 (US)

(72) Inventors:
• **Zäpf, Wolfgang**
36041 Fulda (DE)
• **Schu, Markus**
55597 Wöllstein (DE)
• **Dielmann, Jens**
55246 Mainz-Kostheim (DE)

(74) Representative: **Waibel, Stefan Christopher**
Klunker Schmitt-Nilson Hirsch
Patentanwälte
Destouchesstrasse 68
80796 München (DE)

(56) References cited:
DE-A1- 2 320 208 US-A- 4 300 358
US-A- 5 442 932 US-A1- 2003 217 560

EP 2 166 296 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] 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 as defined in the preamble of claim 1. Such a freezer is known, for example, from DE-A1-23 20 208.

[0002] 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.

[0003] 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.

[0004] 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.

[0005] 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.

[0006] DE 2320208 discloses a freezing chest with a top-opening goods compartment. The opening is insulated against the environmental air by a cold air cushion produced by cooling means in a transition chamber surrounding the top-opening above the goods compartment. In the transition chamber there is disposed at least one fan to maintain the cold air cushion by a continuous cold air stream.

[0007] It is therefore an object of the present invention to prevent regions of elevated temperature especially at the sides of the goods department.

[0008] The top-opening freezer according to the present invention is defined in claim 1.

[0009] The top-opening freezer comprises 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 is 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.

[0010] 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.

5 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.

[0011] 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.

10 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.

15 **[0012]** 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.

20 **[0013]** 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.

25 **[0014]** 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.

30 **[0015]** 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.

35 **[0016]** 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.

40 **[0017]** According to a further embodiment the channel of the second flow path includes one or more flow con-

nections 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 compartment. 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.

[0018] 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.

[0019] 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.

[0020] 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.

[0021] 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.

[0022] 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.

[0023] 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 wall 11 of the goods compartment 5. The side walls 25, 27 of the goods compartment 5 are not specifically cooled.

[0024] 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.

[0025] 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 and through a unit 41, comprising a fan and a heat exchanger extending almost along the entire width of the bottom wall 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);
 wherein a side wall cooling means is provided for cooling at least one side wall of the goods compartment, said side wall cooling means being positioned between a side wall (25, 27) of the goods compartment (5) and the outer casing (3); and
 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):
 the freezer further comprising,
 a cooling gas circulating means (15) for circulating a cooling gas through at least one of the first and second flow paths; and **characterized by** a guide vane (43) by means of which a gas flow coming from the cooling gas circulating means (15) is divided into the first and second flow path.

2. Freezer according to claim 1, 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).

3. Freezer according to claim 1 or 2, 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).

4. Freezer according to one of claims 1 to 3, wherein the channel (29, 31) of the second flow path is positioned laterally adjacent an upper edge of said one side wall (25, 27) of the goods compartment (5).

5. Freezer according to one of claims 1 to 4, wherein the channel (29, 31) of the second flow path includes flow connections (38) to the goods compartment (5).

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

7. Freezer according to one of claims 1 to 6, 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).

8. Freezer according to one of claims 5 to 7, wherein the flow connections (38) are arranged at a filling limit of the goods compartment (5).

9. Freezer according to one of claims 5 to 8, wherein the flow connections (38) are arranged at a portion of the side wall (25, 27) proximal to the rear wall (11).

Patentansprüche

1. Tiefkühlgerät (1) mit Öffnung an der Oberseite, aufweisend:

ein Außengehäuse (3);
 einen in dem Außengehäuse (3) angeordneten Warenraum (5) mit einer Bodenwand (7), einer vorderen Wand (9), einer hinteren Wand (11), zwei Seitenwänden (25, 27) und einer oberen Öffnung (13);
 wobei ein erster Strömungsweg derart vorgesehen ist, dass Kühlgas von einer Öffnung (17) in einem oberen Bereich auf der Seite der vorderen Wand (9) des Warenraums zu einer Öffnung (19) in einem oberen Bereich auf der Seite der gegenüberliegenden hinteren Wand (11) des Warenraums geführt wird, um **dadurch** einen Kühlgasvorhang über die obere Öffnung (13) zu schaffen;
 wobei eine Seitenwand-Kühleinrichtung zum

- Kühlen von mindestens einer Seitenwand des Warenraums angeordnet ist, wobei die Seitenwand-Kühleinrichtung zwischen einer Seitenwand (25, 27) des Warenraums (5) und dem Außengehäuse (3) angeordnet ist; und wobei die Seitenwand-Kühleinrichtung mindestens einen Kanal (29, 31) für einen zweiten Strömungsweg aufweist, der derart vorgesehen ist, dass Kühlgas in den mindestens einen Kanal (29, 31) geleitet wird; wobei das Tiefkühlgerät des Weiteren eine Kühlgas-Zirkulationseinrichtung (15) zum Zirkulieren eines Kühlgases durch mindestens einen von dem ersten und dem zweiten Strömungsweg (33, 35; 39) umfasst; und **gekennzeichnet durch** eine Leitplatte (43), mittels derer eine von der Kühlgas-Zirkulationseinrichtung (15) kommende Gasströmung auf den ersten und den zweiten Strömungsweg aufgeteilt wird.
2. Tiefkühlgerät nach Anspruch 1, wobei der Kanal (29, 31) des zweiten Strömungsweges (39) durch eine jeweilige Seitenwand (25, 27) des Warenraums (5) und des Außengehäuses (3) gebildet ist.
 3. Tiefkühlgerät nach Anspruch 1 oder 2, wobei der Kanal (29, 31) des zweiten Strömungsweges (39) sich von einer Seite an der vorderen Wand (9) des Warenraums (5) zu einer Seite an der hinteren Wand (11) des Warenraums (5) erstreckt.
 4. Tiefkühlgerät nach einem der Ansprüche 1 bis 3, wobei der Kanal (29, 31) des zweiten Strömungsweges (39) seitlich neben einem oberen Rand der einen Seitenwand (25, 27) des Warenraums (5) angeordnet ist.
 5. Tiefkühlgerät nach einem der Ansprüche 1 bis 4, wobei der Kanal (29, 31) des zweiten Strömungsweges (39) Strömungsverbindungen (38) zu dem Warenraum (5) beinhaltet.
 6. Tiefkühlgerät nach Anspruch 5, wobei die Strömungsverbindungen (38) durch Öffnungen in der Seitenwand (25, 27) des Warenraums (5) gebildet sind.
 7. Tiefkühlgerät nach einem der Ansprüche 1 bis 6, wobei der zweite Strömungsweg in einen ersten Strömungsbereich (33, 35), der sich von einer Seite an der vorderen Wand (9) des Warenraums (5) zu einer Seite an der hinteren Wand (11) des Warenraums (5) erstreckt, und in einen zweiten Strömungsbereich (39) unterteilt ist, der Strömungsverbindungen (38) zu dem Warenraum (5) aufweist.

8. Tiefkühlgerät nach einem der Ansprüche 5 bis 7, wobei die Strömungsverbindungen (38) an einer Füllgrenze des Warenraums (5) angeordnet sind.

- 5 9. Tiefkühlgerät nach einem der Ansprüche 1 bis 8, wobei die Strömungsverbindungen (38) in einem Bereich der Seitenwand (25, 27) in der Nähe der hinteren Wand (11) angeordnet sind.

10

Revendications

1. Congélateur à ouverture par le haut (1) incluant :

15

un boîtier externe (3) ;

un compartiment de denrées (5) disposé au sein du boîtier externe (3) comportant une paroi inférieure (7), une paroi avant (9), une paroi arrière (11), deux parois latérales (25, 27), et une ouverture par le haut (13) ;

20

où un premier trajet d'écoulement est prévu de telle sorte qu'un gaz de refroidissement est guidé depuis une ouverture (17) au niveau d'une portion supérieure du côté de la paroi avant (9) du compartiment de denrées, vers une ouverture (19) dans une portion supérieure du côté de paroi arrière opposée (11) du compartiment de denrées, formant ainsi un rideau de gaz de refroidissement à travers l'ouverture par le haut (13) ;

30

où un moyen de refroidissement de paroi latérale est prévu pour refroidir au moins une paroi latérale du compartiment de denrées, ledit moyen de refroidissement de paroi latérale étant positionné entre une paroi latérale (25, 27) du compartiment de denrées (5) et le boîtier externe (3) ; et

35

où le moyen de refroidissement de paroi latérale comprend au moins un canal (29, 31) pour un second trajet d'écoulement prévu de telle sorte qu'un gaz est guidé dans le au moins un canal (29, 31) ;

40

le congélateur comprenant en outre un moyen de circulation de gaz de refroidissement (15) permettant de faire circuler un gaz de refroidissement à travers au moins l'un des premier et second trajets d'écoulement ; et

45

caractérisé par une aube fixe (43) au moyen de laquelle un écoulement de gaz provenant du moyen de circulation de gaz de refroidissement (15) est divisé en les premier et second trajets d'écoulement.

50

2. Congélateur selon la revendication 1, dans lequel le canal (29, 31) du second trajet d'écoulement est défini par une paroi latérale (29, 31) respective du compartiment de denrées (5) et le boîtier externe (3).

55

3. Congélateur selon la revendication 1 ou 2, dans lequel le canal (29, 31) du second trajet d'écoulement s'étend depuis un côté de paroi avant (9) du compartiment de denrées (5) vers un côté de paroi arrière (11) du compartiment de denrées (5). 5
4. Congélateur selon l'une des revendications 1 à 3, dans lequel le canal (29, 31) du second trajet d'écoulement est positionné latéralement adjacent à un bord supérieur de ladite paroi latérale (25, 27) du compartiment de denrées (5). 10
5. Congélateur selon l'une des revendications 1 à 4, dans lequel le canal (29, 31) du second trajet d'écoulement comprend des raccords d'écoulement (38) au compartiment de denrées (5). 15
6. Congélateur selon la revendication 5, dans lequel les raccords d'écoulement (38) sont formés par des trous dans la paroi latérale (25, 27) du compartiment de denrées (5). 20
7. Congélateur selon l'une des revendications 1 à 6, dans lequel le second trajet d'écoulement est divisé en une première portion d'écoulement (33, 35) s'étendant depuis un côté de paroi avant (9) du compartiment de denrées (5) vers un côté de paroi arrière (11) du compartiment de denrées (5) et une seconde portion d'écoulement (37, 39) comportant des raccords d'écoulement au compartiment de denrées (5). 25
30
8. Congélateur selon l'une des revendications 5 à 7, dans lequel les raccords d'écoulement (38) sont agencés à une limite de remplissage du compartiment de denrées (5). 35
9. Congélateur selon l'une des revendications 5 à 8, dans lequel les raccords d'écoulement (38) sont agencés en une portion de la paroi latérale (25, 27) à proximité de la paroi arrière (11). 40

45

50

55

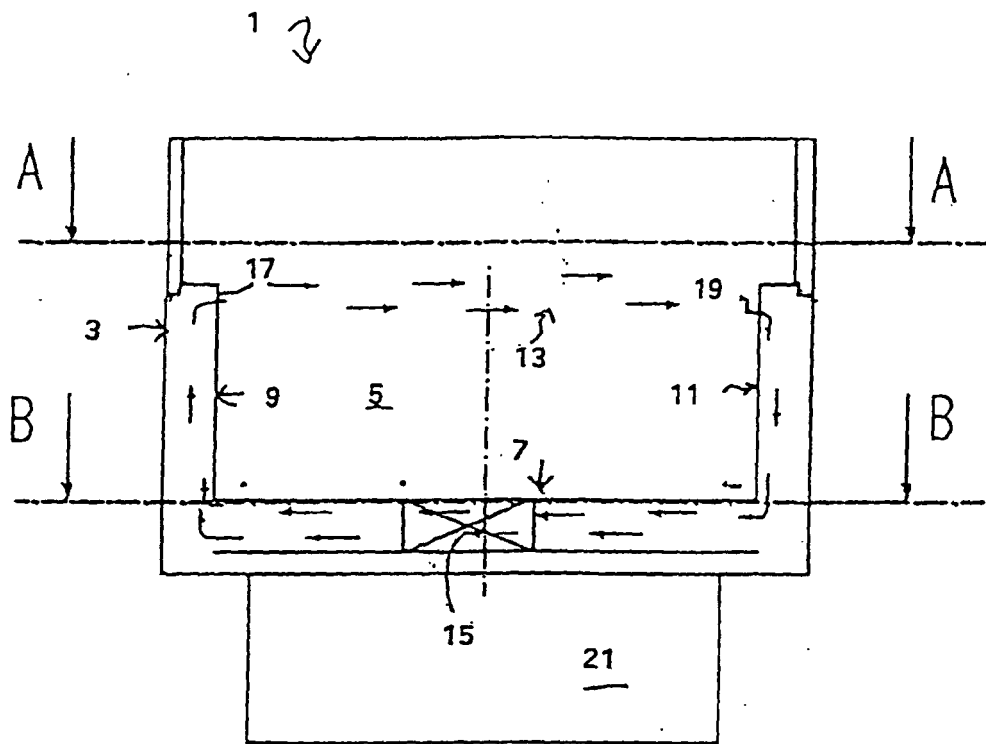


Fig. 1

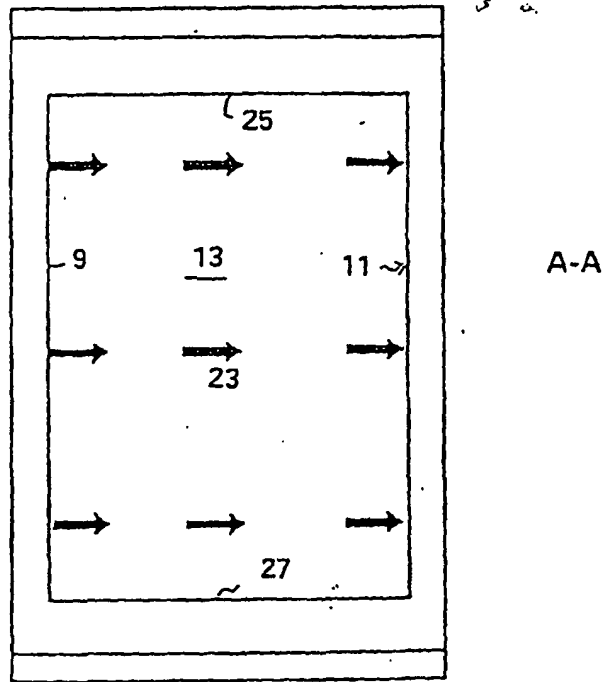


Fig. 2 (prior art)

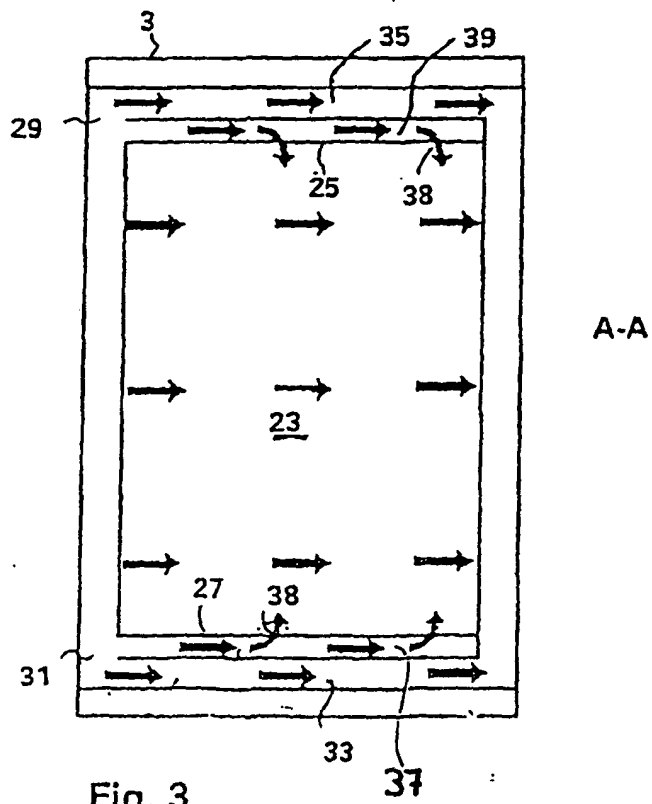
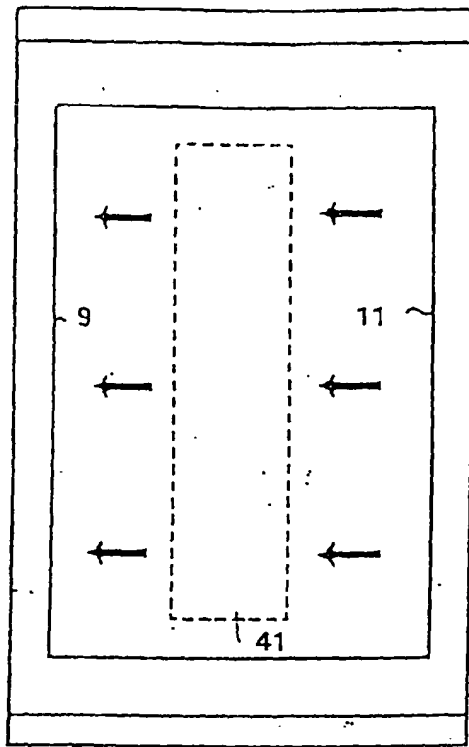
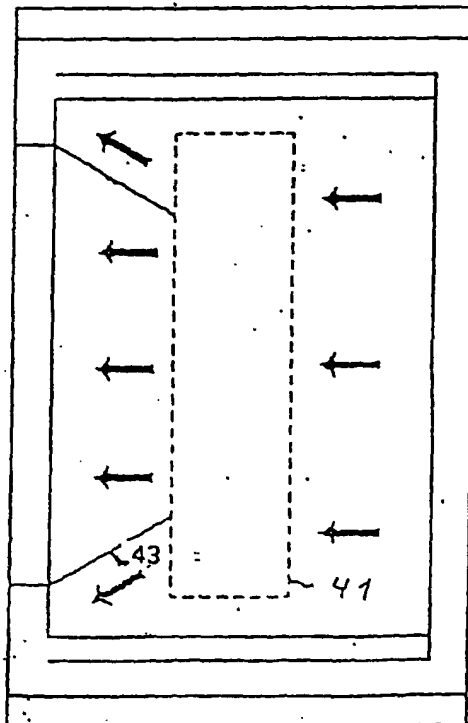


Fig. 3



B-B

Fig. 4 (prior art)



B-B

Fig. 5

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 2320208 A1 [0001]
- DE 2320208 [0006]