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(54) **A CLIMATIZATION CONTAINER**

(57) A climatization container comprising a compartment for storage of products, at least one shelf to support the products and a fan for distribution of air within the climatization container. The compartment is defined by walls and closable by a door. The fan is positioned proximal to a top wall of the compartment and angled relative to a vertical direction such that air expelled by the fan is directed towards the top wall of the compartment.

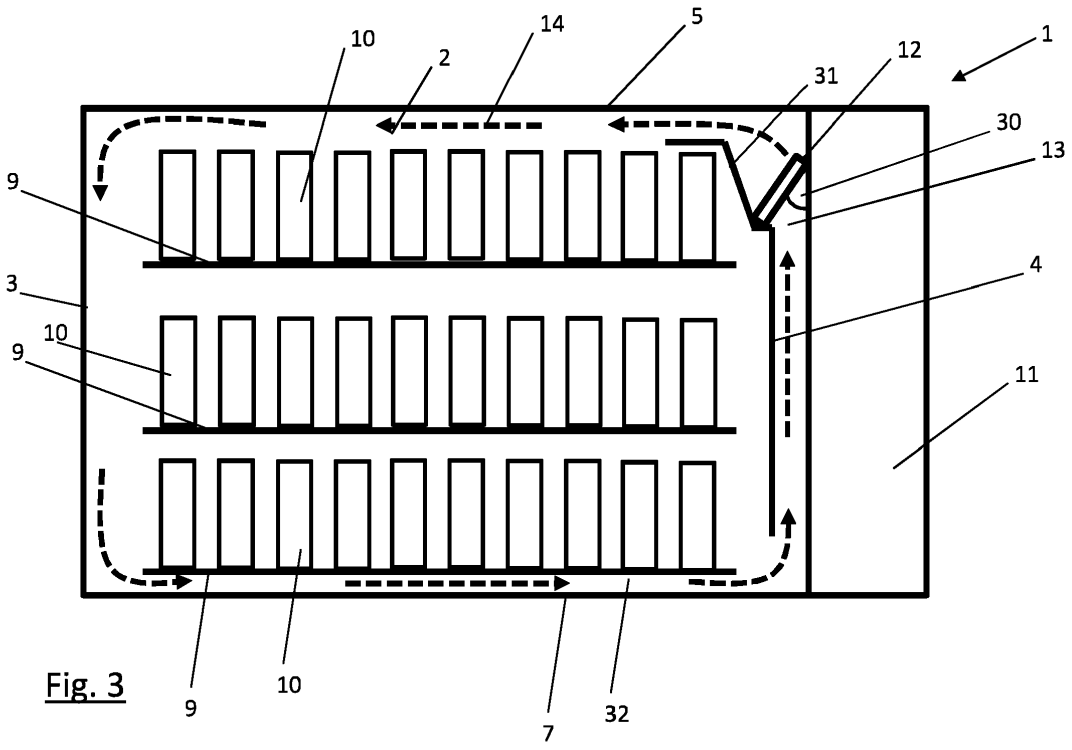

Fig. 3

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Description

[0001] This invention relates generally to a climatization container, for instance a refrigerator.

[0002] A climatization container comprises a container suitable for keeping contents stored therein under particular climatic conditions, for instance within a predetermined temperature or humidity range. Climatization containers are commonly used for storing products such as food and beverages. Particular examples include refrigerators and freezers where the primary requirement is to store food and beverages within a predetermined temperature range. Where in the present document reference is made to a particular example of a climatization container, for instance a refrigerator, this should be understood to include all types of climatization containers unless the context requires that it is limited to the particular example.

[0003] A climatization container may comprise a compartment defined by walls and closable by a door. Within the compartment is a shelf support, or series of shelf supports, supporting one or more shelves. On each shelf products, for instance food and beverage products, may be stored.

[0004] A climatization container typically requires air to be distributed around a compartment, and for this a fan is provided to draw air in from one part of the compartment and expel air to another part of the compartment. The fan intake and outlet may be spaced apart to encourage air flow around the compartment. For the example of a refrigerator, a cooling system will also be provided to cool the air, and the fan may be provided upstream or downstream of the cooling system. The effectiveness of air circulation within a refrigerator impacts upon the energy consumption of a refrigerator (in addition to other factors, including the required degree of cooling, ambient temperature surrounding the refrigerator and the materials and construction of the refrigerator).

[0005] It would be advantageous to provide improvements to air circulation in a climatization container.

[0006] According to a first aspect of the present invention there is provided a climatization container comprising: a compartment for storage of products, the compartment being defined by walls and closable by a door; at least one shelf to support the products; and a fan for distribution of air within the climatization container; wherein the fan is positioned proximal to a top wall of the compartment and angled relative to a vertical direction such that air expelled by the fan is directed towards the top wall of the compartment.

[0007] Advantageously, because the fan is angled relative to a vertical direction such that air expelled by the fan is directed towards the top wall of the compartment, for the example of a refrigerator, cooled air may be directed up and over products on an uppermost shelf such that the cool air flow does not immediately strike products proximal to the fan. Accordingly, air may circulate more effectively around the compartment and so cool products throughout the compartment more evenly.

[0008] For embodiments including a return airspace underneath a bottom shelf, this again improves the even distribution of air throughout the compartment by avoiding products positioned on the bottom of the compartment from occluding the airflow returning to the fan.

[0009] For embodiments including a baffle directing air expelled from the fan up and over products on an uppermost shelf, this again improves the efficient distribution of air through the compartment.

[0010] For the avoidance of doubt, any of the features described herein apply equally to any aspect of the invention.

[0011] Within the scope of this application it is expressly intended that the various aspects, embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings, and in particular the individual features thereof, may be taken independently or in any combination. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination, unless such features are incompatible.

[0012] For the avoidance of doubt, the terms "may", "and/or", "e.g.", "for example" and any similar term as used herein should be interpreted as non-limiting such that any feature so-described need not be present. Indeed, any combination of optional features is expressly envisaged without departing from the scope of the invention, whether or not these are expressly claimed. The applicant reserves the right to change any originally filed claim or file any new claim accordingly, including the right to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally claimed in that manner.

[0013] Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a refrigerator according to the prior art;

Figure 2 is a schematic cross section view of the refrigerator according to the prior art of figure 1;

Figure 3 is a schematic cross section view of a refrigerator according to an example of the present invention;

Figure 4 is a perspective view of a portion of the refrigerator according to an example of the present invention of figure 3;

Figure 5 is a schematic perspective view of the refrigerator according to an example of the present invention of figure 3; and

Figures 6 and 7 respectively illustrate rotation of a refrigerator fan about the Y axis and the Z axis of a

refrigerator.

[0014] Referring to figures 1 and 2 these illustrate a refrigerator 1 according to the prior art. The following description refers to refrigerators as examples of climatization containers according to the present invention. The invention is not limited only to refrigerators.

[0015] The refrigerator 1 in each of figures 1 and 2 comprises a compartment 2 defined by side walls 3, 4, top wall 5, rear wall 6 and bottom wall 7. The compartment 2 is closable at the front by doors 8, in this example a pair of doors.

[0016] Within refrigerator 1 there is provide one or more shelves 9. In figures 1 and 2 there are two shelves 9, but there may be more or fewer. Each shelf 9 is supported by shelf supports (not visible, but they may comprise one or more ladder rack on each side wall 3, 4 allowing the vertical position of the shelves within compartment 2 to be adjusted). Products 10, for instance beverage bottles, are position on each shelf 9. Additionally, products 10 are supported directly on the bottom wall 7 of compartment 2 in order to maximise the number of products that can be stored in the compartment 2.

[0017] Refrigerator 1 further comprises a cooling system in cooling system compartment 11. Details of the cooling system are not shown, except for fan 12 which is located upon side wall 4 of compartment 2 in order to expel cooled air into the compartment 2. The fan 12 cooperates with air duct 13 in order to draw in air from proximal to the bottom wall 7 and expel cooled air proximal to the top wall 5. It will be appreciated that the cooling system will include an evaporator within the air duct 13 such that air is drawn through the evaporator by the fan 12 and so cooled.

[0018] Fan 12 is vertically orientated and so generally directs air horizontally into the compartment towards the opposite side wall 3. Dashed arrows 14 indicate the flow of air around the compartment 2. It can be seen that cooled air expelled by fan 12 may directly strike products 10 positioned on an uppermost shelf proximal to the fan 12. Disadvantageously, this may result in uneven cooling in that these products may be cooled more that products further away from the fan 12. In order to ensure that all products are adequately cooled it may be required to install a fan 12 with greater air flow capacity (or operate it at a higher speed) or increase the cooling capacity of the cooling system. It will be appreciated that such a prior art refrigerator 1 suffers from energy inefficiency and uneven product cooling.

[0019] As a partial solution to the above problem, it is known to provide a fan grill in the form of a honeycomb with the cells of the honeycomb shaped to steer the airflow, particularly to steer the airflow upwards. However, uneven cooling and energy inefficiency still results.

[0020] A further problem with the refrigerator of figures 1 and 2 is that products supported on the bottom wall 7 of the compartment 2 occlude the flow of air returning to duct 13.

[0021] Figures 3 to 5 illustrate an example of a refrigerator in accordance with an example of the present invention, which addresses some or all of the above described problems associated with conventional refrigerators. Where figures 3 to 5 illustrate corresponding parts to the refrigerator of figures 1 and 2, the same reference numerals are used, and the above description is considered to apply equally to figures 3 to 5. Parts which are unchanged are not described again.

[0022] The refrigerator 1 of figures 3 to 5 differs in that fan 12 is angled upwards. In particular, fan 12 is shown being positioned under an angle 30 relative to the vertical Z direction. Angle 30 may be 30° meaning that air is expelled from fan towards the top wall 5 at an angle of 60° relative to the vertical Z direction. An airflow angle of 60° has been found to give an acceptable distribution of cooling throughout the refrigerator. However, the precise angle may vary, and air may be expelled at an angle relative to the Z direction within a range of 30° to 90°, preferably 45° to 75°. This serves to direct the air flow (indicated by dashed arrows 14) up and above products 10 upon the uppermost shelf 9. Accordingly, more even product cooling is achieved by not excessively cooling products proximal to the fan 12. Fan 12 may thus be specified and operated to be more energy efficient.

[0023] In some examples, including that of figures 3 to 5, there may also be provided a baffle 31 arranged to further guide air expelled by fan 12 up and over products 10 and to cause the air flow to be close to the top wall 5 and parallel to the X axis as the cooled air enters compartment 2. This further improves the evenness of cooling products.

[0024] In some examples, including that of figures 3 to 5, there may also be provided a bottom shelf 9 proximal to the bottom wall 7 but spaced apart from bottom wall 7 to define air space 32. This air space 32 may be relatively compact but serves to allow air returning to air duct 13 to pass relatively unimpeded by products 10 within the compartment 2. That is, refrigerator 1 of figures 3 to 5 differs from refrigerator 1 of figures 1 and 2 in that a third, bottommost shelf 9 is provided instead of products 10 in the lower part of compartment 2 being supported directly on the bottom wall 7 of the compartment 2. More efficient air circulation results, at the cost of only a small reduction of usable volume within compartment 2. Each shelf 9 may be supported by a ladder rack on side walls 3 and 4 to allow their vertical position to be adjusted (according to size of products). In some examples the lowest shelf support setting on the ladder rack may preserve the minimum required air space 13 for efficient air circulation.

[0025] The perspective view of figure 5 shows the air circulation in greater detail, indicated by arrows 14. It can be seen that air expelled by fan 12 is guided proximal to top wall 5 towards the far side wall 3, but also towards the front of the compartment 2 (closed by doors 8) and towards the back of compartment 2. This flow of cooled air may be aided by the shape and configuration of fan 12 and baffle 31. Cooled air thus travels around all sides

of the compartment 2. Cooled air travelling towards the front the compartment 2 (towards doors 8) is important for energy efficiency as the doors 8 represent the highest energy loss due to being opened and reduced insulation even when closed. Supplying cooled air to the doors 8 counteracts this energy loss.

[0026] In some embodiments the fan 12 may additionally be rotated slightly about the Z axis (as well as about the Y axis as described above) to direct a greater proportion of air towards doors 8. Accordingly, air flow along the Y axis is not uniform in the compartment 2. With reference also now to figures 6 and 7, rotation of the fan 12 (and hence also the airflow) about the Y axis and the Z axis is illustrated.

[0027] Figure 6 is a side view showing rotation of the fan and air flow about the Y axis in order to direct the airflow up and over products on the top shelf. The fan 12 is shown relative to the side wall 4, which is aligned with the Z axis shown in figure 5. The angle 30 relative to the Z axis (the vertical direction) is identified. The angle selected is, in some examples, proportional to the width of the refrigerator. That is, for a wider refrigerator it may be necessary to angle the air flow up more to pass over the full length of products on the top shelf. In some examples this may relate to the number of doors 8 that the refrigerator has: a one door refrigerator may be narrower than a two, three or four door refrigerator. The angle 30 of the air flow relative to the Z axis may be a range of 30° to 90° (where 90° indicates that the airflow is parallel to top wall of the refrigerator and smaller angles indicate an inclination towards the top wall of the refrigerator), preferably 45° to 75°, and preferably approximately 60°.

[0028] Figure 7 is a side view showing rotation of the fan and air flow about the Z axis in order to direct the airflow preferentially towards the door or doors 8. The fan 12 is shown relative to the side wall 4 and door 8. Angle 33 is rotation of the fan 12 about the Z axis and relative to side wall 4 which is aligned with the Y axis. The angle selected is, in some examples, proportional to the energy loss from the doors (from their sealing and when opened). The angle 33 of the air flow relative to the Y axis may be a range of 75° to 90° (where 90° indicates that the airflow is parallel to the doors and smaller angles indicate an inclination towards the doors).

[0029] It will be appreciated by those skilled in the art that several variations to the aforementioned embodiments are envisaged without departing from the scope of the invention. It will also be appreciated by those skilled in the art that any number of combinations of the aforementioned features and/or those shown in the appended drawings provide clear advantages over the prior art and are therefore within the scope of the invention described herein.

Claims

1. A climatization container comprising:

a compartment for storage of products, the compartment being defined by walls;
at least one shelf to support the products; and
a fan for distribution of air within the climatization container;
wherein the fan is positioned proximal to a top wall of the compartment and angled relative to a vertical direction such that air expelled by the fan is directed towards the top wall of the compartment.

2. A climatization container according to claim 1, wherein the fan is angled such that air is directed upwards within a range of 30° to 90°, preferably 45° to 75° and preferably 60° relative to the vertical direction.

3. A climatization container according to claim 1 or claim 2, wherein the fan is supported upon a side wall of the compartment, the compartment further comprising an air duct configured such that the fan draws air from a position proximal to a bottom wall of the compartment.

4. A climatization container according to claim 3, wherein a bottom shelf is located proximal to but spaced from the bottom wall of the compartment to define an air space underneath the bottom shelf in fluid communication with the air duct such that the fan draws air from the air space underneath the bottom shelf.

5. A climatization container according to claim 4, wherein shelf supports are mounted upon side walls of the compartment to permit a plurality of shelves to be positioned at variable heights within the compartment.

6. A climatization container according to any one of the preceding claims, further comprising a baffle configured to direct air expelled by the fan towards the top wall of the compartment.

7. A climatization container according to any one of the preceding claims, wherein at least two fans are provided in tandem to distribute air within the compartment.

8. A climatization container according to any one of the preceding claims, wherein the climatization container comprises a refrigerator or freezer and further comprises a cooling system for cooling air drawn in to the fan such that cooled air is expelled by the fan.

9. A climatization container according to any one of the preceding claims, wherein the fan is additionally angled towards a front of the compartment which is closed off by a door such that a larger proportion of

air expelled by the fan passes to the front of the compartment than passes to the back of the compartment.

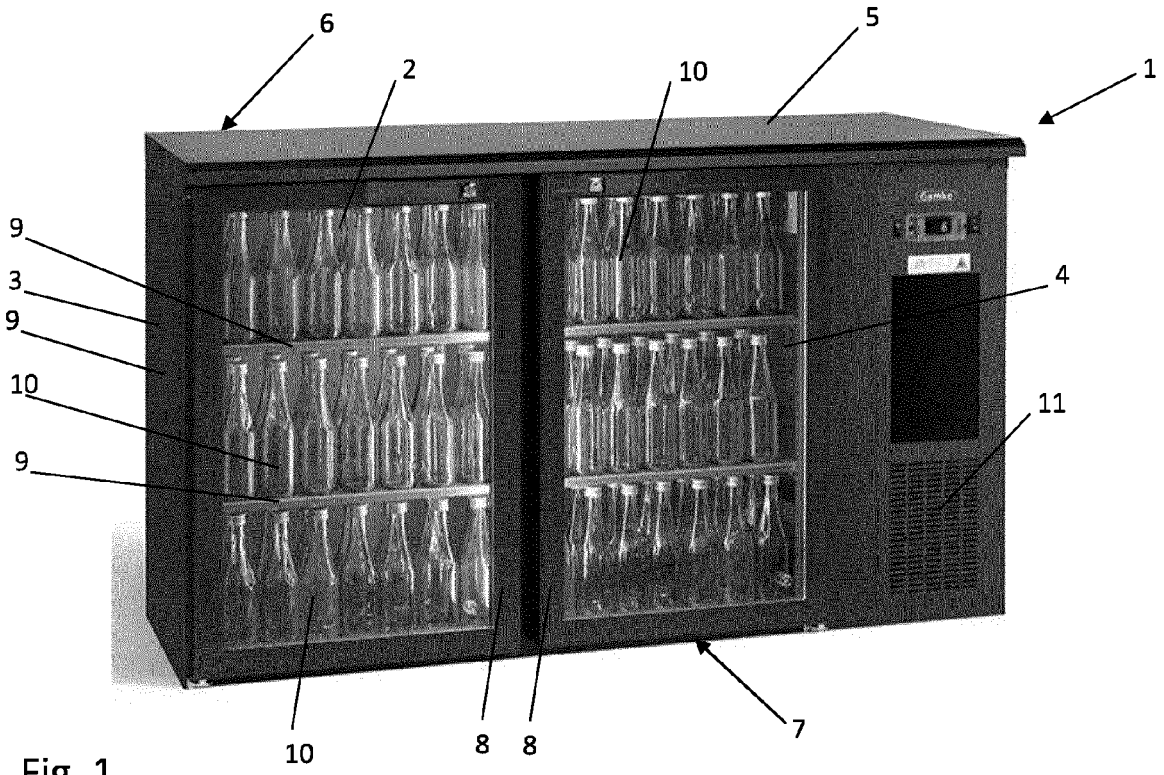

Fig. 1

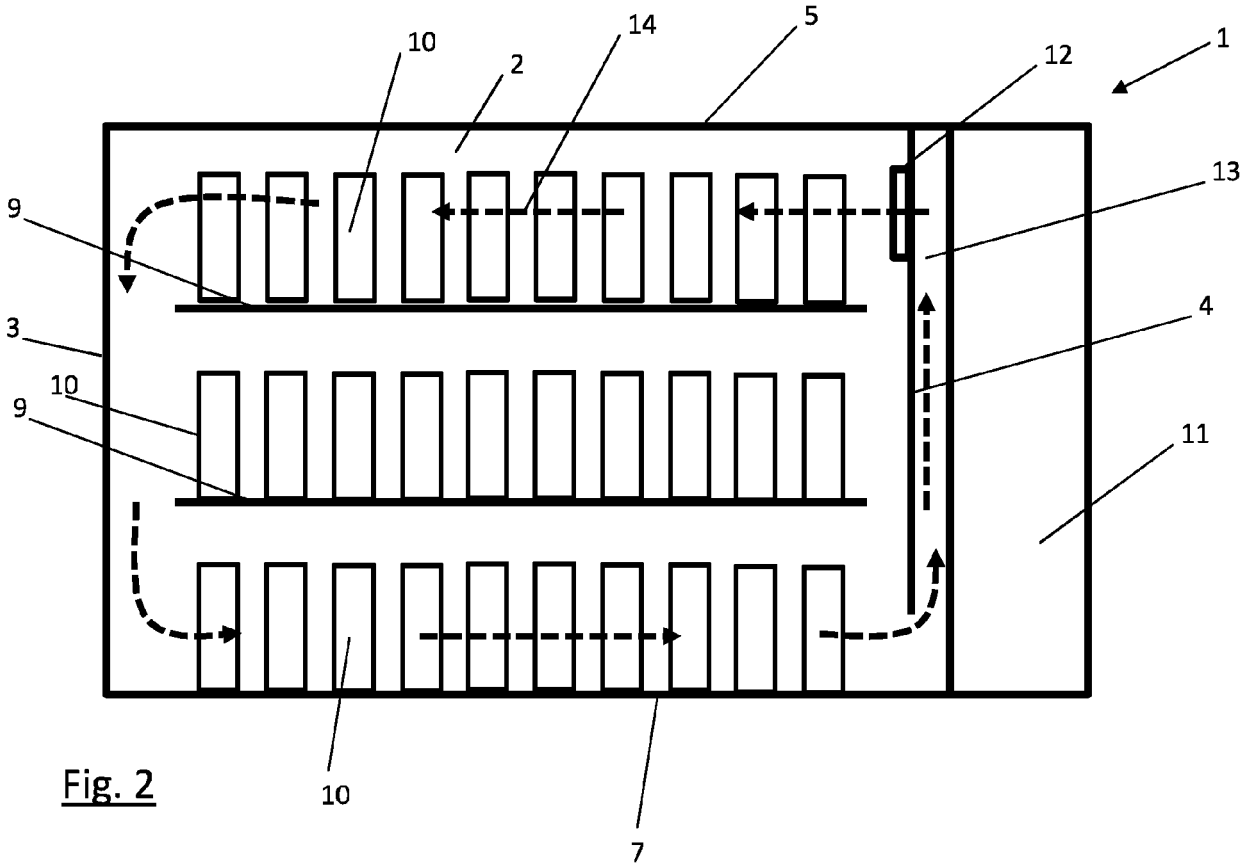

Fig. 2

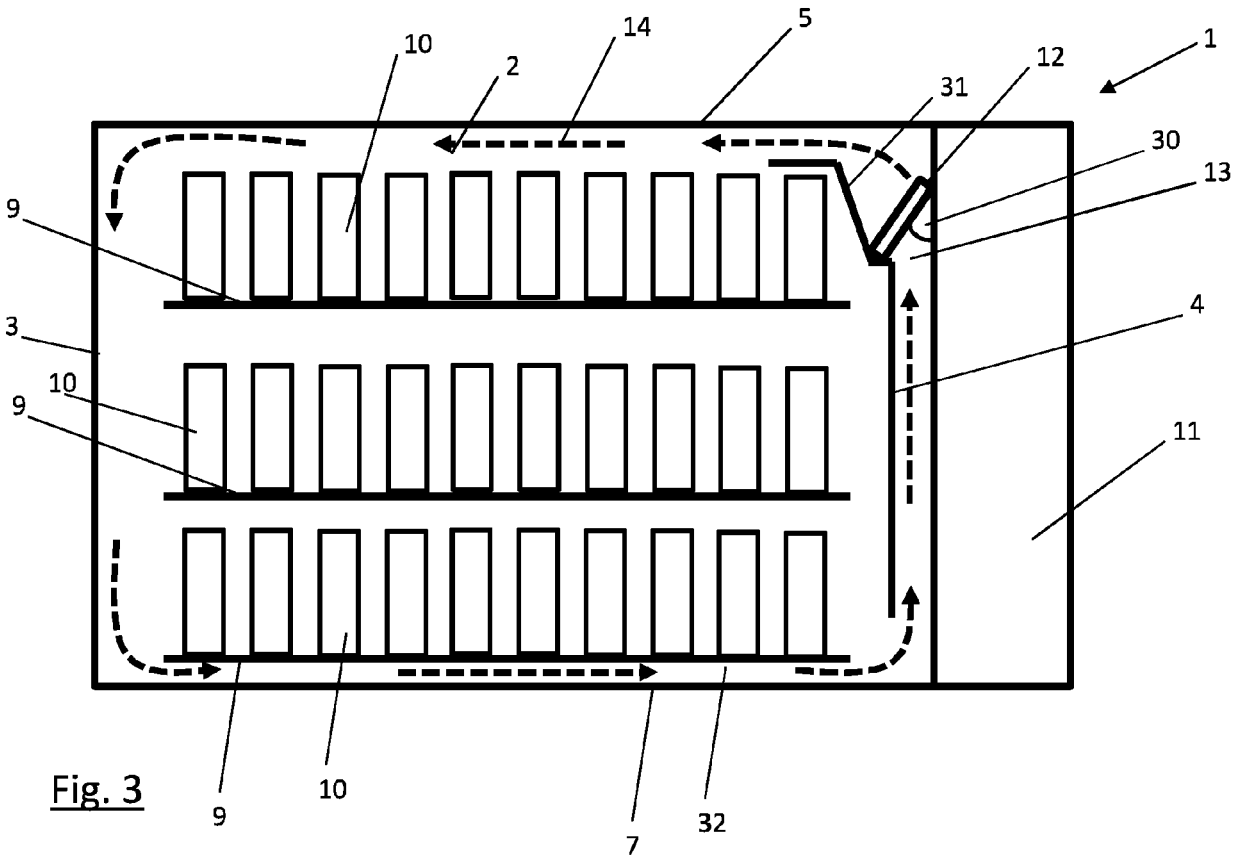

Fig. 3

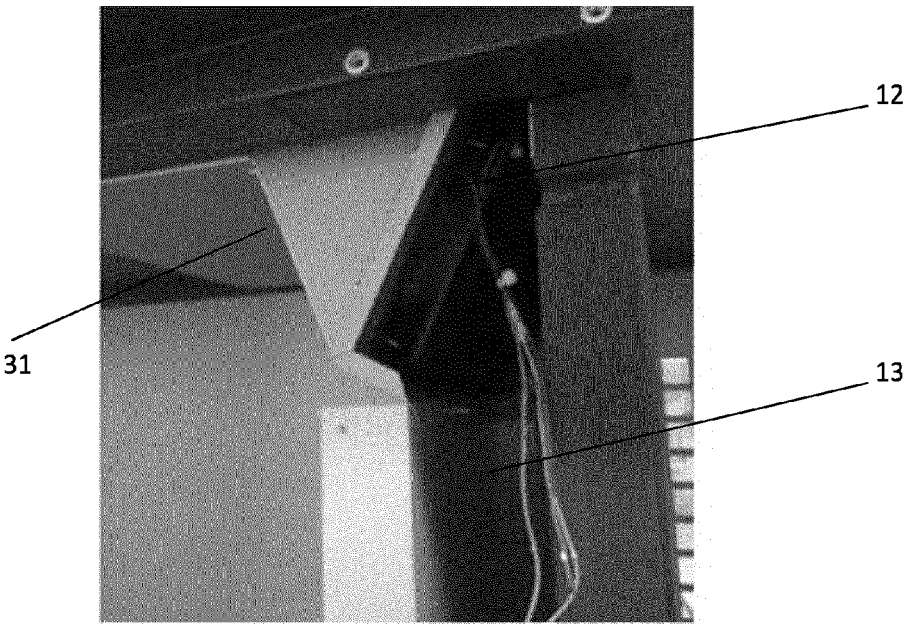

Fig. 4

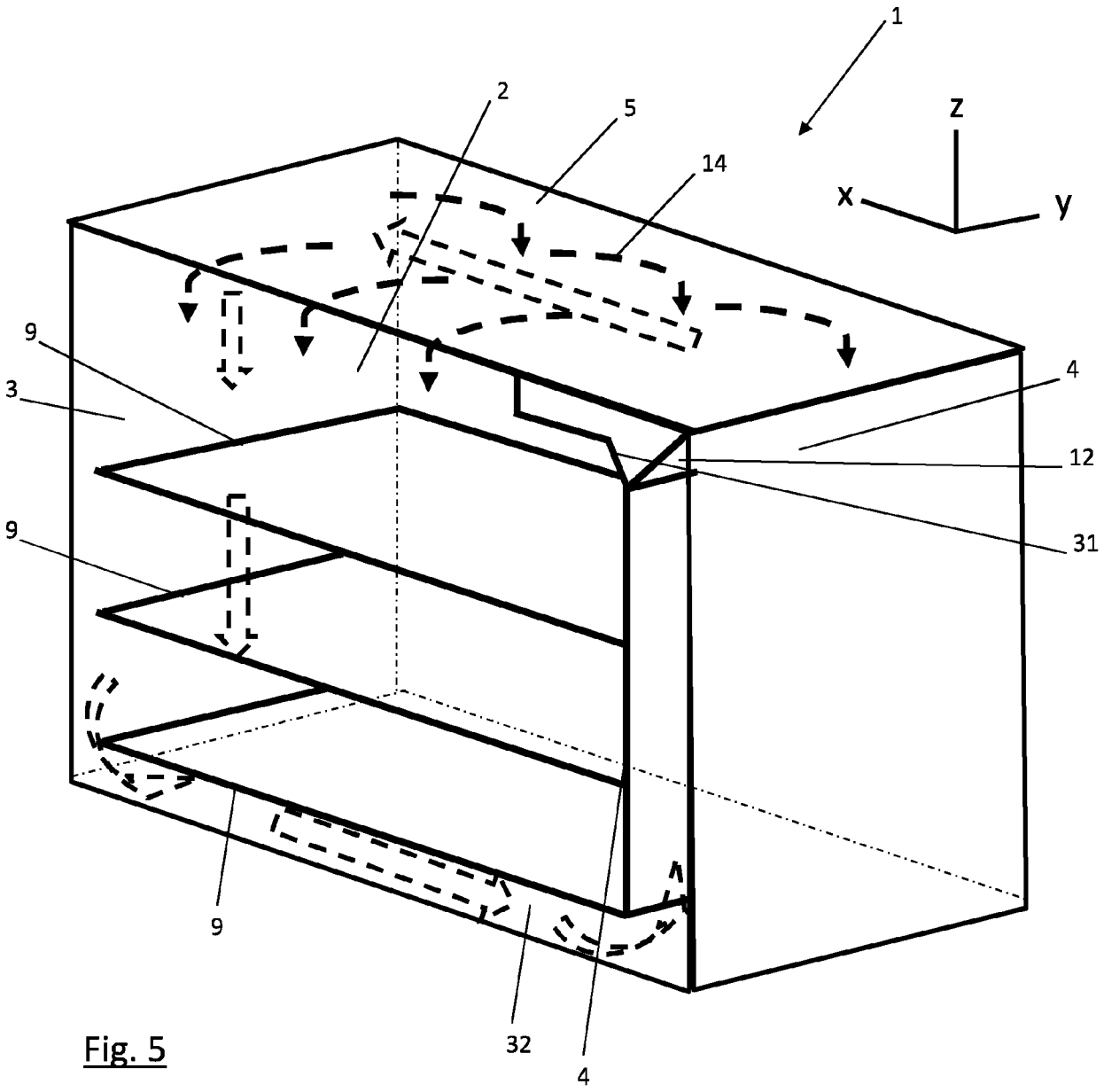

Fig. 5

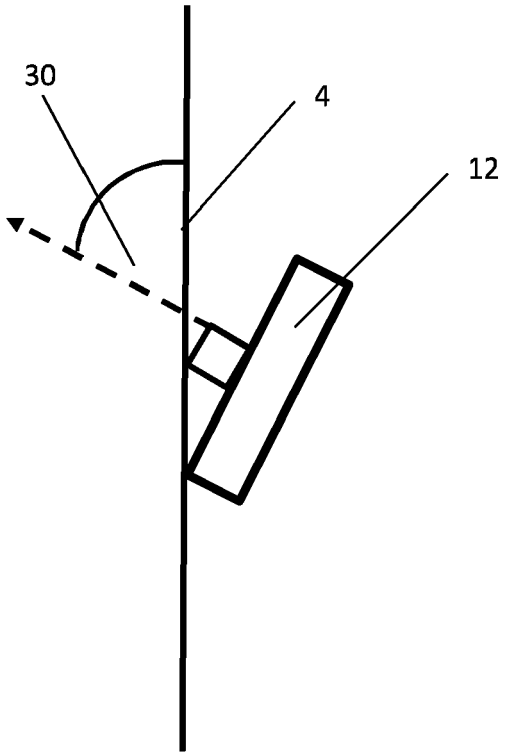

Fig. 6

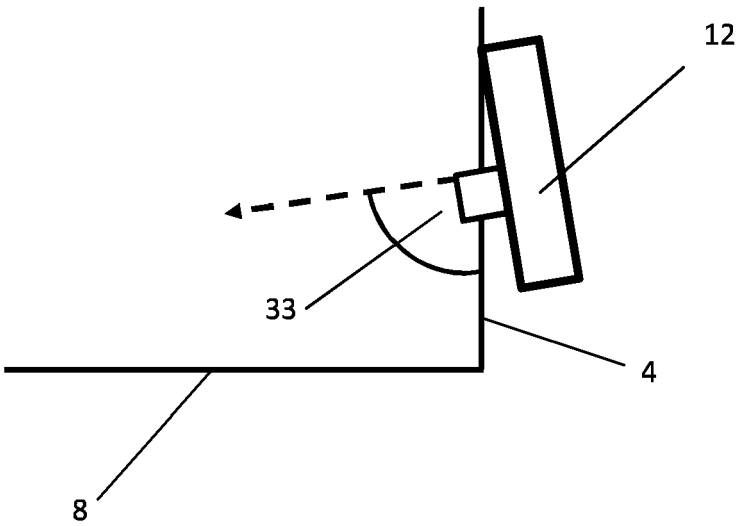

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 21 16 3397

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 2006/112720 A1 (KIM BRIAN S [US]) 1 June 2006 (2006-06-01) * paragraph [0031]; figure 4 * * paragraph [0036] *	1-9	INV. F25D17/06
X	WO 2016/082622 A1 (QINGDAO HAIER JOINT STOCK CO LTD [CN]) 2 June 2016 (2016-06-02) * figure 2 *	1-3,8	
X	US 2016/209098 A1 (KIM JEONG KAP [KR]) 21 July 2016 (2016-07-21) * figure 5 *	1,8	
X	WO 2014/198152 A1 (HAIER GROUP CORP [CN]; HAIER ASIA INT CO LTD [JP] ET AL.) 18 December 2014 (2014-12-18) * paragraph [0006]; figure 8 *	1,4,8	
			TECHNICAL FIELDS SEARCHED (IPC) F25D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20 August 2021	Vigilante, Marco

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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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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20-08-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006112720 A1	01-06-2006	NONE	
WO 2016082622 A1	02-06-2016	CN 104567203 A	29-04-2015
		WO 2016082622 A1	02-06-2016
US 2016209098 A1	21-07-2016	AU 2013399274 A1	17-03-2016
		CN 105518399 A	20-04-2016
		JP 2016533470 A	27-10-2016
		KR 101327739 B1	11-11-2013
		US 2016209098 A1	21-07-2016
		WO 2015030285 A1	05-03-2015
WO 2014198152 A1	18-12-2014	JP 6131116 B2	17-05-2017
		JP 2015001330 A	05-01-2015
		WO 2014198152 A1	18-12-2014

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