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(54) Title: AUTOMATIC, PERIODIC PLATE-FREEZING

(57) Abstract: The present invention relates to a method and a device for periodic in feeding of boxes containing food items into plate freezers. The invention solves problems relating to handling of boxes, where traditional methods damage the boxes and the harm the food objects within the boxes. The new method and device solve this problem in such an automatic and periodic manner that food items can be frozen in sensitive packing such as thin carton boxes.



Automatic, periodic plate-freezing

Field of the invention

The present invention relates to a method and a device for periodic, automatic in feeding of carton-boxes containing food products into horizontal plate freezers.

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Background of the invention

Several methods and devices for freezing food objects in carton-boxes are known in the art. Traditional carton-box freezing is usually performed in two different ways. Either, the carton-boxes are placed in a rack which is then transported into a blow freezing unit or
10 alternatively the carton-boxes are placed in special freezing pans which are then feed into horizontal, automatic plate freezers. The problem with current methods of freezing food products in carton-boxes is that the carton-boxes need quite a lot of handling and a proper solution of automatic and continuous freezing process is needed.

The most common way of freezing food objects in carton-boxes is blow-freezing, where
15 the boxes are loaded onto racks and the racks are then feed into a freezing compartment. The food in the carton-boxes is frozen by blowing cold air through a specially designed device around the carton-boxes. This method requires that the carton-boxes used can handle the blow-freezing treatment, which is quite time consuming. Long freezing time is a disadvantage with respect to quality as well as shrinkage of the food
20 objects in the carton-boxes. Furthermore, another disadvantage of the blow-freezing method is that the energy efficiency is poor, as it requires at least 40% more energy than plate freezing methods.

Plate freezing of objects in carton-boxes can be performed in vertical and horizontal freezer systems. Plate-freezers operate such that the objects to be frozen are in contact
25 with plates, usually made from aluminium or metals with conductive properties. The plates are cooled with liquid cooling medium which flows inside the plate. In general, plate freezing is both quick and energy efficient. Plate freezing using horizontal plates is quite common and also quite efficient for large scale freezing processes.

Plate freezing using horizontal plates is the most common and efficient method for large
30 scale production. The biggest drawback of this method is that it has been difficult to establish automation for boxes without using specially designed freezing pans. Automatic pate-freezers exist, but the problem of using such freezers is that it has been shown to be difficult to freeze a larger boxes because the in-feeding technology available. Current techniques involve pushing boxes with unfrozen product into the freezer and therefore

pushing on to the boxes already in the freezer. This means that each box un-frozen box must tolerate the force of pushing all existing boxes in the freezer frozen forward and a frozen box out of the freezer. As stated above, this has been solved by using freezing pans which freezing pans unless very light products are being processed. Figure 1 shows the process for plate freezing by conventional methods.

When using traditional plate freezing, boxes are positioned so that they are in contact with the freezing plate, both below and above the boxes. This has two implications, first that the box and the product contained therein freezes inwardly towards the centre and secondly that the product has no space to expand vertically. The combination of these two factors causes the freezing to press the product, which can result in damaging the product.

Blow freezing can be performed in a semi-automatic process to some extent primarily by loading freezing-racks, which are then with automated transport equipment or forklifts to freezing chambers. This is not only very time consuming and labour intensive, but this also requires increased handling using such transfer steps. The same is true of the traditional plate-freezers as more handling is required for placing the boxes into freezing pans resulting in an extra step in the handling.

US 5,038,916 discloses an apparatus for feeding products to be frozen onto a freezer plate, having a conveyor arranged to place the products in front of an in-feeding opening of a freezer, and a device for transferring the products in a translatory movement from the conveyor through the in-feeding opening onto the freezer plate. The transferring device comprises a pusher bar arranged to engage the products to be frozen on the conveyor and a chain drive arranged to impart the translatory movement to the pusher bar engaging the products. This device ejects a row of fully frozen boxes from a freezing plate, through a discharge opening, by pushing a new row of unfrozen boxes onto the plate from a conveyor through an in-feed opening. This in-feeding and ejecting process is repeated until the plate is filled with un-frozen boxes. The ejection/in-feeding process starts again when the row of boxes next to the discharge opening is frozen.

Summary of the Invention

The present invention relates to a new method and a device fore freezing food objects in carton-boxes and solving the problems stated above. The present invention provides a method and a device having the following advantages:

- To feed plate-freezers with objects in boxes without placing the boxes in freezer pans and thereby reducing manual labour,

- avoiding to deform, distort or damage the boxes during in feeding into the plate freezer by not using unfrozen boxes to push other boxes,
- providing space for the boxes to expand during the freezing process in plate freezer allowing the products to expand upwardly instead of laterally and thereby deforming the boxes,
- providing a continuous and fully automatic freezing process with the advantages stated above.

The automatic and periodic in feeding method is essentially different from the traditional methods of feeding plate freezers in the following way. The traditional method requires that every unfrozen box is either manually placed into the freezer pans or placed in the freezer by pushing forward boxes onto freezer plates and thereby pushing ahead the boxes in front of the box being pushed to fill the freezing plate. The traditional methods cause damage to the boxes and deformation of the unfrozen box. The new method is different in that every box is only pushed in as far as they destined to, such that the unfrozen box will never be subjected to more stress or force than necessary by using an unfrozen box to push another box further into the freezer or out of the freezer. This prevents damage and deformation as the in-feeding and out feeding of the boxes from the freezer is completely separated, because when a box with fluid on the outside of the box has been frozen in a plate freezer it will stick to the plate. Then, when a box with unfrozen food products is pushed onto the freezer plate and used to push the box frozen to the plate off the plate, it will at least deform the unfrozen box and most likely deform the product within the box.

Another important feature of the new method and device is that it allows the boxes to expand vertically or upwardly into the space between the product and the lid of the box and in the worst case pushing the lid up a certain small distance. This prevents the boxes and their contents damaged due to lateral pressure arising if the box has no room to expand upwardly. This feature is achieved by a spacer for setting or determining the distance between the freezing plates and thereby adjusting the space between the plates depending on the product and the thickness of the box each time.

The traditional way of handling freezing of sensitive products, which can not withstand conventional plate freezing has been the blower freezing method. The traditional blow freezing methods are less efficient in many ways in that they require longer freezing time, more energy, increased product loss as well as additional equipment floor space. However, when it comes to freezing products, blow-freezing has been the first

choice of method for freezing in order to ensure delivery of undamaged products. This new method now replaces the only advantage of blow freezing over plate freezing.

5 An additional advantage of using plate freezing of sensitive products is automation which is obtained by using freezing plates instead of freezing pans. The automation makes it possible to freeze a large volume of products in boxes with constant quality and low cost compared with older, traditional methods.

10 In a first aspect of the present invention a method is provided for freezing food products in boxes. The method comprises a) releasing a whole stack of fully frozen boxes in a plate freezer from a freezing plate, b) forming a new stack by transporting one or more rows of boxes all the way into the far end of the freezing plate, c) transporting another row or rows of boxes up against the first row or rows boxes. Steps a-c) are repeated until the plate is full and a whole new stack is formed. The freezing plate above the boxes
15 loaded onto the plate is positioned in a certain distance from the boxes below the plate, such that the boxes are able to expand upwardly towards the freezing plate above the boxes. Furthermore, a positioning means determines the position of a row of boxes loaded onto the plate so that the following row of boxes is transported next to the preceding row of boxes but not but not against the preceding row of boxes. This will
20 prevent the following row of boxes to crash into a newly loaded row of boxes and thereby deform the boxes being pushed into the freezer and harming the food products therein.

In a second aspect of the present invention a device is provided for freezing objects in boxes according to the method above. The device comprises a freezer chamber further comprising a plurality of freezing plates, an in feeding unit, and an out feeding unit. The
25 device further comprises spacer means for determining the distance between the freezing plates and a positioning means for determining the distance each row of boxes transported into the freezer, so that each row of boxes is pushed next to the preceding row of boxes but not but not against the preceding row of boxes.

In another aspect of the present invention a method is provided for freezing food
30 products in boxes. The method comprises a) pushing a whole stack of fully frozen boxes from a freezing plate in a plate freezer, b) forming a new stack by pushing a first row of boxes all the way into the far end of the freezing plate, c) pushing another row of boxes up against the first row of boxes. Steps a-c) are repeated until the plate is full and a whole new stack is formed. The method is characterised in that the freezing plate above
35 the boxes loaded onto the plate is positioned at a certain distance from the boxes on the plate below by means of a spacer, such that the boxes are able to expand upwardly towards the freezing plate above the boxes. Furthermore, positioning means determines

how far onto the plate each row of boxes is pushed, so that each row of boxes is pushed next to the preceding row of boxes but not but not against the preceding row of boxes.

The following embodiments and definitions relate to both the device and the method of the present invention.

- 5 In an embodiment of the present invention the distance between the boxes and the freezing plate above the boxes is between 0.02 to 20 mm.

In an embodiment of the present invention the step a) of the method is performed in a single movement where the whole stack of boxes is transported of the freezing plate in one movement.

- 10 In an embodiment of the present invention step a) of the method is performed in a single movement and where one row of boxes is transported of the freezing plate at the time and onto an out feeding device.

- In an embodiment of the present invention the one row of boxes transported onto the out feeding device are transported away from the freezer before the next row or rows of
15 boxes are transported out of the freezer.

In an embodiment of the present invention the unfrozen boxes are transported to the plate freezer by an in feeding device.

In an embodiment of the present invention the in feeding devices or units and out feeding devices or units are conveyor belts.

- 20 In an embodiment of the present invention step c) of the method is performed such that more than one row of boxes are transported onto the plate in a single movement.

In an embodiment of the present invention the boxes are carton-boxes.

- In an embodiment of the present invention the transporting in steps a-c of the method involves a pushing means for pushing the boxes onto the plate and off the plate. The
25 pushing means can be a pushing bar which pushes the whole row onto the plate. The mechanic for operating such a pushing bar is well known in the art.

In an embodiment of the present invention the apparatus and method are fully automatic and controlled by a processing means such as a computer.

- In an embodiment of the present invention the positioning means determines the
30 distance each row of boxes is pushed into the freezer. The positioning means can be a sensor which detects the position of a previous row and sends information to the computer. The next row of boxes is pushed onto the plate at a distance determined by the sensor, in such a manner that the row will be positioned next to the preceding row of boxes but not but not against the preceding row of boxes. This will prevent the row being

pushed into the freezer to bump into the preceding row of boxes and deform them or cause harm to the content of the boxes.

In the present context the term "continuous" in relation to freezing process refers to a constant delivery of frozen boxes in whole stacks rather than delivering them in divided doses (batches).

Detailed Description of the Invention

The invention will now be described with reference to the following drawings:

Figure 1 shows the process for plate freezing by conventional methods.

10 Figure 2 shows a specific implementation of the invention and the organization of a freezing system for freezing food items in carton boxes according the method of the invention.

Figure 3 shows a cross section of an automatic plate freezer.

Figure 4 shows a top view of an automatic plate freezer.

15 Figure 5 shows the process for freezing plate with the method of the present invention.

Figure 1 outlines how a traditional method of freezing food objects in boxes is performed.

(A) One unfrozen box (shown a dark grey box) is pushed into the first row of a freezer plate and onto a receiver conveyor belt (shown in a white box). As a result one frozen box (shown a light grey box) is pushed out of the last row of the freezer plate. (B) Three more unfrozen boxes have been pushed onto the plate filling rows 1-4 with unfrozen boxes. (C) One unfrozen box (shown a dark grey box) is pushed into the second row of a freezer plate in a freezer, below the first plate. As a result one frozen box (shown a light grey box) is pushed out of the last row of the freezer plate and onto a receiver conveyor belt. The place being filled has (C) has been moved upwards to be at the same height as the in and out feeding conveyor belts

The main features of the freezing system implementation are shown in Figure 2

comprising feeding a tray (1) for food objects into or into a weighing device (2). Weighted food items, such as in a batch) are released onto a conveyor belt (3) carrying the food items packaging station (4). A worker monitors the packaging and optionally places a lid on the carton box. Next, the box of food items is transferred over to a conveyor belt (5) which brings the box to a sealing device (6). The box is then transferred from the sealing device by conveyor belts (7.01-08) onto an in-feeding

conveyor (8) next to the freezers (9.01-07). The number and the capacity of freezers and processing capacity of the system as a whole vary depending on the need in every plant. After freezing the boxes are pushed onto out-feeding conveyors (10) which transfers them to conveyor belts (11.01-02) for transport to stacking stations (12:01) where boxes are stacked on a pallet. The pallets of frozen products are then transferred to a freezing storage (13). Service platforms (14.01-02) are positioned at the in-feeding side and the out-feeding side of the freezers to allow access of workers for service and monitoring. Otherwise, the system is fully automated and independent of manual labour of workers.

Figure 3 shows a cross section of an automatic plate freezer and figure 4 shows a projection (or top view) of the same freezer. Boxes enter the freezer by a conveyor belt and an in-feeding device places the boxes onto the freezer plates. The freezer shown in the figures 3 and 4 has 24 freezing plates, but the number and size places for each freezer depends on the performance required and the size of the boxes desired. The gap between the freezer plates is determined by the spacers to fit the used each time. This will result in that the food products will not be harmed or crushed and careful handling is ensured. The in-feeding device (15) is kept at a constant height whereas the freezer plates, which the boxes are being placed onto, are adjusted to the height of the in-feeding device. Initially, the in-feeding starts for the top plate and then the next one below and then one by one until the freezer is filled with boxes for freezing. The out-feeding belt (16) is shown on the other side of the chamber.

Figure 5 shows one round of filling and emptying a freezer. In the first step (A) emptying of a full freezer is starting, where all the boxes are frozen (shown in light gray). Means for pushing boxes onto and off a plate has started to push a full plate of boxes off a plate, where the first row of boxes is being pushed onto the out-feeding belt 16, three boxes at a time (Figure 4). When the first three boxes have been pushed out off the freezer, the pushing means stops until the out-feeding belt has transported the boxes away from the out-feeding opening of the freezer. Then the next three boxes are pushed to the out-feeding belt and thereafter each row from that plate until the plate (17) is empty (B). The pushing means retrieves a first row of unfrozen boxes from an in-feeding belt (C) and pushes them across the entire freezing plate to the outermost position on the plate (D). The pushing means retrieves the next row of unfrozen boxes and pushes them adjacent to the first row of boxes (E). the According to the present invention, only one row of boxes unfrozen boxes is pushed onto the plate each time, thus ensuring that sensitive boxes will not dented or harmed during loading of the freezer plates. Several

rows of frozen boxes can be pushed out off the freezer when the freezer plate is emptied as frozen boxes tolerate such handling much better than unfrozen boxes. When the plate is fully loaded of rows of boxes, the next plate to be loaded is moved to the height of the in-feeding belt and the pushing means and the pushing means pushes a full plate of
5 boxes off the plate (F) and out of the freezer onto an out-feeding belt, one row at the time.

Claims

1. A method for freezing food products in boxes, the method comprises:

- 5 a) releasing a whole stack of fully frozen boxes in a plate freezer from a freezing plate,
 b) forming a new stack by transporting one or more rows of boxes all the way into the far end of the freezing plate,
 c) transporting another row or rows of boxes up against the first row or rows boxes,
 d) Repeat steps a-c until the plate is full and a whole new stack is formed.

10 2. The method according to claim 1, wherein step a) is performed in a single movement and wherein the whole stack of boxes is released of the freezing plate in one movement.

15 3. The method according to claim 1, wherein step a) is performed such that one row of boxes is released from the freezing plate at the time and onto an out feeding device.

20 4. The method according to claim 3, wherein the one row of boxes released onto the out feeding device is transported away from the freezer before the next row or rows of boxes are transported out of the freezer.

5 5. The method according to claim 1, wherein step c) is performed such that more than one row of boxes are transported onto the plate in a single movement.

25 6. The method according to claim 1, wherein the unfrozen boxes are transported to the plate freezer by an in feeding device.

7 7. The method according to any of the preceding claims, wherein the boxes are carton-boxes.

30 8. The method according to any of the preceding claims, wherein the transporting in steps a-c involves a pushing means for pushing the boxes onto the plate and off the plate.

35 9. The method according to any of the preceding claims, wherein the distance each row of boxes is pushed into the freezer is determined by a positioning means.

10. A device for freezing objects in boxes according to the method of claims 1-11, the device comprises:

- a freezer chamber,
- a plurality of freezing plates,
- an in feeding unit, and
- an out feeding unit

wherein the device comprises spacer means for determining the distance between the freezing plates, and wherein the device further comprises a positioning means for determining the distance a row of boxes is transported into the freezer.

11. The device according to claim 10, wherein the freezing plate above the row boxes is positioned in a certain distance from the boxes below the plate.

12. The device according to claim 2, wherein the distance between the boxes and the freezing plate above the boxes is between 0.02 to 20 mm.

13. The device according to claim 1, wherein in feeding and the out feeding unit are conveyor belts.

14. The device according to claim 1, wherein a positioning means determines the position of a row of boxes.

15. The device according to any of the preceding claims, wherein the positioning means determines the distance each row of boxes is pushed into the freezer.

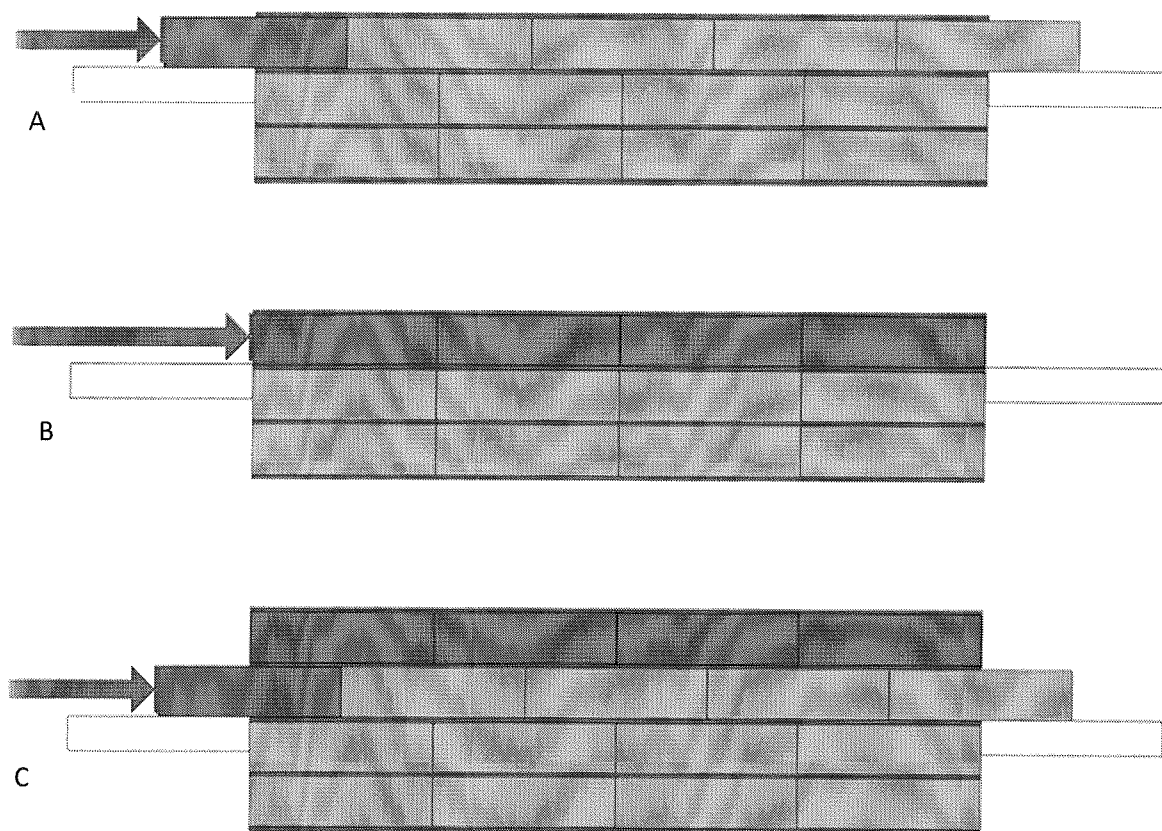


Fig. 1

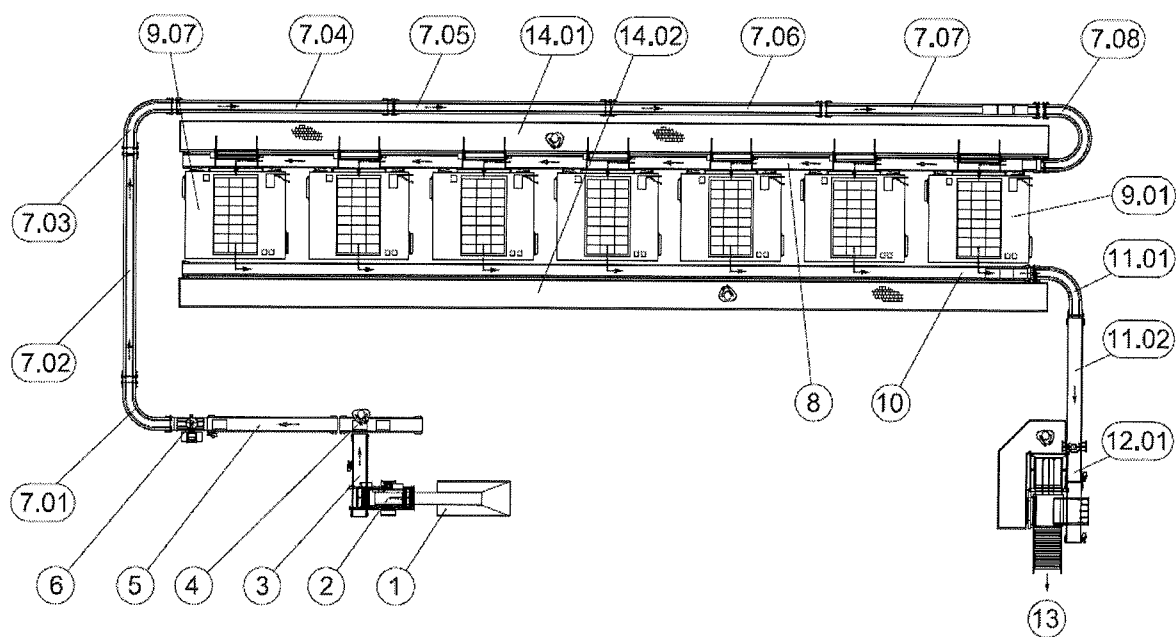


Fig. 2

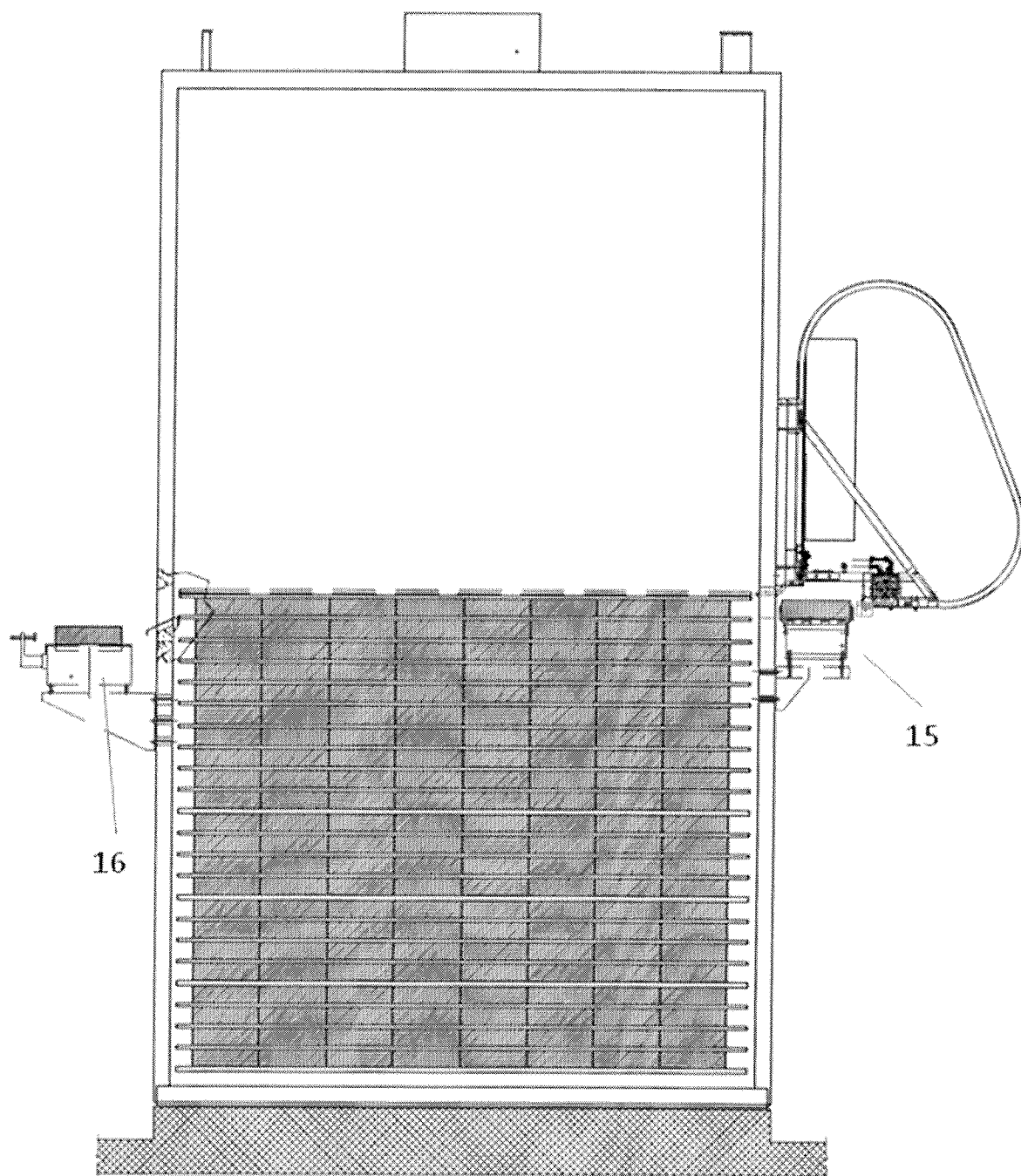


Fig. 3

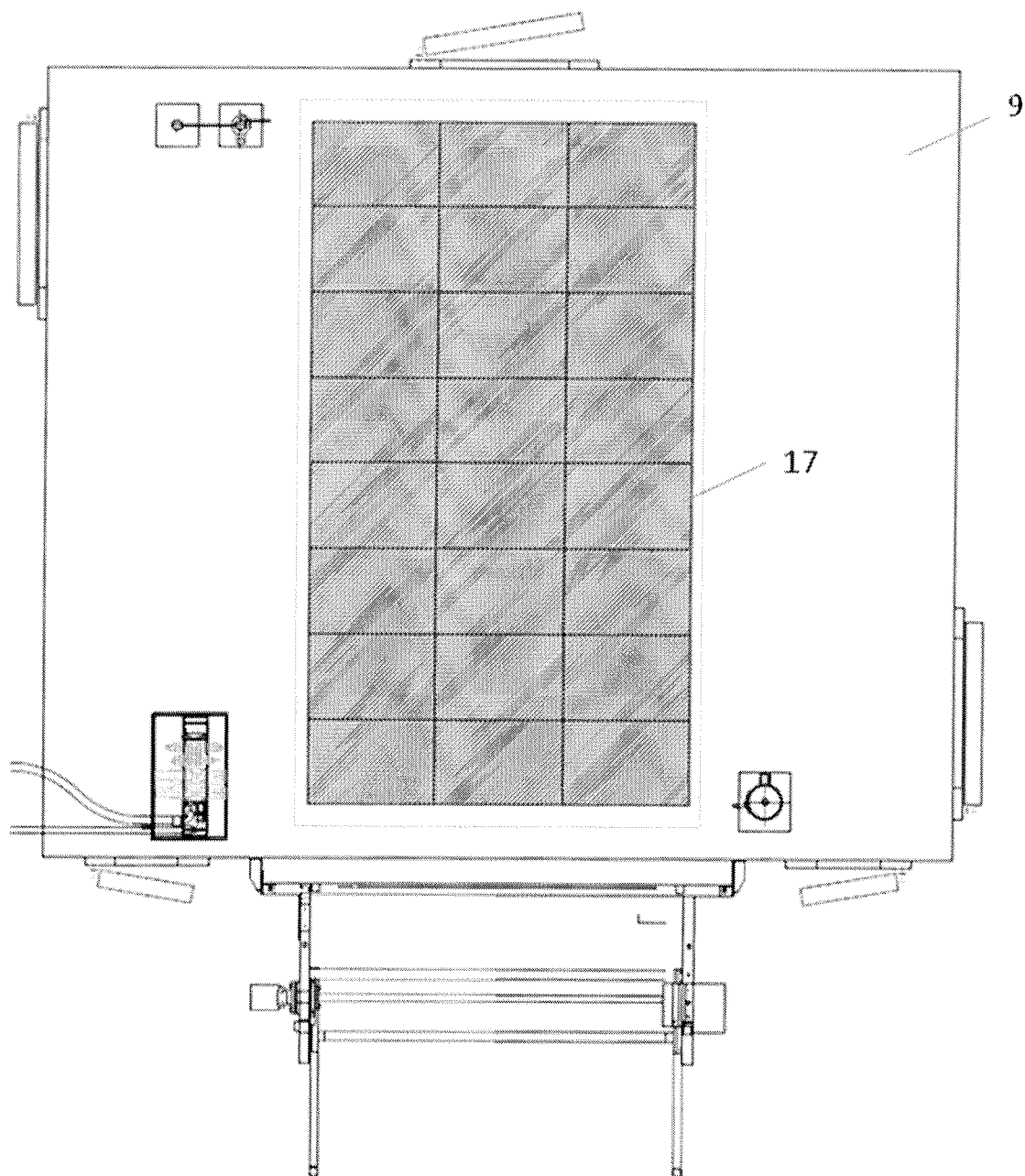


Fig. 4

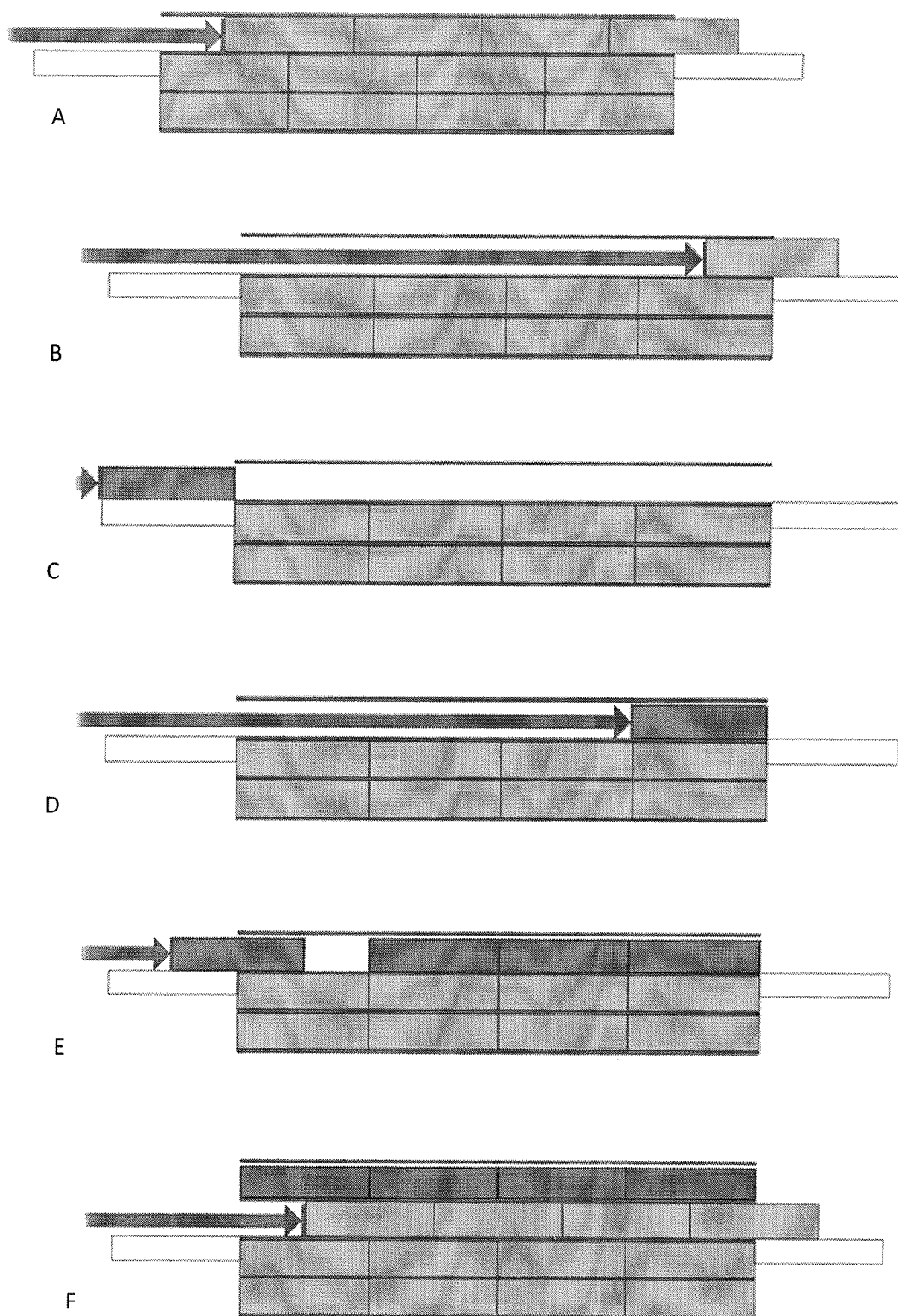


Fig. 5