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DESCRIPTION

Technical field

[0001] The present invention relates to the field of storage systems, and more specifically to a picking/supply station for use in storage systems and a bin holding device for use in such picking/supply stations.

Background

[0002] The Applicant's already known Auto Store system is a storage system comprising a three-dimensional storage grid structure wherein storage bins/containers are stacked on top of each other to a certain height. Such a prior art system is shown in fig. 1a.

[0003] The storage system is disclosed in detail in for instance NO317366 and WO 2014/090684 A1.

[0004] The storage system 10 comprises a grid structure 20 constructed as aluminium columns interconnected by top rails. Between the columns, vertical compartments are defined, in which the storage bins 30 may be stacked vertically above each other. A number of vehicles 40, or robot vehicles, are arranged on the top rails and may move horizontally on top of the storage grid.

[0005] Each vehicle is equipped with a lifting device for picking up, carrying, and placing storage bins 30 that are stored in the storage grid.

[0006] The system also comprises picking and/or supply stations 60, where one or several product items are picked out from the storage bin 30 or where one or several product items are placed into the storage bin 30.

[0007] When a product item stored in a storage bin is to be picked from the storage grid, the robot vehicle is arranged to pick up the storage bin containing that product type and then transport it to a bin lift 50. The bin lift transports the storage bin to the picking and/or supply station 60, where the item of the product type is retrieved from the storage bin. The storage bin with the remaining product items is thereafter returned to the storage grid by means of a bin lift and a robot vehicle. The picking and/or supply station 60 illustrated in fig. 1a is only shown schematically as a simple table upon which the storage bin is arranged. A more advanced prior art picking and/or supply station 60 illustrated in fig. 1b.

[0008] The same procedure is used for supplying product items into the storage grid. First, items are supplied into a storage bin at a picking and/or supply station. The bin lift then lifts the

storage bin up to the upper level where a robot vehicle transports the storage bin to its correct position within the storage grid.

[0009] A storage control and communication system is used to monitor inventory, to keep track of the location of respective storage bins (within storage grid and/or during transport), the content of each storage bins etc. Further, the storage control and communication system may also comprise, or may be provided in communication with, a control system for controlling the robot vehicles to pick a desired storage bin and to deliver it at the desired location at the desired time - without colliding with other vehicles.

[0010] The storage bins 30 have the same footprint and in most prior art systems are of the same height. To allow for increased storage flexibility it is desirable to have a storage system, wherein the storage bins may have different heights.

[0011] However, prior art picking and/or supply stations, also called work stations, designed for storage bins having a specific height, see fig. 1b, are not suitable for use with a storage system comprising storage bins of different heights. Such stations comprise an opening 1 for operator access to the storage bin 30. The top edge of the storage bin is arranged below the opening at substantially the same level to minimize any gap between said top edge and the circumference of the opening. This provides the operator with an ergonomic work position, keeping the bottom of the storage bin as close to the operator as possible, minimizes exposure of the station interior and minimizes the operator risk of squeeze/crush injuries.

[0012] An example of a prior art picking/supply station is disclosed in WO 2012/026824 A1. The exemplary prior art picking/supply station comprises box-shaped holding devices for receiving storage bins from a storage system. The holding devices are disclosed having stop devices to prevent a storage bin from sliding through the holding device. The stop devices are not further defined; however, from the drawings they appear to be multiple inclined arms interacting with corresponding recesses extending from the bottom of the storage bin. WO2012/026824 A1 discloses a bin holding device according to the preamble of claim 1.

[0013] The purpose of the present invention is to provide a picking/supply station suitable for storage bins of different heights.

Summary of the invention

[0014] The present invention is defined by the attached claims and in the following:

In a first aspect, the present invention provides a bin holding device comprising two vertical side elements spaced to accommodate a storage bin between them, and each side element provided with a bin supporting assembly comprising a bin support and

an actuator, wherein

- the bin support comprises an upper bin interacting part arranged to interact with a storage bin accommodated in the bin holding device, such that a top edge of the accommodated storage bin is held at a predetermined level; and
- the actuator is operably connected to the bin support and comprises a lower bin interacting part arranged to interact with a storage bin during introduction into the bin holding device, such that the upper bin interacting part is moved to interact with the storage bin (e.g. when the lower bin interacting part interacts with a storage bin during introduction into the storage bin holding device, the bin support is moved from an inactive position, wherein the upper bin interacting part is not interacting with the storage bin being introduced, to an active position, wherein the upper bin interacting part interacts with the storage bin, such that the top edge of the storage bin is held at a predetermined level).

[0015] Preferably, the bin support is arranged to support/suspend a storage bin when the storage bin is accommodated in the bin holding device, such that a top edge of the accommodated storage bin is held at a predetermined level.

[0016] The predetermined level may be relative any part of equipment in which the bin holding device is used, such as an opening in a picking/supply station, or relative a base/bottom level of the bin holding device or relative an upper edge of the bin holding device 2.

[0017] In an embodiment of the bin holding device, the vertical side elements are plate-shaped and arranged in parallel vertical planes. The distance between the two side elements is suitable for accommodating a storage bin between them.

[0018] In an embodiment, the bin holding device comprises a base and the two vertical side elements are arranged on opposite sides, or side edges, of the base.

[0019] In an embodiment of the bin holding device, the bin support is arranged to interact with an external edge or rib on a sidewall of the storage bin introduced into the storage bin holding device. Preferably, the bin support interacts with a downwards directed surface of the edge or rib. The edge or rib is preferably horizontal when the storage bin is in an upright position, i.e. when the storage bin is arranged on a horizontal surface. The edge or rib is preferably arranged at the upper half of the storage bin.

[0020] In an embodiment of the bin holding device, the lower bin interacting part is arranged to be displaced by a bottom, or lower, part of an introduced storage bin, preferably by a bottom edge.

[0021] In an embodiment of the bin holding device, the upper bin interacting part of the bin support is moved in a horizontal direction towards a storage bin being introduced when the lower bin interacting part of the actuator is displaced by the storage bin. Preferably, the lower

bin interacting part of the actuator is displaced in a horizontal direction away from the storage bin.

[0022] In all embodiments, the bin holding device is arranged such that a storage bin must be introduced to the bin holding device in a downward vertical direction/movement.

[0023] In an embodiment of the bin holding device, the bin supporting assembly is pivotably connected to the side element, such that the upper bin interacting part of the bin support is arranged on the opposite side of a pivot point relative the lower bin interacting part of the actuator. The bin supporting assembly may also be defined as a lever, wherein one end of the lever comprises the bin support and the other end of the lever comprises the actuator.

[0024] In an embodiment of the bin holding device, the upper bin interacting part features a top, or upwards facing, surface for supporting a downwards facing surface on a sidewall of a storage bin. Alternatively, the upper bin interacting part may be defined as comprising a stop, i.e. the top surface, which engages a step on a side of the storage bin, i.e. the downwards facing surface on a sidewall of a storage bin, to suspend the bin within the bin holding device.

[0025] In an embodiment of the bin holding device, the lower bin interacting part is a flat arm.

[0026] In an embodiment of the bin holding device, each of the side elements is provided with two bin supporting assemblies. The two bin supporting assemblies are spaced such that an accommodated storage bin is balanced at the predetermined level.

[0027] In an embodiment of the bin holding device, the bin support is movable between an inactive position, wherein the upper bin interacting part is not interacting with a storage bin being introduced into the bin holding device, and an active position, wherein the upper bin interacting part interacts with a storage bin, such that the top edge of the storage bin is held at a predetermined level.

[0028] In an embodiment of the bin holding device, the actuator is able to move the bin support between an inactive position and an active position, wherein the bin supports of the two vertical side elements are closer to each other in the active position than in the inactive position.

[0029] In an embodiment of the bin holding device, the bin support and/or the upper bin interacting part is pretensioned, or biased, into a non-interacting, or inactive, position when the actuator and/or the lower bin interacting part, is not interacting with a storage bin, the bin support and/or the upper bin interacting part is preferably pretensioned/biased by a spring.

[0030] Alternatively, the bin holding device of the first aspect may be defined as comprising a bin support mounted on a pivot, the bin support comprising an actuating lever disposed at a lower end below the pivot for interacting with a lower portion of a bin, and a stop provided at an upper end above the pivot and displaceable about the pivot by the lever being pushed by the

bin between an inactive (retracted) position where the lower portion of the bin is able to move past and an active (projecting) position where the stop is positioned to interact with and suspend the bin.

[0031] In a second aspect, the present invention provides a picking/supply station for receiving a storage bin from a storage system, comprising at least one bin holding device according to any of the embodiments of the first aspect, the bin holding device arranged to receive a storage bin from the storage system and transport the storage bin to a position for operator access to the storage bin.

[0032] In an embodiment of the picking/supply station, the position for operator access is below an opening in the picking/supply station and the at least one bin holding device is arranged such that a top edge of the storage bin is arranged at a predetermined level relative the opening.

[0033] In a third aspect, the present invention provides a storage system comprising a three-dimensional grid having multiple storage columns, in which storage bins are stored one on top of another in vertical stacks, and a picking/supply station according to the second aspect.

[0034] In a fourth aspect, the invention provides a method of arranging a top edge of a storage bin at a predetermined level in a bin holding device according to the first aspect, comprising the steps of:

- lowering the storage bin into the bin holding device;
- pushing a lower part of the storage bin against the lower bin interacting part provided on each of the vertical side elements, such that the upper bin interacting part of the operatively connected bin support moves towards a sidewall of the storage bin; and
- further lowering the storage bin until the upper bin interacting part supports a downwards facing surface on the sidewall, such that the top edge of the storage bin is held at the predetermined level.

[0035] In a preferred embodiment, the method comprises a step of lowering the lower part of the storage bin past the upper bin interacting part, before the lower part is pushed against the lower bin interacting part.

Short description of the drawings

[0036] Embodiments of the invention will now be described in greater detail by way of example only and with reference to the following drawings:

Fig. 1a is a perspective view of a prior art storage system.

Fig. 1b is a perspective view of a prior art picking/supply station.

Fig. 2 is a front side view of an exemplary embodiment of a picking/supply station according to the invention.

Fig. 3 is a cross-sectional view along A-A of the picking/supply station in fig. 2.

Fig. 4a is a topside view of a first embodiment of a bin holding device according to the invention.

Fig. 4b is an exploded perspective view of one of the bin supporting assemblies of the bin holding device in fig. 4a.

Figs. 5a and 5b are cross-sectional views along B-B of the bin holding device in fig. 4a receiving a storage bin.

Fig. 6 is a perspective side view of a second embodiment of a bin holding device according to the invention.

Fig. 7 is a perspective view of the bin holding device in fig. 6 and a storage bin to be introduced into the device.

Fig. 8 is a side view of the bin holding device and storage bin in fig. 7.

Figs. 9a-9c are cross-sectional views along B-B of the bin holding device and storage bin in fig. 8 showing the steps of introducing the storage bin into the device.

Detailed description of the invention

[0037] The purpose of the present invention is to alleviate or avoid problems associated with the use of bins having different heights in a prior art storage system as shown in fig. 1a.

[0038] An embodiment of a picking/supply station according to the invention is shown in fig. 2. The main differential feature of the inventive station relative the prior art station disclosed in fig. 1b and in WO 2012/026824 is the feature of the storage bin holding devices 2 according to the invention. In the prior art stations, the bin holding devices (not shown in fig. 1b and termed "holding devices" in WO 2012/026824) are not suitable for securely holding storage bins of different heights.

[0039] During use a storage bin 30', 30" is transferred from a storage system grid 20, for instance by use of a bin lift 50, to the port 19 in the picking/supply station 60, as best shown in fig. 3. The storage bin is lowered onto/into a bin holding device 2 for subsequent transportation to a position below the access opening 1. In the illustrated picking/supply station 60 a maximum height storage bin 30' is shown below the port 19, while a shorter storage bin 30 is

shown below the access opening 1. Due to the bin holding device 2 according to the invention, the top edge 18 of a storage bin will always be arranged at a predetermined level below the access opening 1 independent of the height of the storage bin. That is, the top edge 18 of the maximum height storage bin 30' and the top edge 18 of the shorter storage bin 30" will be arranged at the same predetermined level. The predetermined level may be relative the opening 19, relative a base/bottom level of the bin holding device 2 or relative an upper edge 22 of the bin holding device 2. It is of course a prerequisite that the height of the storage bins is equal to or less than a certain maximum value.

[0040] The bin holding device 2 shown in the picking/supply station in fig. 3 is shown in detail in figs. 4a and 4b. The bin holding device 2 features a base plate 3 and two vertical side elements 4. The side elements 4 are arranged at opposite side edges of the base plate 3, and are spaced to accommodate a storage bin 30 between them. The base plate 3 is not an essential feature of the bin holding device 2 and may be replaced by any suitable structure suitable for holding the two side elements 4 in the required structural relationship, for instance a frame interconnecting the two side elements.

[0041] Each of the side elements 4 features two bin supporting assemblies 23 comprising a bin support element 5 (i.e. a bin support) and an actuator lever 6,9 (i.e. an actuator), see fig. 4b. The bin supporting assembly is connected at the side element 4 via a bracket 15. The bracket features through holes 16 in which the supporting assembly is pivotably mounted.

[0042] The function of the bin holding device is explained by reference to figs. 5a and 5b, wherein the interaction between a storage bin and the bin holding device is illustrated. Fig. 5a shows the initial interaction when a storage bin is lowered onto the bin holding device, while fig. 5b shows the final position of the storage bin relative the bin holding device.

[0043] A top surface 12 (i.e. an upper bin interacting part) of the bin support element 5 is arranged to interact with a downwards facing surface 14 of an external side edge 8 arranged on the sidewall 7 of the storage bin 30. By supporting the storage bin via the external side edge 8, a top edge 18 of the storage bin is always held at a predetermined level relative the base plate 3 of the device 2, provided the level of the surface 14 is kept constant relative the top edge 18 on all storage bins to be used with the bin holding device. In this manner the level of the top edge 18, when accommodated in the bin holding device, will be independent of the height of the storage bin. During introduction of the storage bin, a bottom edge 11 of the storage bin 30 will push the actuator levers 6,9 in a horizontal direction (H 1) away from the storage bin. Each of the actuator levers is pivotably connected (i.e. operably connected) to a corresponding bin support element 5, such that the horizontal movement (H1) of the actuator levers provides a similar and opposite direction movement (H2) of the top surface 12 of the bin support element 5 (i.e. the bin interacting part of the bin support element). The movement of the actuator levers causes the bin support elements 5 to be positioned such that the lower surface 14 of the edge 8 will rest upon the surfaces 12 of the bin support elements when fully accommodated in the bin holding device, see fig. 5b. Each of the bin supporting assemblies is pretensioned/biased by a spring 17, see. fig. 4b, such that the actuator levers 6,9 return to

their non-actuated position when the storage bin is lifted off, or out of, the bin holding device. The bin support element 5 is moved between an inactive position in fig. 5a to an active position in fig. 5b. In the active position, at least the top surfaces 12 of the bin support elements is moved closer to each other, or in other words, closer to the storage bin accommodated between the side elements.

[0044] A second embodiment of a bin holding device is shown in fig. 6. The main differentiating features of the second embodiment relative the first embodiment are a set of sidewalls 21, providing structural support to the vertical side elements 4, and the manner in which the bin supporting assemblies are mounted on the vertical side elements 4. In the second embodiment, the bin supporting assemblies are not mounted via a separate bracket 15, but through an integral bracket 24 formed by a cutout 25 in the vertical side element 4. The bin holding device 2 and a storage bin 30 to be introduced are shown in fig. 7. The function of the bin holding device 2 is identical to the first embodiment described above and is illustrated in figs. 8 and 9a-9c using the same reference numbers for the same features.

[0045] The main advantage of the bin holding device 2 of the present invention is the ability to hold storage bins having a wide range of different heights at a predetermined vertical level.

[0046] In the disclosed embodiments, the bin supporting assemblies 23 comprises two interconnected elements, i.e. a bin support 5 element and an actuator 6. In other embodiments, the bin support 5 element and the actuator 6 may advantageously be made as a single element, for instance by molding the bin supporting assembly in one piece.

[0047] In the disclosed embodiments, each of the side elements 4 comprises two bin supporting assemblies. However, embodiments having side elements 4 comprising a single supporting assembly, wherein the bin support element is sufficient to balance/stabilize the supported storage bin is also contemplated. In these embodiments, the bin support element may for instance extend in a horizontal direction and comprise multiple spaced bin interacting parts (i.e. multiple top surfaces 12).

[0048] The inventive concept of the present invention is described in detail by reference to the two embodiments of a bin holding device above. In both embodiments, the bin support element is actuated by a pivotably connected lever mechanism. However, based on the present disclosure, the skilled person would be able to design similar actuator solutions. Any actuator solution that is able to interact with a storage bin being lowered into the bin holding device and transform said interaction into a horizontal movement of a bin support element towards the storage bin is considered to be encompassed by the present invention. The actuator may for instance be a hook element providing a downwards pull on a wire when interacting with the bottom part of a storage bin being introduced. The wire may be connected to the bin support element, for instance via a lever/pulley/pivot arm system etc., such that the bin support element moves in a horizontal direction towards the storage bin when the wire is pulled downwards. To allow for storage bins of different heights the wire may be elastic or the lever/pulley/pivot arm system may allow the wire/hook to travel further downwards after

actuation of the bin support element.

REFERENCES CITED IN THE DESCRIPTION

Cited references

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Patent documents cited in the description

- NO317366 **[0003]**
- WO2014090684A1 **[0003]**
- WO2012026824A1 **[0012]** **[0012]**
- WO2012026824A **[0038]** **[0038]**

PATENTKRAV

1. Beholderholdeanordning (2), der omfatter to vertikale sideelementer (4) adskilt for at rumme en opbevaringsbeholder mellem sig,

hvert sideelement (4) er forsynet med en beholderbærerenhed (23), der omfatter en beholderbærer (5), hvor

- beholderbæreren (5) omfatter en øvre beholdersamvirkende del (12), der er indrettet til at samvirke med opbevaringsbeholderen (30), når opbevaringsbeholderen er placeret i beholderholdeanordningen, således at en topkant (18) af den placerede opbevaringsbeholder holdes på et forudbestemt niveau; og

kendetegnet ved, at beholderholdeanordningen (2) endvidere omfatter en aktuator (6), hvor

- aktuatoren (6) er operativt forbundet med beholderbæreren (5) og omfatter en nedre beholdersamvirkende del (9) indrettet til at samvirke med opbevaringsbeholderen (30) under indføring af opbevaringsbeholderen i beholderholdeanordningen i en nedadgående vertikal retning, således at den øvre beholdersamvirkende del (12) bevæges for at samvirke med opbevaringsbeholderen.

2. Beholderholdeanordning ifølge krav 1, hvor den øvre beholdersamvirkende del (12) er indrettet til at samvirke med en ekstern kant (8) eller ribbe på en sidevæg (7) af opbevaringsbeholderen (30) placeret i opbevaringsbeholderholdeanordningen.

3. Beholderholdeanordning ifølge et hvilket som helst af de foregående krav, hvor den nedre beholdersamvirkende del (9) er indrettet til at blive forskudt af en nedre del af en indført opbevaringsbeholder, fortrinsvis af en bundkant (11).

4. Beholderholdeanordning ifølge krav 3, hvor den øvre beholdersamvirkende del (12) er indrettet til at blive bevæget i en horisontal retning (H2) mod en opbevaringsbeholder (30), der indføres, når den nedre beholdersamvirkende del (9) forskydes af opbevaringsbeholderen.

5. Beholderholdeanordning ifølge krav 4, hvor den nedre beholdersamvirkende del (9) forskydes i en horisontal retning (H1) væk fra opbevaringsbeholderen under indføring af opbevaringsbeholderen (30).

6. Beholderholdeanordning ifølge et hvilket som helst af de foregående krav, hvor beholderbærerenheden er drejbart forbundet med sideelementet (4), således at den øvre

beholdersamvirkende del (12) er anbragt på den modsatte side af et drejepunkt (13) i forhold til den nedre beholdersamvirkende del (9).

7. Beholderholdeanordning ifølge krav 4, hvor den øvre beholdersamvirkende del har en opadvendende flade (12) til at bære en nedadvendende flade (14) på en sidevæg (7) af en opbevaringsbeholder.

8. Beholderholdeanordning ifølge et hvilket som helst af kravene 3 til 7, hvor den nedre beholdersamvirkende del er en flad arm (9).

9. Beholderholdeanordning ifølge et hvilket som helst af de foregående krav, hvor hvert af sideelementerne (4) er forsynet med to beholderbærerenheder (23).

10. Beholderholdeanordning ifølge et hvilket som helst af de foregående krav, hvor beholderbæreren (5) er forspændt ind i en ikke-samvirkende position, når aktuatoren (6) ikke samvirker med en opbevaringsbeholder (30), fortrinsvis forspændt af en fjeder (17).

11. Beholderholdeanordning ifølge et hvilket som helst af de foregående krav, hvor de vertikale sideelementer er pladeformede og anbragt i parallelle, vertikale plan.

12. Beholderholdeanordning ifølge et hvilket som helst af de foregående krav, og som omfatter en base (3), hvor de to vertikale sideelementer (4) er anbragt på modsatte sider af basen.

13. Plukke-/forsyningsstation til modtagelse af en opbevaringsbeholder fra et opbevaringssystem, som omfatter mindst én beholderholdeanordning ifølge et hvilket som helst af de foregående krav, hvilken beholderholdeanordning er indrettet til at modtage en opbevaringsbeholder fra opbevaringssystemet og transportere opbevaringsbeholderen til en position for operatøradgang til opbevaringsbeholderen.

14. Opbevaringssystem (10), der omfatter et tredimensionelt gitter (20) med flere opbevaringssøjler, hvori opbevaringsbeholdere (30) opbevares oven på hinanden i vertikale stakke, og en plukke-/forsyningsstation ifølge krav 13.

15. Fremgangsmåde til anbringelse af en topkant (18) af en opbevaringsbeholder (30) på et forudbestemt niveau i en beholderholdeanordning (2) ifølge et hvilket som helst af kravene 1-

12, og som omfatter følgende trin:

- sænkning af opbevaringsbeholderen (30) ind i beholderholdeanordningen (2);

- skubning af en nedre del af opbevaringsbeholderen (30) mod den nedre beholdersamvirkende del (9) tilvejebragt på hvert af de vertikale sideelementer (4), således at den øvre beholdersamvirkende del (12) af den operativt forbundne beholderbærer (5) bevæger sig mod en sidevæg af opbevaringsbeholderen; og

- yderligere sænkning af opbevaringsbeholderen, indtil den øvre beholdersamvirkende del bærer en nedadvendende flade (14) på sidevæggen (7), således at topkanten af opbevaringsbeholderen holdes på det forudbestemte niveau.

DRAWINGS

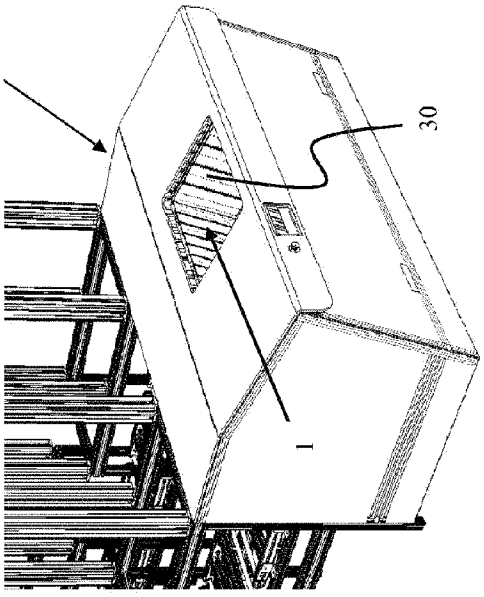

Fig. 1b

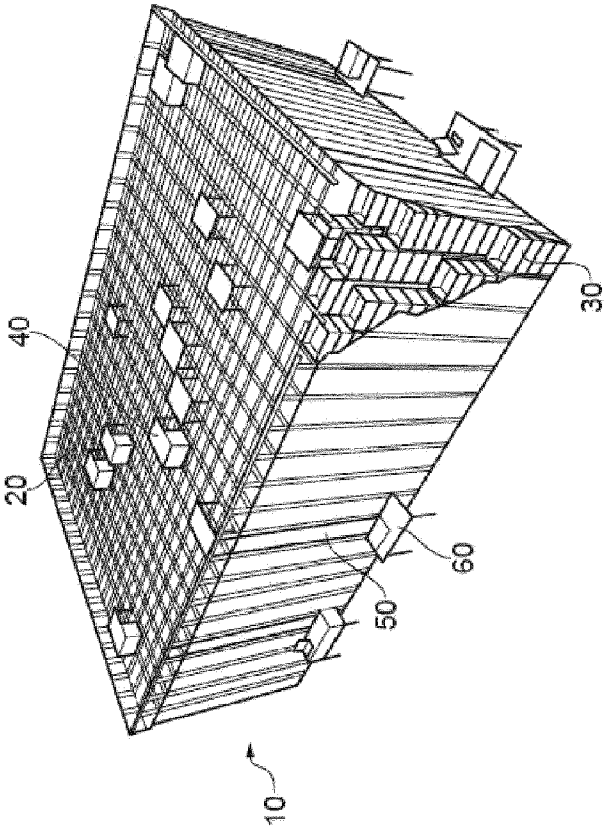

Fig. 1a

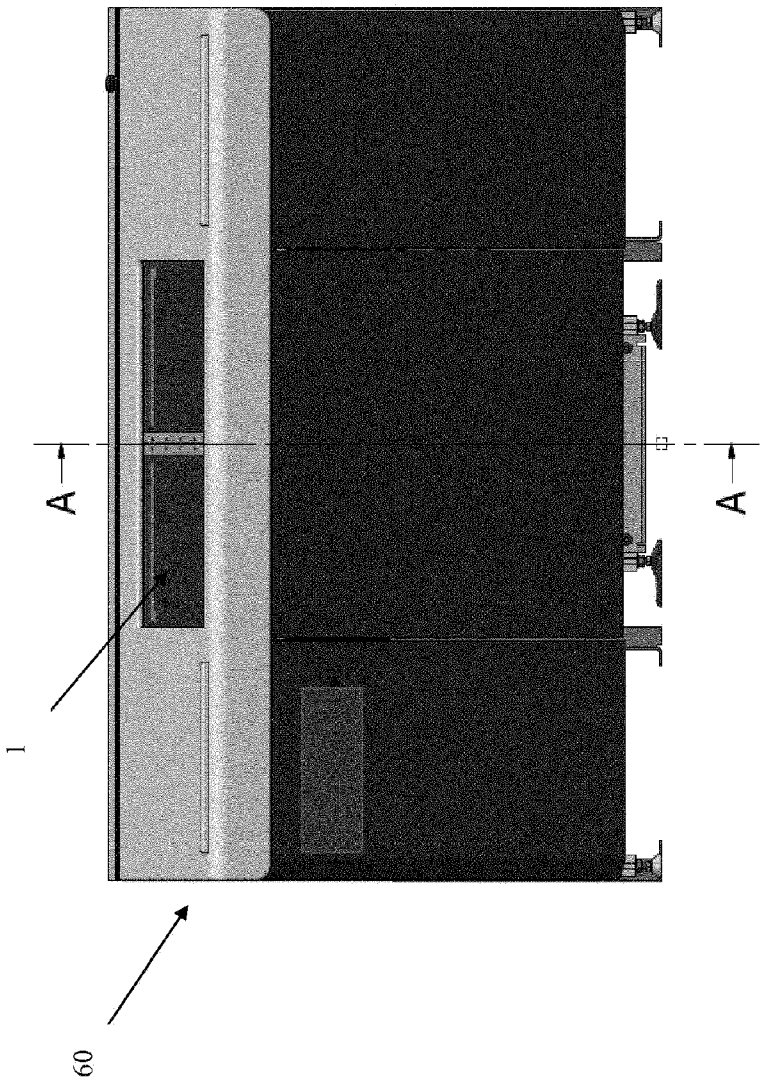

Fig. 2

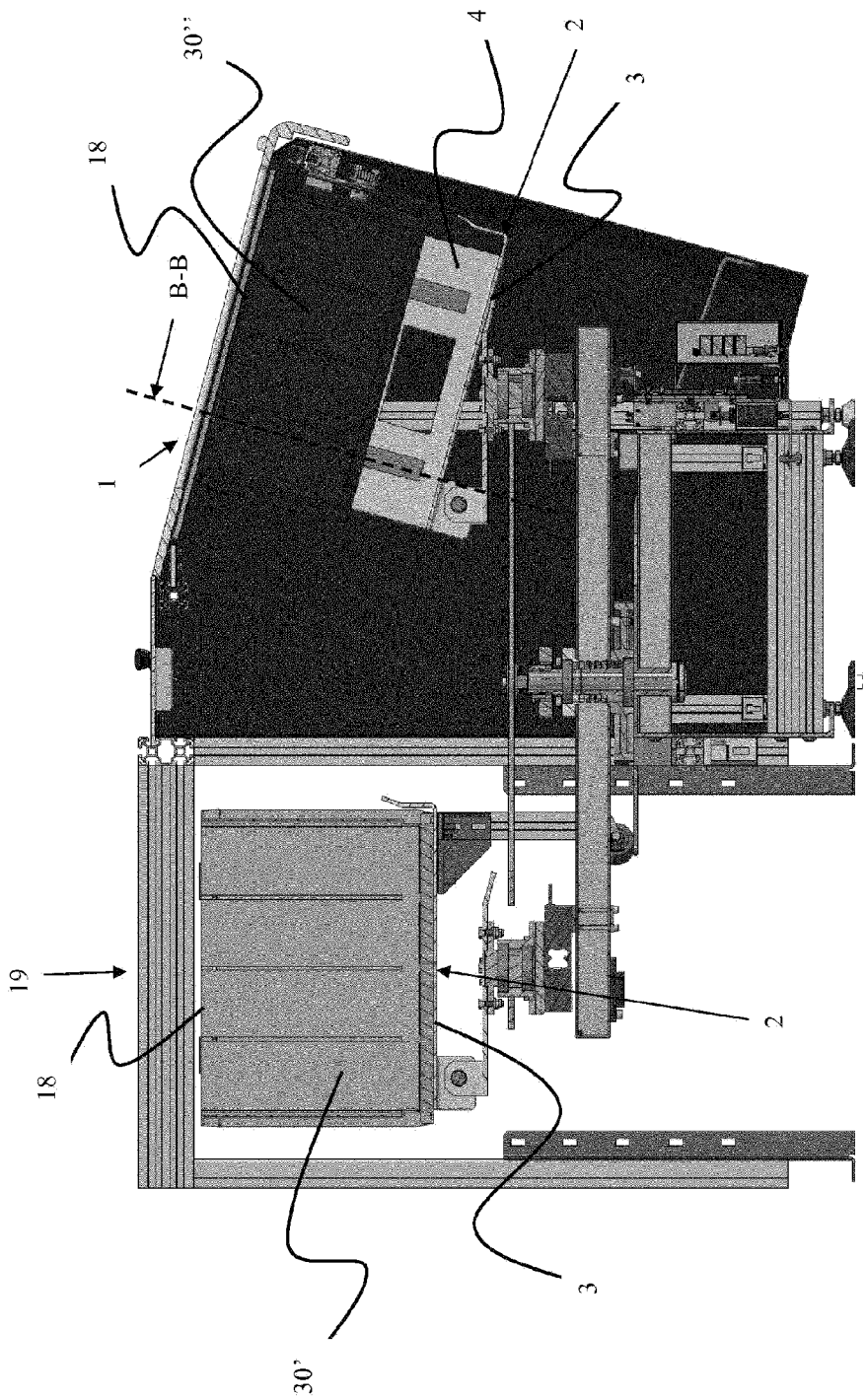

Fig. 3 (A-A)

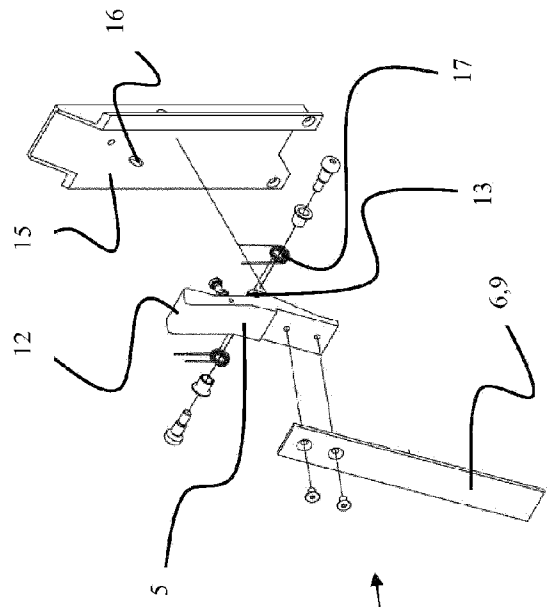

Fig. 4b

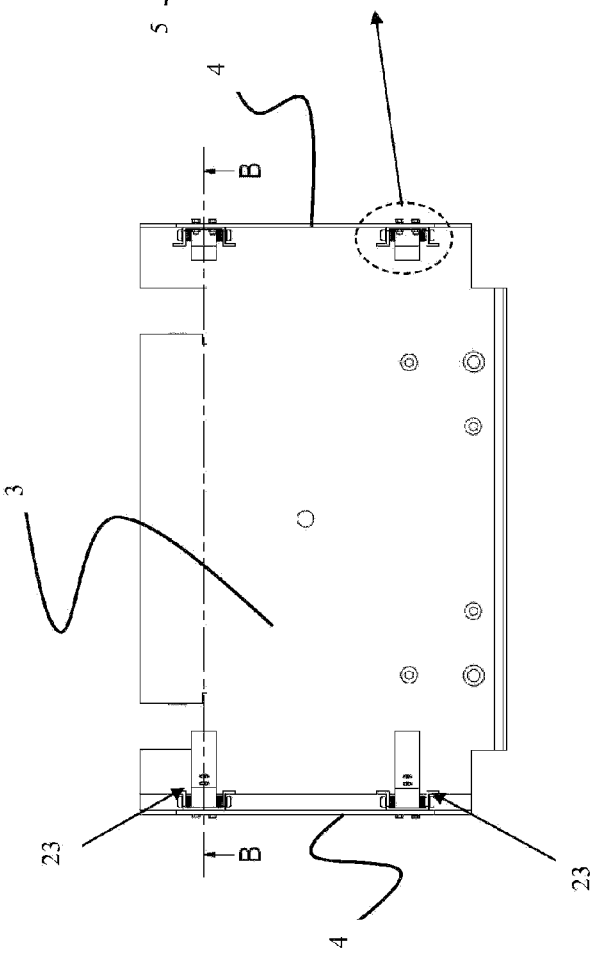

Fig. 4a

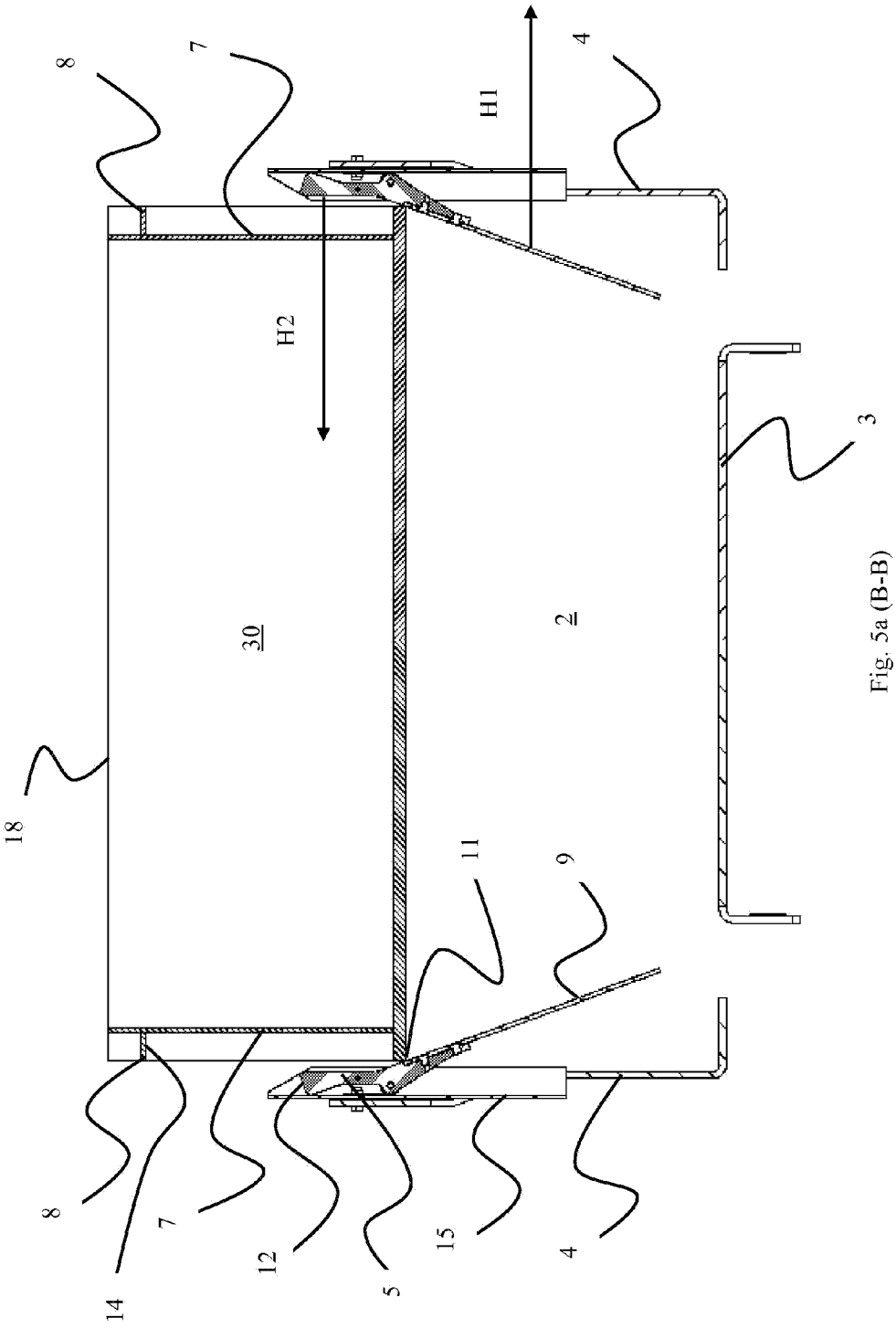

Fig. 5a (B-B)

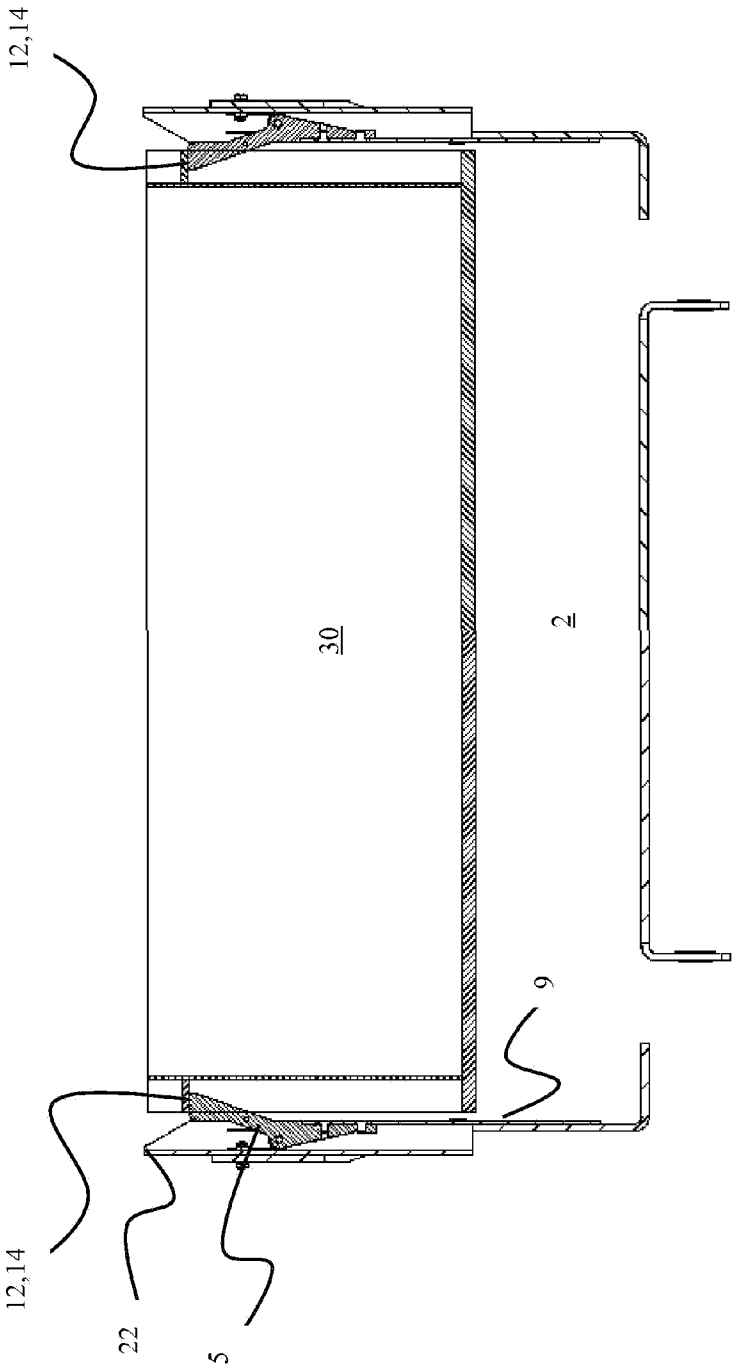

Fig. 5b (B-B)

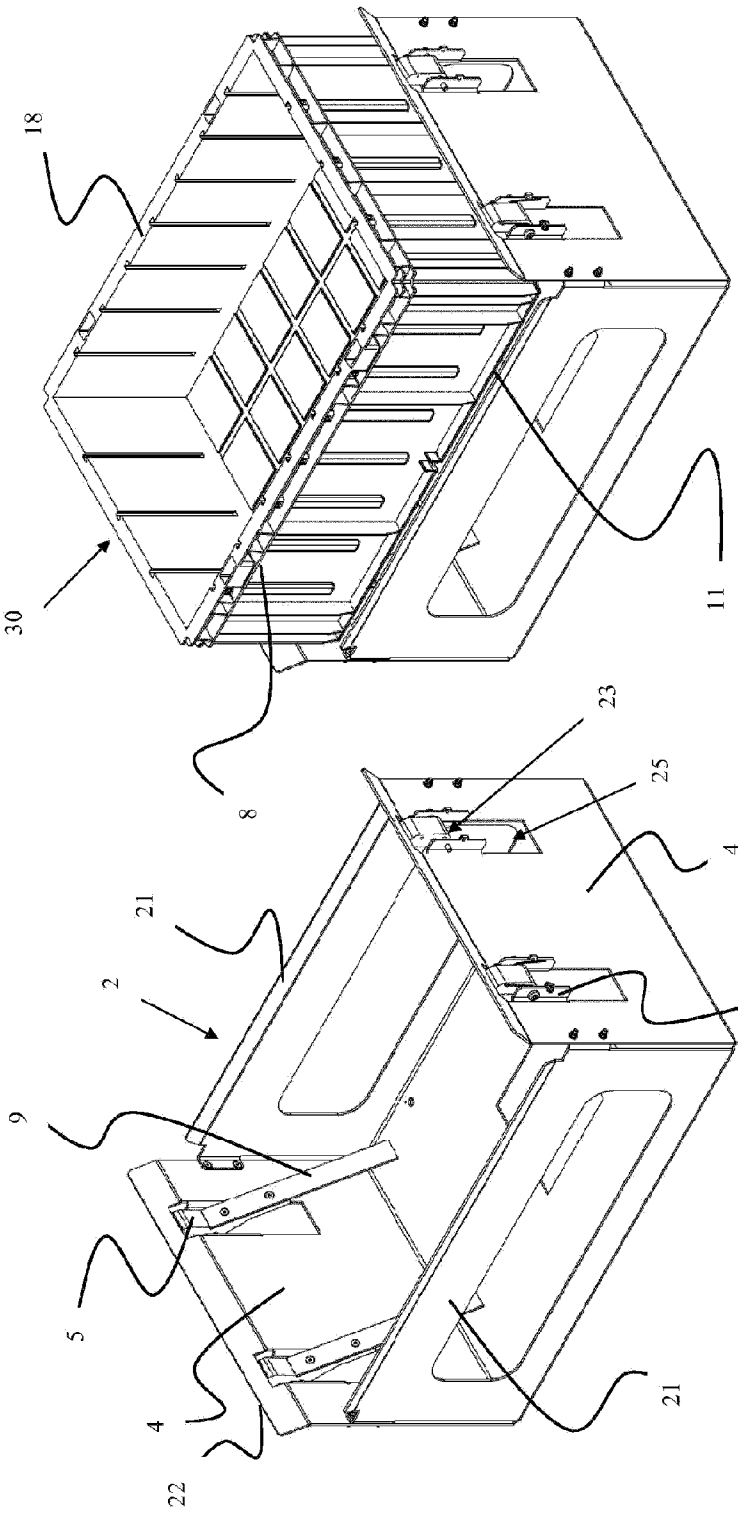

Fig. 6

Fig. 7

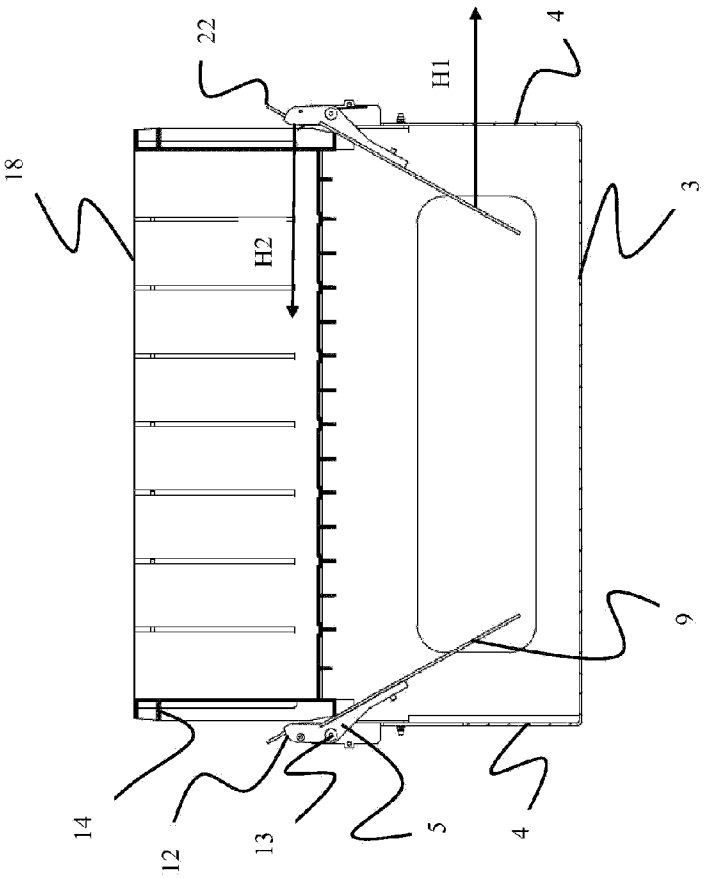

Fig. 9a (B-B)

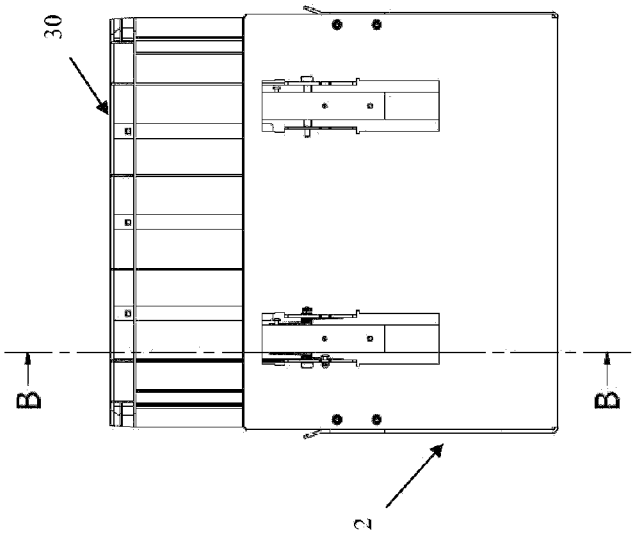

Fig. 8

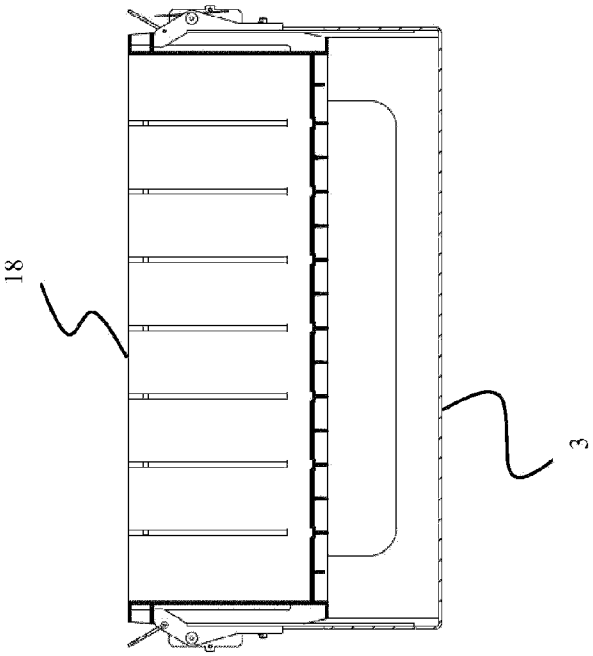

Fig. 9c

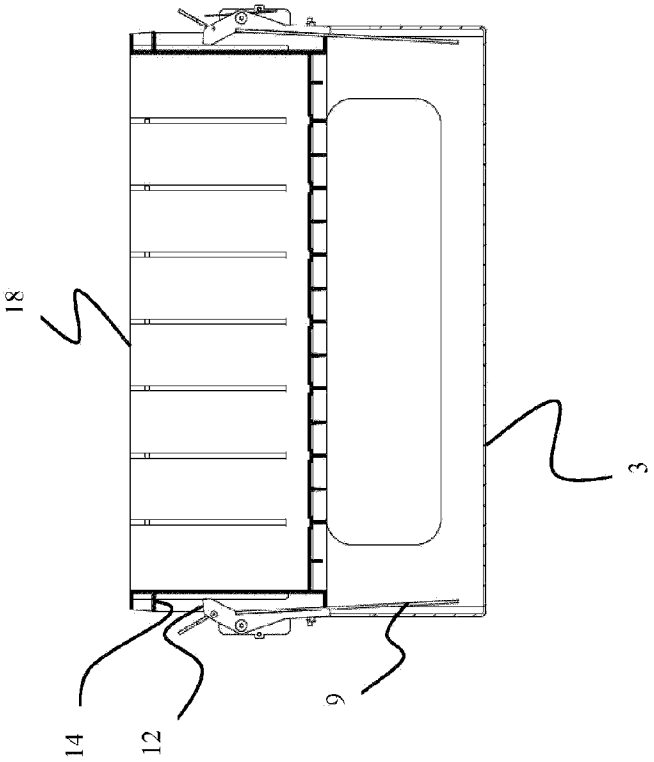

Fig. 9b