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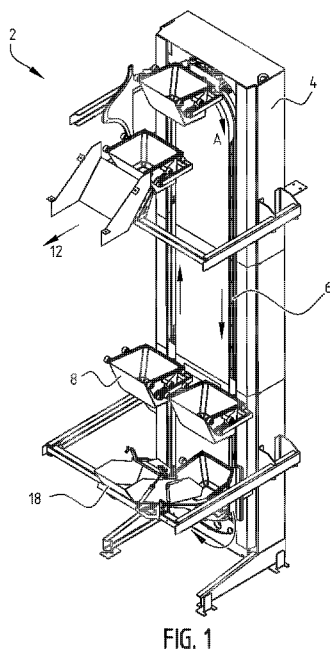
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(54) Title: VERTICAL CUP-ELEVATOR FOR TRANSFERRING BULK PRODUCT, BULK TRANSPORT SYSTEM COMPRISING SUCH ELEVATOR AND METHOD FOR TRANSFERRING BULK PRODUCT WITH SUCH ELEVATOR



(57) Abstract: The present invention relates to a vertical cup-elevator for transferring bulk products, a bulk product transport system comprising such elevator and a method for further transferring bulk product therewith. The vertical cup-elevator comprises: a frame; an endless drive comprising a number of cup carrier frames with cups for receiving bulk product, wherein the drive is configured for moving the cup carrier frames with the cups in a substantially vertical direction; a supply section configured for supplying bulk product to the cups; and a discharge section configured for outputting bulk product from the cups, wherein the frame comprises a discharge guide and/or a supply guide and the cups comprise a guide follower configured for tilting the cups relative to the cup carrier frame.

VERTICAL CUP-ELEVATOR FOR TRANSFERRING BULK PRODUCT, BULK
TRANSPORT SYSTEM COMPRISING SUCH ELEVATOR AND METHOD FOR
TRANSFERRING BULK PRODUCT WITH SUCH ELEVATOR

5 The present invention relates to an elevator for transferring bulk product. Such bulk products may relate to grain, flour, other powder materials, potatoes, apples, and other bulk product. The elevator is used for transferring bulk products over a height difference.

Conventional conveyors for transferring bulk product over a height difference typically involve belt conveyors that transport the product over a horizontal and vertical distance at a transport angle.

10 This requires substantial space. Alternatively, conventional vertical conveyors are used that apply centrifugal discharge. Such discharge may result in product damage, product loss, and/or generating “dust”.

An objective of the present invention is to provide an elevator for transferring bulk product, wherein the aforementioned problems are obviated or at least reduced.

15 Said objective is achieved with a vertical cup-elevator for transferring product according to the invention, the vertical cup-elevator comprising:

- a frame;
- an endless drive comprising a number of cup carrier frames with cups for receiving bulk product, wherein the drive is configured for moving the cup carrier frames with the cups in
- 20 a substantially vertical direction;
- a supply section configured for supplying bulk product to the cups; and
- a discharge section configured for outputting bulk product from the cups,

wherein the frame comprises a discharge guide and/or a supply guide and the cups comprise a guide follower configured for tilting the cups relative to the cup carrier frame.

25 The vertical cup-elevator transfers bulk product in a substantially vertical direction over a certain height between a supply section and a discharge section. The frame of the vertical cup-elevator extends in a substantially vertical direction over at least the maximum height difference for the bulk product transfer. Cups are attached to, or cups are provided in or on cup carrier frames. The carrier frames are moveable relative to the frame using a drive. Preferably, the drive relates to

30 an endless drive. The cups are configured for transferring bulk products such as grain, flour, other powder materials, potatoes, apples and other suitable bulk products between the supply section configured for supplying bulk product to the cups and a discharge section configured for outputting bulk products from the cups.

Preferably, one cup is provided for each individual cup carrier frame. The cup carrier frame

35 holds the cups at a certain distance from the drive system such that the cups may move with the

cup carrier frame relative to the frame and are capable of being tilted relative to the cup carrier frame.

In a presently preferred embodiment, the cups are provided with a tilting axis that extends in a substantially horizontal direction, and more preferably in a plane parallel to the drive system. This drive system moves the cups in a substantially vertical plane to which is also referred to as a drive plane. Alternatively, the cups tilt around a tilting axis that extends in a substantially horizontal direction substantially transversal to the drive system and drive plane. Such configuration of the vertical cup-elevator is also referred to as an elevator with a side discharge. In both configurations the carrier frame preferably comprises a tilting axis, more preferably a tilting shaft.

According to the present invention the vertical cup-elevator comprises a discharge guide and/or a supply guide, and wherein the cups comprise a guide follower configured for following a discharge guide and/or supply guide configured for tilting the cups relative to the cup carrier frame.

Providing cups for the transfer of the bulk products enables a transfer of the product in a substantially vertical direction, either upwards or downwards. The cups can be designed taking into account the specific product characteristics. Providing tiltable cups enables moving the bulk product from a supply section to a discharge section in a gentle manner, thereby reducing or even obviating the risk of product damage. When transferring powders or powder-like bulk products, the relatively gentle tilting of the cups prevents or at least reduces the creation of so-called “dust”, thereby also contributing to the reduction of the risk of a dust-explosion.

The position, and preferably shape, of the supply guide and/or discharge guide are in conformity with the position of the supply section and/or discharge section, respectively. Also, the bulk product type may affect the position and shape of the discharge guide and/or supply guide.

The vertical cup-elevator comprises an endless drive wherein the drive is configured for moving the cup carrier frames that hold the cups. Such drive can be of various types and configurations. However, in a presently preferred embodiment the drive may involve an operational system similar to the so-called MK5 conveyor lift that is developed and offered by the applicant. In the cup-elevator the cup-carrier frames are maintained in a substantially horizontal position during movement by the endless drive. Such configuration is described in EP 2403782 B1 of the applicant. Maintaining the substantial horizontal position enables an effective transfer of the cups in the vertical cup-elevator.

In a presently preferred embodiment of the invention the discharge guide comprises a tilting part having a tilting shape and a returning part.

In the tilting part of the discharge guide the guide follower of the cup forces the cup to tilt around the tilting axis thereby contributing to the discharge possibilities for bulk products from the cup. A returning part of the discharge guide defines the return of the cups to the transfer position.

Preferably, this return part provides an effective and smooth return of the cups from a tilted position to the transfer position.

Preferably, the cup and/or cup carrier frame comprises a spring or spring element that forces the cup to return to the transfer position. Such spring element cooperates with the discharge guide, especially the returning part thereof, to position the cup correctly for transfer of bulk product. The characteristics of the tilting part with the tilting shape and the returning part, as well as the optional spring element, may depend on the actual configuration and dimensions of the vertical cup-elevator and also to the product characteristics such as weight.

Preferably, the tilting shape of the discharge guide comprises a substantially exponential shape. The application of a substantially exponential shape provides a smooth curvature that enables an effective and efficient discharge of the bulk product from the cups, while at the same time minimizing the risk of product damage.

In a presently preferred embodiment of the invention the discharge guide is moveable along the frame of the vertical cup-elevator.

By providing a movable discharge guide the position of this discharge guide relative to the frame can be adjusted. This improves the flexibility of the vertical cup-elevator and enables an adjustment of the cup-elevator to bring the configuration into conformity with a (changing) discharge section. Preferably both discharge guide and the supply guide are movable along the frame. This further improves the overall flexibility of the cup elevator according to the present invention.

In a presently preferred embodiment of the invention the guide follower comprises one or more guide wheels.

Providing one or more guide wheels to the guide follower enables an effective following of the trajectory as defined by the discharge guide and/or supply guide and forces the cup to tilt at the appropriate position. Experiments have shown a reliable tilting movement at the correct position for the effective supply and/or discharge of the bulk product to and/or from the cups.

Preferably, the cups comprise a supply and/or discharge follower that is configured for contacting the supply section and/or discharge section. This supply and/or discharge follower enables a temporary contact between the cup and the supply and/or discharge section. This temporary contact can be used for an improved positioning of the cup relative to the discharge and/or supply section.

Optionally, the vertical cup-elevator comprises one or more load cells, preferably attached to the carrier frame to enable detection of the weight of the bulk product in the cup. This contributes to the overall control of the transfer operation of the bulk product.

Furthermore, the vertical cup-elevator optionally comprises a vibrating device. Preferably, a vibrating device is attached to the cup carrier frame and is configured for vibrating the cup and the

bulk product therein. Such vibrating device reduces the risk of clogging of the product in the cups during transfer thereof.

If required, an electric contact can be provided between the frame and the cup carrier of the cup-elevator. This enables providing energy to equipment, such as sensors and/or load cells and/or vibrating devices.

In a further preferred embodiment of a vertical cup-elevator according to the invention the elevator further comprises a second frame and a frame connector that extends between the frames of the elevator, wherein the cups are provided with a tilting axis that extends in a substantially horizontal direction and preferably extends substantially parallel to the frame connector.

Such vertical-cup elevator with at least two frames that extend in a substantially vertical direction is also referred to as a twin configuration comparable to a so-called twin sorter as described in WO 2020/185081 A1 of the applicant. Such twin configuration enables transfer of larger and/or heavier bulk products in an upwardly or downwardly direction. For example, such twin configuration is provided with one cup extending between the two frames in a cup carrier frame capable of transferring up to 200 kg of bulk product in a single cup.

The invention further relates to a bulk transport system comprising a vertical cup-elevator in an embodiment of the present invention, and a supply section and a discharge section.

Such bulk transport system provides the same or similar effects and advantages as described in relation to the vertical cup-elevator.

Optionally, the supply section is provided with a movable supply that is configured for moving of tilting (partly) down together with a moving cup during the actual supply of bulk product into the cup. This improves the gentle transfer of the bulk product from the supply section to the cup, thereby further reducing the risk of product damage and/or “dust” forming.

The invention further also relates to a method for vertically transferring bulk product comprising the steps of:

- providing a vertical cup-elevator in an embodiment of the present invention;
- supplying the bulk product to the cups;
- transferring the bulk product in a substantially vertical direction; and
- discharging the bulk product from the cups.

Such method provides the same or similar effects and advantages as described in relation to the vertical cup-elevator and/or bulk transport system.

The various aspects and features described and shown in the specification can be applied individually, wherever possible. These individual aspects, and a particular aspect of features described in the attached dependent claims, may be made subject of divisional patent applications.

Further advantages, features and details of the invention are elucidated on the basis of preferred embodiments thereof, wherein reference is made to the accompanying drawings, in which:

- Figure 1 shows a vertical cup-elevator in an embodiment according to the present invention;
- Figure 2A-B show side and front views of the elevator of figure 1;
- Figure 3A-B shows the cup in the cup carrier frame from the embodiments shown in figures 1 and 2;
- Figure 4A-E show the tilting process of the cup in relation to a discharge guide;
- Figure 5A-D show the supply of bulk product to cups in a first embodiment;
- Figure 6A-B show the supply of bulk product to the cups in a second embodiment; and
- Figure 7 schematically shows a twin configuration of an embodiment of the vertical cup-elevator according to the present invention.

Vertical cup-elevator 2 (figure 1) comprises frame 4 with drive track 6. A number of carriers 8 move in a direction A along track 6 and pass supply section 10 and output or discharge section 12.

Frame 4 comprises supply guide 14 and discharge guide 16 (figures 2A-B). Guides 14, 16 define the tilting movement of cups 18 relative to cup carrier frames 20. Cup carrier frames 20 move in track 6. In the illustrated embodiment two wheels 21 are provided that enable movement of cups 18 in carrier frames 20 along drive track 6. The operation of wheels 21 can be similar to the configuration described in the aforementioned EP 2403782 B1 of the applicant. This configuration enables maintaining a substantial horizontal position of cup carrier frames 20 during the entire movement along track 6. It will be understood that alternative configurations can also be envisaged in accordance with the present invention.

Supply section 10 supplies bulk product in a direction B from conveyor 10a into supply 10b and next into gutter 10c. From supply 10 bulk product is transferred into cup 18. The tilting movement of cup 18 is achieved by guide follower 22 when in contact with supply guide 14. In (exponential) tilting part 14a cup 18 tilts towards supply section 10. When moving vertically and after being supplied with bulk product, cup 18 returns to a transfer position by guide follower 22 following return part 14b of supply guide 14.

In the illustrated embodiment discharge section 12 receives bulk product in receiver 12a after which the bulk product is moved along conveyor 12b in direction C. The tilting movement of cup 18 is defined by discharge guide 16. Guide follower 22 follows tilting part 16a of discharge guide 16, that is preferably of an exponential shape. It will be understood that other shapes can also be envisaged in accordance with the present invention. The return of cup 18 to a transfer position is achieved by guide follower 22 following return part 16b of discharge guide 16.

Bulk transport system 62 (figure 2A) comprises vertical cup-conveyor 2, discharge section 12 and supply section 10. It will be understood that other configurations can also be envisaged in accordance with the present invention. For example, bulk product can be moved downwards in other configurations.

5 In the illustrated embodiment carrier 8 is provided with cup 18 (figures 3A-B) that is provided in cup carrier frame 20. In the illustrated embodiment guide follower 22 comprises a guide wheel that is positioned with pen 24 at a distance from cup 18. In the illustrated embodiment there is provided supply and/or discharge follower 26 that is capable of contacting parts or elements of supply section 10 and/or discharge section 12. Optionally, spring 28 is provided that provides a
10 force to maintain cup 18 in a transfer position such that bulk products are being held within cup 18. Rotation axis 30 corresponds to a tilting axis of cup 18 relative to cup carrier frame 20. In this illustrated embodiment sensor element 32, such as a load cell, is attached to carrier frame 20 to measure the weight of bulk products in cup 18. Also optionally, vibrating device 33 is attached to cup carrier frame 20 such that the contents of cup 18 can be vibrated to prevent clogging, for
15 example. On edge 34 of cup 18 strip or guide 36 is provided.

In the illustrated embodiment discharging cups 18 (figures 4A-E) involves movement of cup 18 in an upward direction wherein guide follower 22 follows tilting part 16a of discharge guide 16. Cup 18 tilts around tilting axis 30 relative to cup carrier frame 20. The position of discharge guide 16 is in conformity with the position of discharge section 12. Just before the actual discharge of the
20 product from cup 18 a tilting movement is preferably initiated and cup 18 starts tilting towards discharge section 12. After the bulk product is transferred from carrier 18 to discharge section 12 return part 16b allows cup 18 to return to its transfer position and is maintained in that position with the optional assistance of spring 28. Optionally, discharge section 12 comprises an additional discharge section guide 40 to improve positioning of cup 18 relative to discharge section 12.

25 In a first embodiment of supply section 10 the supply of bulk product to cup 8 (figures 5A-D) starts when cup 8 is near supply section 10. Tilting part 14a of supply guide 14 initiates movement of cup 8 around tilting axis 30 with guide follower 22. After advancing cup 18 and filling cup 18 with bulk product by supply section 10 cup 18 returns to the transfer position with guide follower 22 following return part 14b of supply guide 14. Supply guide 14 allows the return of cup 18 in its
30 transfer position, optionally with the use of spring 28.

In an alternative embodiment of supply section 10 (figure 6A-B) supply section 10 has a movable part 42 that moves towards cup 18 when it is near supply section 10 (figure 6A-B). In the illustrated embodiment frame part 38 is provided at a height corresponding to supply section 10. Supply section 10 has supply or moveable part 42 that may contact cup 18. Bulk product is
35 supplied by supply part 46. Support 48 is connected to gas spring 52 and supply spring element 54. In the illustrated embodiment cup 18 contacts supply part 42 and starts movement of supply part 42

with the use of supply and/or discharge guide follower 26 that contacts supply contact 50 of supply section 10. This improves the transfer of bulk product into cup 18. Gas spring 52 dampens the return movement of supply part 24 after filling of the cup 18.

Bulk product is provided by supply section 10. Supply section 10 transfers bulk product into cup 18 of carrier 8, preferably while moving cup 18 in a vertical direction, either upwards or downwards. Optionally, supply section 10 may comprise one or more movable parts to improve the gentle transfer of bulk product into cup 8. The tilting movement of cup 18 is achieved by supply guide 14. Discharge of bulk product from cup 18 is performed at discharge section 12 involving a tilting movement of cup 8 that is achieved using discharge guide 16. Bulk product is transferred from cup 8 to discharge section 12 and transported further.

In an alternative configuration, especially for larger bulk products or for higher capacity, twin configuration 102 (figure 7) is provided with two vertical cup-elevators 2', 2''. Between frames 4' and 4'' there is provided a number of frame connectors 104 to which cup carrier frame 20' with cups 8' are attached. In the illustrated embodiment, cups 8' extend in width direction W of twin configuration 102 over a substantial part thereof. The operation of twin configuration 102 is similar to the operation described for the single frame cup-elevator 2. It is noted that in the illustrated embodiment for twin configuration 102 the tilting movement of cup 8' is around tilting axis transversal to drive plane 106. It will be understood that components that are illustrated in relation to vertical cup-elevator 2 (figures 1-6B) can also be applied to twin configuration 102 (figure 7), such as supply guide 14, discharge guide 16, supply and discharge sections 10, 12, etc..

The present invention is by no means limited to the above-described preferred embodiments thereof. The rights sought are defined by the following claims within the scope of which many modifications can be envisaged. For example, vertical cup-elevator 2 can optionally be provided with a tilting direction sideways to elevator 2 to provide a cup-elevator with a side discharge. In such embodiment tilting axis 30 extends transversal to frame 4 of cup elevator 2.

CLAIMS

1. Vertical cup-elevator for transferring bulk product, the cup-elevator comprising:

- a frame;
- an endless drive comprising a number of cup carrier frames with cups for receiving bulk product, wherein the drive is configured for moving the cup carrier frames with the cups in a substantially vertical direction;
- a supply section configured for supplying bulk product to the cups; and
- a discharge section configured for outputting bulk product from the cups,

wherein the frame comprises a discharge guide and/or a supply guide and the cups comprise a guide follower configured for tilting the cups relative to the cup carrier frame.

2. Vertical cup-elevator according to claim 1, wherein the cups are provided with a tilting axis that extends in a substantially horizontal direction.

3. Vertical cup-elevator according to claim 2, wherein the cup carrier frame comprises the tilting axis.

4. Vertical cup-elevator according to claim 2 or 3, wherein the tilting axis extends in a plane parallel to the drive system.

5. Vertical cup-elevator according to any of the foregoing claims, wherein the cup carrier frame is maintained in a substantial horizontal position during movement by the endless drive.

6. Vertical cup-elevator according to any of the foregoing claims, wherein the discharge guide comprises a tilting part having a tilting shape, and a returning part.

7. Vertical cup-elevator according to claim 6, wherein the tilting shape comprises a substantially exponential shape.

8. Vertical cup-elevator according to any of the foregoing claims, wherein the discharge guide is moveable along the frame of the vertical cup-elevator.

9. Vertical cup-elevator according to any of the foregoing claims, wherein the guide follower comprises one or more guide wheels.

10. Vertical cup-elevator according to any of the foregoing claims, wherein the cups comprise a spring element configured for maintaining the cup in a transport position.

11. Vertical cup-elevator according to any of the foregoing claims, wherein the cups comprise a supply and/or discharge follower that is configured for contacting the supply section and/or discharge section.

12. Vertical cup-elevator according to any of the foregoing claims, further comprising a load cell.

13. Vertical cup-elevator according to any of the foregoing claims, further comprising a vibrating device.

14. Vertical cup-elevator according to any of the foregoing claims, further comprising:

- a second frame; and
- a frame connector that extends between the frames,

wherein the cups are provided with a tilting axis that extends in a substantially horizontal direction and substantially parallel to the frame connector.

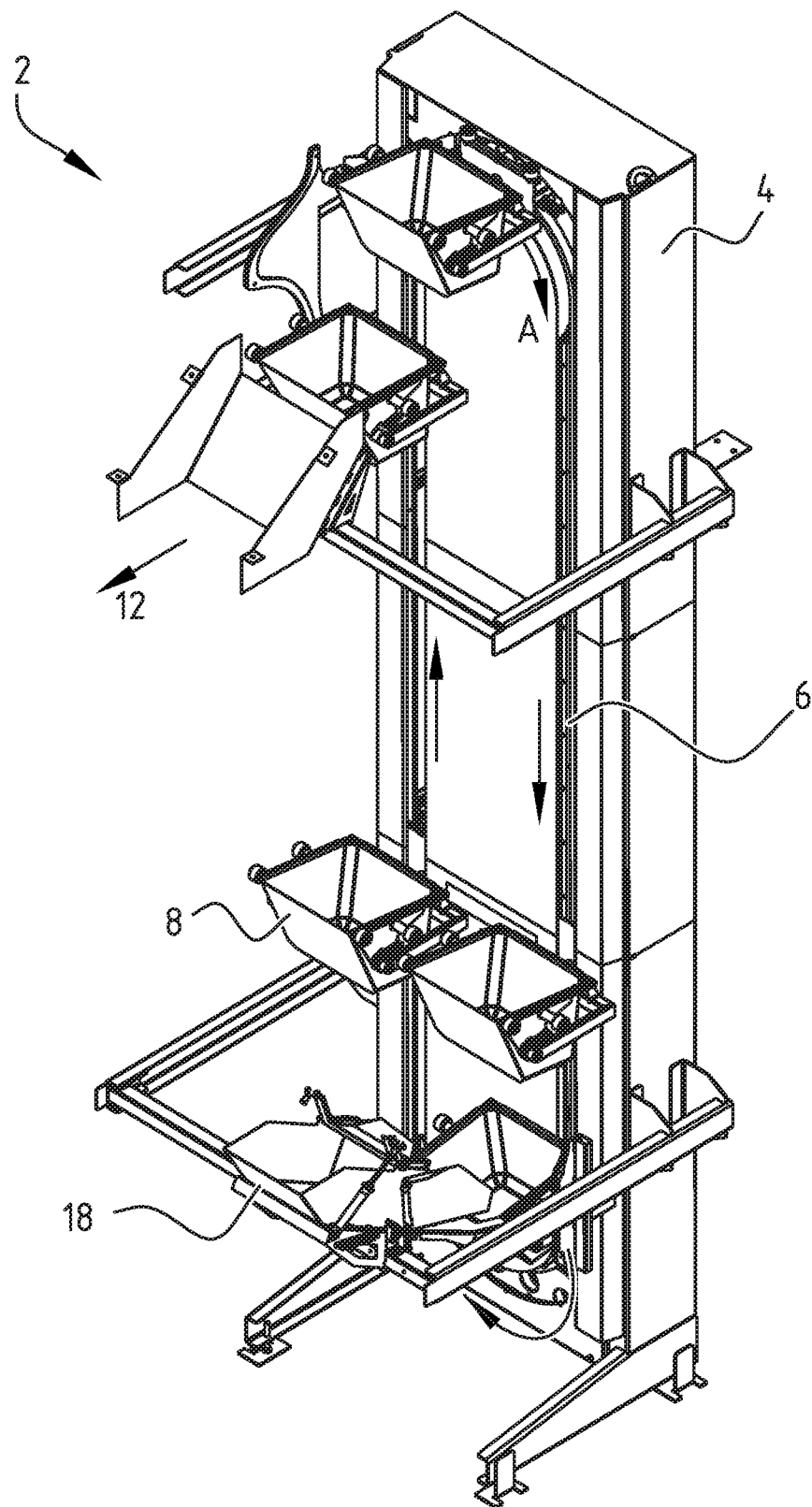
15. Bulk transport system comprising a vertical cup-elevator according to any of the foregoing claims, a supply section, and a discharge section.

16. Bulk transport system according to claim 15, wherein the supply section further comprising a moveable supply.

17. Method for vertically transferring bulk product comprising the steps of:

- providing a vertical cup-elevator according to any of foregoing claims 1-14;
- supplying the bulk product to the cups;
- transferring the bulk product in a substantially vertical direction; and
- discharging the bulk product from the cups.

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FIG. 1

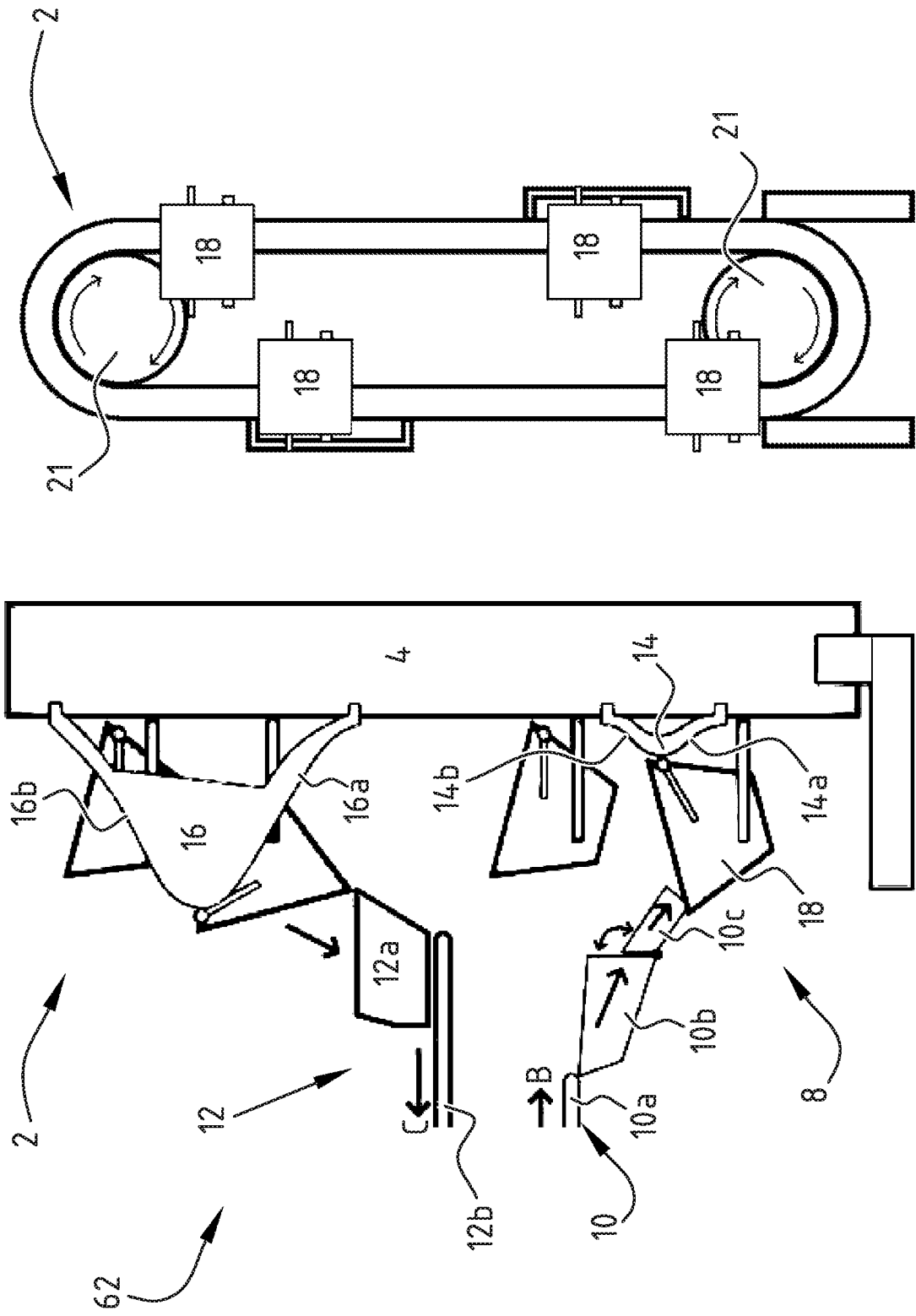


FIG. 2B

FIG. 2A

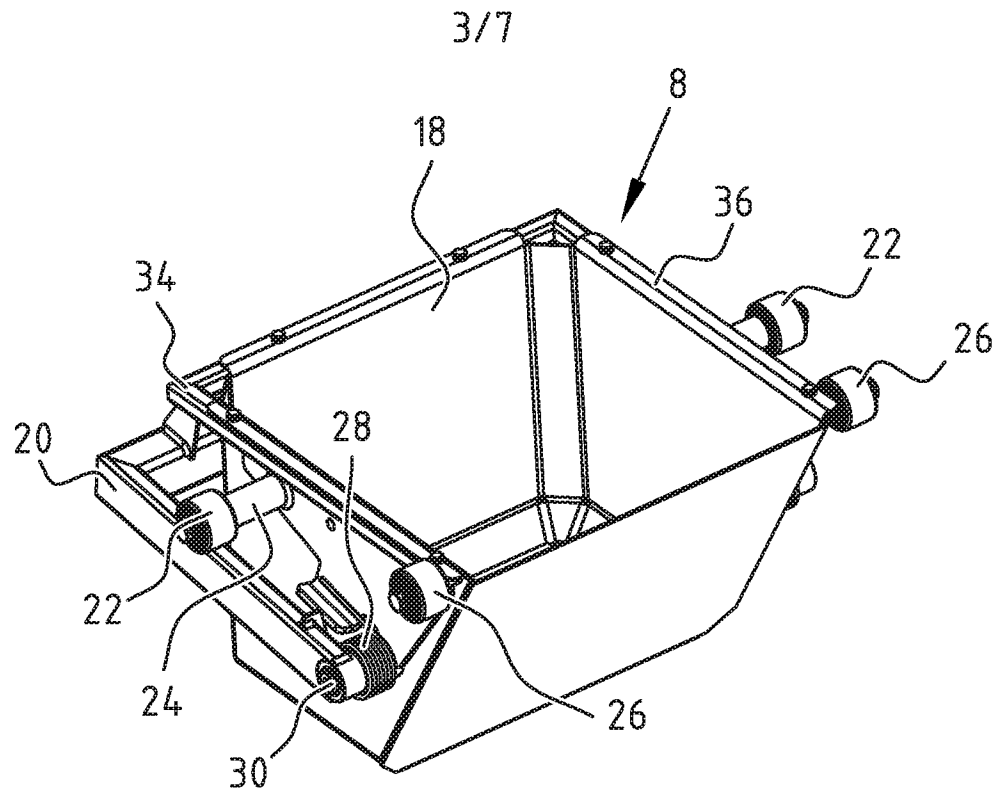


FIG. 3A

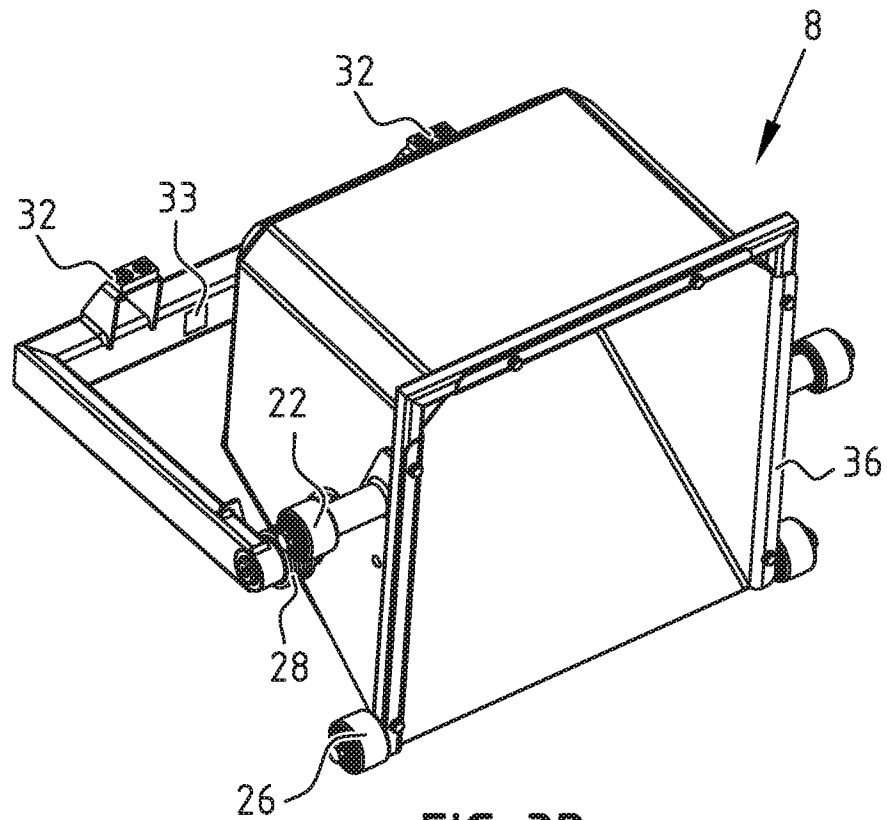
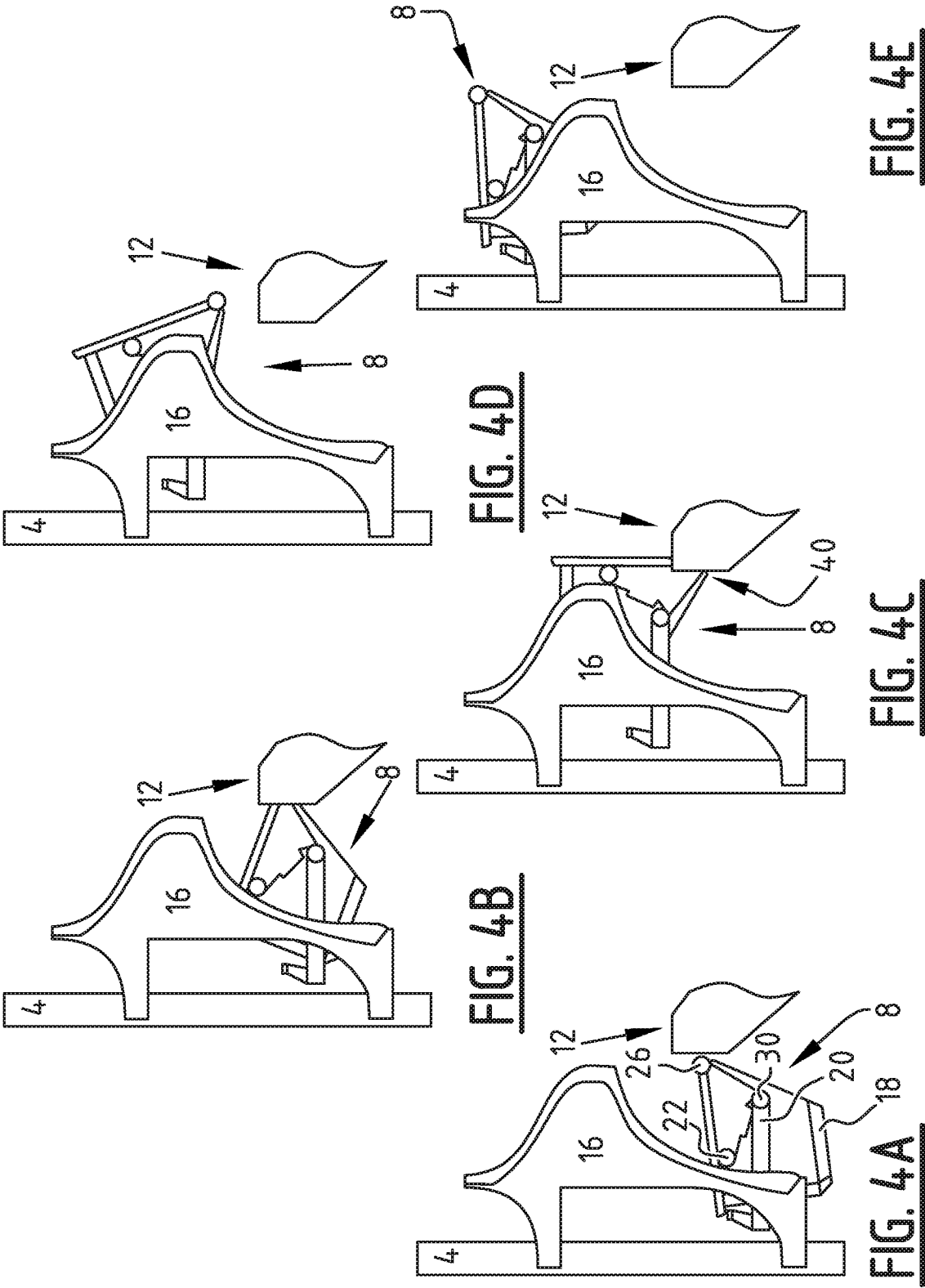


FIG. 3B



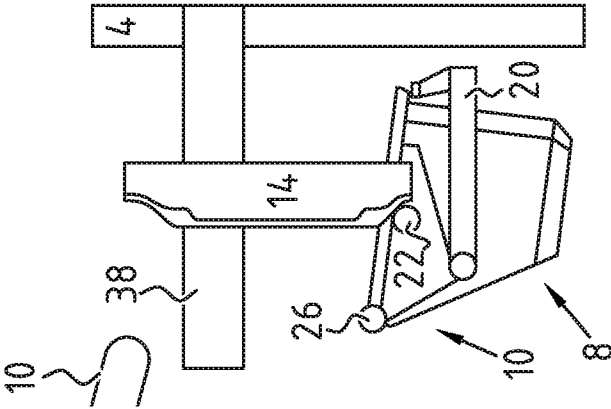


FIG. 5A

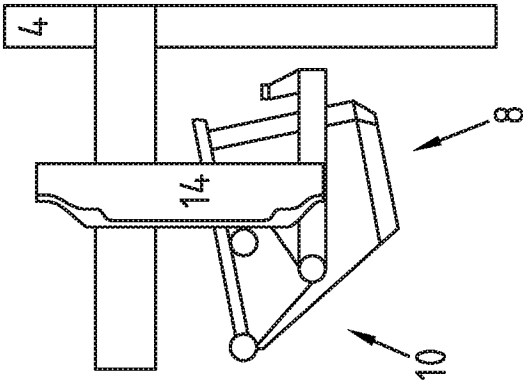


FIG. 5B

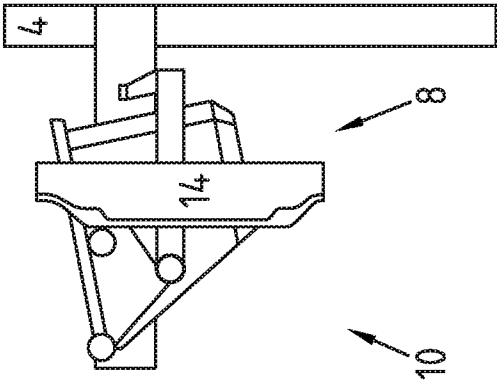


FIG. 5C

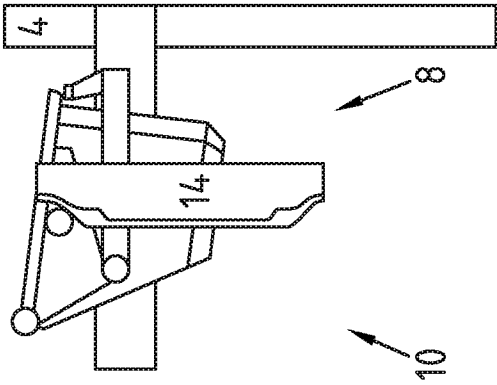


FIG. 5D

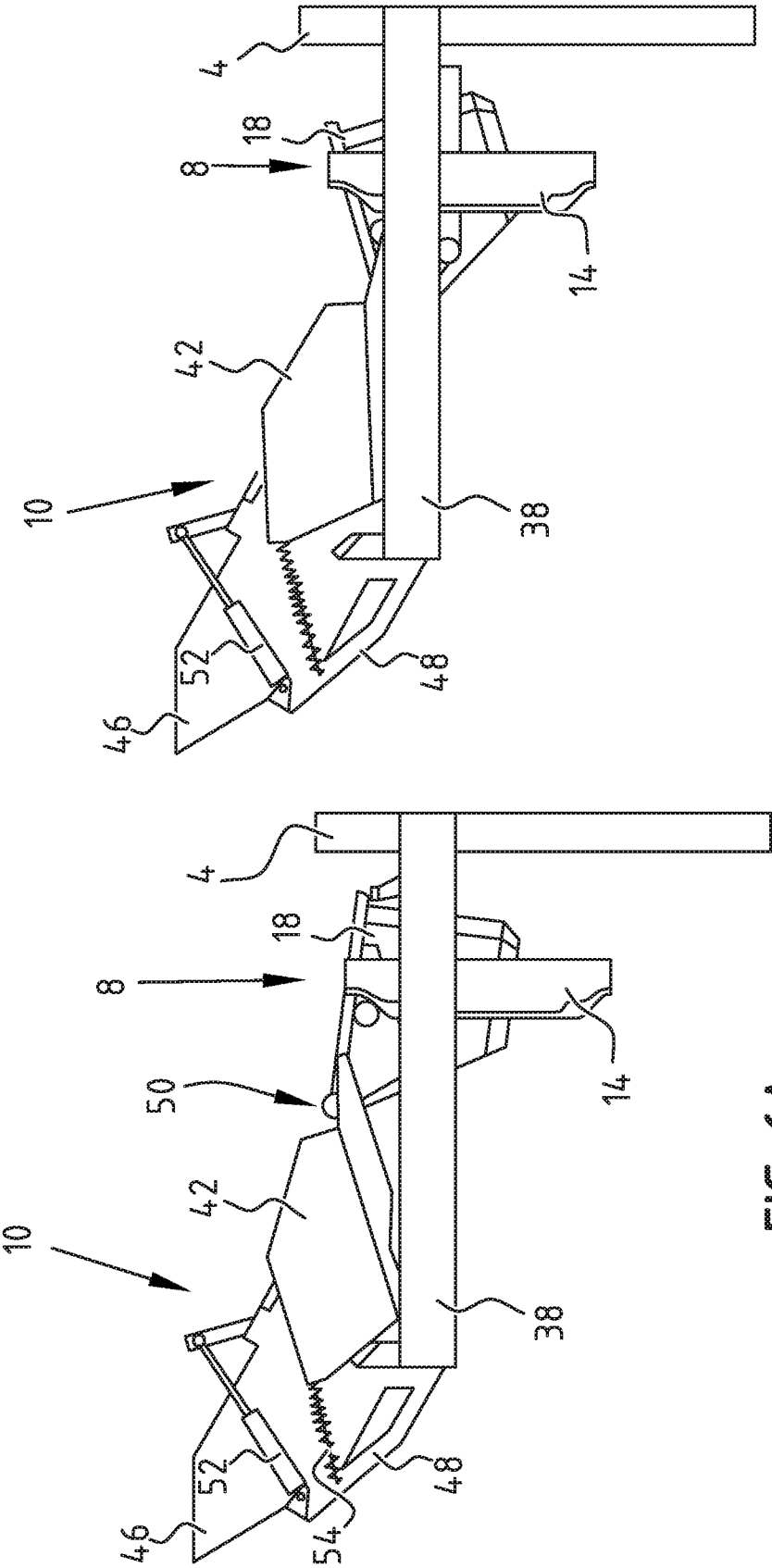


FIG. 6A

FIG. 6B

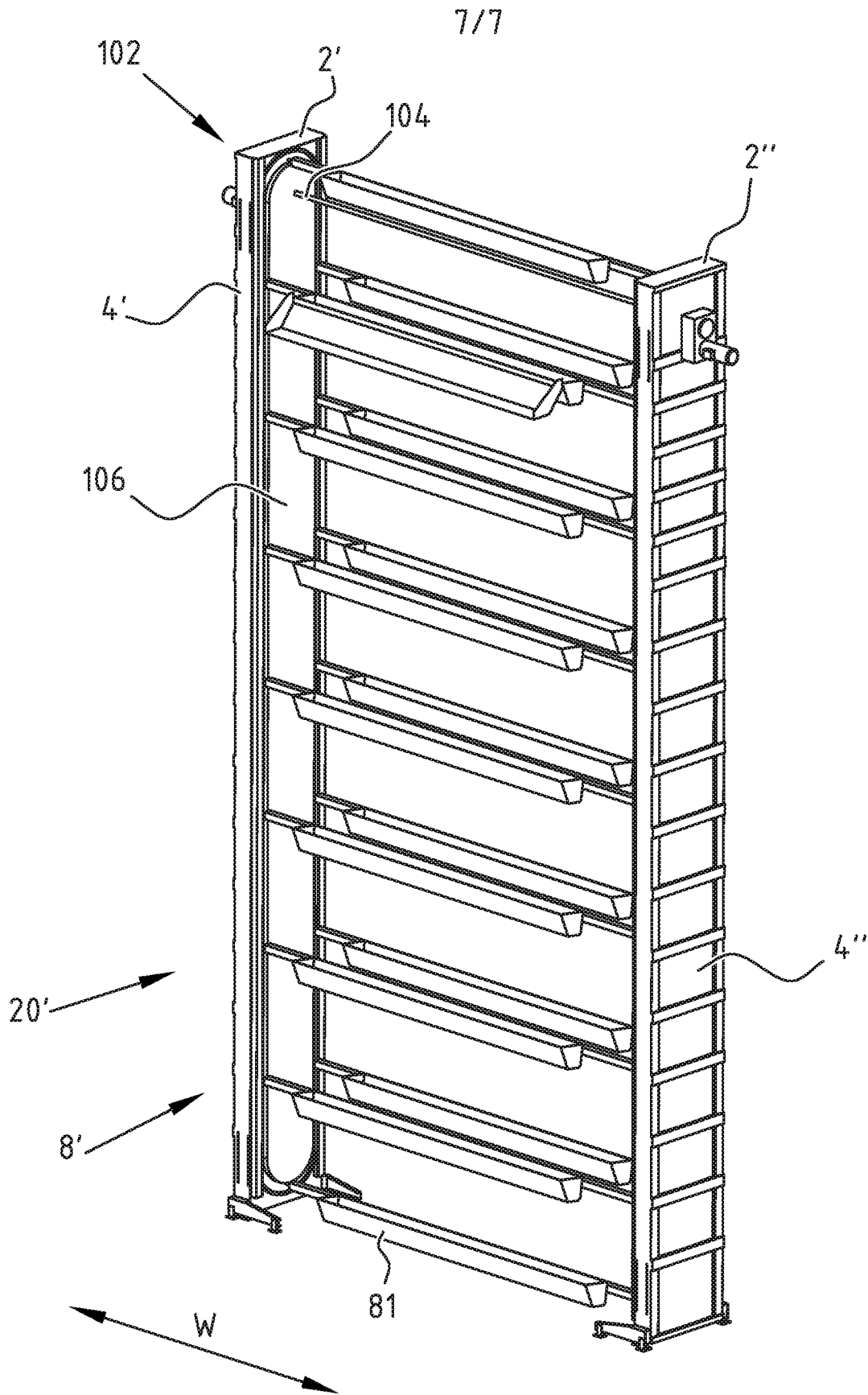


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER		
INV.	B65G17/12	B65G17/18
	B65G17/36	B65G17/48
ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) B65G		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 476 288 A (UNIVET RES LTD [IE]) 22 June 2011 (2011-06-22) abstract page 7 - page 10 figures 2-7 -----	1 - 17
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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