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Koehl

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(54) **UNLOADING CONVEYOR SYSTEMS, METHODS AND APPARATUS**

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(60) Provisional application No. 62/979,220, filed on Feb. 20, 2020, provisional application No. 62/891,744, filed on Aug. 26, 2019.

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B65G 69/28 (2006.01)
B65G 67/32 (2006.01)

(52) **U.S. Cl.**
CPC ***B65G 69/2811*** (2013.01); ***B65G 67/32*** (2013.01); *B65G 2814/0326* (2013.01)

(58) **Field of Classification Search**
CPC B65G 69/2811; B65G 67/32; B65G 2814/0326; B65G 69/2823; B65G 69/30
See application file for complete search history.

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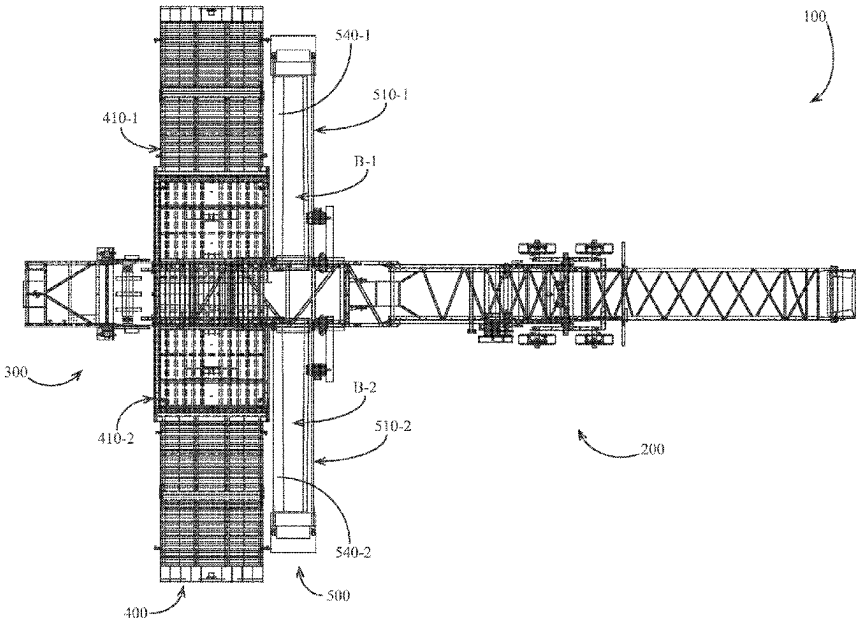
(57) **ABSTRACT**

A side-dump truck containing aggregate material can be driven over a ramp assembly for unloading. Aggregate material from the side-dump truck is deposited laterally to a side conveyor system, which has a first side conveyor and a second side conveyor pivotable from the conveying configuration to a transport configuration. The aggregate material is conveyed by the side conveyor system being in the conveying configuration to an unloading conveyor system, which has a first unloading conveyor at least partially beneath the side conveyor system.

10 Claims, 17 Drawing Sheets



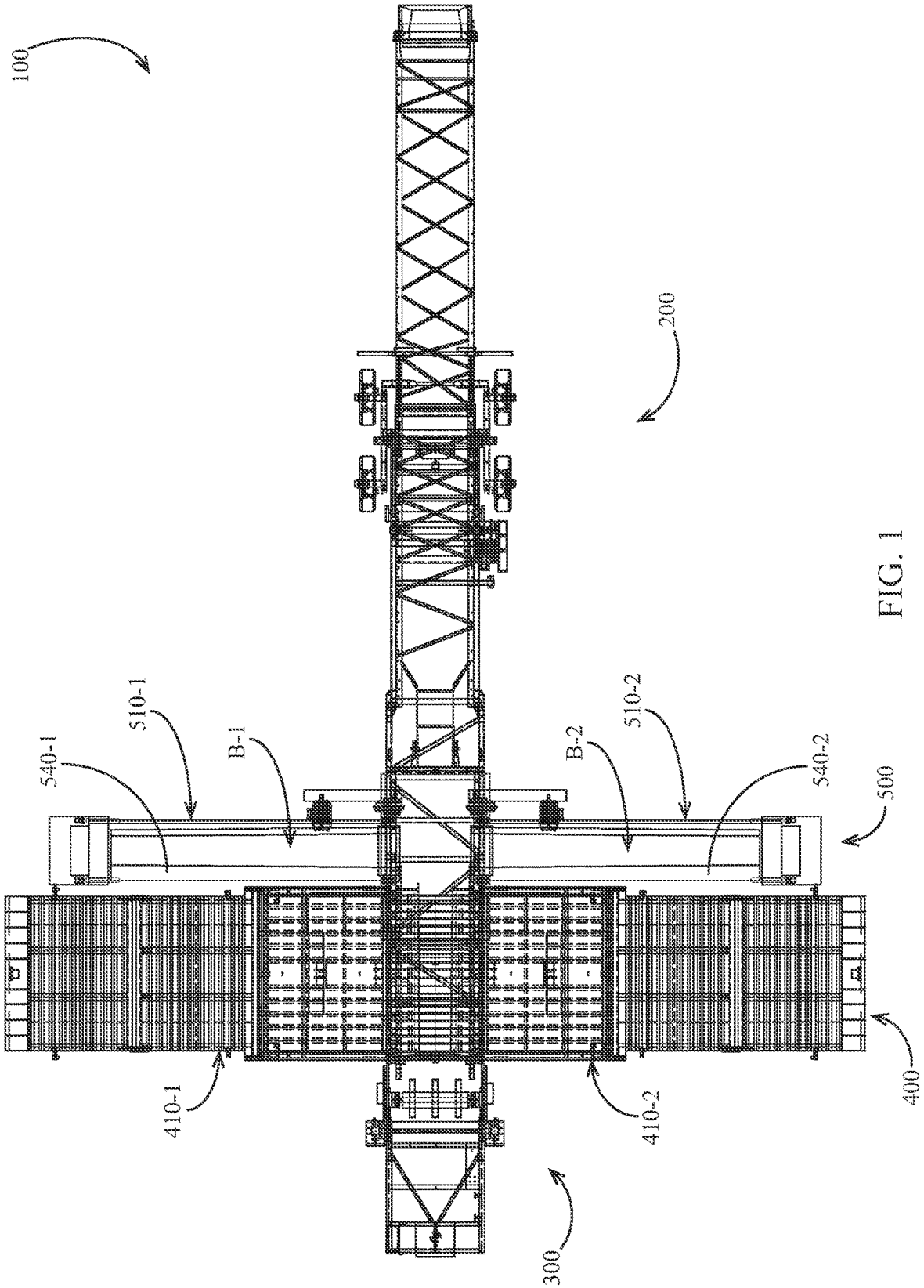


FIG. 1

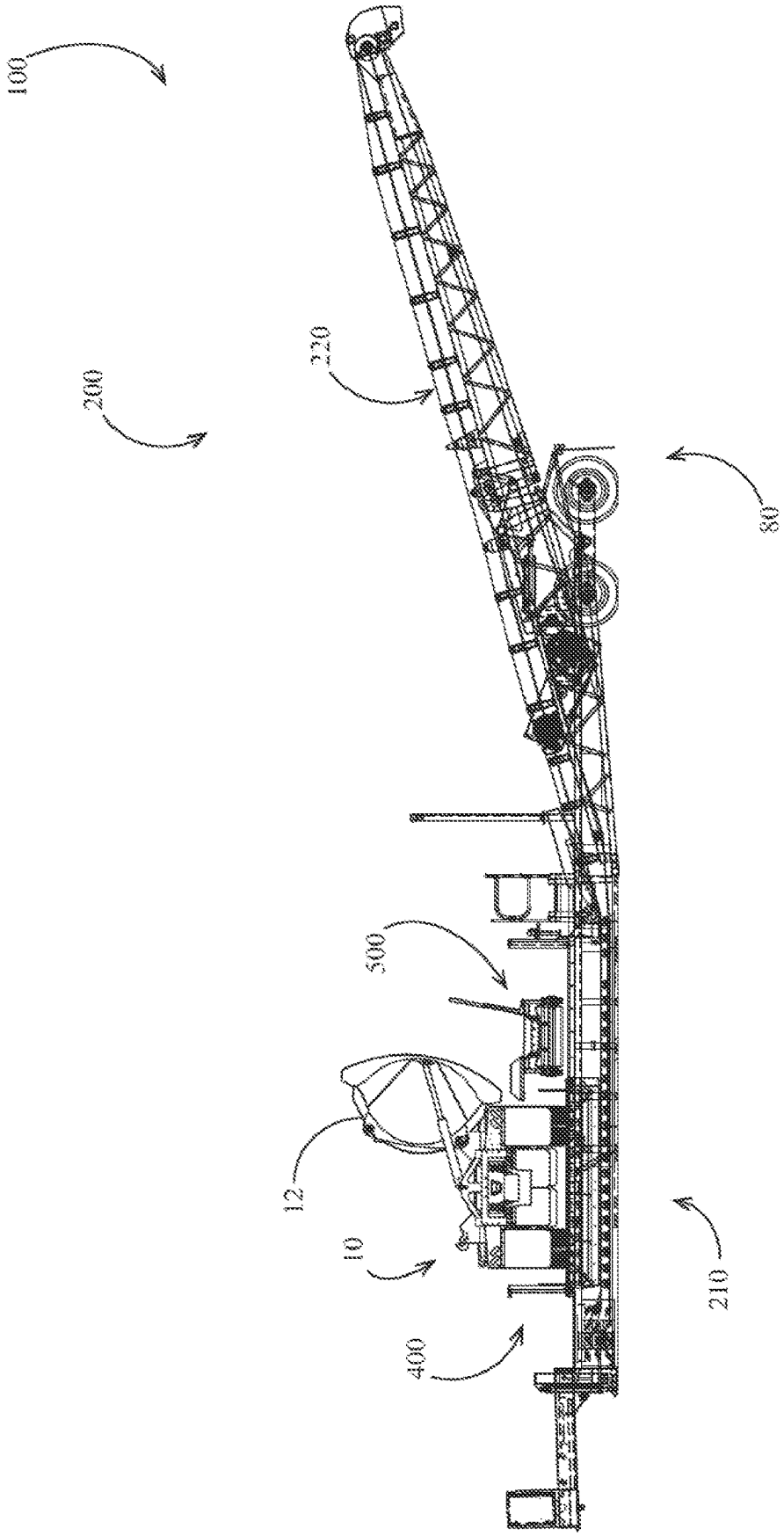


FIG. 2

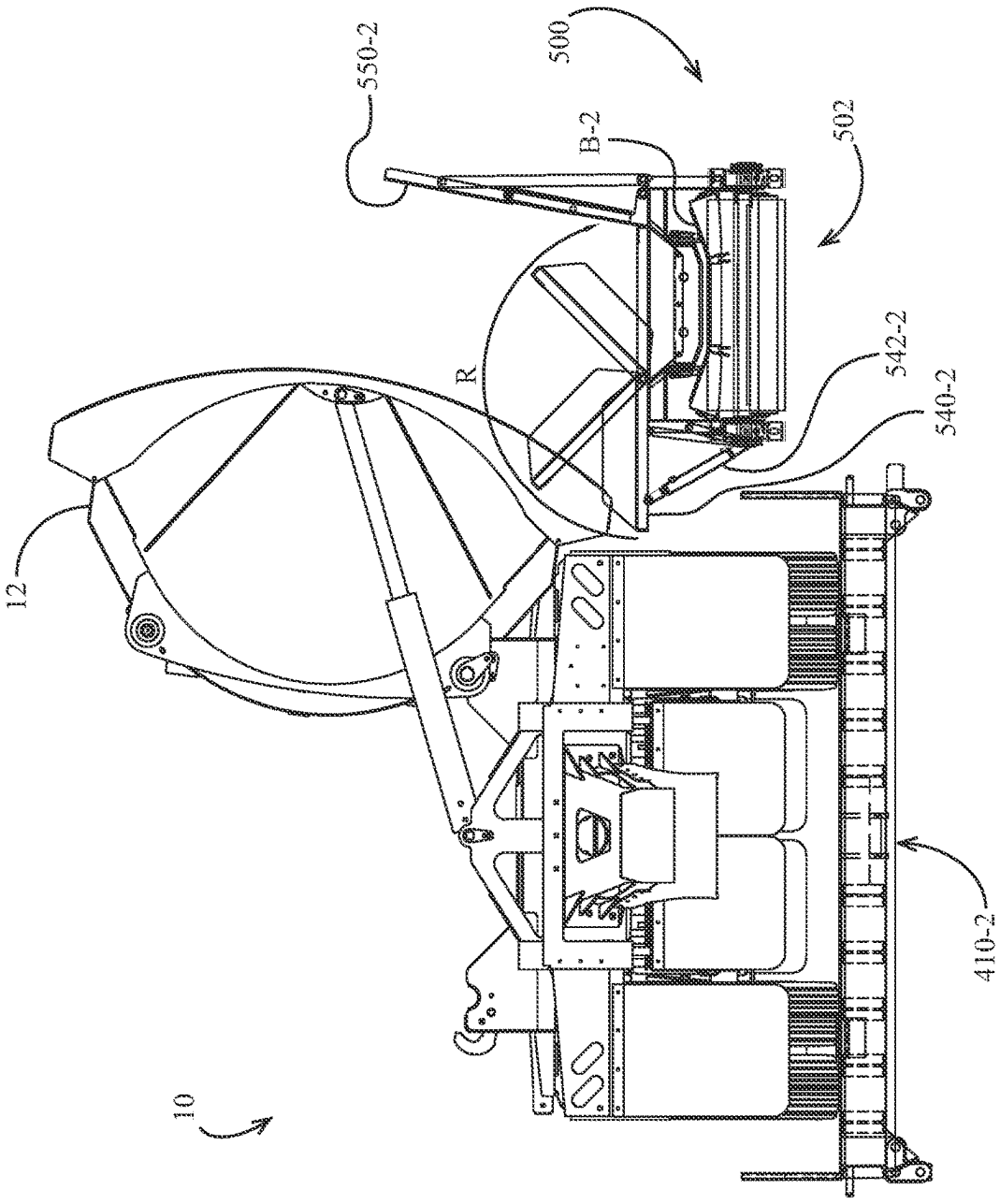


FIG. 3

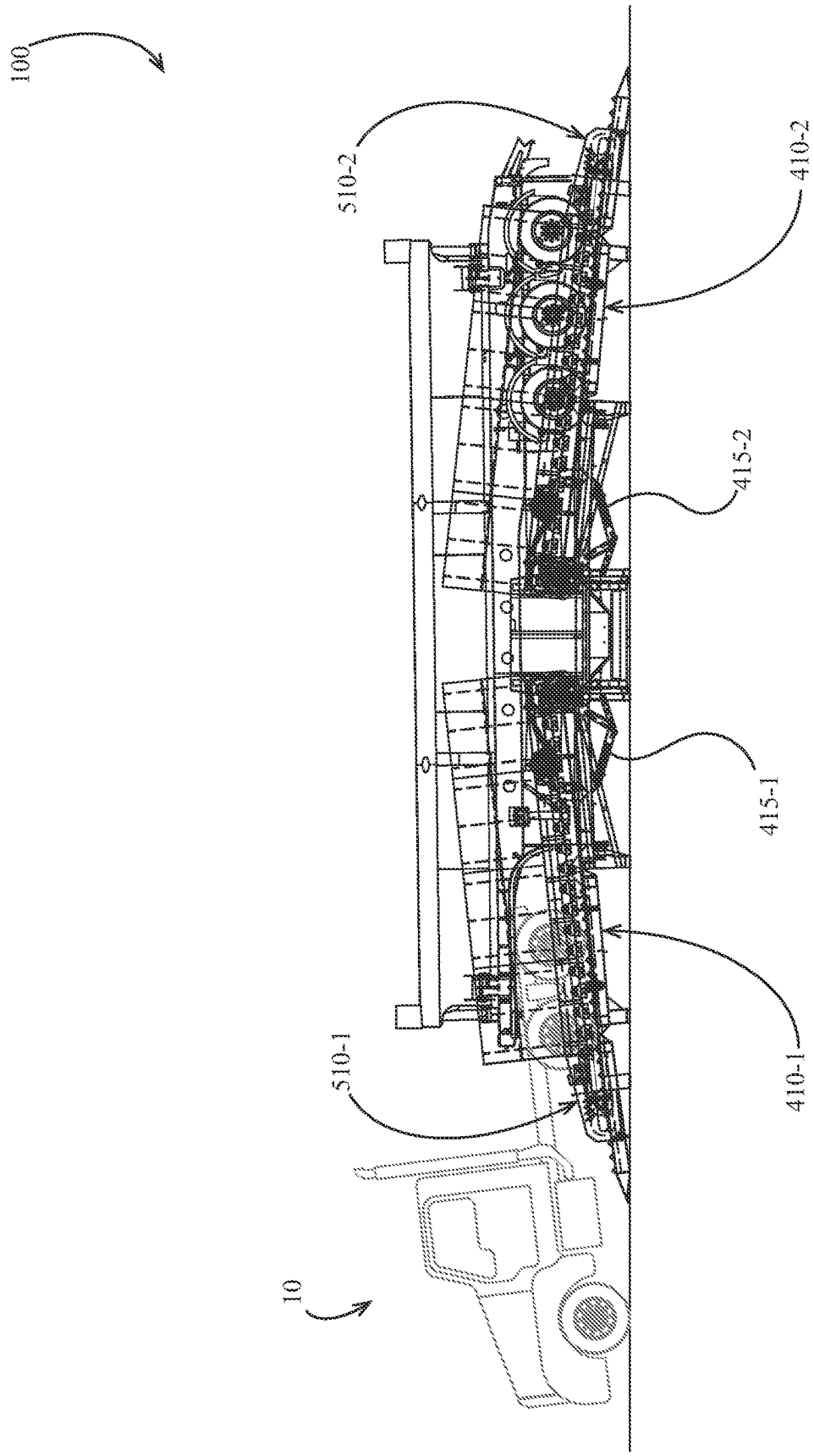


FIG. 4

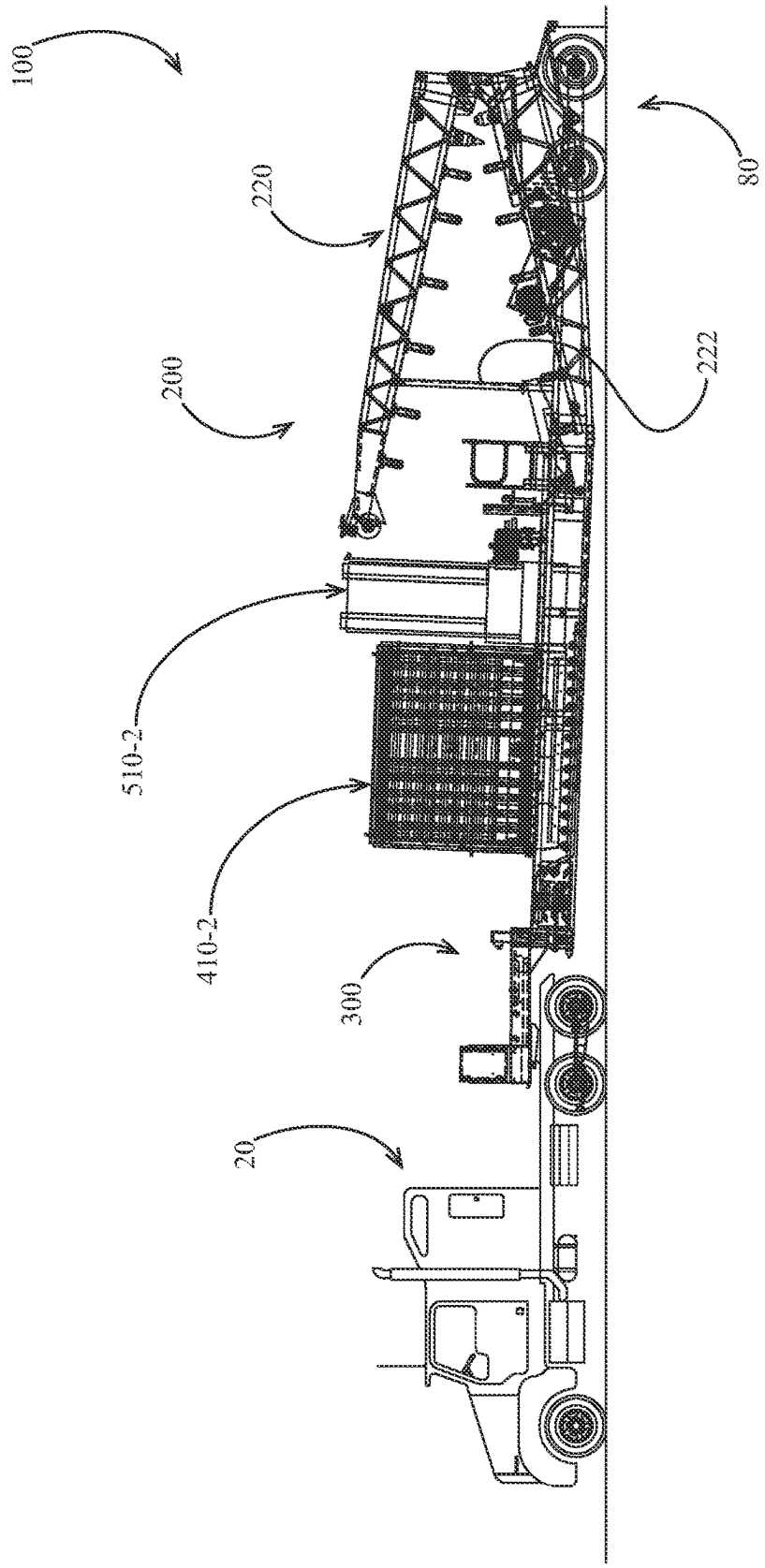


FIG. 5

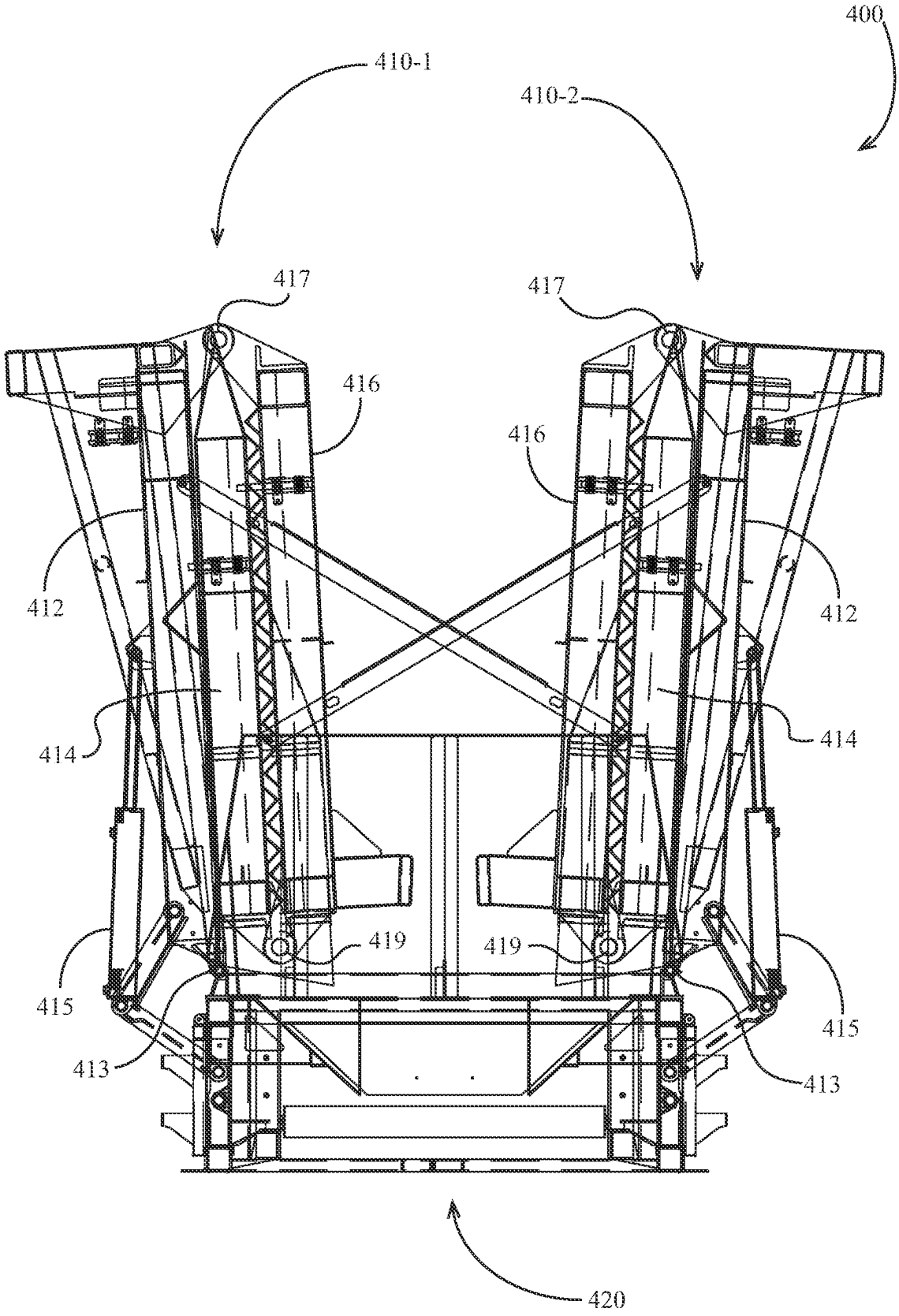

400
410-1
410-2
417
417
416
416
412
412
414
414
419
419
415
415
413
413
420

FIG. 6

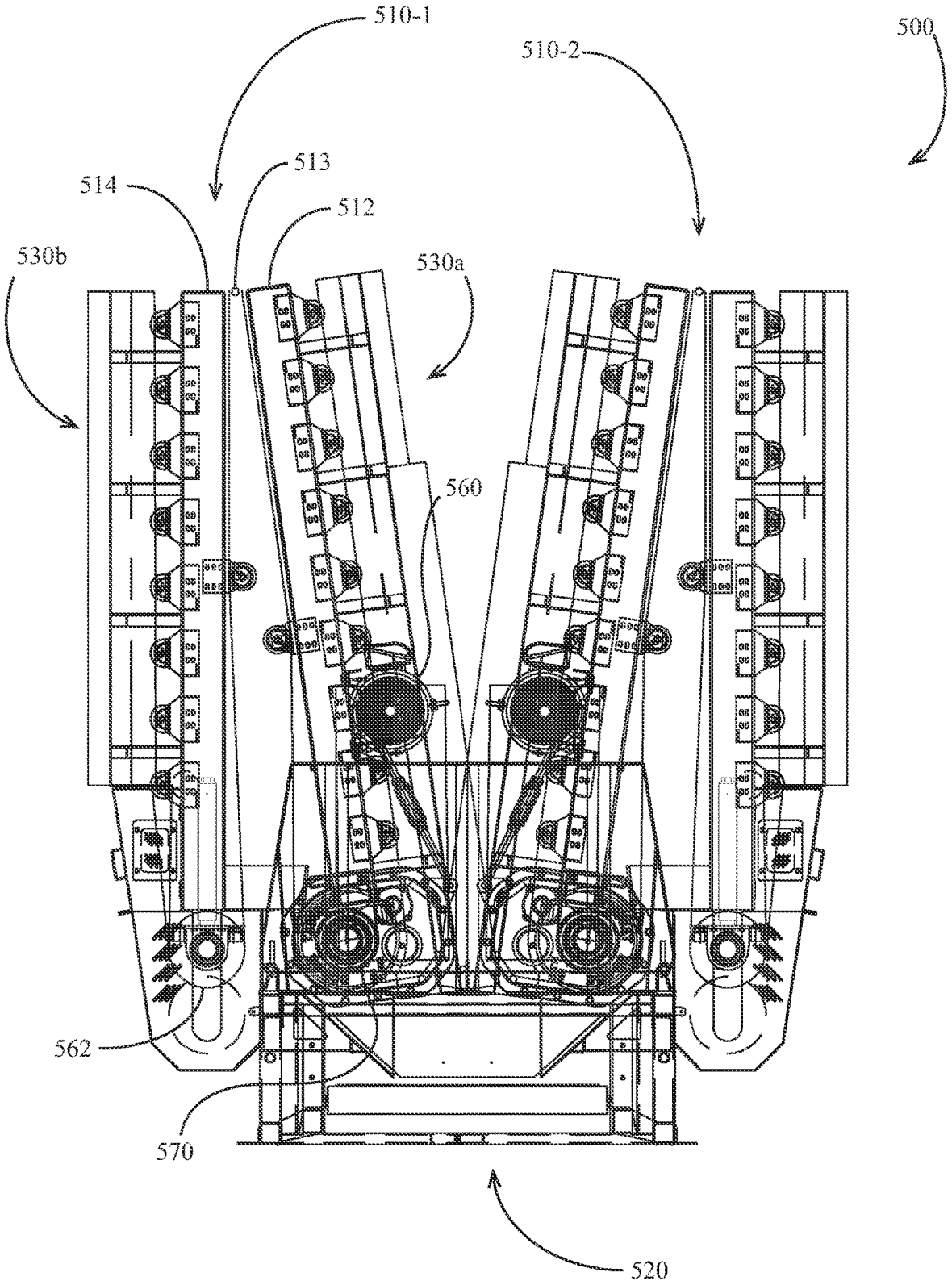


FIG. 7

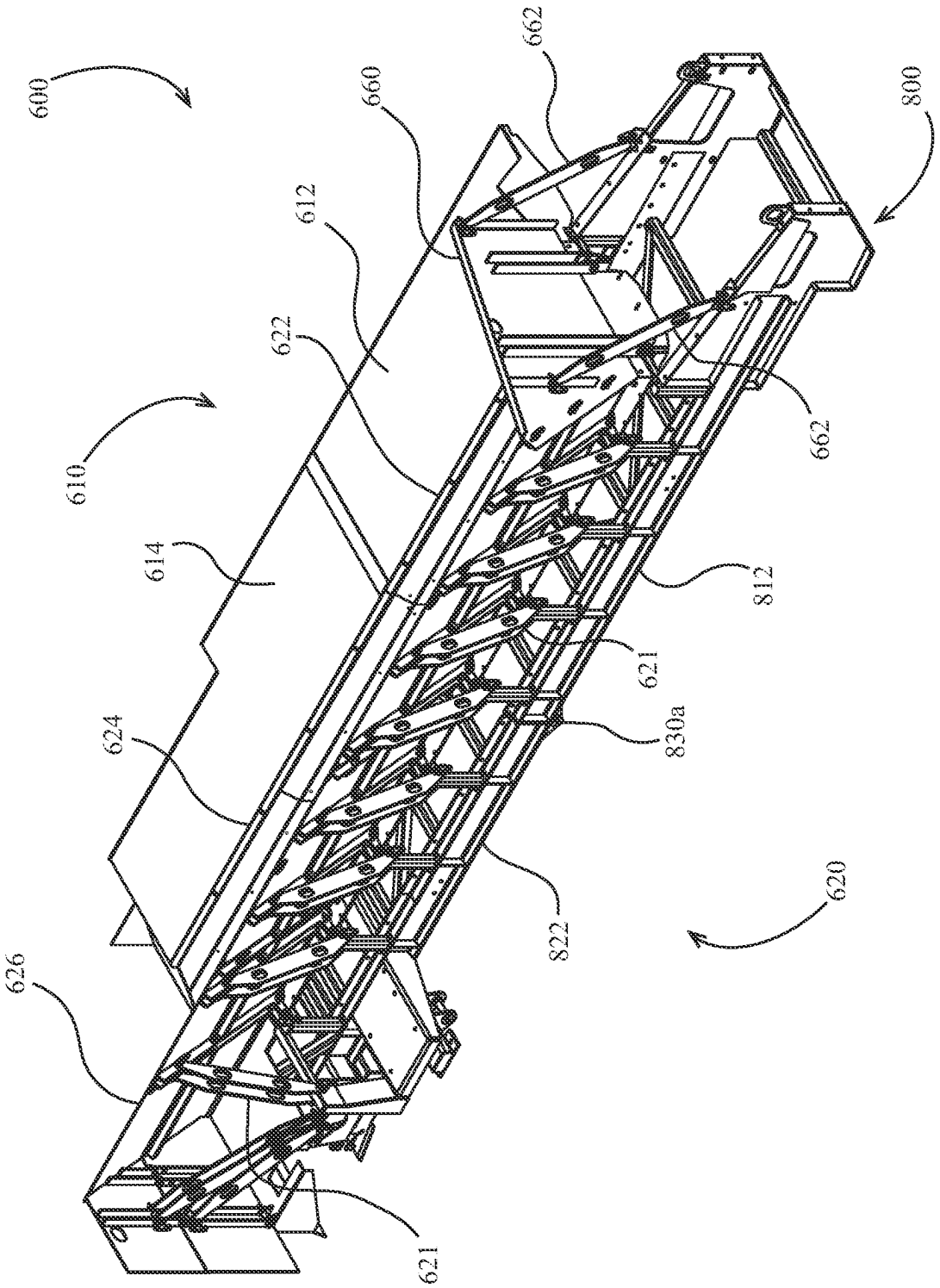

600
660
662
800
612
622
610
662
614
812
621
624
830a
620
822
626
621

FIG. 8

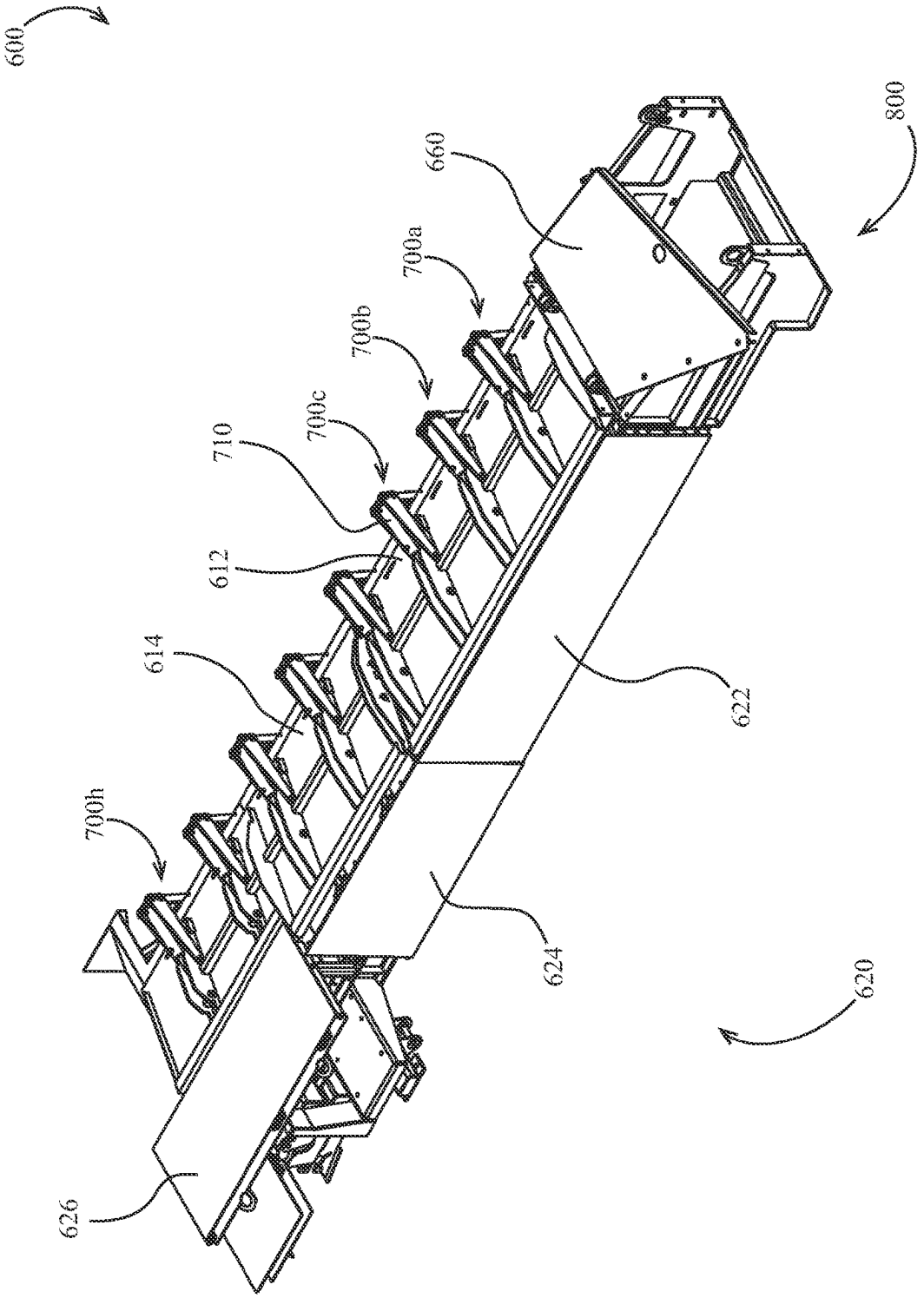


FIG. 9

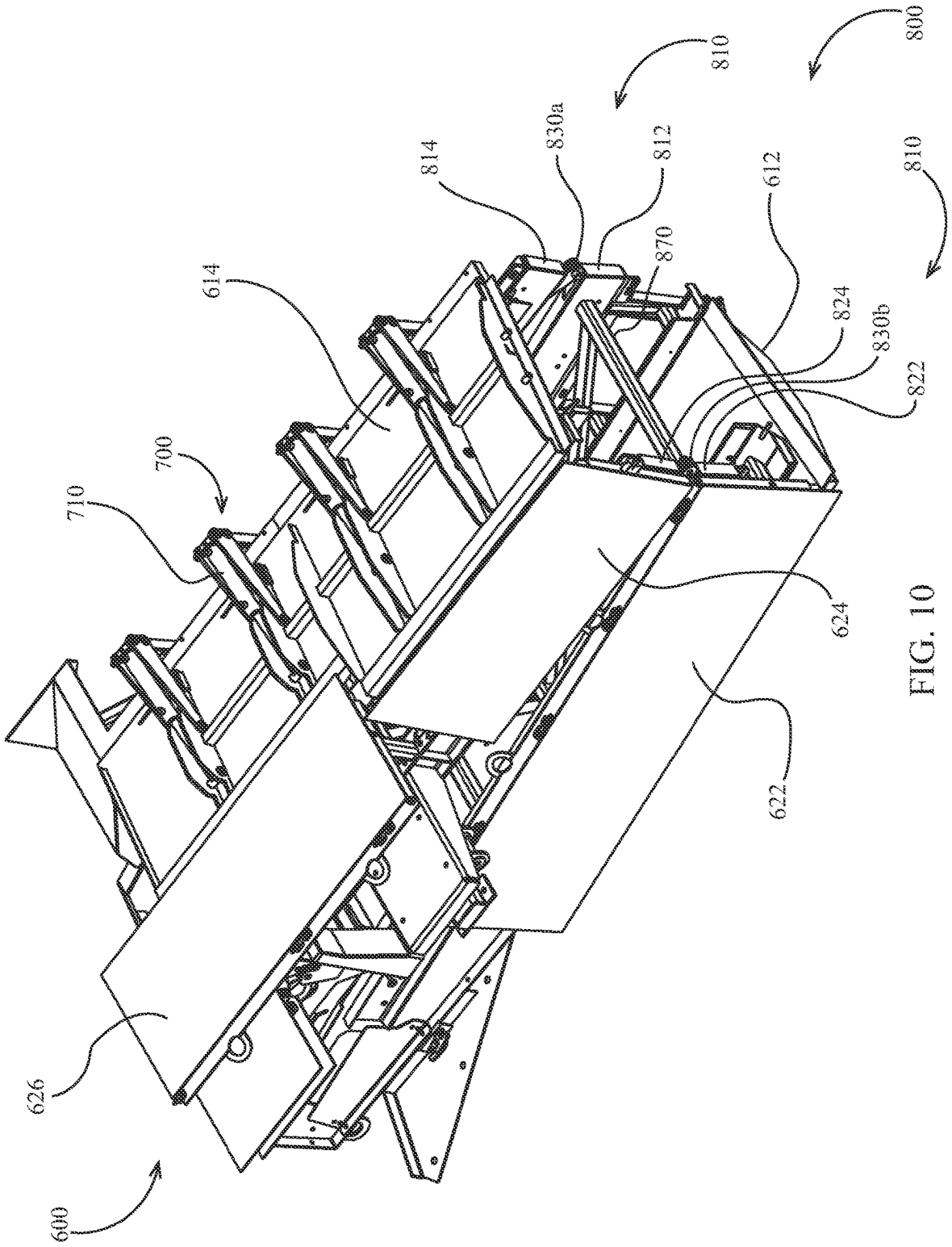

800
810
830a
814
812
612
810
870
614
824
830b
822
700
710
624
622
626
600

FIG. 10

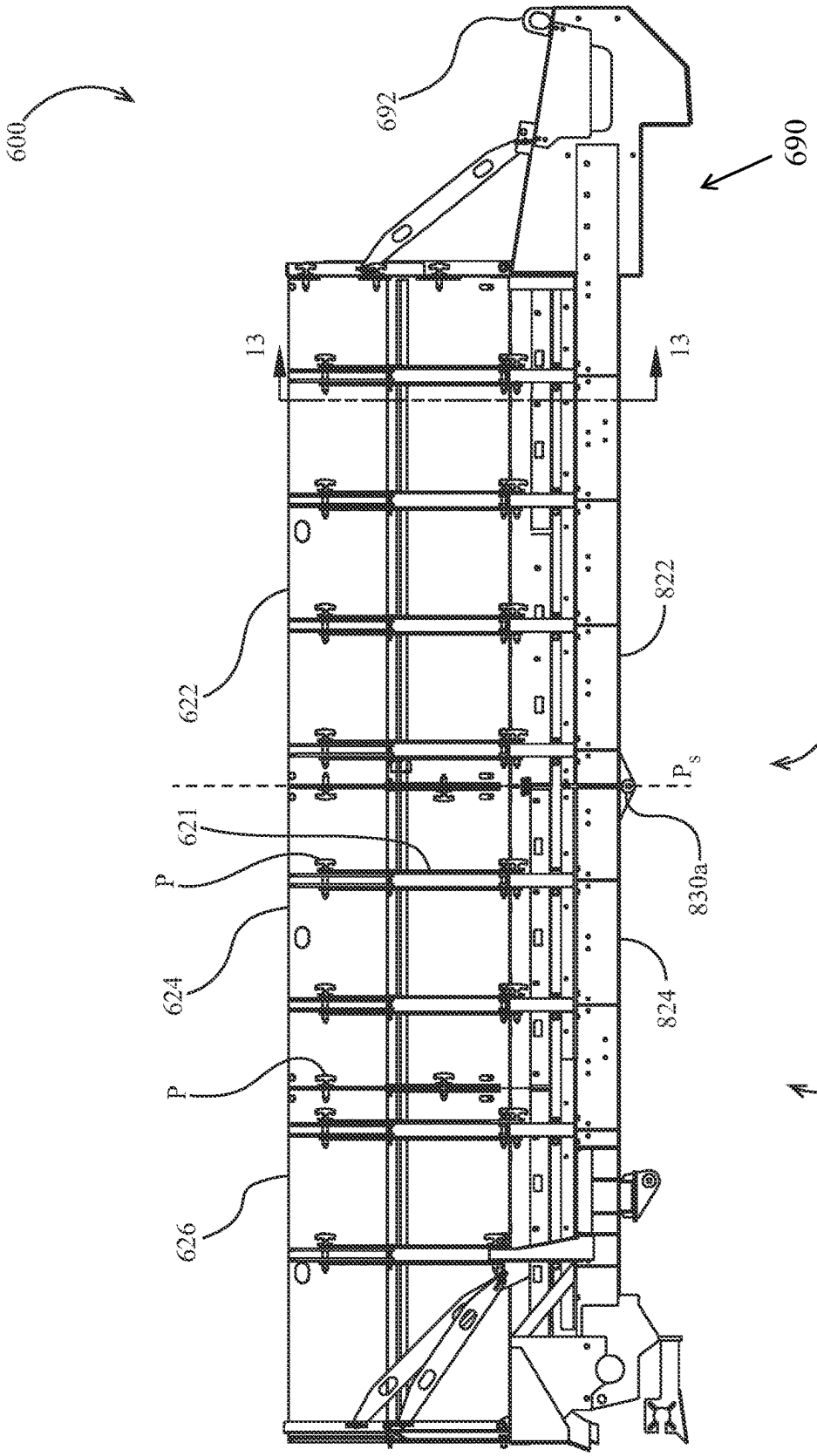


FIG. 11

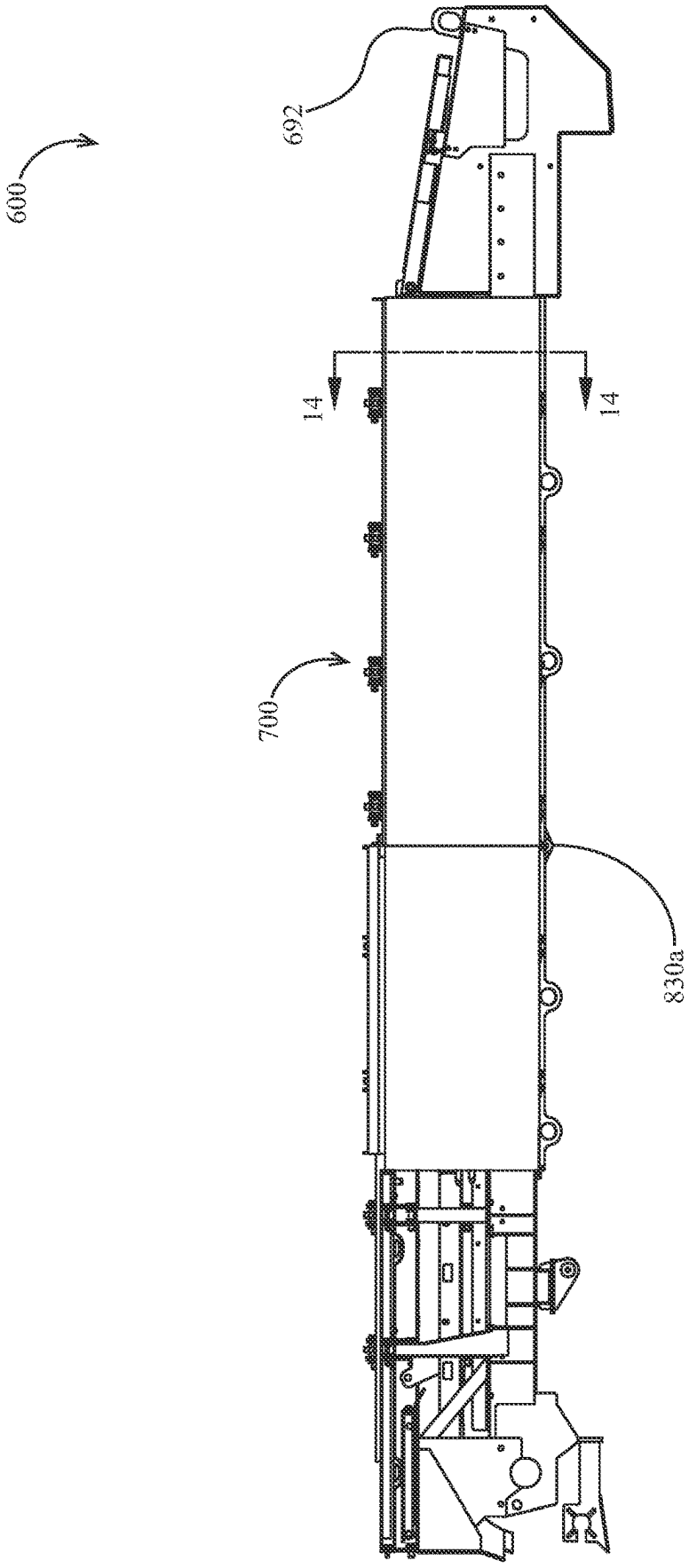


FIG. 12

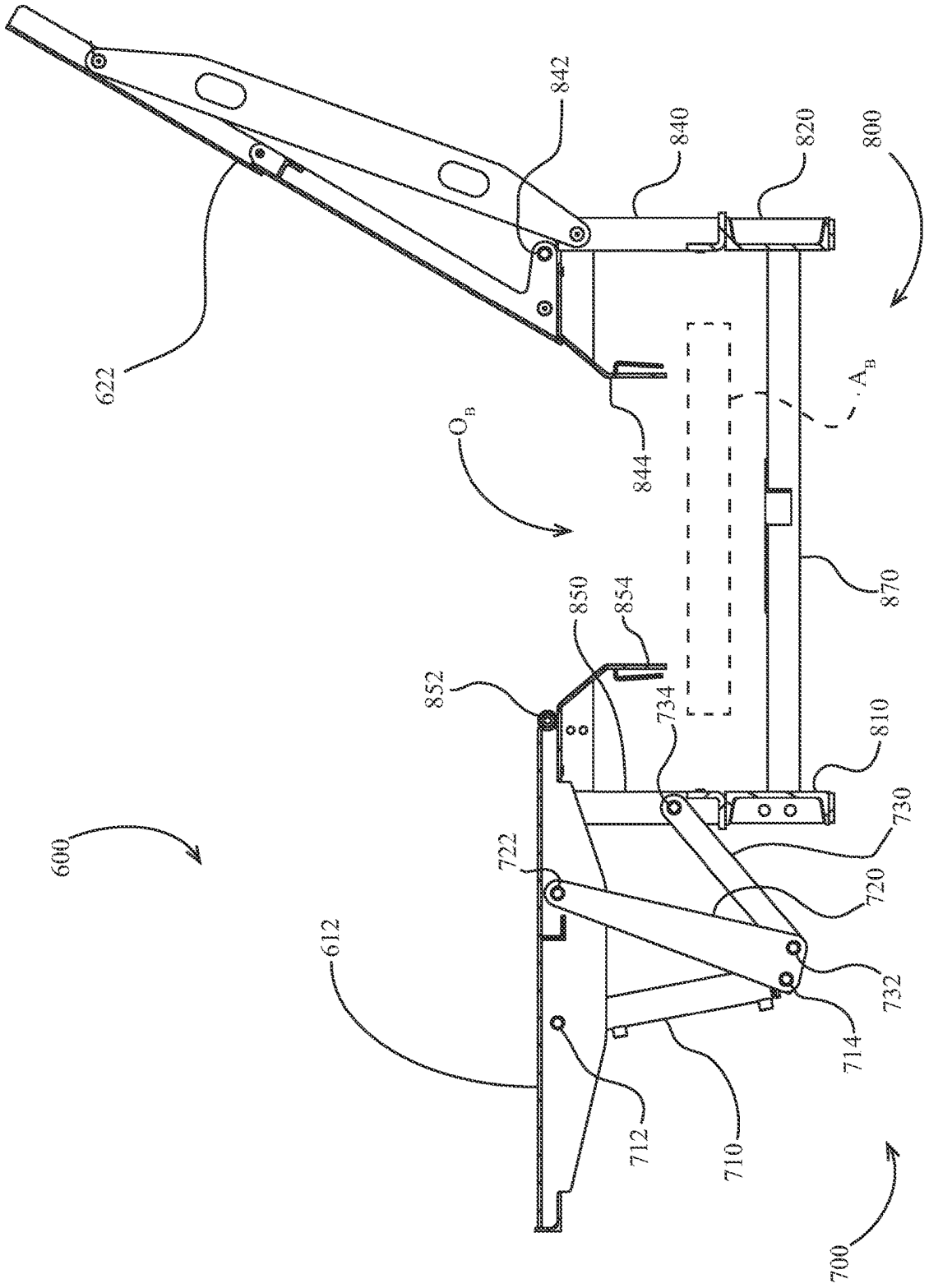
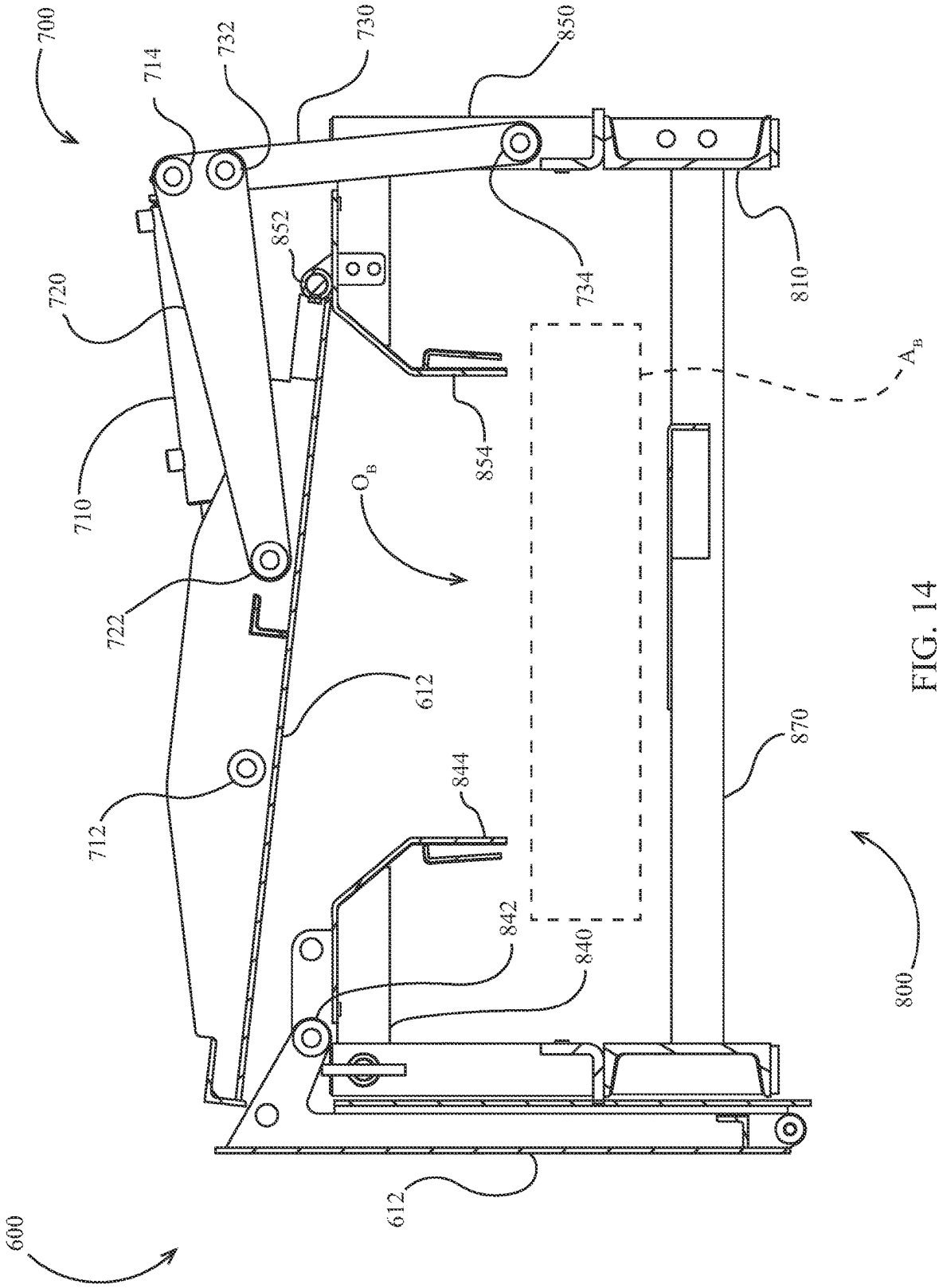

842
840
820
800
622
844
O_B
A_B
870
850
854
852
734
810
730
600
722
720
612
732
714
712
710
700

FIG. 13


700
714
732
730
850
852
720
734
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A_B
710
854
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722
612
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844
870
842
840
800
612
600

FIG. 14

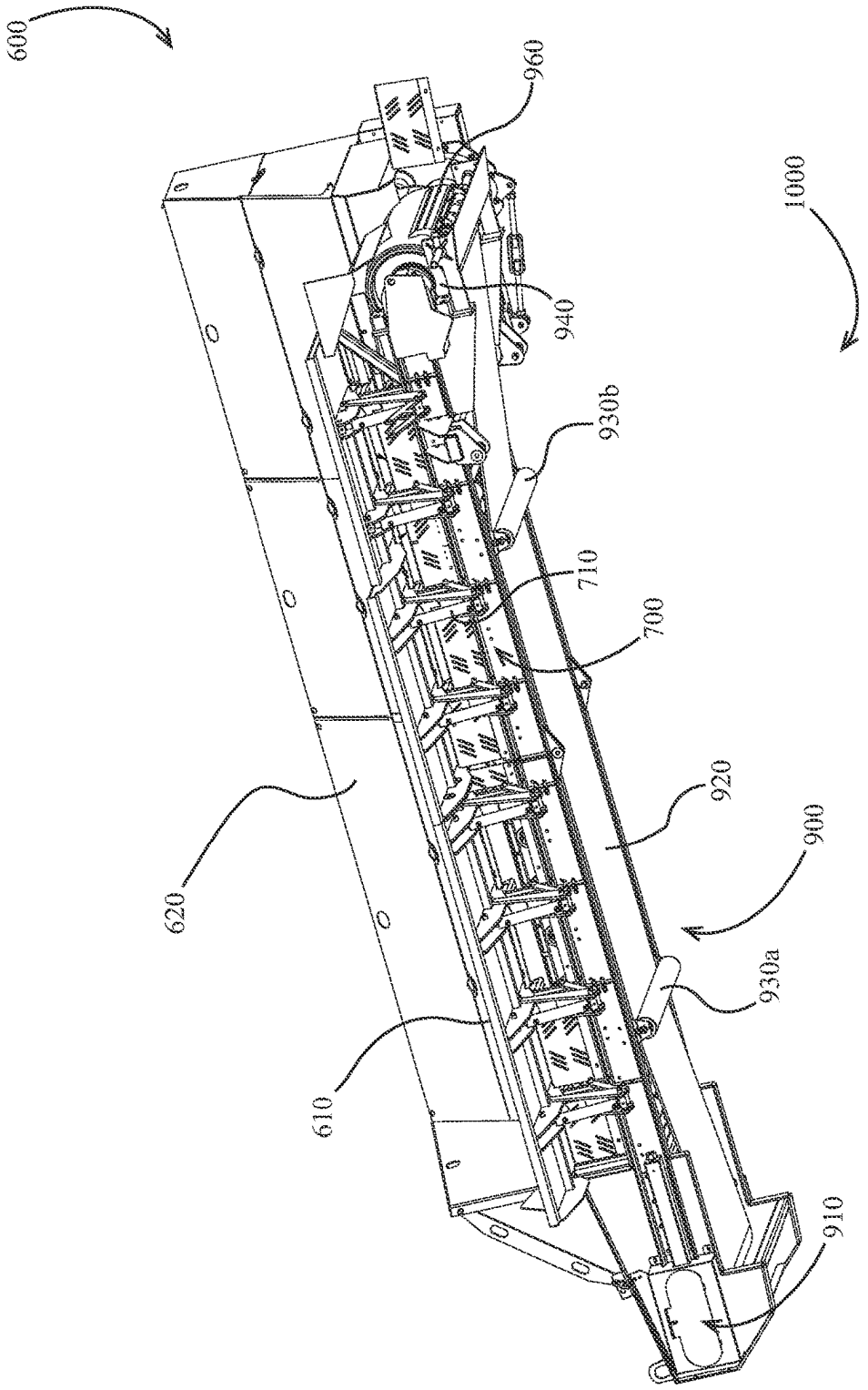

FIG. 15

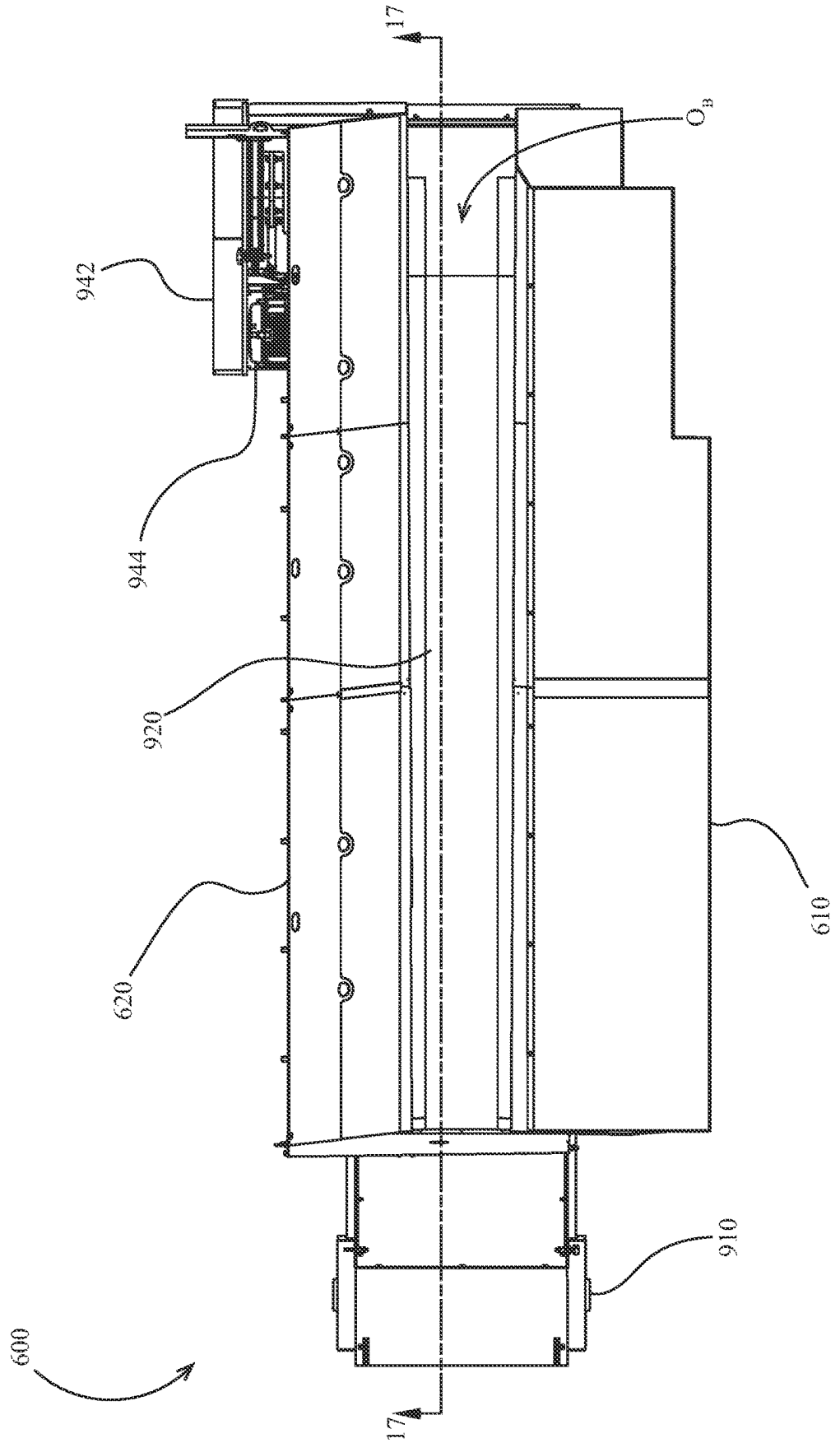

FIG. 16

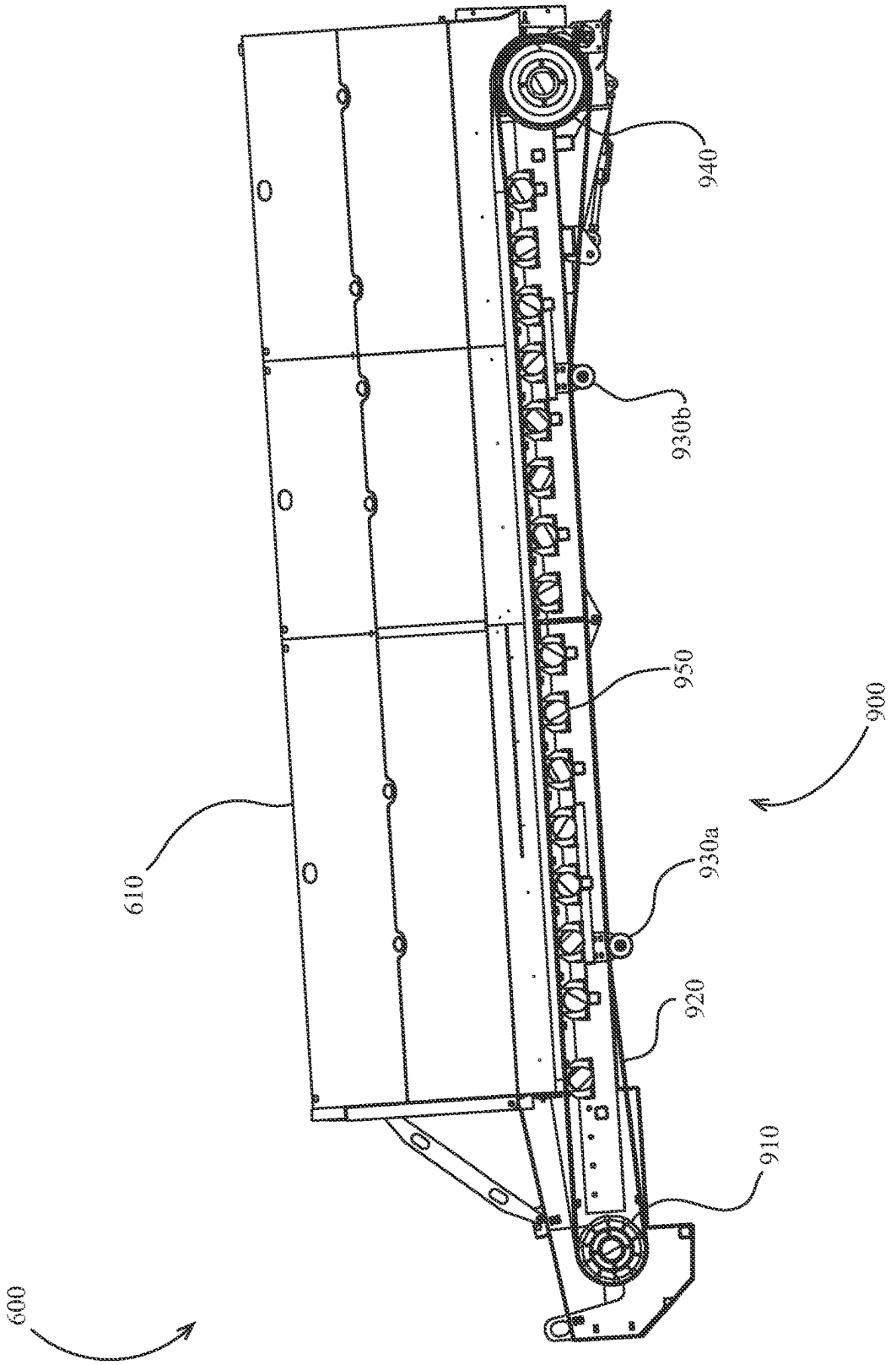

FIG. 17

UNLOADING CONVEYOR SYSTEMS, METHODS AND APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

The present disclosure is a continuation application of U.S. application Ser. No. 17/003,963, filed on Aug. 26, 2020, which claims priority to Provisional Application No. 62/979,220, filed Feb. 20, 2020, and which claims priority to Provisional Application No. 62/891,744, filed Aug. 26, 2019, entitled "Unloading Conveyor Systems, Methods and Apparatus", the contents of which are hereby incorporated by reference herein in their entirety.

BACKGROUND

Unloading conveyors and unloading conveyor systems are used to unload material such as aggregate material, e.g., from trailers, trucks, rail cars, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top view of an unloading conveyor system in an operational configuration.

FIG. **2** is a side elevation view of the unloading conveyor system of FIG. **1** in an operational configuration.

FIG. **3** is an expanded side elevation view of the unloading conveyor system of FIG. **1** in an operational configuration.

FIG. **4** is a rear view of the unloading conveyor system of FIG. **1** in an operational configuration.

FIG. **5** is a side elevation view of the unloading conveyor system of FIG. **1** in a transport configuration.

FIG. **6** is a rear elevation view of ramps of the unloading conveyor system of FIG. **1** in a transport configuration.

FIG. **7** is a rear elevation view of side conveyors of the unloading conveyor system of FIG. **1** in a transport configuration.

FIG. **8** is a perspective view of an embodiment of a side conveyor in an operating configuration.

FIG. **9** is a perspective view of the side conveyor of FIG. **8** in an intermediate configuration.

FIG. **10** is a perspective view of the side conveyor of FIG. **8** in a transport configuration.

FIG. **11** is a side elevation view of the side conveyor of FIG. **8** in an operating configuration.

FIG. **12** is a side elevation view of the side conveyor of FIG. **8** in an intermediate configuration.

FIG. **13** is a sectional view along section **13-13** of FIG. **12**.

FIG. **14** is a sectional view along section **14-14** of FIG. **12**.

FIG. **15** is a perspective view of the side conveyor of FIG. **8** in an operational configuration with an embodiment of a belt conveyor assembly installed.

FIG. **16** is a plan view of the side conveyor of FIG. **8** in an operational configuration with an embodiment of a belt conveyor assembly installed.

FIG. **17** is a sectional view along section **17-17** of FIG. **16**.

DESCRIPTION

Referring to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, FIG. **1** illustrates an unloading conveyor system **100** in an operational configuration. In some embodiments, the unloading conveyor system **100** comprises a ramp assembly **400**, a side conveyor system **500**, and an

unloading conveyor system **200**. Referring to FIG. **2**, the unloading conveyor system **200** optionally includes a first unloading conveyor **210** disposed at least partially beneath the side conveyor system **500**. The unloading conveyor system **200** optionally includes a second unloading conveyor **220** which is optionally disposed to receive material from the first unloading conveyor **210**; the second unloading conveyor **220** optionally extends upwardly and away from the first unloading conveyor **210** for unloading material at an elevated position. With reference to FIGS. **1** and **2**, in operation the ramp assembly **400** optionally includes first and second ramps **410-1**, **410-2** configured to support a vehicle **10**, such as a side-dump truck having a side-dump container **12** configured to be unloaded to the side of the vehicle **10**. In some embodiments, a grate or other support is positioned between ramps **410-1**, **410-2** and configured to support the truck and/or allow aggregate material to fall therethrough. In operation, the side conveyor system optionally receives material (e.g., aggregate material) from the vehicle **10** and conveys the material to the first unloading conveyor **210**.

Referring to FIG. **1**, the side conveyor system **500** optionally includes two side conveyors **510-1**, **510-2** extending transversely away from the unloading conveyor system **200**. Each side conveyor **510** is optionally configured and disposed to convey material toward the first unloading conveyor **210** and optionally to deposit material (directly or indirectly) on the first unloading conveyor **210**.

In some embodiments, the system **200** transportable (e.g., by towing). The system **200** optionally comprises rigid frame coupled to a towing eye or other structure for transport attachment. The system **200** is optionally supported on wheeled supports **80** or on tracks or other transport supports.

Referring additionally to FIG. **3**, each side conveyor **510** optionally includes an extension wing **540** and a backboard **550**. In operation, at least some material dumped generally toward the side conveyor **510** from the container **12** is optionally guided to a conveyor belt B of the side conveyor **510** by the extension wing **540** and/or backboard **550**. The extension wing **540** is optionally pivotally mounted (e.g., for pivoting about a rotational direction R) to a frame **502** of the side conveyor **510**. In some embodiments, an actuator **542** is configured to pivot the extension wing **540** for transport and/or for dumping remaining material onto the conveyor belt B. In some embodiments, the backboard **550** is reconfigurable (e.g., foldable) into a low-profile transport configuration and/or removable for transport.

Referring to FIG. **5**, the conveyor system **100** is shown in a transport configuration. In some embodiments, a rearward end **300** of conveyor system **100** is operably supported for transport on a transport vehicle **20** such as a semi-truck or other tractor unit. In some embodiments, the second unloading conveyor **220** is reconfigurable (e.g., foldable) into a transport configuration having a reduced overall length (e.g., between approximately 20-80% of the overall length). In some embodiments, the ramp assembly **400** and/or side conveyor system **500** are reconfigurable (e.g., foldable) into transport configurations (e.g., those described in more detail below).

Referring to FIG. **6**, each ramp **410** is optionally pivotally mounted (e.g., at a pivot **413**) to a frame **420** (e.g., for pivoting about a generally horizontal axis). In some embodiments, an actuator **415** is configured to raise and lower each ramp **410**. In some embodiments, each ramp **410** comprises a first ramp **412** (e.g., ramp section, ramp portion, portion of a ramp, length of ramp, etc.) pivotally coupled to a second ramp **416** (e.g., ramp section, ramp portion, portion of a

ramp, length of ramp, etc.) by pivot **417**. In some embodiments, each ramp **410** comprises a third ramp **414** (e.g., ramp section, ramp portion, portion of a ramp, length of ramp, etc.) pivotally coupled to the second ramp **416** by a pivot **419**.

Referring to FIG. **7**, the side conveyor system **500** is shown in a transport configuration. Each side conveyor **510** optionally includes two conveyor frames **512**, **514** pivotally connected by a pivot **513**. The conveyor frame **512** is optionally pivotally connected to a frame **520** by a pivot **570**. The conveyor frames **512**, **514** optionally support pluralities of conveyor idler assemblies **530***a*, **530***b*. The conveyor frame **512** optionally supports a pulley **560** (e.g., motor-driven head pulley). The conveyor frame **514** optionally supports a pulley **562** (e.g., tail pulley). Each side conveyor **510** (e.g., an inner end thereof) is optionally provided with one or more scrapers (not shown) for removing material from the conveyor belt (not shown) of the side conveyor. An actuator (not shown) associated with each side conveyor **510** optionally raises and lowers the conveyor frame **512** between the transport and operational configurations.

Referring to FIGS. **8-14**, another embodiment of a side conveyor **600** is illustrated with a belt assembly not shown. Referring to FIGS. **15-17**, a side conveyor system **1000** is illustrated comprising side conveyor **600** with an embodiment of a belt assembly **900** operably installed on the side conveyor.

Referring to FIG. **8**, the side conveyor **600** is illustrated in an operational configuration in which a wing, backboard and/or end board are positioned to guide material onto a conveyor belt. The side conveyor optionally comprises a frame **800** and a wing extension **610** pivotally coupled to the frame. The wing extension **610** optionally comprises a plurality of wing extension sections (e.g., wing extension sections **612**, **614**), each of which is optionally pivotally coupled to the frame **800**. A backboard **620** is optionally pivotally coupled to frame **800**. The backboard **620** optionally comprises a plurality of backboard sections (e.g., backboard sections **622**, **624**, **626**) which are each optionally pivotally coupled to the frame **800**. Each backboard section is optionally supported in the operational configuration by one or more braces **621**. The side conveyor **600** optionally comprises an end board **660** optionally pivotally coupled to frame **800**. The end board **660** is optionally supported in the operational configuration by one or more braces **662**.

Referring to FIG. **9**, the side conveyor **600** is illustrated in an intermediate configuration in which the wing extension **610**, backboard **620** and end board **660** are pivoted toward the frame **800**. The wing extension **610** is optionally pivoted into the intermediate configuration by a plurality of linkages **700** operably coupling each wing extension **610** to the frame **800**. Each linkage **700** optionally includes an actuator **710** (e.g., hydraulic actuator). In some embodiments, the linkage **700** supports the wing extension **610** in the operational configuration in a first state of the actuator **710** and in the intermediate configuration in a second state of the actuator **710**; in some embodiments, the first state of actuator **710** is more retracted than the second state of actuator **710**.

Referring to FIG. **10**, the side conveyor **600** is illustrated in a transport configuration in which the frame **800** is optionally folded. In some embodiments, the side conveyor **600** is optionally first reconfigured into the intermediate configuration prior to folding the frame **800** into the transport configuration. In some embodiments, the frame **800** comprises a first rail **810** to which the wing extension **610** is pivotally coupled and a second rail **820** to which the backboard **620** is pivotally coupled. The first rail **810** optionally comprises a first rail section **812** and a second rail section **814** pivotally coupled to the first rail section at **812** a pivot **830***a*. The second rail **820** optionally comprises a first rail section **822** and a second rail section **824** pivotally coupled to the first rail section **822** at a pivot **830***b*. The pivots **830***a*, **830***b* are optionally aligned along a common pivot axis which optionally extends transverse to the length of the rails **810**, **820**. First rail **810** and second rail **820** are optionally joined by one or more cross-supports **870** (e.g., beams or other structure).

Referring to FIG. **11**, a tail end **690** of the side conveyor **600** is optionally mounted to the frame **800** and configured to rest on the ground or other support (e.g., external frame, ramp, cribbing, etc.). One or more eyes **692** or other structure are optionally provided on the tail end **690** for folding and unfolding the frame **800**. Individual sections of the backboard **620** are optionally separably joined (e.g., in the operational configuration) by one or more removable pins P. In some embodiments, the backboard **620** and/or wing extension are divided into sections along a plane P_S that intersects the pivots **830***a*, **830***b*. The braces **621** are optionally separably joined (e.g., in the operational configuration) to the backboard **620** and/or the frame **800** by one or more removable pins P.

Referring to FIG. **13**, the side conveyor **600** is shown in an operational configuration. In the operational configurations of the side conveyor, the backboard **620** and wing extension **610** are optionally disposed to guide material into an opening O_B disposed generally above a belt area A_B in which a conveyor belt is optionally positioned to move material along the length of the side conveyor toward the center of the unloading conveyor system. The opening O_B is optionally bounded on a first side by a wall **844** supported on a riser **840** mounted to rail **820**. Backboard **620** is optionally pivotally coupled to riser **840** at one or more pivots **842**. The opening O_B is optionally bounded on a first side by a wall **854** supported on a riser **850** mounted to rail **810**. Wing extension **610** is optionally pivotally coupled to riser **850** at one or more pivots **852**.

Continuing to refer to FIG. **13**, the linkage **700** is shown in a configuration in which the actuator **710** is in a relatively retracted state (e.g., less than 50% extended, less than 30% extended, less than 10% extended, etc.) and the wing extension is in a relatively extended position (e.g., folded generally away from the frame **800**). The actuator **710** is optionally pivotally coupled (e.g., at a first end thereof) to wing extension **610** at a pivot **712**. The actuator **710** is optionally pivotally coupled (e.g., at a second end thereof) to a link **720** (e.g., rigid link) at a first end of the link **720**. The link **720** (e.g., the first end thereof) is optionally pivotally coupled to a link **730** at a pivot **732**. The link **720** (e.g., a second end thereof) is optionally pivotally coupled to the wing extension **610** at a pivot **722**. The link **730** is optionally pivotally coupled to the frame **800** (e.g., to riser **850**) at a pivot **734**.

Referring to FIG. **14**, the linkage **700** is shown in a configuration in which the actuator **710** is in a relatively extended state (e.g., more than 50% extended, more than 70% extended, more than 90% extended, etc.) and the wing extension is in a relatively folded position (e.g., folded generally into the frame **800**). It should be appreciated that linkage **700** enables a relatively large pivotal movement of wing extension **610** with a relatively small linear extension (or retraction) of actuator **710**, e.g., compared to at least some alternative embodiments in which the actuator **710** directly couples the frame **800** to the wing extension **610**.

In some embodiments, the head ends of a plurality of actuators **710** mounted to a single wing extension section (or

the entire wing extension) are fluidly coupled such that the actuators extend simultaneously and/or synchronously. In some embodiments, the rod ends of a plurality of actuators **710** mounted to a single wing extension section (or the entire wing extension) are fluidly coupled such that the actuators retract simultaneously and/or synchronously.

Referring to FIGS. **15-17**, a side conveyor system **1000** is illustrated comprising side conveyor **600** with an embodiment of a belt assembly **900** operably installed on the side conveyor. The belt assembly **900** optionally comprises an endless belt **920** supported on a head pulley **940** and tail pulley **910**. Head pulley **940** is optionally driven by a motor **944** (e.g., via a belt assembly **942** or other device). The endless belt **920** is optionally supported on a plurality of idler assemblies **950** (e.g., troughing idler assemblies, straight idlers, etc.). The endless belt **920** is optionally supported at a lower side thereof by one or more return idlers **930**. The idlers and pulleys of the belt assembly **900** are optionally supported on frame **800** of the side conveyor **600**.

In some embodiments, the unloading systems described may be used alternately or simultaneously for unloading material onto one or more unloading conveyors both to the side of a truck (e.g., on side conveyors) or beneath or at the end of a truck (e.g., between ramps). In some embodiments, raising the ramps causes material deposited on the ramps to be gathered and deposited onto one or more unloading conveyors.

Although various embodiments have been described above, the details and features of the disclosed embodiments are not intended to be limiting, as many variations and modifications will be readily apparent to those of skill in the art. Accordingly, the scope of the present disclosure is intended to be interpreted broadly and to include all variations and modifications within the scope and spirit of the appended claims and their equivalents. For example, any feature described for one embodiment may be used in any other embodiment.

The invention claimed is:

1. A method of operating and transporting a truck unloader, comprising:

driving a side-dump truck containing aggregate material over a ramp assembly, the ramp assembly comprises a first ramp and a second ramp, each of the first ramp and the second ramp having a first side;

depositing aggregate material from the side-dump truck laterally to a side conveyor system, wherein the side conveyor system comprises a first side conveyor and a second side conveyor, the first side conveyor and second side conveyor in a conveying configuration, the first side conveyor and the second side conveyor pivotable from the conveying configuration to a transport configuration, wherein the first side conveyor and the second side conveyor are disposed laterally on the first side of the first ramp and the first side of the second ramp;

by said side conveyor system in the conveying configuration, conveying aggregate material from the side-dump truck to an unloading conveyor system, the unloading conveyor system comprising a first unloading conveyor disposed at least partially beneath the side conveyor system; and

pivoting the first side conveyor and the second side conveyor from the conveying configuration to the transport configuration.

2. The method of claim **1**, wherein the first ramp and the second ramp are each pivotally mounted to a frame for pivoting about respective first and second horizontal axes.

3. The method of claim **2**, wherein at least one of the first ramp and the second ramp comprises a first portion and a second portion pivotally coupled to the first portion.

4. The method of claim **3**, wherein at least one of the first ramp and the second ramp comprises a third portion pivotally coupled to the second portion.

5. The method of claim **1**, wherein at least one of the first side conveyor and the second side conveyors comprises:

a first conveyor frame supporting a first plurality of conveyor idler assemblies;

a second conveyor frame supporting a second plurality of conveyor idler assemblies, said second conveyor frame pivotally connected to said first conveyor frame.

6. The method of claim **5**, wherein said first conveyor frame supports a tail pulley, and wherein said second conveyor frame supports a motor-driven head pulley.

7. A method of operating and transporting a truck unloader, comprising:

driving a side-dump truck containing aggregate material over a ramp assembly, the ramp assembly comprises a first ramp and a second ramp;

depositing aggregate material from the side-dump truck laterally to a side conveyor system, wherein the side conveyor system comprises a first side conveyor and a second side conveyor, the first side conveyor and second side conveyor in a conveying configuration, the first side conveyor and the second side conveyor pivotable from the conveying configuration to a transport configuration, wherein the first side conveyor comprises:

a first frame section;

a first board pivotally coupled to the first frame section;

a first plurality of linkages coupled to the first board and to the first frame section, each linkage comprising at least first, second and third links; and

at least a first actuator operably coupled to one of the links of the first plurality of linkages and to one of the first board and the first frame section,

by said side conveyor system in the conveying configuration, conveying aggregate material from the side-dump truck to an unloading conveyor system, the unloading conveyor system comprising a first unloading conveyor disposed at least partially beneath the side conveyor system; and

pivoting the first side conveyor and the second side conveyor from the conveying configuration to the transport configuration.

8. The method of claim **7**, wherein at least one of said first and second side conveyors comprises:

a first conveyor frame supporting a first plurality of conveyor idler assemblies;

a second conveyor frame supporting a second plurality of conveyor idler assemblies,

said second conveyor frame pivotally connected to said first conveyor frame.

9. The method of claim **8**, wherein said first conveyor frame supports a tail pulley, and wherein said second conveyor frame supports a motor-driven head pulley.

10. The method of claim **7**, wherein the second side conveyor comprises:

a second frame section;

a second board pivotally coupled to said second frame section,

a second plurality of linkages coupled to said second board and to said second frame section, each said linkage comprising first, second and third links;

at least a second actuator operably coupled to at least one of said second plurality of linkages and to one of said second board and said second frame section.

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