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APPARATUS AND METHOD FOR INSTALLATION AND REMOVAL OF AN ORE CHUTE

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ABSTRACT

An ore chute installation and removal apparatus 10 for use with an ore loadout facility and including a mobile ore chute carrier 40 which has a lift mechanism 60 and an ore chute support frame 20. The lift mechanism 60 being operable to lift and lower the support frame 20 and the support frame 20 including an arrangement for coupling with an ore chute 100. The lift mechanism 60 being operable to support the support frame 20 and an ore chute 100 coupled to the support frame 20 during lifting and lowering movement. The apparatus 10 having an installation mode in which the lift mechanism 60 is operable to lift the support frame 20 and an ore chute 100 coupled to the support frame 20 into a position for engagement of the ore chute 100 with an ore loadout facility and a removal mode in which the lift mechanism 60 is operable to position the support frame 20 into a position to couple with an ore chute 100 which is connected with an ore loadout facility and with the ore chute 100 disconnected from the ore loadout facility and coupled to the support frame 20, to the lower the support frame 20 and the ore chute 100 relative to the ore loadout facility.

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Apparatus and Method for Installation and Removal of an Ore Chute

Field of the Invention

The present invention relates to the field of ore chutes that are employed for loading trains with ore and to an apparatus and method for the removal of ore loading chutes from ore loadout facilities for maintenance and for installing a replacement ore chute.

Background

Ore loadout facilities are employed in the mining industry for the loading of ore onto trains for transport to port facilities and the like. In the ore mining industry ore train load out facilities comprise a conveyor system adapted to continuously convey ore, such as iron ore, to an elevated hopper or the like. The ore is fed into an ore chute which itself is elevated and which is located above a railway track. The ore chute is adapted to funnel ore into an open ore carriage as it slowly passes underneath. As the rear of the carriage approaches the ore chute, the chute is closed until the next ore carriage is located beneath the ore chute. Accordingly, such ore chutes are located above a railway track typically at least several metres or more above ground level.

Ore chutes require maintenance and sometimes need to be removed and taken away for repair or reconditioning. Ore chutes of the kind described above typically weigh about 20 metric tonnes and are large, bulky pieces of heavy equipment. Furthermore, downtime for repair or replacement of ore chutes in loadout facilities must be minimised. When an ore chute is removed to be taken away for repair and maintenance a replacement ore chute is typically installed to minimise downtime or disruption to the operation of the ore loadout facility.

The process of removing an ore chute from an ore loadout facility is a significant undertaking. Scaffolding is erected around the ore chute and chain blocks are used to support the weight of the ore chute before it is disconnected from the loadout facility and lowered onto a cradle. The cradle is then moved to a location where a hoist, such as a mobile crane, is used to hoist the ore chute and cradle onto a flat-bed of a transport vehicle.

A replacement ore chute already mounted to a cradle and loaded on the flat-bed of a transport vehicle is lifted by the crane and moved into position to be raised using the aforementioned scaffolding and chain blocks and fixed to the ore loadout facility. The existing process for removal and replacement of ore chutes is time consuming, labour intensive, equipment intensive and dangerous. Accordingly, a need exists for an improved method and apparatus for the removal and installation of ore chutes in an ore loadout facility.

Summary of the Invention

Accordingly, in one aspect, the present invention provides an ore chute installation or removal apparatus including a mobile ore chute carrier adapted to be located beneath an ore chute connected when in-use to a loadout facility, the mobile ore chute carrier including a lift mechanism and an ore chute support frame, the lift mechanism being adapted to lift the ore chute support frame into engagement with the installed ore chute, the ore chute support frame including means for coupling with the ore chute, wherein the lift mechanism is adapted to support the ore chute support frame and the ore chute when disconnected from the loadout facility and to lower the ore chute support frame and the ore chute relative to the ore loadout facility.

In an alternative aspect, the present invention provides an ore chute installation or removal apparatus for installation to or removal from an ore loadout facility, the apparatus including:

a mobile ore chute carrier which includes a lift mechanism and an ore chute support frame,

the lift mechanism being operable to lift and lower the ore chute support frame,

the ore chute support frame including an arrangement for coupling with an ore chute so that an ore chute can be coupled to the ore chute support frame,

the lift mechanism being operable to support the ore chute support frame and an ore chute coupled to the ore chute support frame during lifting and lowering movement,

the apparatus having an installation mode in which the lift mechanism is operable to lift the ore chute support frame and an ore chute coupled to the ore chute support frame into a position for engagement of the ore chute with an ore loadout facility, and

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the apparatus having a removal mode in which the lift mechanism is operable to position the ore chute support frame into a position to couple with an ore chute which is connected with an ore loadout facility and with the ore chute disconnected from the ore loadout facility and coupled to the ore chute support frame, to the lower the ore chute support frame and the ore chute relative to the ore loadout facility.

Preferably, the lift mechanism includes a support assembly that is adapted to engage and to support the ore chute support frame and the ore chute coupled thereto wherein the support assembly is adapted for movement relative to the ore chute connected when in-use to a loadout facility in multiple degrees of freedom of movement.

The degrees of freedom of movement can include longitudinal movement, lateral movement, vertical movement, pitch movement, yaw movement and roll movement.

Preferably, the ore chute carrier includes wheels adapted to be supported on a supporting surface, such as a railway track, that provides for the longitudinal movement.

In embodiments, the support assembly includes a movement platform providing four of the degrees of freedom of movement including lateral movement, pitch movement, yaw movement and roll movement.

In embodiments, the movement platform includes a platform frame, an intermediate platform frame and a platform sub-frame which are movably interconnected to provide the four degrees of freedom of movement.

In embodiments, the platform frame is movably coupled to the lift mechanism via a pivot connection allowing for the pitch movement of the platform frame, intermediate platform frame and platform sub-frame relative to the lift mechanism.

Preferably, the pitch movement of the platform frame about the pivot connection is driven by a linear actuator.

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In embodiments, the intermediate platform frame is movably coupled to the platform frame via a second pivot connection allowing for the roll movement of the intermediate platform frame and platform sub-frame relative to the platform frame and the lift mechanism.

Preferably, the roll movement of the intermediate platform frame about the second pivot connection is driven by a second linear actuator.

In embodiments, the platform sub-frame is movably coupled to the intermediate platform frame by a lateral movement coupling, such as a slidable coupling, allowing for the lateral movement and the yaw movement of the platform subframe relative to the intermediate platform frame, the platform frame and the lift mechanism.

Preferably, the lateral movement of the platform sub-frame by the lateral movement coupling is driven by a linear actuator or by more than one linear actuator.

In embodiments, the lift mechanism is a scissor lift mechanism that is adapted to lift and lower the support assembly relative to the ore chute connected when in-use to a loadout facility.

Preferably, the ore chute support frame includes a frame member and a plurality of adjustable engagement members that are vertically adjustable relative to the frame member and are adapted for coupling the ore chute to the frame member.

In embodiments, the frame member has a length and a width dimension substantially equivalent to the standard dimensions of a shipping container, preferably 6.1m long by 2.44m wide, and includes means for coupling the frame member to a hoist as well to a transport vehicle.

In embodiments, the apparatus further includes an ore chute carrier sub-frame to support the chute carrier on a transport vehicle.

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Preferably, the ore chute carrier sub-frame has a length and a width dimension substantially equivalent to the standard dimensions of a shipping container, preferably 6.1m long by 2.44m wide.

In another aspect, the invention provides a method for removing an ore chute from an ore loadout facility, the method including:

providing an ore chute installation and removal apparatus including a mobile ore chute carrier including a lift mechanism and an ore chute support frame;

positioning the ore chute installation and removal apparatus below beneath an ore chute connected when in-use to an ore loadout facility;

operating the lift mechanism to lift the ore chute support frame into engagement with the installed ore chute;

coupling the ore chute support frame to the ore chute;

disconnecting the ore chute from the ore loadout facility; and

operating the lift mechanism to lower the ore chute support frame and the ore chute coupled thereto relative to the ore loadout facility.

Preferably, before the step of coupling the ore chute support frame to the ore chute, the position of the ore chute support frame is adjusted relative to the ore chute connected when in-use to the loadout facility in multiple degrees of freedom of movement.

Preferably, the degrees of freedom of movement include longitudinal movement, lateral movement, vertical movement, pitch movement, yaw movement and roll movement.

Preferably, the ore chute is articulated from an in-use configuration to a stowed configuration when the ore chute support frame is lifted into engagement with the installed ore chute before coupling the ore chute support frame to the ore chute.

In embodiments, after the lift mechanism is operated to lower the ore chute support frame with the ore chute coupled thereto the mobile ore chute carrier is translated along a railway track to a location remote from the ore loadout facility.

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In embodiments, the ore chute support frame with the ore chute coupled thereto is lifted off the mobile ore chute carrier and is placed upon a transport vehicle and another like ore chute support frame with ore chute coupled thereto is lifted from a transport vehicle onto the mobile ore chute carrier.

Preferably, wherein the other like ore chute support frame with ore chute coupled thereto is installed in the ore loadout facility by carrying out the reverse of the steps of the method described above including any one or more of the forms or embodiments thereof.

Brief Description of the Drawings

The present invention will now be described in detail below with reference to a preferred embodiment of the invention described below and illustrated in the figures, wherein:

Figure 1 illustrates a perspective view of an ore chute installation and removal apparatus in accordance with an embodiment of the invention including a chute carrier and lift mechanism and a chute support frame spaced apart from and above the lift mechanism;

Figure 2 illustrates a perspective view of the ore chute installation and removal apparatus of Figure 1 and an ore chute illustrated in broken lines that is spaced apart from and above the chute support frame and wherein a scissor lift mechanism of the lift mechanism is in a vertically extended position;

Figure 3 illustrates a perspective view of the ore chute installation and removal apparatus of Figure 1 including the ore chute illustrated in broken lines of Figure 2 coupled to the chute support frame and wherein the scissor lift mechanism is in the vertically retracted position;

Figure 4 illustrates a side view of the ore chute installation and removal apparatus of Figure 1;

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Figure 5 illustrates a top view of the ore chute installation and removal apparatus of Figure 1;

Figure 6 illustrates a top view of the lift mechanism and chute carrier of the ore chute installation and removal apparatus of Figure 1;

Figure 7 illustrates an end view of the ore chute installation and removal apparatus of Figure 1;

Figure 8 illustrates a side view of the ore chute installation and removal apparatus of Figure 1, wherein the scissor lift mechanism is in the vertically extended position;

Figure 9A illustrates the ore chute installation and removal apparatus of Figure 1 located on a railway track wherein longitudinal translation of the apparatus along the railway track is illustrated;

Figure 9B illustrates a partial view of the ore chute installation and removal apparatus of Figure 1 including, in particular, an upper portion of the lift mechanism comprising a support member and part of the scissor lift mechanism and also illustrating how lateral translation of the support member relative to the scissor lift and chute carrier is achieved;

Figure 9C illustrates a partial view of the ore chute installation and removal apparatus of Figure 1 including, in particular, an upper portion of the lift mechanism comprising a support member and part of the scissor lift mechanism and also illustrating how roll movement of the support member relative to the scissor lift is achieved;

Figure 9D illustrates a partial view of the ore chute installation and removal apparatus of Figure 1 including, in particular, an upper portion of the lift mechanism comprising a support member and part of the scissor lift mechanism and also illustrating how pitch movement of the support member relative to the scissor lift and chute carrier is achieved; and

Figure 9E illustrates a partial view of the ore chute installation and removal apparatus of Figure 1 including, in particular, an upper portion of the lift mechanism comprising a support member and part of the scissor lift mechanism and also illustrating how yaw movement of the support member relative to the scissor lift and chute carrier is achieved.

Detailed Description

Referring to Figures 1 to 9E, there is shown an embodiment of an ore chute installation and removal apparatus 10 in accordance with an embodiment of the invention. The apparatus 10 includes a chute carrier 40 and a lift mechanism 60 and a chute support frame 20. Referring to Figures 1, 4 and 7, the chute support frame 20 is adapted to be placed upon the lift mechanism 60 in a manner that will be described below.

The chute carrier 40 is a mobile chute carrier that is adapted to be located beneath an ore chute 100, as illustrated in Figure 2, in which the ore chute 100 is represented in broken lines which, when in use, is connected to a loadout facility (not shown). The ore chute 100 has an upper portion 105 adapted for connection to the loadout facility and a lower portion 115 for funnelling ore into ore carriages (not shown). The upper portion 105 and the lower portion 115 are adapted to pivot relative to each other about a central pivot point X-X between an in-use configuration and a stowed configuration, wherein the stowed configuration of the chute 100 is illustrated in Figures 2 and 3. The lift mechanism 60 is adapted to lift the ore chute support frame 20 into engagement with the installed ore chute 100, as illustrated in Figure 2. The ore chute support frame 20 includes means, in the form of engagement members 26, 27, 30, 31, for coupling with, and supporting, the ore chute 100. The lift mechanism 60 is adapted to support the weight of the ore chute support frame 20 and the ore chute 100 when disconnected from the loadout facility and to lower the ore chute support frame 20 and the ore chute 100 relative to the ore loadout facility in a manner which will be described in more detail below.

The lift mechanism 60 includes a support assembly 70 that is adapted to engage and to support the ore chute support frame 20 and the ore chute 100 coupled thereto. The support assembly 70 is adapted for movement relative to the ore chute 100 when

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connected, in use, to the ore loadout facility. As will become apparent from the foregoing description, the support assembly 70 is adapted to move relative to the ore chute 100, and indeed to the lift mechanism 60, in multiple degrees of freedom of movement.

The chute carrier 40 includes a carrier frame 45 that is comprised essentially of a pair of opposite longitudinally extending structural members 41, 43 that are interconnected at opposite ends thereof by a pair of longitudinally opposite cross members 42, 44. Thus, the carrier frame 45 has the overall form of a rail bogey. A set of wheels 46, 47, 48, 49 are adapted to support the carrier frame 45 on a railway track 200, as illustrated in Figure 9A. One or more of the wheels 46, 47, 48, 49 are driven by any suitable means, such as a traction motor, to drive movement of the carrier frame 45 along the railway track 200. Thus, driven movement of the carrier frame 45 is responsible for longitudinal movement of the chute carrier 40, lift mechanism 60 and the chute support frame 20 relative to the ore chute 100 when connected, in use, to an ore loadout facility thereby providing one of the degrees of freedom of movement thereof.

The mobile chute carrier 40 further includes a support assembly 70 that is adapted to be lifted into engagement with the chute support frame 20 by the lift mechanism 60. The support assembly 70 includes a movement platform 110 that is adapted for providing three of the degrees of freedom of movement of the support assembly 70 relative to the ore chute 100 when connected, in use, to the ore loadout facility. The movement platform 110 includes a platform frame 120, which is a generally rectangular member comprising spaced apart longitudinally extending structural members 121, 123 and transverse structural members 122, 124 interconnecting the longitudinal structural members 121, 123. The movement platform 110 further includes an intermediate platform frame 130 which is similarly configured as a rectangular structural member comprising spaced apart longitudinal structural members 131, 133 and transverse structural members 132, 134 extending therebetween. The movement platform 110 further includes a platform sub-frame 140 which also has a generally rectangular form comprising a pair of spaced apart longitudinal structural members 141, 143 and a pair of transverse structural members 142, 144 interconnecting the longitudinal structural members 141, 143. The

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interconnection of the platform frame 120, the intermediate platform frame 130, the platform sub-frame 140 and the lift mechanism 60 provides four of the degrees of freedom of movement of the support assembly 70, namely lateral movement, pitch movement, yaw movement and roll movement in a manner that will be described below.

The platform frame 120 is moveably coupled to the lift mechanism 60 by a pivot connection 125 that allows for the pitch movement of the platform frame 120, intermediate platform frame 130 and platform sub-frame 140 relative to the lift mechanism 60. A linear actuator 127, which as illustrated in Figure 9C is in the form of a hydraulic piston and cylinder actuator, is adapted to drive the pitch movement of the platform frame 120 about the pivot connection 125.

The intermediate platform frame 130 is moveably coupled to the platform frame 120 by a set of two pivot connections 135 that, as illustrated in Figure 9C allows for the roll movement of the intermediate platform frame 130 and the platform sub-frame 140 relative to the platform frame 120 and the lift mechanism 60. The roll movement of the intermediate platform frame 130 about the pivot connections 135 is driven by a set of two linear actuators 137. The linear actuators 137 are in the form of two hydraulic piston and cylinder linear actuators that drive the movement of the intermediate platform frame 130 relative to the platform frame 120 about the second pivot connection 135.

The platform sub-frame 140 is moveably coupled to the intermediate platform frame 140 by two lateral movement couplings 145 which, as illustrated in Figure 9B, is in the form of slidable couplings between the platform sub-frame 140 and the intermediate platform frame 130. The lateral movement couplings 145 allows for the lateral movement of the platform sub-frame 140 relative to the intermediate platform frame 130, the platform frame 120 and the lift mechanism 60, as illustrated in Figure 9B. The lateral movement of the platform sub-frame 140 by the lateral movement couplings 145 is driven by a linear actuators 147 disposed at longitudinally opposite ends of the platform sub-frame 140. Linear actuators 147 are in the form of hydraulic piston and cylinder linear actuators. The lateral movement of the platform sub-frame 140 is caused by simultaneously operating the linear actuators 147 in the same

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direction at substantially the same speed. The yaw movement of the platform sub-frame 140 is caused by simultaneously operating the linear actuators 147 in opposite directions or in the same direction at different relative speeds.

The lift mechanism 60 is comprised of a scissor lift mechanism 65 that is adapted to lift and lower the support assembly 70, comprising the movement platform 110 described above, relative to the carrier frame 45 to which the scissor lift mechanism 65 is mounted. The lift mechanism 60 is also operable to lift and lower the support assembly 70, comprising the movement platform 110, relative to the ore chute 100 connected, when in use, to the ore loadout facility as illustrated in Figure 2. The scissor lift mechanism 65 includes a means for driving the scissor lift mechanism 65. The means for driving the scissor lift mechanism 65 is comprised of a further linear actuator 67 that, as illustrated Figures 2 and 8, is in the form of a pair of hydraulic linear actuators. Thus, the lift mechanism 65 provides the vertical movement of the support assembly 70 relative to the ore chute 100 connected, when in use, to the ore loadout facility.

Thus, the features of the mobile chute carrier 40 described above provide for the six degrees of freedom of movement of the support assembly 70 including longitudinal movement, lateral movement, vertical movement, pitch movement, yaw movement and roll movement. Thus, the support assembly 70 when supporting a chute support frame 20 as described herein, which in turn supports the ore chute 100, provides adjustability necessary to properly engage the ore chute 100 and allow the support frame 20 to be coupled to the chute 100 when connected, in use, to the ore loadout facility. Also, the provision of multiple degrees of freedom of movement of the support assembly 70 allows for balancing the load of the ore chute 100 and the chute support frame 20 when the ore chute is disconnected from the ore loadout facility and lowered from a significant height of several metres or more above ground level.

The ore chute support frame 20 which is operable to support the ore chute 100 in the support assembly 70 of the mobile chute carrier 40 is comprised of a frame member 25 which, as illustrated in Figures 1, 2, 3 and 5, has a generally rectangular footprint and includes transversely spaced apart longitudinally extending structural members 21, 23 and a pair of transverse structural members 22, 24 extending therebetween.

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The set of engagement members 26, 27, 30, 31 of the chute support frame 20 are adapted to engage the ore chute 100 to firmly connect the ore chute 100 to the chute support frame 20. The engagement members 26, 27, 30, 31 are generally located towards four corners of the frame member 25. The frame member 25 is adapted to be supported on the support assembly 70 of the mobile chute carrier 40 in a secure manner either by being fixed thereto or by simply resting thereupon. The chute support frame 20 further includes an initial chute contact points 28, 29 that initially contact the bottom of the installed ore chute 100 to cause the chute to articulate or pivot around the central pivot point X-X into the stowed configuration, prior to contact with the engagement members 26, 27, 30, 31 of the ore chute support frame 20.

The carrier frame 45 of the chute carrier 40 has a length and a width dimension substantially equivalent to the standard dimensions of a shipping container. That is preferably about 6.1 metres long by about 2.44 metres wide. The carrier frame 45 of the chute carrier 40 preferably also includes means for coupling the carrier frame 45 to a hoist (not shown) such as a crane and also to a transport vehicle (not shown) such as a flat-bed of a transport vehicle.

The chute carrier 40 is transported on another like ore chute support frame 20. Positive engagement is achieved between the chute carrier 40 and the another like ore chute support frame 20 by coupling container corner castings 50, 51, 52, 53 of the chute carrier 40 to container twistlocks 32, 33, 34, 35 disposed at each corner of the chute support frame 20.

A method of removing an ore chute 100 from an ore loadout facility will now be described with reference to the embodiment of the ore chute installation and removal apparatus 10 described above and illustrated in the Figures.

The mobile chute carrier 40 supported on the chute support frame 20 on the flat-bed of a transport vehicle and a replacement ore chute 100 supported by another like chute support frame 20 on a flat-bed of a transport vehicle are delivered to the site of the ore loadout facility. A hoist, such as a crane, is used to lift the mobile chute carrier 40 off the chute support frame 20 and to place the chute carrier 40 on the railway track 200, as illustrated in Figure 9A. The chute support frame 20 is then similarly

lifted onto the mobile chute carrier 40. The mobile chute carrier 40 is then driven along the railway track 200 into position below an ore chute 100 connected, in use, to the loadout facility. The ore chute 100 will be in its in-use configuration. The lift mechanism 60 is operated to lift the ore chute support frame 20 supported on the support assembly 70 of the lift mechanism 60 into engagement with the installed ore chute 100. The initial chute contact points 28, 29 contact the bottom of the installed ore chute 100. The movement platform 110 of the support assembly 70 is operated to adjust the position of the ore chute support frame 20 relative to the installed ore chute 100. For example, the movement platform 110 may be moved in the pitch direction, roll direction, yaw direction or lateral direction to align the chute support frame 20 with the ore chute 100. As the lift mechanism 60 continues to raise the support frame 20, the installed ore chute 100 articulates or pivots around the central pivot point X-X from the in-use configuration to the stowed configuration until contact is made between the installed ore chute 100 and the engagement members 26, 27, 30, 31 of the ore chute support frame 20. The ore chute support frame 20 and the installed ore chute 100 are then coupled together via the engagement members 26, 27, 30, 31 and the ore chute 100 is disconnected from the ore loadout facility so that the entire weight of the ore chute 100 is supported on the mobile chute carrier 40. The lift mechanism 60 is operated to lower the ore chute support frame 20 and ore chute 100 coupled thereto relative to the ore loadout facility.

The mobile chute carrier 40 is driven along the railway track 200 to a location remote from the ore loadout facility where the chute support frame 20 and the ore chute 100 supported thereon are lifted by a hoist, such as a crane, onto the flat-bed of the transport vehicle. The replacement ore chute 100 supported on another like chute support frame 20 on a flat-bed of a transport vehicle is hoisted, such as by the same crane, off the flat-bed of the transport vehicle and onto the support assembly 70 of the mobile chute carrier 40. The replacement ore chute 100 is installed in the ore loadout facility by carrying out the reverse of the steps of the method described above.

The present invention is susceptible to modification and mechanical equivalents without departing from the spirit or ambit of the invention described herein.

Claims

1. An ore chute installation and removal apparatus for installation to or removal from an ore loadout facility, the apparatus including:

a mobile ore chute carrier which includes a lift mechanism and an ore chute support frame,

the lift mechanism being operable to lift and lower the ore chute support frame, the ore chute support frame including an arrangement for coupling with an ore chute so that an ore chute can be coupled to the ore chute support frame,

the lift mechanism being operable to support the ore chute support frame and an ore chute coupled to the ore chute support frame during lifting and lowering movement,

the apparatus having an installation mode in which the lift mechanism is operable to lift the ore chute support frame and an ore chute coupled to the ore chute support frame into a position for engagement of the ore chute with an ore loadout facility, and

the apparatus having a removal mode in which the lift mechanism is operable to position the ore chute support frame into a position to couple with an ore chute which is connected with an ore loadout facility and with the ore chute disconnected from the ore loadout facility and coupled to the ore chute support frame, to the lower the ore chute support frame and the ore chute relative to the ore loadout facility.

2. The apparatus of claim 1, wherein the lift mechanism includes a support assembly that is adapted to engage and to support the ore chute support frame, wherein the support assembly is adapted for movement relative to an ore chute that is engaged with an ore loadout facility in multiple degrees of freedom of movement.

3. The apparatus of claim 1, wherein the lift mechanism includes a support assembly that is adapted to engage and to support the ore chute support frame and an ore chute coupled to the ore chute support frame, wherein the support assembly is adapted for movement relative to an ore chute that is engaged with an ore loadout facility in multiple degrees of freedom of movement.

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4. The apparatus of claim 2 or 3, wherein the degrees of freedom of movement include longitudinal movement, lateral movement, vertical movement, pitch movement, yaw movement and roll movement.

5. The apparatus of claim 4, wherein the ore chute carrier includes wheels adapted to be supported on a supporting surface, such as a railway track, that provides for the longitudinal movement.

6. The apparatus of claim 4 or 5, wherein the support assembly includes a movement platform providing four of the degrees of freedom of movement including lateral movement, pitch movement, yaw movement and roll movement.

7. The apparatus of claim 6, wherein the movement platform includes a platform frame, an intermediate platform frame and a platform sub-frame which are movably interconnected to provide the four of the degrees of freedom of movement.

8. The apparatus of claim 7, wherein the platform frame is movably coupled to the lift mechanism via a pivot connection allowing for the pitch movement of the platform frame, intermediate platform frame and platform sub-frame relative to the lift mechanism.

9. The apparatus of claim 8, wherein the pitch movement of the platform frame about the pivot connection is driven by a linear actuator.

10. The apparatus of any one of claims 7 to 9, wherein the intermediate platform frame is movably coupled to the platform frame via a second pivot connection allowing for the roll movement of the intermediate platform frame and platform sub-frame relative to the platform frame and the lift mechanism.

11. The apparatus of claim 10, wherein the roll movement of the intermediate platform frame about one or more pivot connections is driven by one or more linear actuators.

12. The apparatus of any one of claims 7 to 11, wherein the platform sub-frame is movably coupled to the intermediate platform frame by a lateral movement coupling, such as a slidable coupling, allowing for the lateral movement and yaw movement of

the platform subframe relative to the intermediate platform frame, the platform frame and the lift mechanism.

13. The apparatus of claim 12, wherein the lateral movement and yaw movement of the platform sub-frame by the lateral movement coupling is driven by one or more linear actuators.

14. The apparatus of any one of the proceeding claims, wherein the lift mechanism is a scissor lift mechanism that is adapted to lift and lower the support assembly relative to the ore chute connected when in-use to a loadout facility.

15. The apparatus of any one of the proceeding claims, wherein the ore chute support frame includes a frame member and a plurality of adjustable engagement members that are vertically adjustable relative to the frame member and are adapted for coupling the ore chute to the frame member.

16. The apparatus of claim 15, wherein the frame member has a length and a width dimension substantially equivalent to the standard dimensions of a shipping container, preferably 6.1m long by 2.44m wide, and includes means for coupling the frame member to a hoist as well to a transport vehicle.

17. The apparatus of any one of the proceeding claims, further including an ore chute carrier sub-frame to support the chute carrier on a transport vehicle.

18. The apparatus of claim 17, wherein the ore chute carrier sub-frame has a length and a width dimension substantially equivalent to the standard dimensions of a shipping container, preferably 6.1m long by 2.44m wide.

19. A method for removing an ore chute from an ore loadout facility, the method including:

providing an ore chute installation and removal apparatus including a mobile ore chute carrier including a lift mechanism and an ore chute support frame;

positioning the ore chute installation and removal apparatus beneath an ore chute connected to an ore loadout facility;

operating the lift mechanism to lift the ore chute support frame into engagement with the ore chute;

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coupling the ore chute support frame to the ore chute;

disconnecting the ore chute from the ore loadout facility; and

operating the lift mechanism to lower the ore chute support frame and the ore chute coupled thereto relative to the ore loadout facility.

20. The method of claim 19, wherein before the step of coupling the ore chute support frame to the ore chute, the position of the ore chute support frame is adjusted relative to the ore chute in multiple degrees of freedom of movement.

21. The method of claim 20, wherein the degrees of freedom of movement include longitudinal movement, lateral movement, vertical movement, pitch movement, yaw movement and roll movement.

22. The method of any one of claims 19 to 21, wherein the ore chute is articulated from an in-use configuration to a stowed configuration when the ore chute support frame is lifted into engagement with the installed ore chute before coupling the ore chute support frame to the ore chute.

23. The method of any one of claims 19 to 22, wherein after the lift mechanism is operated to lower the ore chute support frame with the ore chute coupled thereto the mobile ore chute carrier is translated along a railway track to a location remote from the ore loadout facility.

24. The method of claim 23, wherein the ore chute support frame with the ore chute coupled thereto is lifted off the mobile ore chute carrier and is placed upon a transport vehicle and another like ore chute support frame with ore chute coupled thereto is lifted from a transport vehicle onto the mobile ore chute carrier.

25. The method of claim 24, wherein the other like ore chute support frame with ore chute coupled thereto is installed in the ore loadout facility by carrying out the reverse of the steps defined in claims 19 to 22.

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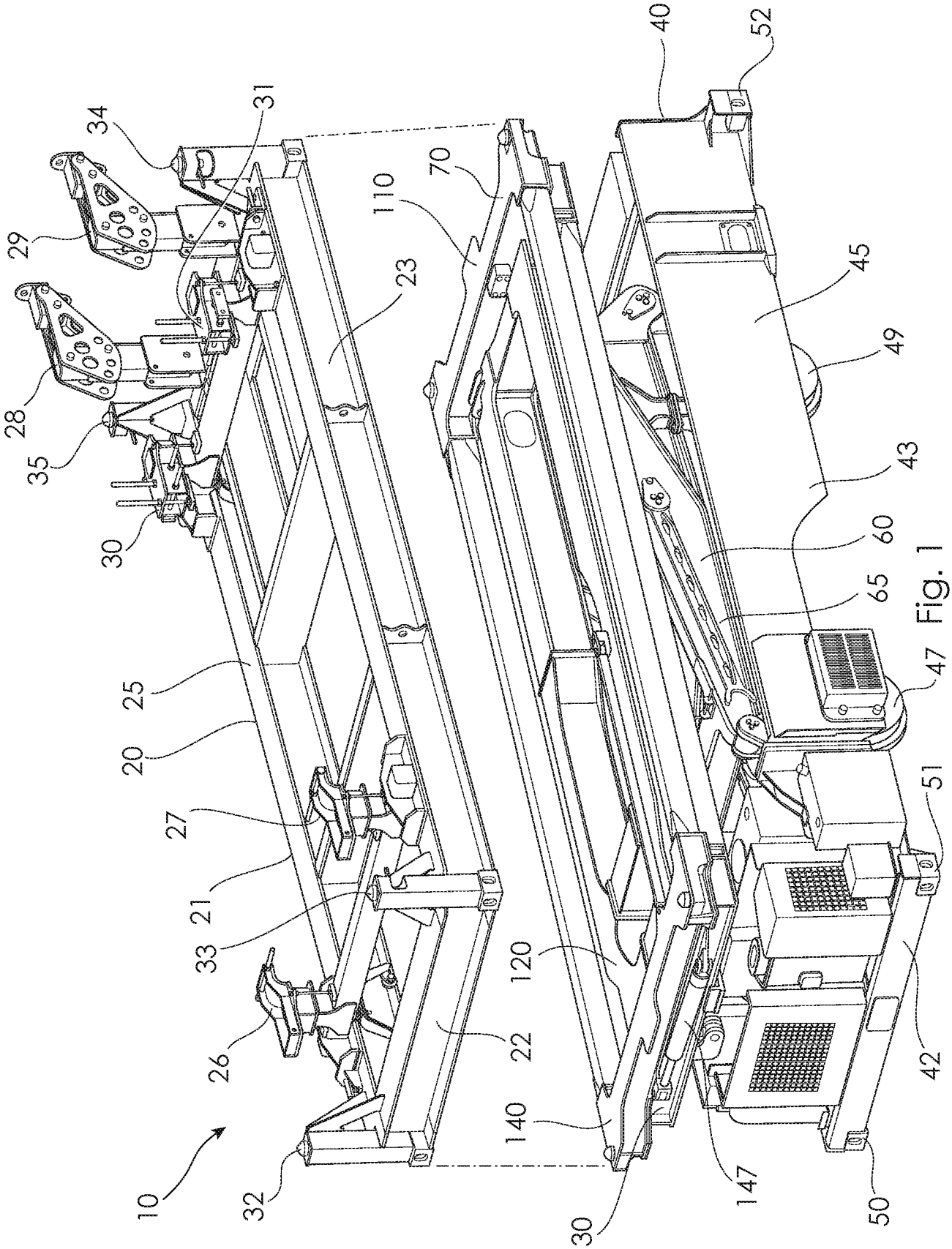

Fig. 1

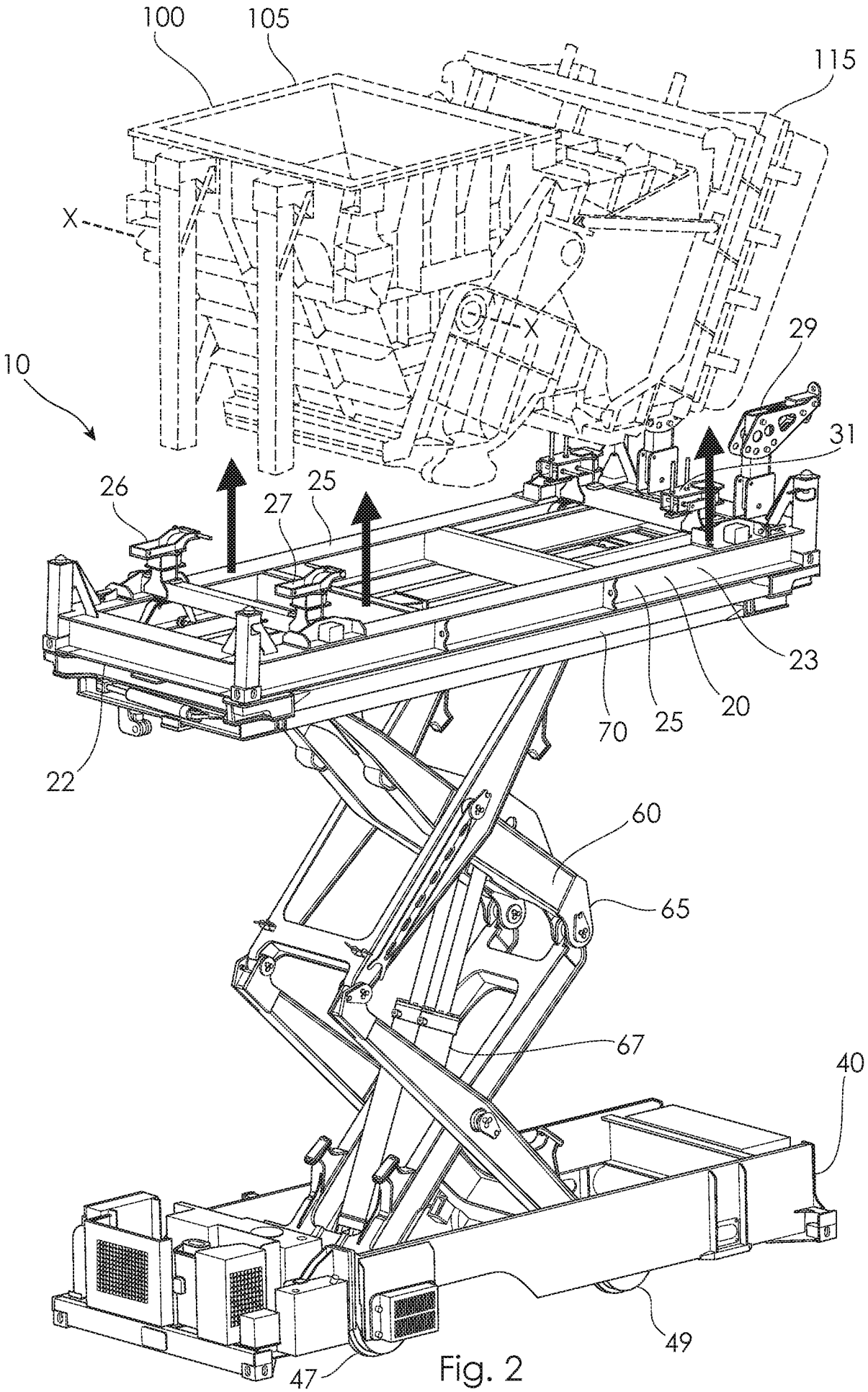

Fig. 2

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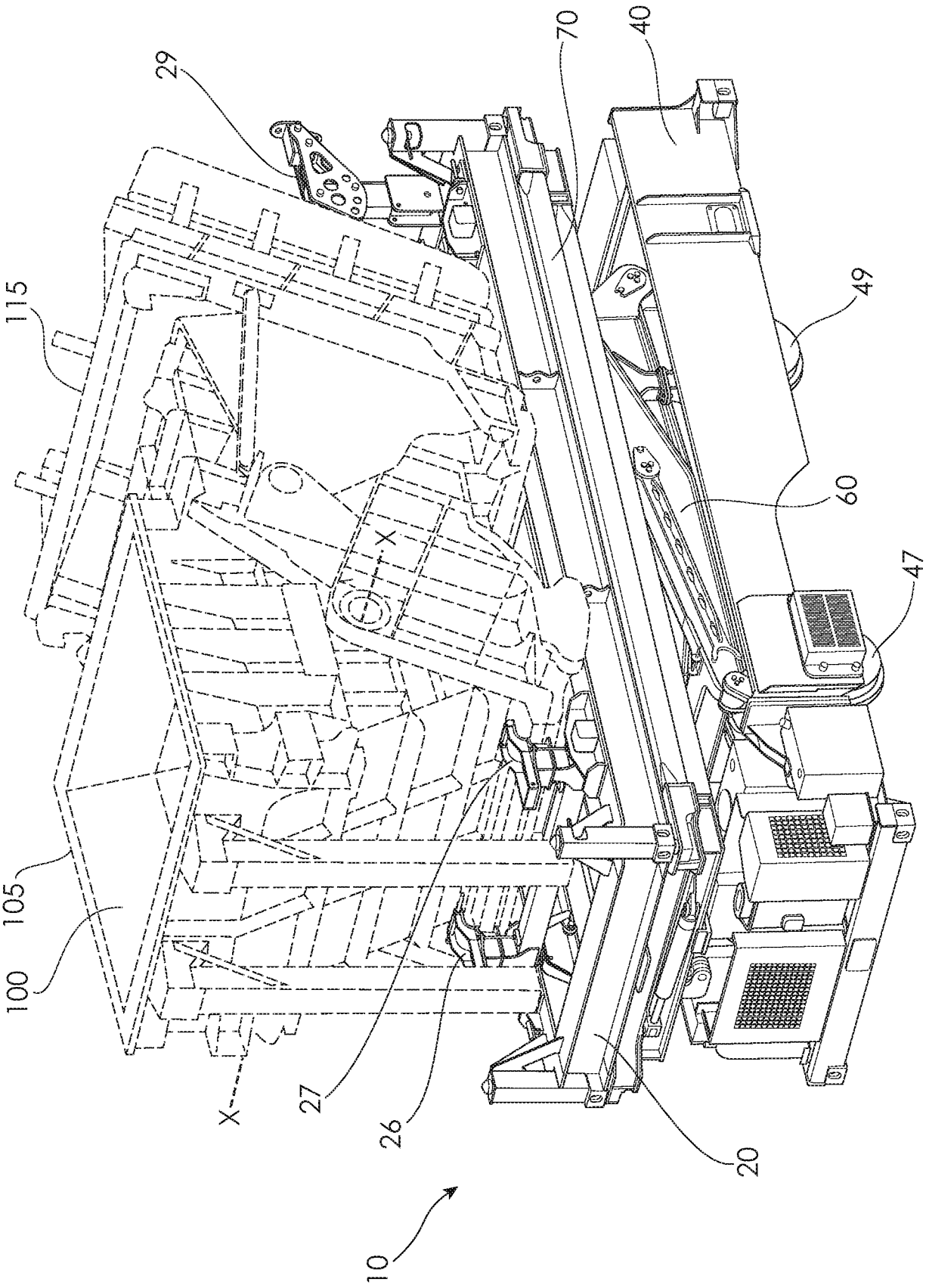

Fig. 3

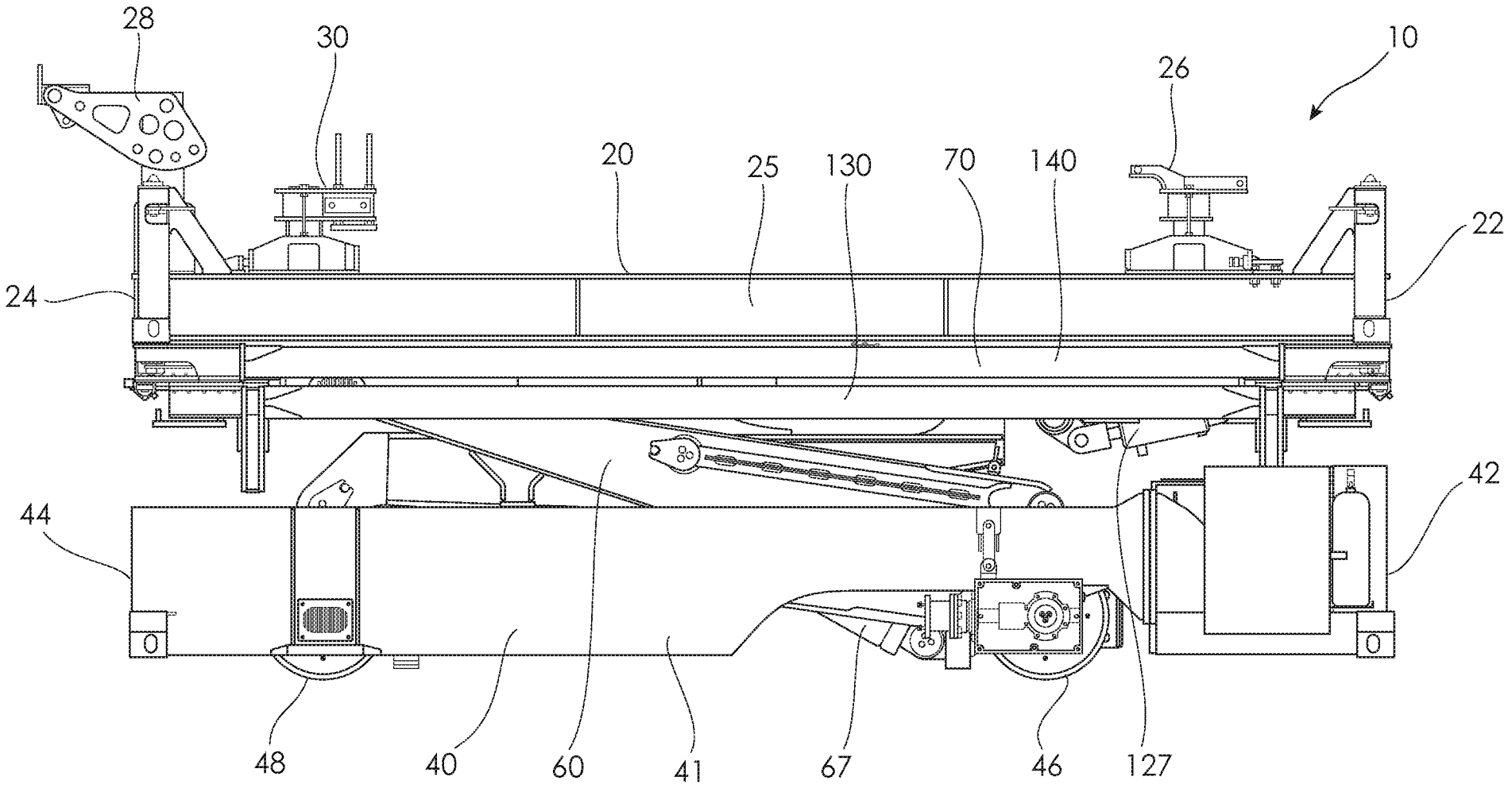

Fig. 4

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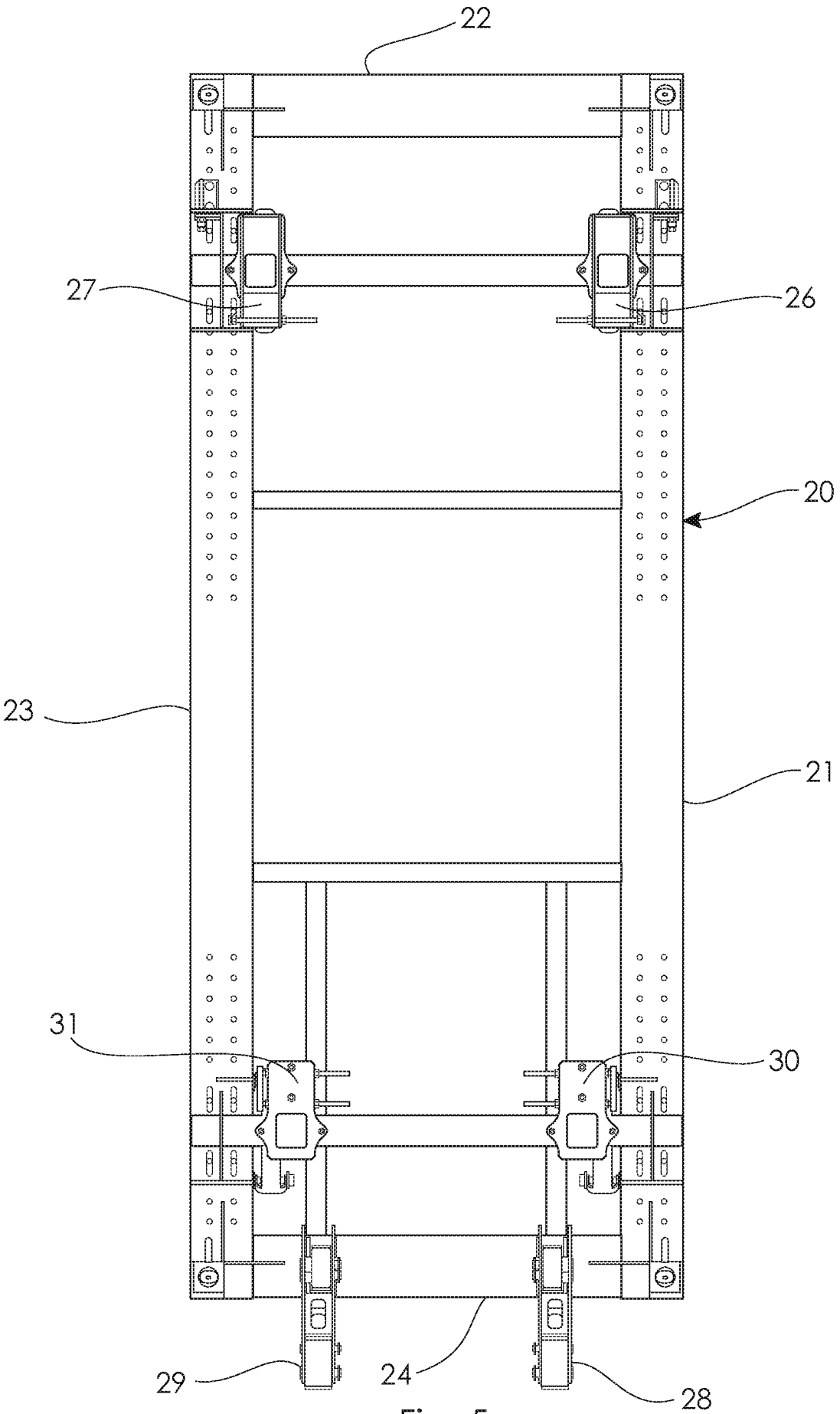

Fig. 5

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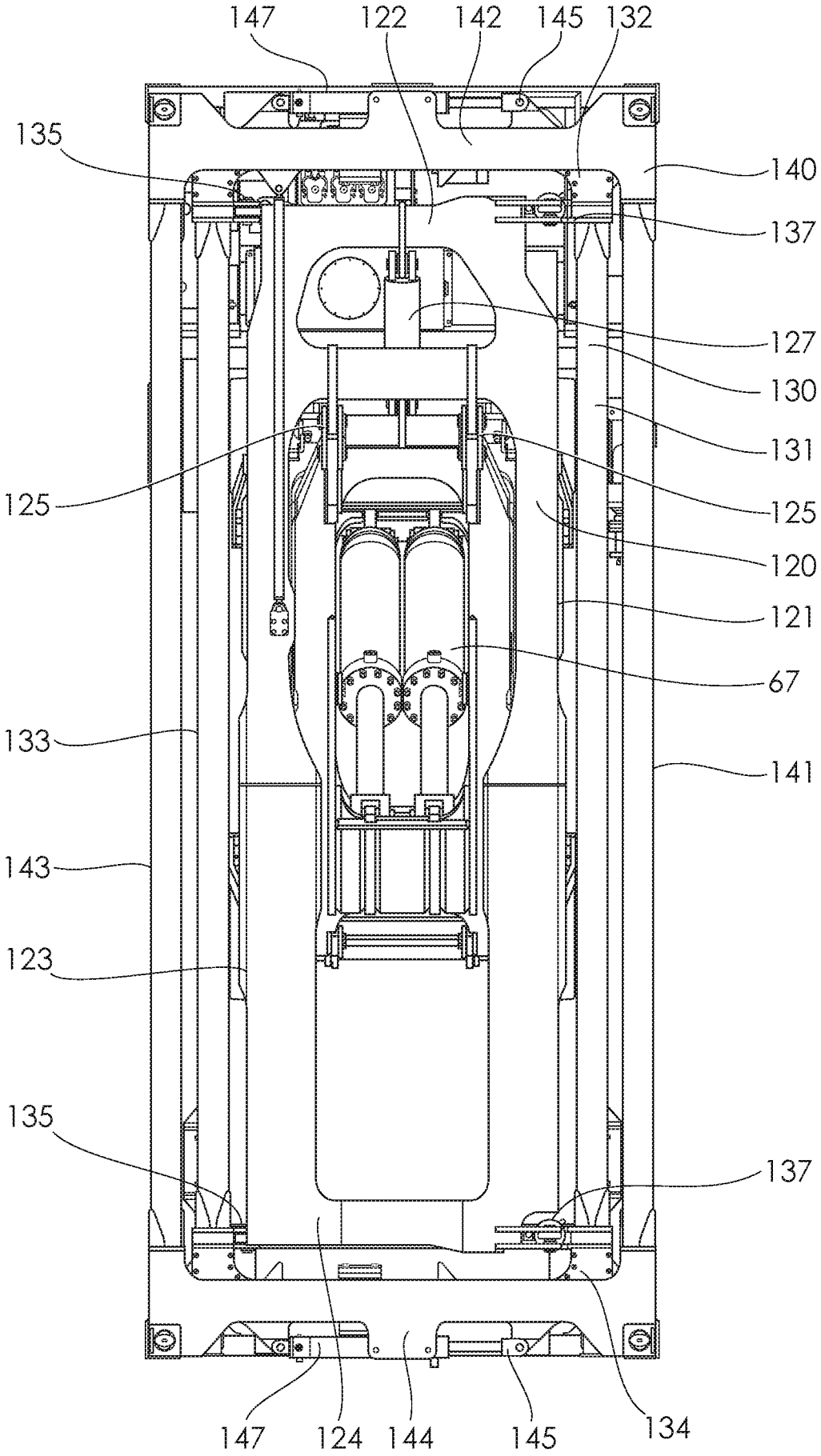

Fig. 6

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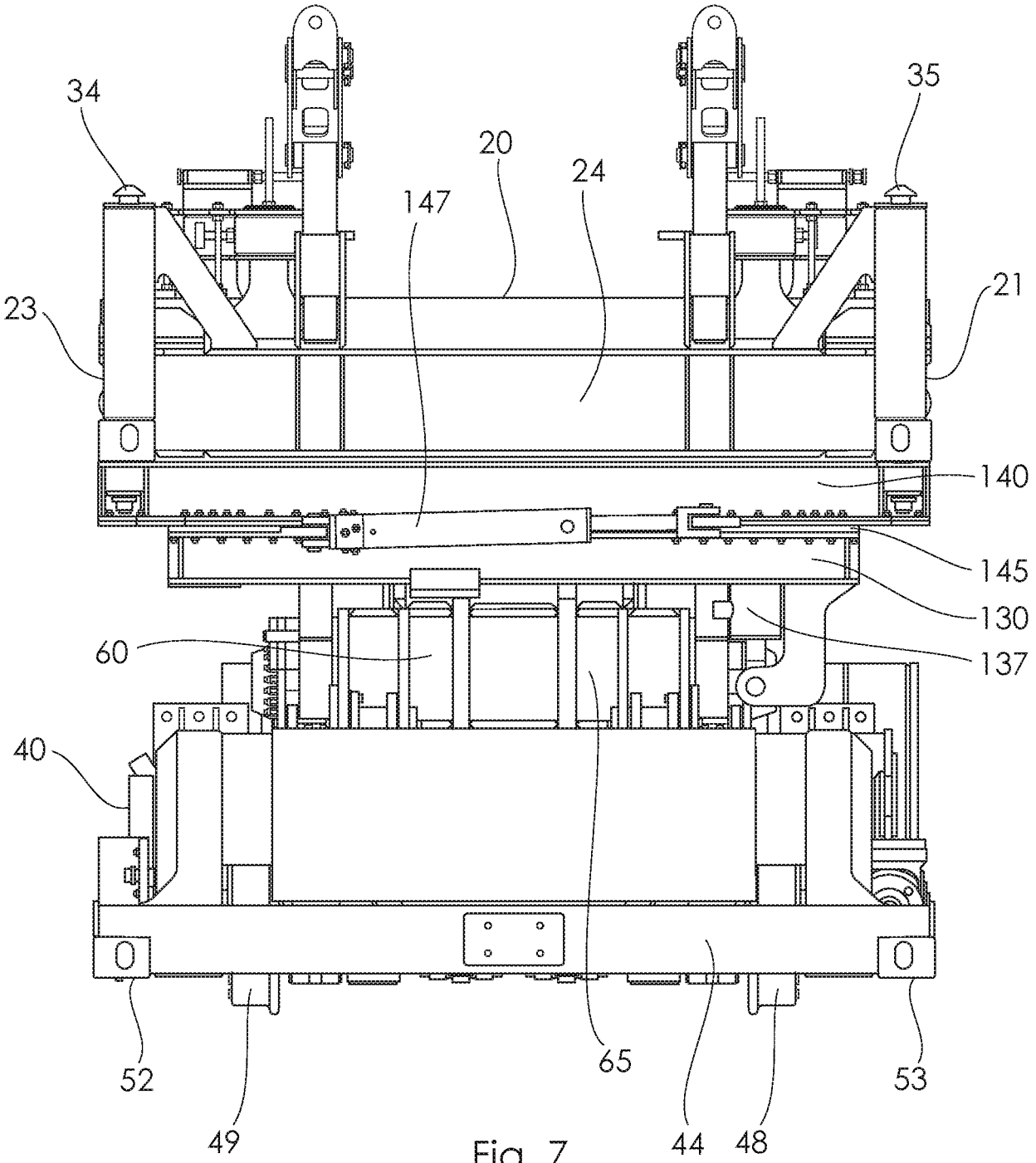

Fig. 7

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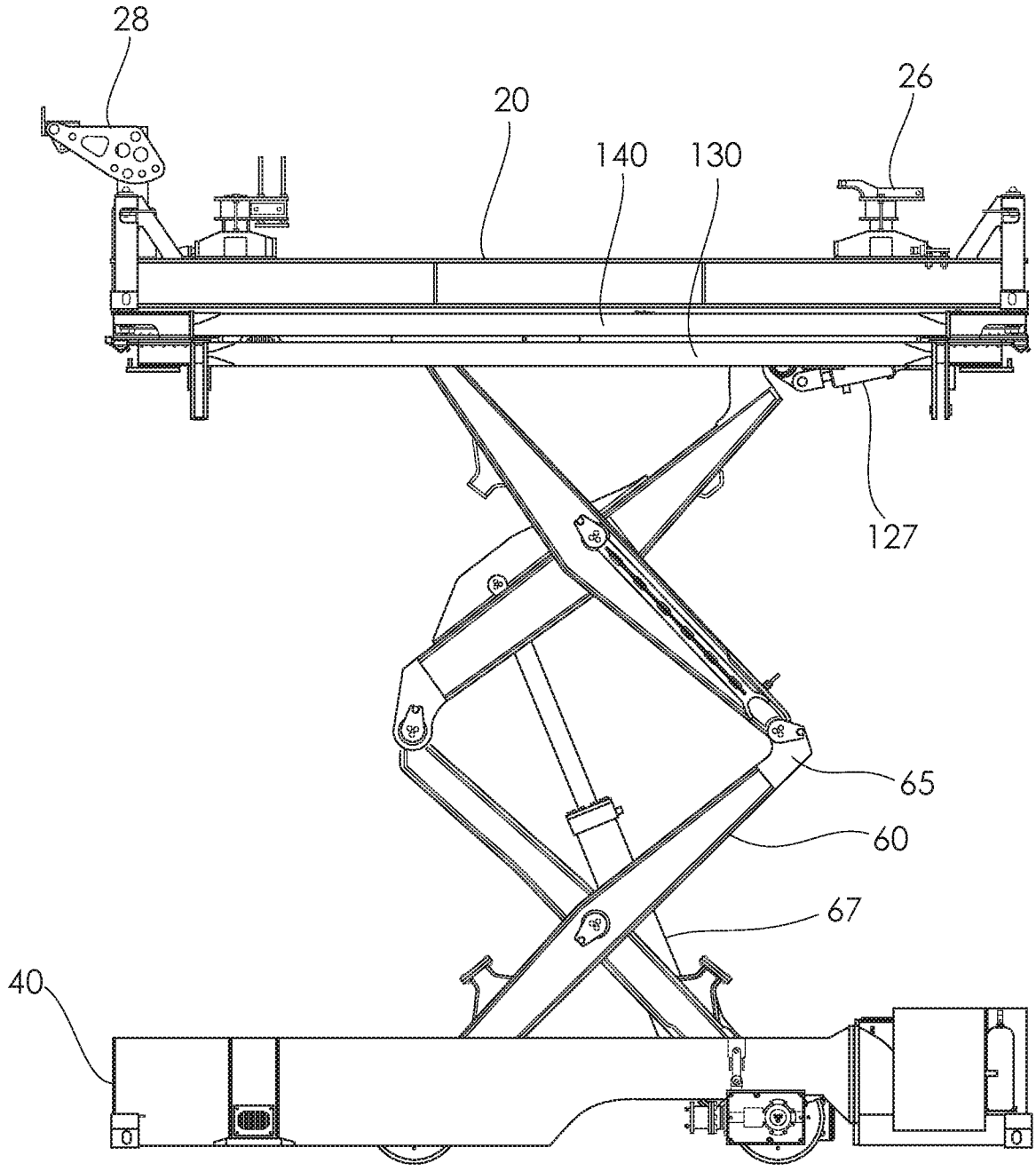

Fig. 8

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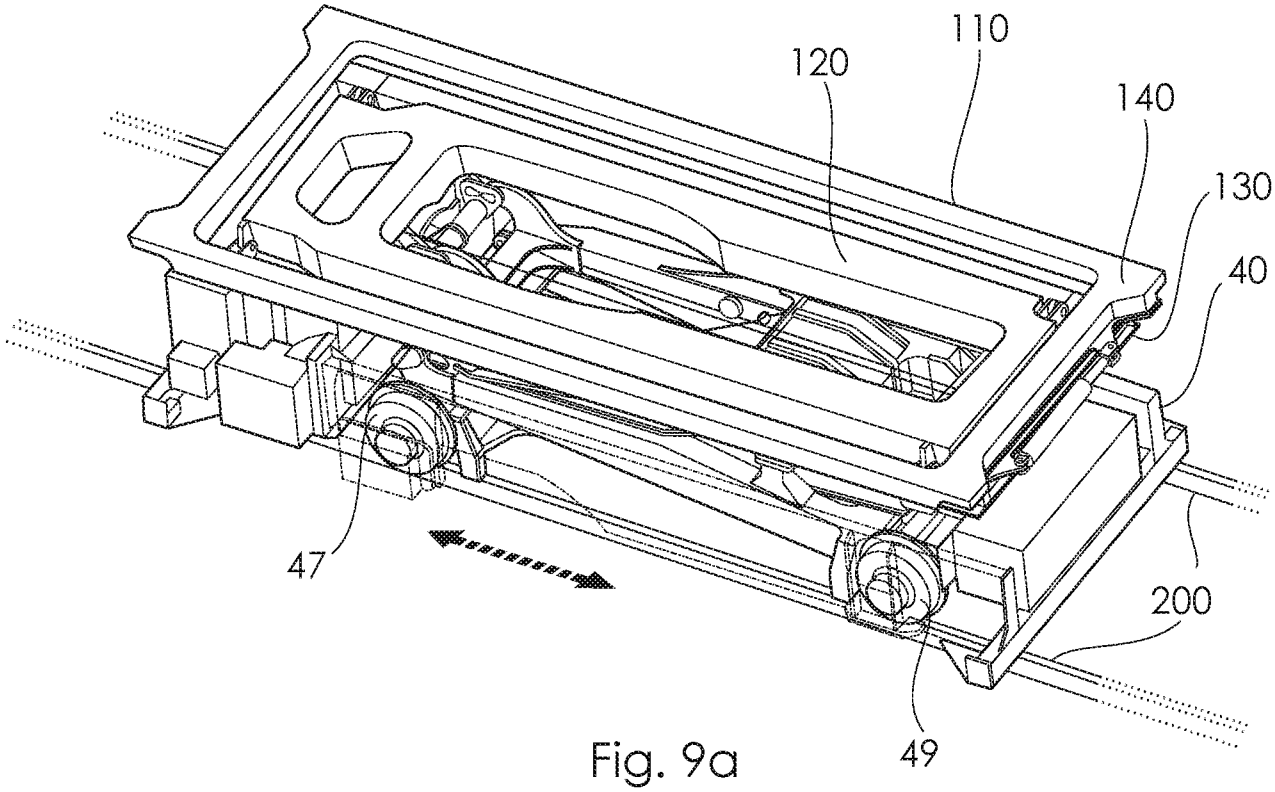

Fig. 9a

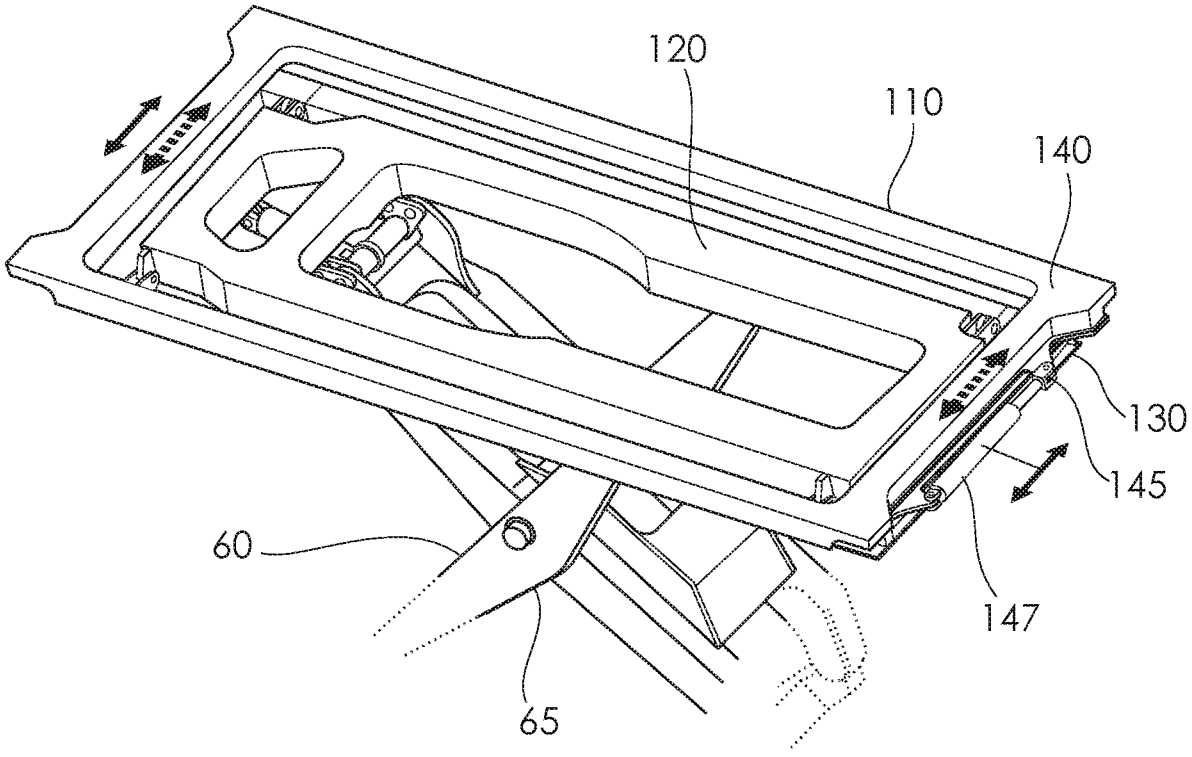

Fig. 9b

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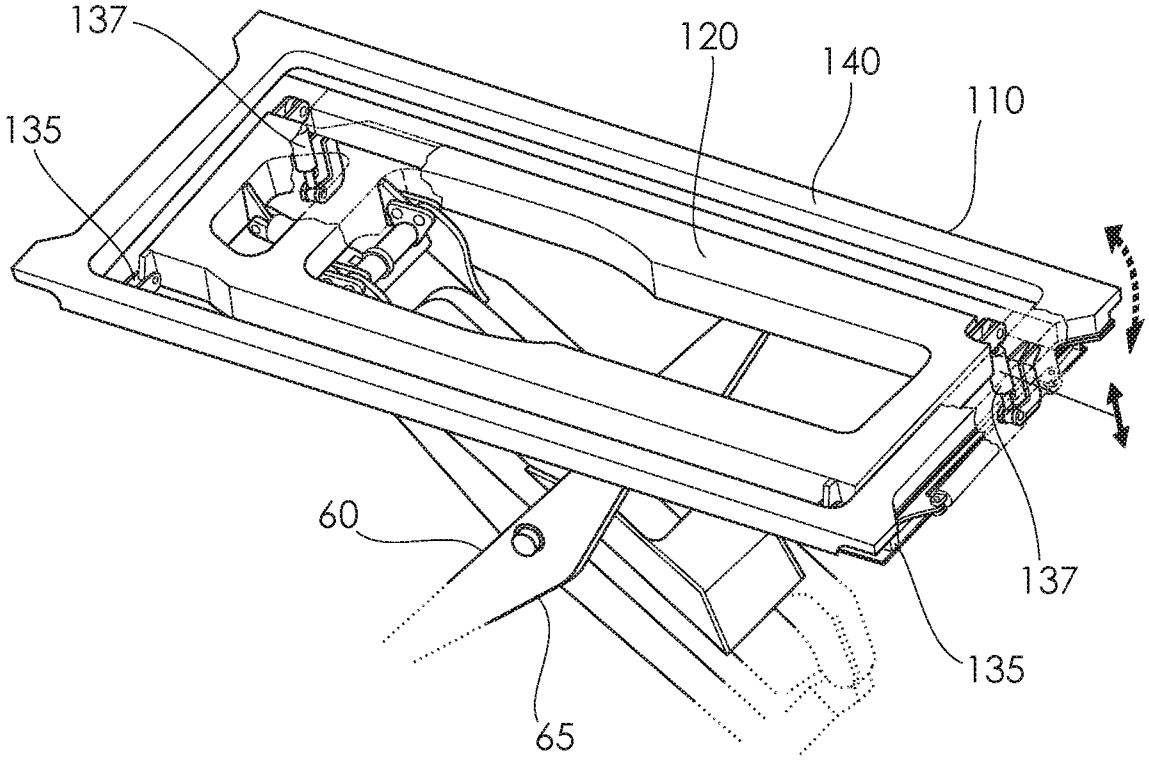

Fig. 9c

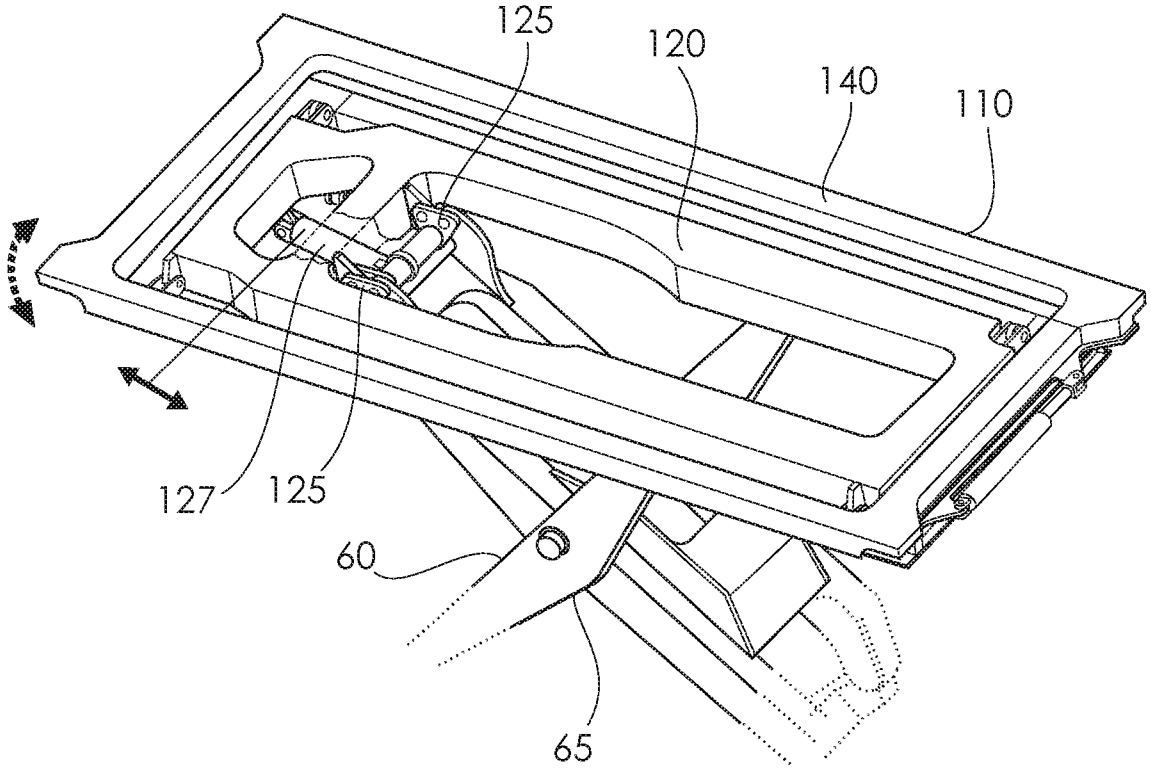

Fig. 9d

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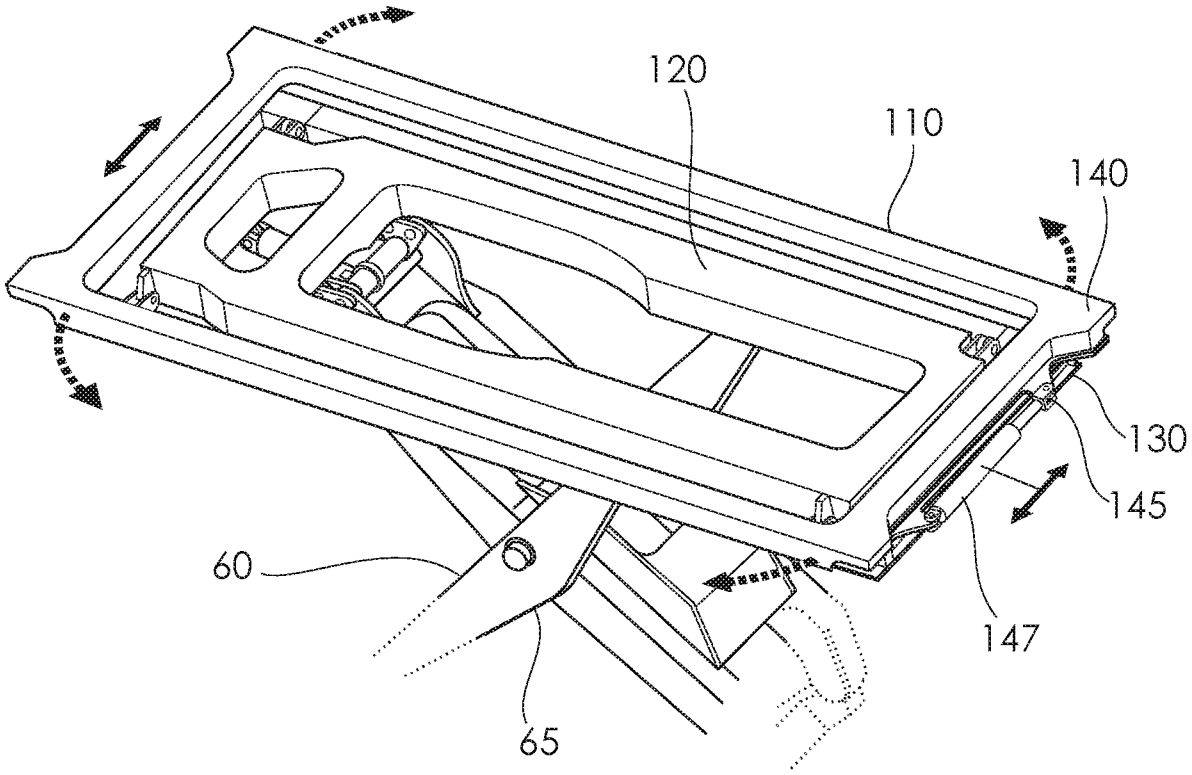

Fig. 9e