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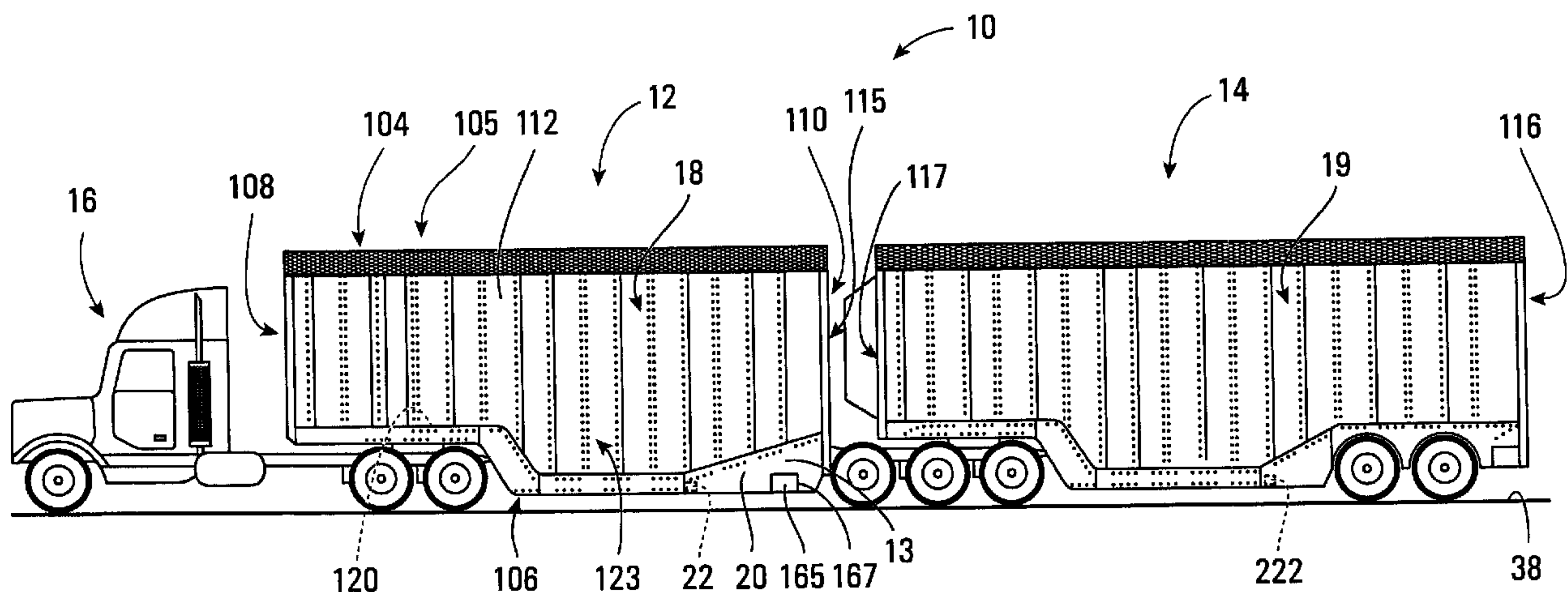
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(54) Title: APPARATUS AND SYSTEM FOR DENSIFYING AND TRANSPORTING BULK MATERIALS, AND RELATED
METHODS



(57) Abrégé/Abstract:

An apparatus for densifying and transporting bulk materials, the apparatus comprising a container for holding bulk materials, a wheeled chassis for transporting the container along a roadway, and a shaker, mounted on the chassis and transportable therewith, for shaking the container while the container is being loaded, to increase packing density of bulk materials in the container. A related transportation system and methods are also provided.

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ABSTRACT

5 An apparatus for densifying and transporting bulk materials, the apparatus comprising a container for holding bulk materials, a wheeled chassis for transporting the container along a roadway, and a shaker, mounted on the chassis and transportable therewith, for shaking the container while the container is being loaded, to increase packing density of bulk materials in the container. A related transportation system and methods are also provided.

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APPARATUS AND SYSTEM FOR DENSIFYING AND TRANSPORTING BULK MATERIALS, AND RELATED METHODS

BACKGROUND OF THE INVENTION

5 1. Field of Invention

This invention relates generally to the field of transportation, and more particularly, to apparatuses, methods and systems for densifying and transporting bulk materials.

10 2. Related Art

Various vehicles, including trains and trucks, are commonly used to transport bulk materials such as powder, grain, sawdust and wood chips, for example. For such vehicles, it is desirable to maximize the amount of bulk materials that are transported per trip while staying within legally permissible size and weight limits for the vehicle. For example, various laws and regulations constrain the maximum weight of cargo that may be hauled by a tractor and semi-trailer assembly along a public roadway. In addition, regulations also restrict the maximum size of the semi-trailer(s) that may be hauled by one tractor.

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Thus, various attempts have been made to maximize the load-carrying capacity of vehicles designed for transporting bulk materials. Transportation systems are often built to the maximum sizes in length, height and depth permissible by law. For instance, wood chips and other wood residuals are typically hauled in tractor-towable trailers with containers which are specially designed to maximize the amount of wood chips that are transported. First, the trailers typically use cargo containers which are made of fastened-together aluminum strips, rather than steel, to reduce the overall weight of the trailers, in order to preserve as much of the permissible weight limit as possible for carrying wood chips and wood residue. Second, container capacity is increased by including a lowered drop bed portion adjacent the wheels of a trailer in order to increase the height of the trailer. Furthermore,

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first and second trailers with respective containers mounted thereon may be assembled together to be hauled in tandem behind a tractor. Trailer assemblies of this design may be called B-Trains or SuperTrains, with the first and second trailers being referred to as "A-box" and "B-box" respectively. Such trailers are manufactured, for instance, by TY-CROP Manufacturing Ltd. of Rosedale, British Columbia, Canada, V0X 1X0, phone number 604-794-7078.

Despite the aforementioned attempts to increase carrying capacity, in some cases it remains possible to load a maximally-sized transportation system completely full in terms of volume without reaching the maximum weight limits which are legally permissible to transport. That is, it is possible for a vehicle to "volume out" before "weighing out". This problem is especially acute in the case of relatively light and/or irregularly-shaped bulk materials, such as wood chips. Such loads may retain air spaces in between bulk material particles loaded into a container. It is desirable to overcome this problem to increase the carrying capacity of such transportation systems.

Various shakers and vibrators have been used in the past attempt to vibrate loads in order to reduce air spaces between bulk material particles to increase carrying capacity. These shakers and vibrators may be unsuitable for the types of vehicles that are used on roadways for transporting bulk materials such as wood chips. To take one example, rail car shakers are installed adjacent to railroad tracks and are used to shake an entire rail car to cause bulk materials held within to be compacted. Rail car shakers are heavy, external machines which are not transportable with the vehicle and are ordinarily installed at a fixed location, such as a railway yard, thus rail car shakers are not convenient for use with road-based transportation systems such as SuperTrain truck assemblies. In the railway industry, smaller vibrators may be attached to the walls of rail cars, to compact bulk materials therein. However, such vibrators may be unsafe to use on containers such as those described above for hauling wood chips because these containers are

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typically made of aluminum which is not designed to withstand the stress of vibration. The walls of such a container are typically comprised of strips of aluminum material joined together by fasteners such as rivets to form an enclosure for carrying the bulk materials. Attaching a vibrator directly to such a container would likely stress and eventually damage the fasteners thereby creating a risk of the entire container rupturing. Thus, a different approach is needed.

Various after-market "vibrators" are available for use in unloading applications. For example, vibrators such as the Phillips Temro 12 Volt Dump Body Vibrator Part 800-0875, available from Gregg Distributors of Edmonton, Alberta, Canada or Hayworth Equipment Sales of Acheson, Alberta, Canada, are often attached to the underside of the tiltable bed of a dump truck, in order to facilitate unloading of materials in the bed. To dislodge a frozen load, for instance, the dump truck operator may actuate the vibrator for 15 seconds or so while the dump truck bed is being tilted. However, such vibrators are not suitable for installation on containers comprised of aluminum strip material joined by fasteners. More generally, it would not be prudent to attach a vibrator directly to the cargo containers of many transportation systems, since they are built far less sturdily than a dump truck bed. Moreover, the motors used in many of these vibrators are "starter-type" motors which are generally unsuitable for applications that require sustained operation for more than, say, 30 seconds. Such motors draw excessive amounts of power as well.

Another problem frequently encountered in connection with the loading of bulk materials is that bulk materials do not always readily spread to all the extremities of the cargo container being loaded. For example, if wood chips are being loaded from an overhead chute into a container having an inlet opening in its top portion, the wood chips may pile up in the container at a point underneath the chute, rather than spreading to the far corners of the container. Failing to completely fill all the corners of the container effectively reduces the carrying capacity of the container. To address this problem, an

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operator of the vehicle often climbs up on top of the trailer to "groom" the crown of the load so as to cause it to fill the unfilled portions of the container. However, grooming the load in this manner is time-consuming and dangerous since the operator might fall.

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An ASG Loading System™ presented and described herein addresses the above problems and other needs in the field of bulk material transport.

SUMMARY OF THE INVENTION

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In accordance with one aspect of the invention, there is provided an apparatus for densifying and transporting bulk materials. The apparatus includes a container for holding bulk materials, a wheeled chassis for transporting the container along a roadway, and a shaker, mounted on the wheeled chassis and transportable therewith, for shaking the container while the container is being loaded, to increase packing density of bulk materials in the container.

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The shaker may be permanently connected to the chassis.

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The chassis may include first and second spaced apart longitudinal beams, disposed generally parallel to a longitudinal axis of the chassis.

The shaker may be operably mounted on at least one of the first and second longitudinal beams.

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The chassis may further include a transverse beam extending between the first and second longitudinal beams and the shaker may be operably mounted on the transverse beam.

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The apparatus may include a plate extending from the transverse beam, the shaker being operably mounted on the plate. A gusset may be provided for reinforcing the plate.

- 5 The apparatus may include a mount, affixed to the chassis, operably configured to mount the shaker to the chassis, and may further include a reinforcing member for reinforcing the mount.

- 10 The container may include a plurality of sheet material panels and fasteners fastening the plurality of sheet material panels together to form an enclosure.

- 15 The container may include top, bottom, front, rear and first and second side portions, the top portion having an inlet for receiving bulk materials to be loaded into the container, and the rear portion having an outlet for discharging the bulk materials from the container.

- 20 The container may include an inner floor, a substantial part of which may include at least one generally planar floor section having a longitudinal axis generally parallel to a longitudinal axis of the chassis.

The inner floor may be continuous.

The apparatus may include a hitch on the front portion of the container for hitching the apparatus to a vehicle.

- 25 The container may include a drop-bed portion, between the front and rear portions, the chassis directly supporting the rear portion but not the drop-bed portion.

- 30 The apparatus may include at least one connector for receiving power from a power supply, for actuating the shaker.

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At least one connector may be releasably connectable to a complementary connector on a vehicle, to facilitate separation of the apparatus from the vehicle.

5 The apparatus may further include a first control operably configured to selectively cause the power supply to supply power through the at least one connector to the shaker when the at least one connector is receiving the power for actuating the shaker.

10 The first control may be located on the container.

The container may have a recess and the first control may be located in the recess.

15 The control may include an electrical switch.

In accordance with another aspect of the invention, there is provided a system for densifying and transporting bulk materials in a container. The system includes the aforesaid apparatus and a power supply, a second control, and a
20 complementary connector, complementary to the at least one connector. The second control is operably configured to selectively cause the power supply to supply power to the complementary connector for receipt by the at least one connector for actuating the shaker.

25 The system may further include a signaling device operably configured to provide a signal to an operator when power for actuating the shaker is being supplied to the complementary connector.

30 The second control may be located in a cab of a vehicle operable to haul the apparatus.

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The signaling device may be mounted on a vehicle operable to haul the apparatus.

5 The shaker may include a rotatable shaft, an eccentric weight mounted on the shaft and a motor operable to rotate the shaft in response to power received from the power supply.

The power supply may be selected from the group consisting of an electrical power supply, a hydraulic power supply, and a pneumatic power supply.

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In accordance with another aspect of the invention, there is provided a method of manufacturing an apparatus for densifying and transporting bulk materials. The method involves operably connecting a shaker to a wheeled chassis on which is mounted a container formed of individual sheet material panels fastened together, for carrying bulk materials. The method further involves operably connecting a power controller to at least one of the chassis and the container in a location accessible by an operator, and operably connecting the power controller to at least one releasable connector for receiving power from a power supply associated with a vehicle operable to the apparatus. The method further involves operably connecting the power controller to the shaker to facilitate operator control of power supplied to the shaker to permit the operator to control the power to cause the shaker to shake the chassis and the container mounted thereto, to increase packing density of bulk material in the container.

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Connecting the shaker to the wheeled chassis may involve operably connecting the shaker to at least one of a longitudinal or transverse beam of the chassis.

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Connecting the shaker to the wheeled chassis may involve welding a base of the shaker to a mount supported by a transverse beam of the chassis.

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5 The method may also involve installing an additional connector on the apparatus, the additional connector being operable to receive at least some power from the at least one connector and to supply the at least some power to a connector connected thereto for powering a second shaker on a second apparatus.

10 In accordance with another aspect of the invention, there is provided an apparatus for densifying and transporting bulk materials, the apparatus including holding means for holding bulk materials, transporting means for transporting the holding means along a roadway, and shaking means, mounted on the transporting means, for shaking the transporting means to impart shaking to the holding means while the holding means is being loaded, to increase packing density of bulk materials held by the holding means.

15 In accordance with another aspect of the invention, there is provided a method of densifying bulk materials for transport, the method involving causing a container, operable to hold bulk materials, to shake, in response to actuation of a shaker mounted on a wheeled chassis on which the container is mounted, while causing bulk materials to be received in the container.

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The method may involve facilitating receipt and storage of the bulk materials in a drop bed of the container, wherein the drop bed is located adjacent wheels of the wheeled chassis.

25 Causing the container to shake may involve controlling power supplied to the shaker.

Controlling power supplied to the shaker may involve actuating a switch to selectively supply power to the shaker.

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Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon review of the following description of

specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

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In drawings which illustrate embodiments of the invention,

- Figure 1 is a side view of a system for densifying and transporting bulk materials according to an embodiment of the invention, the system including first and second apparatuses shown being towed in tandem behind a towing vehicle;
- 10 Figure 2 is a simplified perspective view of a chassis of the first apparatus shown in Figure 1, showing a shaker of the first apparatus connected to a transverse or longitudinal beam of the chassis frame;
- 15 Figure 3 is a view along lines III-III in Figure 2, showing a side view of a shaker installed on the transverse beam of the chassis frame shown in Figure 2;
- Figure 4 is a cross sectional view along the lines IV-IV in Figure 2, showing a side view of a shaker connected to a longitudinal beam of the chassis frame shown in Figure 2 according to a second embodiment of the first apparatus shown in Figure 1;
- 20 Figure 5 is a top view of an embodiment of a shaker shown in Figures 2 to 4;
- Figure 6 is a top view of the system shown in Figure 1 illustrating exemplary locations of the shakers shown in Figures 2 to 4;
- 25 Figure 7 is a schematic diagram of an electrical system of the system shown in Figure 1;
- Figure 8 is a flowchart illustrating a method of manufacturing the first or second apparatus shown in Figure 1; and
- 30 Figure 9 is a flow chart illustrating a method of densifying bulk materials for transport in the system shown in Figure 1.

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DETAILED DESCRIPTION

Referring to Figure 1, a system for densifying and transporting bulk materials is shown generally at **10**. In this embodiment, the system includes a first apparatus for densifying and transporting bulk materials, shown generally at **12**, and a second apparatus for densifying and transporting bulk materials, shown generally at **14**. In addition, the system **10** includes a towing vehicle such as a tractor, shown generally at **16**, connected to the first apparatus **12**. The second apparatus **14** is connected to the first apparatus **12**. While the system **10** has been shown with two apparatuses **12** and **14**, it will be appreciated that the system may be used with only one apparatus such as apparatus **12**, or the apparatus **14**, for example. In the embodiment shown, the tractor is operable to tow both apparatuses **12** and **14** at the same time.

The first apparatus **12** includes a container **18** for holding bulk materials. In this embodiment, the container includes a plurality of sheet material panels fastened together by fasteners, such as rivets, to form an enclosure. The apparatus **12** further includes a wheeled chassis, shown generally at **20**, for transporting the container **18** along a roadway **38**. The chassis **12** includes a frame **13** to which the container **18** is permanently connected. The apparatus **12** further includes a shaker **22**, mounted on the wheeled chassis **20** and transportable therewith, for shaking the container **18** while the container is being loaded, to increase packing density of bulk materials in the container.

Referring to Figure 2, the chassis **20** of the first apparatus **12** is shown in greater detail. (The chassis of the second apparatus **14** is similar.) The chassis **20** is shown without extraneous parts. For example, suspension, brakes, and other parts associated with the chassis, are omitted in this figure. In this embodiment, the chassis **20** includes first and second spaced apart longitudinal beams **24** and **26**, each of which is formed of a steel I-beam. The first longitudinal beam **24** has a horizontally disposed portion, shown generally at **28**, and a downwardly sloping angularly disposed (i.e., angled) portion,

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shown generally at **30**. The second longitudinal beam **26** also has a generally horizontal portion **32** and a downwardly sloping angled portion **34**. The first and second longitudinal beams **24** and **26** are disposed generally parallel to each other such that the chassis **20** has a longitudinal axis **36**. The horizontal portions **28** and **32** of the first and second longitudinal beams **24** and **26** are disposed generally parallel to a roadway, shown generally at **38**, over which the apparatus **12** may be towed by the tractor vehicle **16** shown in Figure 1. Referring back to Figure 2, the chassis **20** further includes a plurality of wheeled axles shown generally at **40**, **42**, and **44**, enabling the chassis to be towed over the roadway surface **38**.

Still referring to Figure 2, the angled portions **30** and **34** of the first and second longitudinal beams have distal end portions **46** and **48**, respectively. Between these distal end portions, a transverse beam **50**, which is sometimes referred to as the "reaction beam", is secured to extend between the first and second longitudinal beams **24** and **26**. In this embodiment, the transverse beam **50** also extends out to the edge of the apparatus **12** and the container **18** is bolted to end plates of the transverse beam **50**. In one embodiment, the shaker **22** is mounted to the transverse beam **50**.

Referring to Figure 3, the shaker **22** is shown mounted to the transverse beam **50**, in greater detail. In this embodiment, the transverse beam **50** has a trapezoidal shape with first and second generally flat planar leg portions **52** and **54** joined together by a cross portion **56**. The first and second leg portions **52** and **54** have first and second securing portions **58** and **60**, respectively, which are configured to lie in a common plane for connection to the under surfaces **62** of the longitudinal beams **24** or **26**. To the second leg **54**, there is connected a flat plate, shown generally at **64**. A gusset **66** is connected between the cross portion **56** of the transverse beam **50** and the plate **64** to reinforce and rigidly secure the plate to the transverse beam. The shaker **22** includes an enclosure **68** and a base **70** which, in this embodiment, includes an 8 inch "C-shaped" channel. The base **70** is secured to the plate

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64 to permanently affix the shaker 22 to the chassis 20. Effectively, the plate 64 is used as a mount for the shaker 22. In this embodiment, the base 70 of the shaker 22 is welded to the plate 64, and the plate is welded to the transverse beam 50. The plate 64 increases the amount of surface area for welding the base 70 of the shaker 22, thereby improving its connection with the transverse beam 50. Mounting the shaker 22 on the second (rear) leg 54 of the transverse beam 50 helps to ensure adequate clearance to the roadway 38 and also shelters the shaker somewhat from roadway debris.

Referring to Figure 4, a shaker 23 (analogous to shaker 22) is shown mounted to the longitudinal beam (24 or 26) according to a second embodiment of the apparatus 12. In this embodiment, the base 70 of the shaker 23 is connected to the web of the longitudinal beam 24 by welding the base 70 to a plate 65, which is itself welded to the web of the longitudinal beam 24, for example. In some embodiments, the shaker 23 could be mounted directly to the longitudinal beam 24, however, in this embodiment, the plate 65 is effectively used as a mount for the shaker. Using the plate 65 to mount the shaker 23 also facilitates easy and secure connection of the shaker to the beam 24.

Referring now to Figure 5, an embodiment of the shaker 22 is shown in greater detail. The shaker 22 includes a motor 74 mounted to the base 70. The motor 74 has a shaft 75 disposed generally parallel to a longitudinal axis of the base 70 and is coupled to an eccentric weight system, shown generally at 76, through a coupler 78. The eccentric weight assembly 76 includes first and second support plates 80 and 82 to which are connected bearings 84 and 86. A shaft 88 is supported for rotation by the bearings 84 and 86 and is connected to the shaft 75 for rotation therewith.

A weight 90 is secured eccentrically to the shaft 88. In this embodiment, the weight 90 includes a length of solid square metal stock approximately 2x2 inches in size and weighing approximately 16 lbs. The weight 90 is secured

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to the shaft **88** by first and second end plates **94** and **96** such that a centre line **92** through the centre of mass of the weight **90** is parallel and spaced apart from the centre line of the shaft. When the shaft **88** is rotated by the motor **78**, the eccentric weight **90** rotates with the shaft and creates a vibration or shaking motion that is transferred to the support plates **80** and **82**, the base **70**, and, ultimately, to the chassis **20**.

The motor **74** is mounted to the C-channel base **70** by mounting straps **99**. In this embodiment, the motor comprises a **1** HP, **12V** DC motor nominally rotating at **1800** RPM and drawing a maximum of about **85** amps when accelerating and drawing about **35** amps when operating in steady state. In this embodiment, the motor **74** comprises a custom Baldor Industrial **12V** DC Motor, Type **PM3435P**, Cat. No. **CDP3445-V12**, capable of operating for **30** minutes or longer without overheating, in contrast to the starter-type motors which are typically used in vibrators intended for unloading operations on dump trucks, for example. The use of such a design is significant because loading both apparatuses **12** and **14** of the system **10** may take **20-30** minutes when loading the containers **18** and **19** from an overhead chute, or even longer, when a loader is used to deposit wood chips in the containers.

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Referring now to Figures **1** and **6**, the container **18** will now be generally described. The container **18** comprises a top portion shown generally at **104**, a bottom portion shown generally at **106**, a front portion shown generally at **108**, a rear portion shown generally at **110**, and first and second side portions **112** and **114**, respectively. The container **18** includes a hitch **126** on the front portion **108** of the container for hitching the apparatus **12** to the vehicle **16** for towing the apparatus.

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The top portion **104** includes a top inlet opening **105** for receiving bulk materials to be loaded into the container **18**, and the rear portion **110** has an outlet opening **115** for discharging the bulk materials from the container. The inlet opening **105** is typically covered by a tarpaulin during transport to

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enclose the bulk materials held in the container **18**. The rear portion **110** includes outlet doors (not shown) operable to be opened to facilitate unloading through the outlet opening **115**. When opened, the outlet doors of the apparatus **12** interface with a front inlet opening **117** on a front portion of the second container **19**, effectively bridging the gap between the apparatuses **12** and **14**, to provide a channel between the first container **18** and the second container **19**. Bulk materials are unloaded from the system **10** by fastening the entire system onto a hydraulic ramp which then tilts the entire system at a sharp angle to allow bulk materials held in the first container **18** to be discharged through the outlet opening **115**, into the second container **19** and through an outlet opening **116** in the second container.

Referring to Figure 6, the container **18** includes an inner floor **120** for supporting the bulk materials loaded in the container **18**. The inner floor **120** in this embodiment is continuous and thus prevents any of the bulk materials from being discharged therethrough. The inner floor **120** in this embodiment includes a number of generally planar floor sections, including a first floor section **121**, a second floor section **122**, and a third floor section **124**. The first floor section **121** is located in the front portion **108** of the apparatus **12**, the third floor section **124** is located in the rear portion **110**, and the second floor section **122** is located between the first and third floor sections **121** and **124**. The floor sections **121**, **122**, and **124** may not be perfectly flat since they may include embedded longitudinal members (not shown) arranged generally in a plane to reinforce the floor sections. Nevertheless, in this embodiment, the first and second floor sections **121** and **122** have a generally planar profile that is generally parallel to the longitudinal axis **125** of the system **10**. Referring back to Figure 1, the depth of the container **18** drops suddenly between the first and second floor portions **121** and **122** such that the second floor section **122** effectively comprises a drop bed portion **123** between the front and rear portions **108** and **110** of the apparatus **12**.

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In this embodiment, the third floor section **124** also has a planar profile and slopes gradually upward to facilitate discharge of bulk materials from the outlet opening **115** of the first apparatus **12** into the front inlet opening **117** of the second apparatus **14**. It will be noted that the chassis **20** generally supports the rear portion **110** of the container **18** but not the drop bed portion. The upwardly sloping third floor section **124** is supported by the angled portion (**30, 34** in Figure 2) of the underlying chassis **20**.

Referring to Figure 7, a circuit for powering the shakers **22** and **222** on the first and second apparatuses **12** and **14** shown in Figure 1, is shown generally at **130**. In this embodiment, the circuit includes a power supply portion **132**, a first distribution portion **134** associated with the first apparatus **12** and a second distribution portion **136** associated with the second apparatus **14**. The power supply portion **132** is located on the towing vehicle **16**. In this embodiment, the power supply portion **132** includes a battery **138**, which may be a battery of the vehicle **16** or a second, deep cycle battery, for example. The battery **138** is connected through a fuse **140** to a master control **142** which may include a high current switch, for example. The master control **142** is further connected to an indicator device, which in this embodiment includes a buzzer **144**, that is actuated when the master control is placed in an "on" position. The power supply portion **132** further includes a connector **146** which may be located at a rear portion of the towing vehicle **16** for connection to a complementary connector **148** of the first distribution circuit **134** on the first apparatus **12**. The connector **146** is supplied with power through the master control **142** such that when the master control is in the "on" position, power is available to the first distribution circuit **134** through the connector **146**.

The first distribution circuit **134** includes the complementary connector **148** which is operable to receive power through the connector **146** from the power supply circuit **132** for actuating the first shaker **22**. The connectors **146** and **148** are releasable, to facilitate separation of the apparatus **12** from the towing

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vehicle **16**. The distribution circuit **134** further includes a first control shown generally at **150** operably configured to selectively cause power received at the connector **148** to be supplied to the first shaker **22**. In this embodiment, the first control **150** includes a toggle switch **152** and a solenoid **154**. The toggle switch **152** controls the solenoid **154** such that when the toggle switch is closed, the solenoid **154** is energized to cause power to be received from the connector **148** and supplied to the first shaker **22**. The toggle switch **152** may be located on the first apparatus **12** in a convenient location to facilitate easy user access and operation to enable a user standing beside the apparatus to actuate the toggle switch **152** to cause the shaker **22** to begin shaking when the container **18** of the first apparatus **12** is being loaded.

In this embodiment, the circuit **130** may optionally include a second power distribution circuit portion **136** including a second connector **156** operable to receive at least some power from the connector **148**. The second power distribution portion **136** is similar to the first power distribution portion **134** in that it includes a control **160**, which in this embodiment includes a toggle switch **162**, and a solenoid **164**. When the second toggle switch **162** is closed, the solenoid **164** is energized thereby causing power to be supplied from the connector **148** to the connector **156**. The second connector **156** may be located near the rear portion **110** of the apparatus **12** to facilitate connection to a complementary connector **158** of the second power distribution portion **136** on a front portion of the apparatus **14**, for example. The connectors **156** and **158** are releasably connectable such that the second apparatus **14** may be separated from the first apparatus **12** if necessary.

The first and second controls **150** and **160**, and in particular the switches **152** and **162** thereof, may be mounted on the container **18** in a recess **165** in a wall of the first container **18**. In one embodiment, the first and second controls **150** and **160** are mounted in a control box **167** in Figure 1 embedded in a side wall of the container **18** such that the controls **150** and **160**, and more particularly the switches **152** and **162** thereof, are accessible to the

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operator but are protected from the elements by a cover of the control box. The control box **167** may be lockable to prevent unauthorized access to the controls **150** and **160**.

5 Although the power supply circuit **130** of this embodiment has been described as an electrical system, it will be appreciated that the power supply assembly could be alternately implemented as a hydraulic or pneumatic system, for example.

10 Referring now to Figure **8**, a method of manufacturing the apparatus **12** is shown generally at **170**. The method involves a number of steps which need not be necessarily taken in the order shown in Figure **8**. Generally, referring to Figure **1**, the method involves operably connecting the shaker **22** to the wheeled chassis **20** to which is mounted the container **18**. The method
15 further involves operably connecting at least one power controller, such as the first and second controls **150** and **160** shown in Figure **7**, in a location accessible by the operator, for example, to the container **18** and/or the chassis **22**. The method further involves connecting the power controller to the releasable connector **148** receiving power from the power supply **132**.
20 The method also involves connecting the power controller to the shaker **22** to facilitate operator control of power supplied to the shaker. The power controller permits the operator to control power supplied to the shaker **22** and thereby to cause the shaker to shake the chassis **20** and the container **18** mounted thereto, to increase packing density of bulk materials in the
25 container.

Referring to Figure **1**, connecting the shaker **22** to the wheeled chassis **20** may involve connecting the shaker **22** to at least one of a longitudinal or transverse beam (e.g., **24** or **50**) of the chassis as shown in Figure **2**. This
30 may involve welding the base **70** of the shaker **22** to a mount supported by the beam. The mount includes the plate **64** or **65** in this embodiment. Since the first apparatus **12** is coupled to tow the second apparatus **14**, manufacture

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of the apparatus **12** may further involve installing an additional connector such as **156** on the apparatus **12** in order to supply power to a complementary connector such as **158** connectable thereto on the second apparatus **14**, for powering the second shaker **222** on the second apparatus **14**. In the case of the first apparatus **12**, this latter step of manufacturing may be unnecessary if no additional container is to be towed behind the first apparatus **12**.

Referring to Figure **9**, a method of densifying bulk materials for transport is shown generally at **200**. The method involves causing the container **18** to shake in response to actuation of the shaker **22** mounted on the wheeled chassis **20**, on which the container is mounted, while causing bulk materials to be received in the container. The method further involves facilitating receipt and storage of the bulk materials in the drop bed portion **123** of the container **18**. Causing the container **18** to shake involves controlling power supplied to the shaker **22**, which, in this embodiment involves actuating the switch **152** of the control **150** to selectively supply power to the shaker. Similarly, bulk materials in the second apparatus **14** are densified for transport by operation of the shaker **22** in response to user actuation of the second control **160**.

It has been found that the embodiments and methods described herein may be capable of increasing the effective capacity of a wood chip transportation system by about **15%** in some cases by densifying, i.e., increasing the packing density of, wood chips in the container **18**. Moreover, the approach described tends to cause wood chips to automatically spread within the container **18** during loading thus reducing the need for the operator to climb on top of the container **18** to groom the crown of the load to fill unused space in the container. This increases the safety and efficiency of the loading operation. Although the exemplary embodiments and methods herein have been described in relation to the densification and transport of wood chips, it should be appreciated that these embodiments and methods may be profitably applied to other types of bulk material cargo as well.

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While specific embodiments of the invention have been described and illustrated, such embodiments should be considered illustrative of the invention only and not as limiting the invention as construed in accordance with the accompanying claims.

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What is claimed is:

1. An apparatus for densifying and transporting bulk materials, the apparatus comprising:

5 a container for holding bulk materials;

a wheeled chassis for transporting the container along a roadway;

10 a shaker, mounted on said wheeled and transportable therewith, for shaking said container while said container is being loaded, to increase packing density of bulk materials in said container.

2. The apparatus of claim 1 wherein said shaker is permanently connected to said chassis.

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3. The apparatus of claim 1 wherein said chassis comprises first and second spaced apart longitudinal beams, disposed generally parallel to a longitudinal axis of said chassis.

20 4. The apparatus of claim 3 wherein said shaker is operably mounted on at least one of said first and second longitudinal beams.

25 5. The apparatus of claim 3 wherein said chassis further comprises a transverse beam extending between said first and second longitudinal beams wherein said shaker is operably mounted on said transverse beam.

6. The apparatus of claim 5 further comprising a plate extending from said transverse beam, said shaker being operably mounted on said plate.

30 7. The apparatus of claim 6 further comprising a gusset for reinforcing said plate.

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8. The apparatus of claim 1 further comprising a mount, affixed to said chassis, operably configured to mount said shaker to said chassis.

5 9. The apparatus of claim 8 further comprising a reinforcing member for reinforcing said mount.

10. The apparatus of claim 1 wherein said container comprises:

a plurality of sheet material panels; and

10

fasteners fastening said plurality of sheet material panels together to form an enclosure.

11. The apparatus of claim 1 wherein said container comprises top, bottom, front, rear and first and second side portions, said top portion having an inlet for receiving bulk materials to be loaded into said container, said rear portion having an outlet for discharging the bulk materials from said container.

15

12. The apparatus of claim 1 wherein said container comprises an inner floor, a substantial part of which comprises at least one generally planar floor section having a longitudinal axis generally parallel to a longitudinal axis of said chassis.

20

13. The apparatus of claim 12 wherein said inner floor is continuous.

25

14. The apparatus of claim 1 further comprising a hitch on said front portion of said container for hitching the apparatus to a vehicle.

15. The apparatus of claim 11 wherein said container comprises a drop-bed portion, between said front and rear portions, said chassis directly supporting said rear portion but not said drop-bed portion.

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16. The apparatus of claim **1**, further comprising at least one connector for receiving power from a power supply, for actuating the shaker.

5 **17.** The apparatus of claim **16** wherein said at least one connector is releasably connectable to a complementary connector on a vehicle, to facilitate separation of said apparatus from said vehicle.

10 **18.** The apparatus of claim **16** further comprising a first control operably configured to selectively cause said power supply to supply power through said at least one connector to said shaker when said at least one connector is receiving said power for actuating the shaker.

15 **19.** The apparatus of claim **18** wherein said first control is located on said container.

20. The apparatus of claim **18** wherein said container has a recess and said first control is located in said recess.

20 **21.** The apparatus of claim **20** wherein said control includes an electrical switch.

25 **22.** A system for densifying and transporting bulk materials in a container, the system comprising the apparatus of claim **18** and further comprising a power supply, a second control and a complementary connector, complementary to said at least one connector, said second control being operably configured to selectively cause said power supply to supply power to said complementary connector, for receipt by said at least one connector for actuating the shaker.

30 **23.** The system of claim **22** further comprising a signaling device operably configured to provide a signal to an operator when power for actuating the shaker is being supplied to said complementary connector.

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24. The system of claim **22** wherein said second control is located in a cab of a vehicle operable to haul said apparatus.

5 **25.** The system of claim **23** wherein said signalling device is mounted on a vehicle operable to haul said apparatus.

10 **26.** The system of claim **22** wherein said shaker comprises a rotatable shaft, an eccentric weight mounted on said shaft and a motor operable to rotate said shaft in response to power received from said power supply.

15 **27.** The system of claim **26** wherein said power supply is selected from the group consisting of an electrical power supply, a hydraulic power supply, and a pneumatic power supply.

28. A method of manufacturing an apparatus for densifying and transporting bulk materials, the method comprising:

20 operably connecting a shaker to a wheeled chassis on which is mounted a container formed of individual sheet material panels fastened together, for carrying bulk materials;

operably connecting a power controller to at least one of said chassis and said container in a location accessible by an operator;

25 operably connecting said power controller to at least one releasable connector for receiving power from a power supply associated with a vehicle operable to tow said apparatus;

30 operably connecting said power controller to said shaker to facilitate operator control of power supplied to said shaker to permit the operator to control said

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power to cause said shaker to shake said chassis and said container mounted thereto, to increase packing density of bulk material in said container.

5 **29.** The method of claim **28** wherein connecting said shaker to said wheeled chassis comprises operably connecting said shaker to at least one of a longitudinal or transverse beam of the chassis.

10 **30.** The method of claim **28** wherein connecting a shaker to said wheeled chassis comprises welding a base of said shaker to a mount supported by a transverse beam of the chassis.

15 **31.** The method of claim **28** further comprising installing an additional connector on said apparatus, said additional connector being operable to receive at least some power from said at least one connector and to supply said at least some power to a connector connected thereto for powering a second shaker on a second apparatus.

20 **32.** An apparatus for densifying and transporting bulk materials, the apparatus comprising:

holding means for holding bulk materials;

transporting means for transporting the holding means along a roadway; and

25 shaking means, mounted on the transporting means, for shaking the transporting means to impart shaking to the holding means while the holding means is being loaded, to increase packing density of bulk materials held by the holding means.

30 **33.** A method of densifying bulk materials for transport, the method comprising:

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causing a container operable to hold bulk materials to shake in response to actuation of a shaker mounted on a wheeled chassis on which said container is mounted, while causing bulk materials to be received in said container.

5 **34.** The method of claim **33** further comprising facilitating receipt and storage of said bulk materials in a drop bed of said container, wherein said drop bed is located adjacent wheels of said wheeled chassis.

10 **35.** The method of claim **33** wherein causing said container to shake comprises controlling power supplied to said shaker.

36 The method of claim **35** wherein controlling power supplied to said shaker comprises actuating a switch to selectively supply power to said shaker.

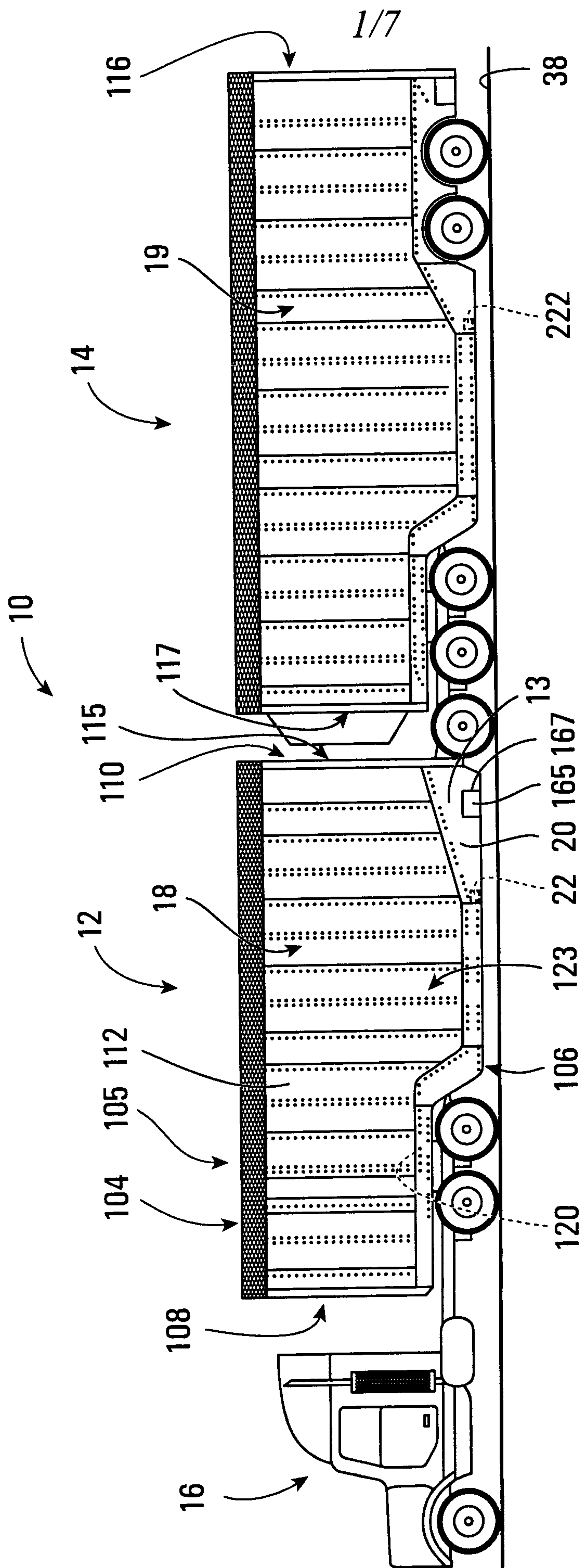
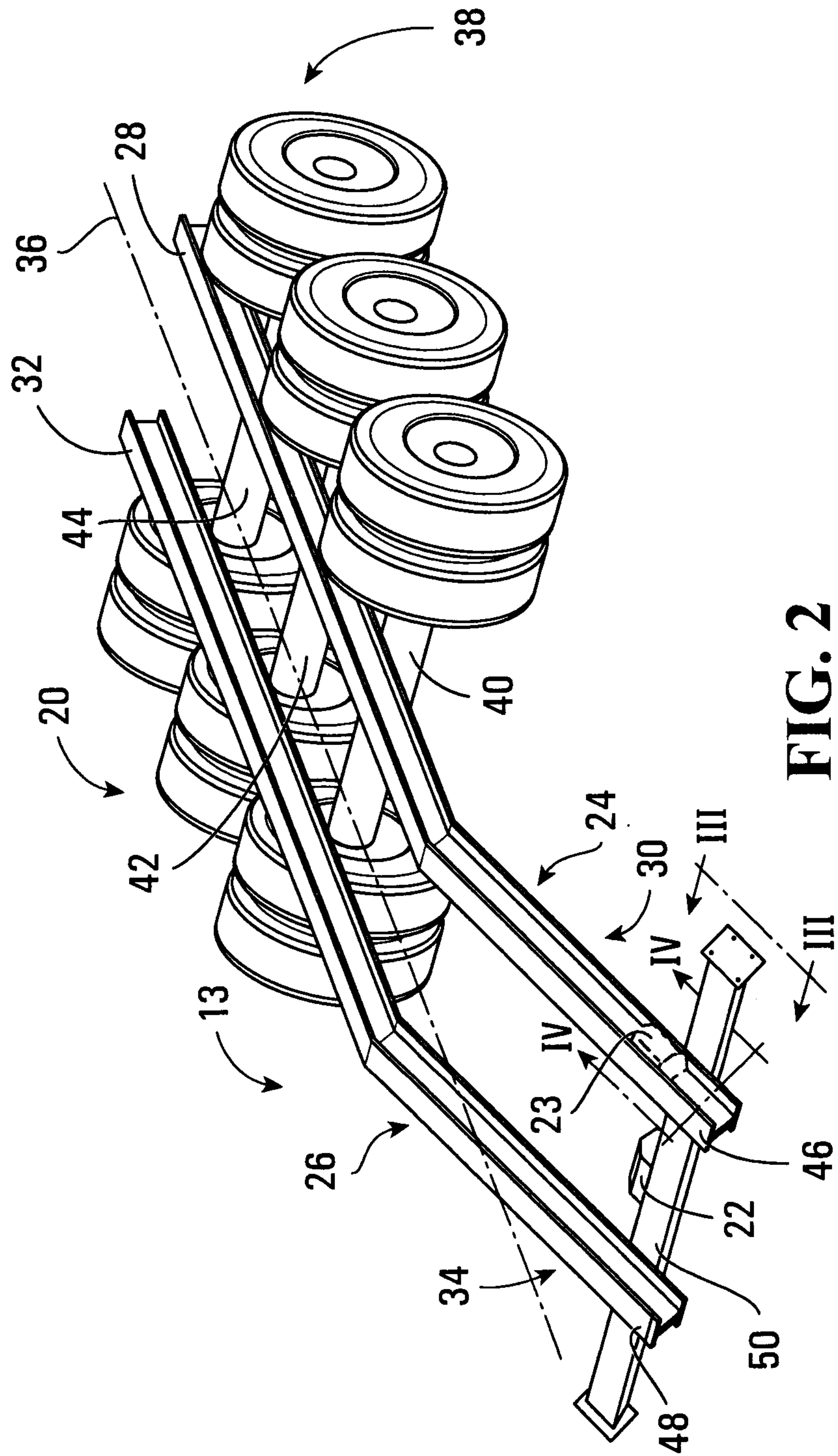


FIG. 1



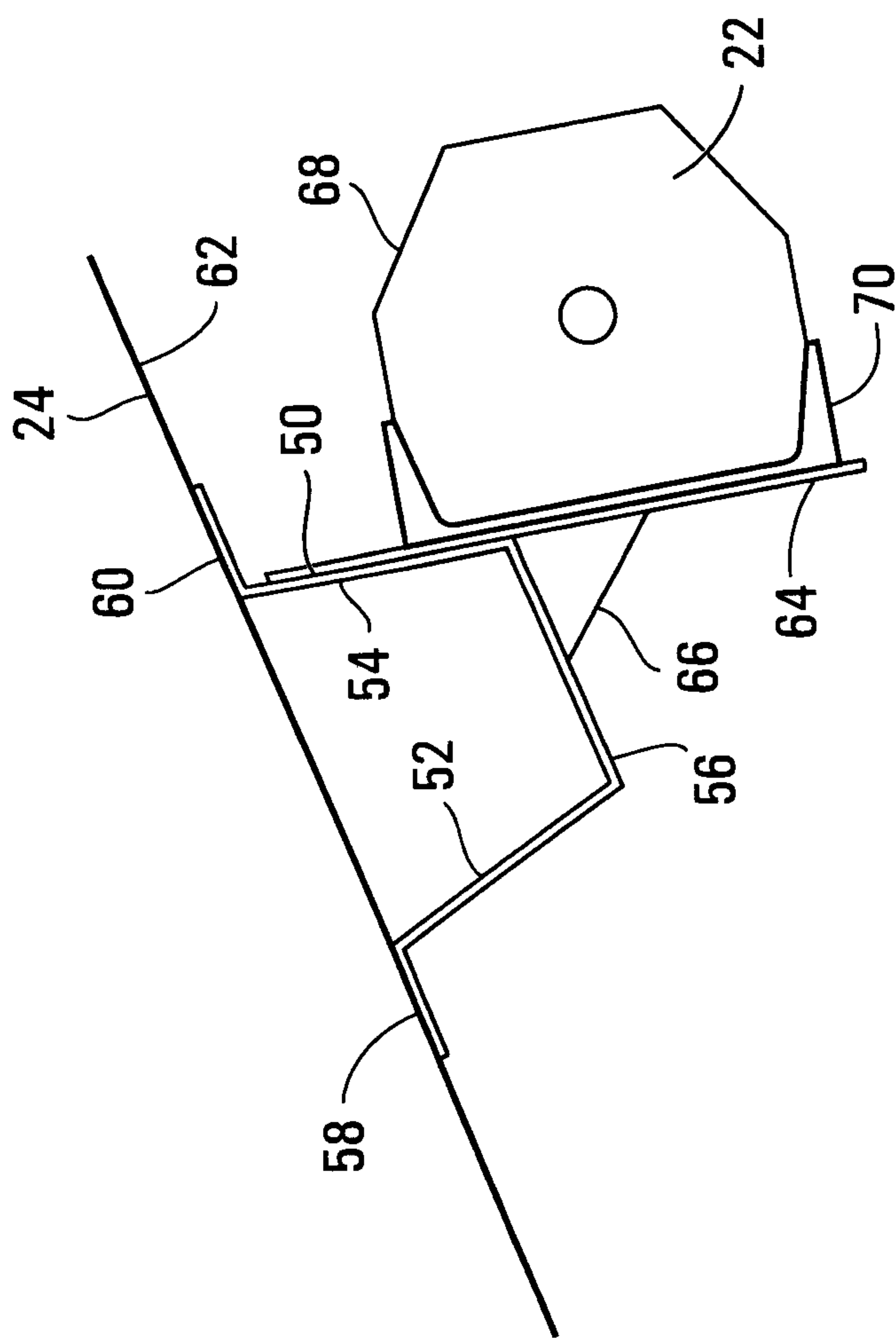


FIG. 3

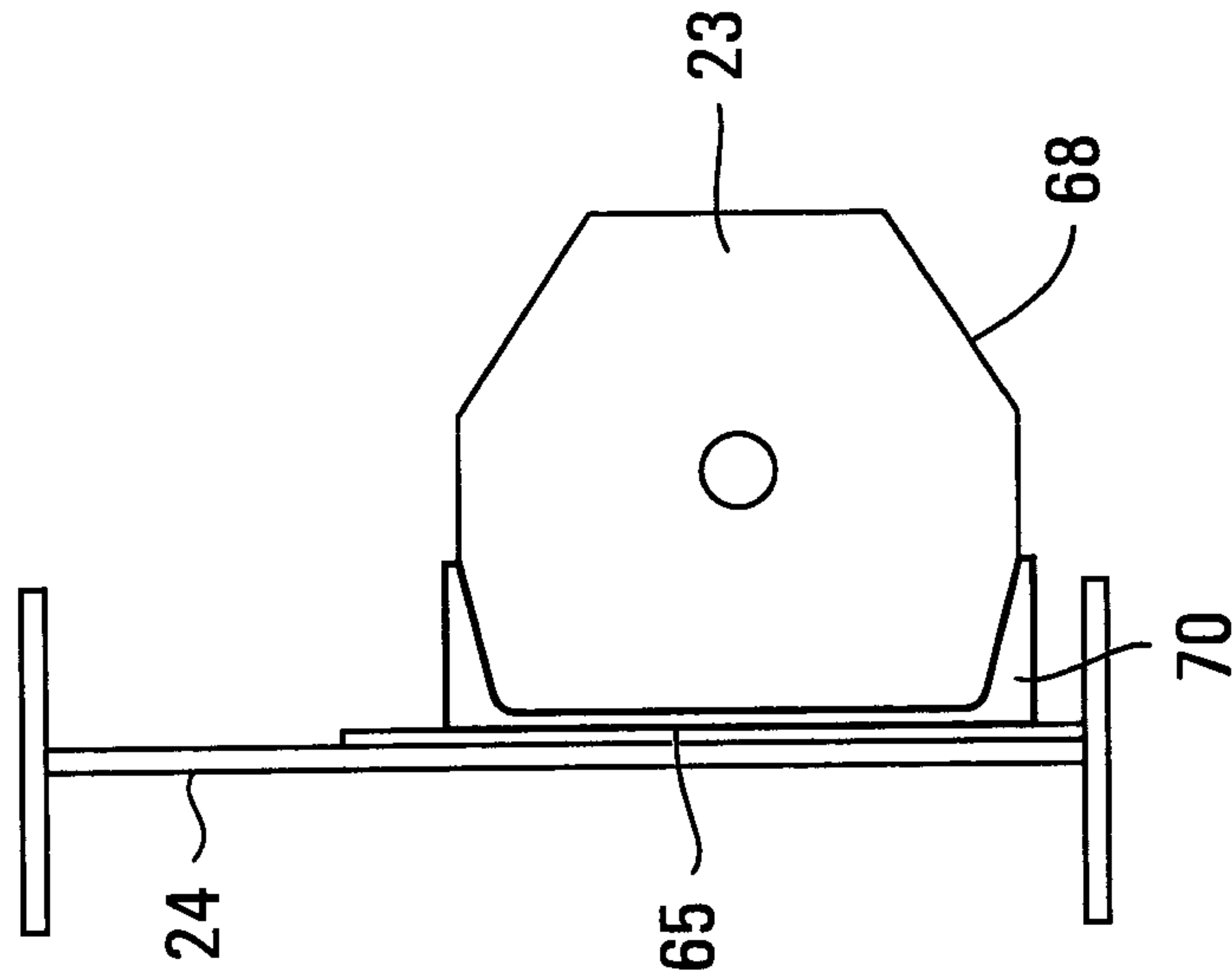


FIG. 4

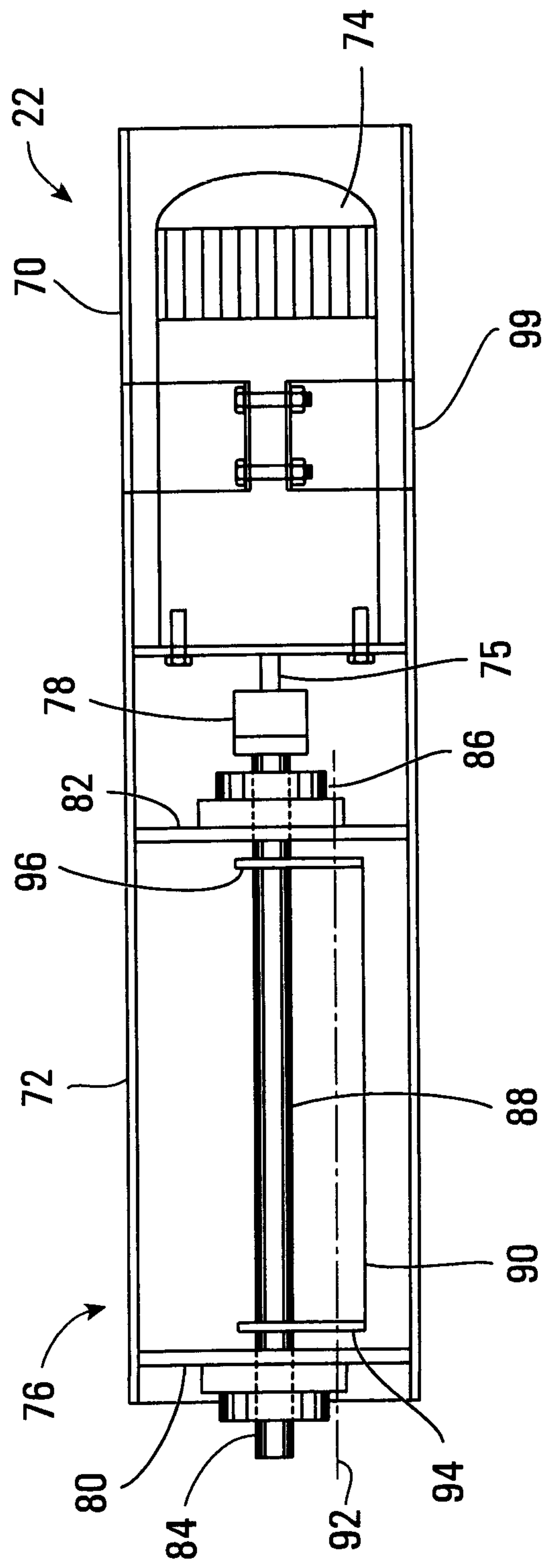


FIG. 5

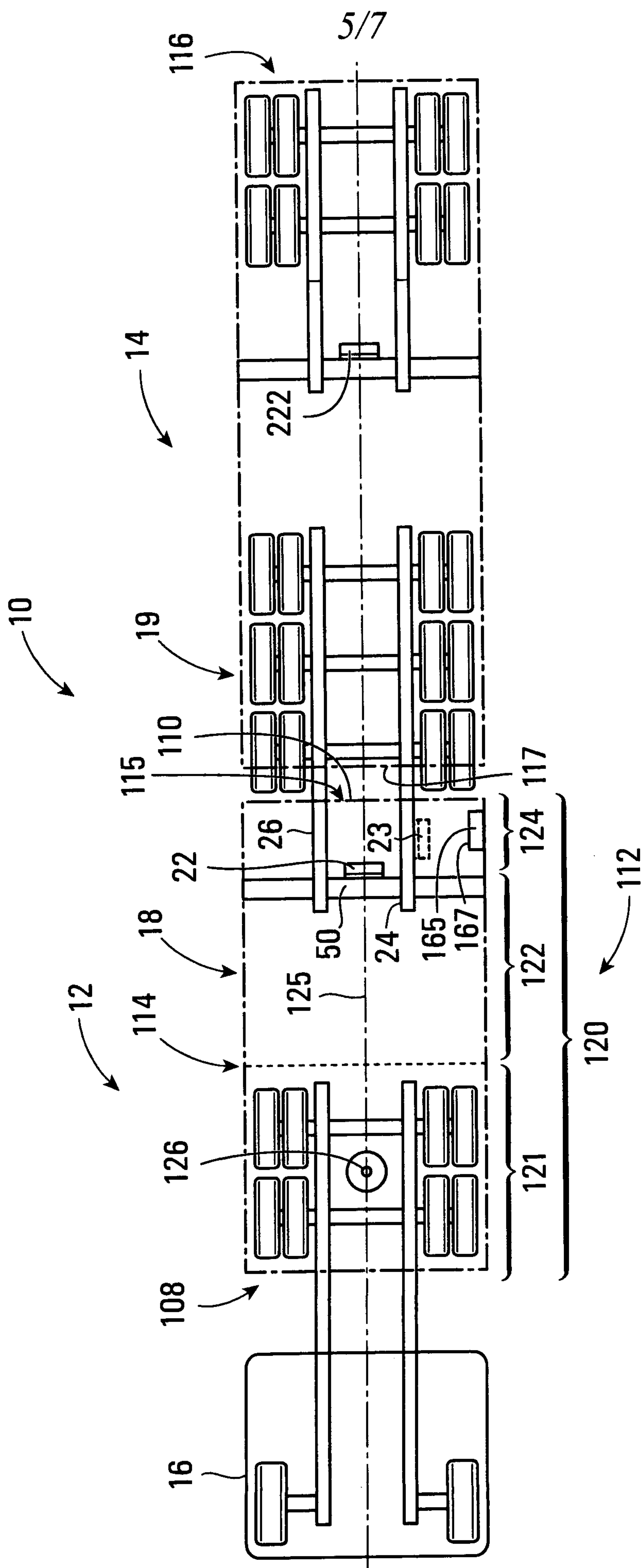
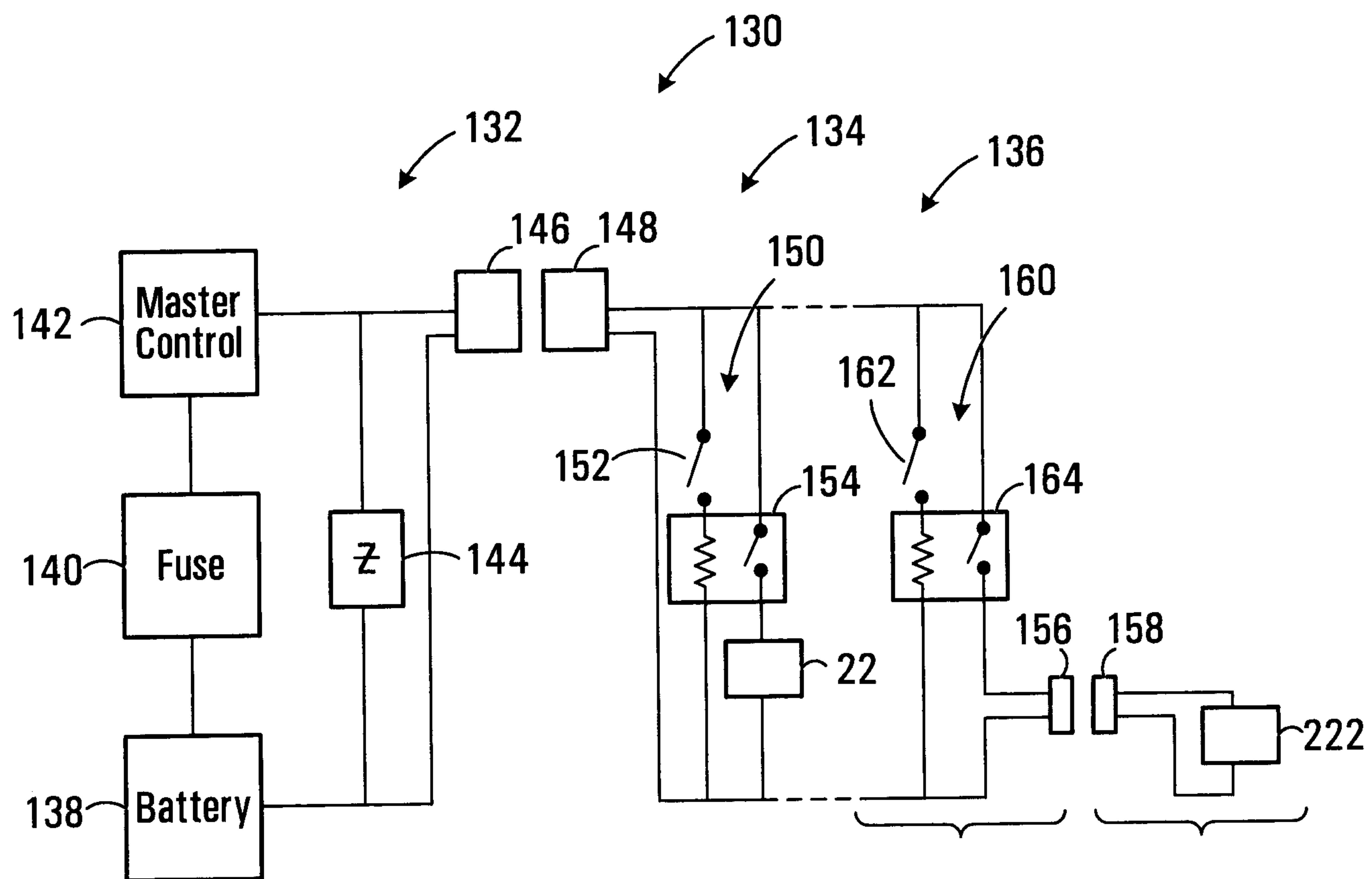
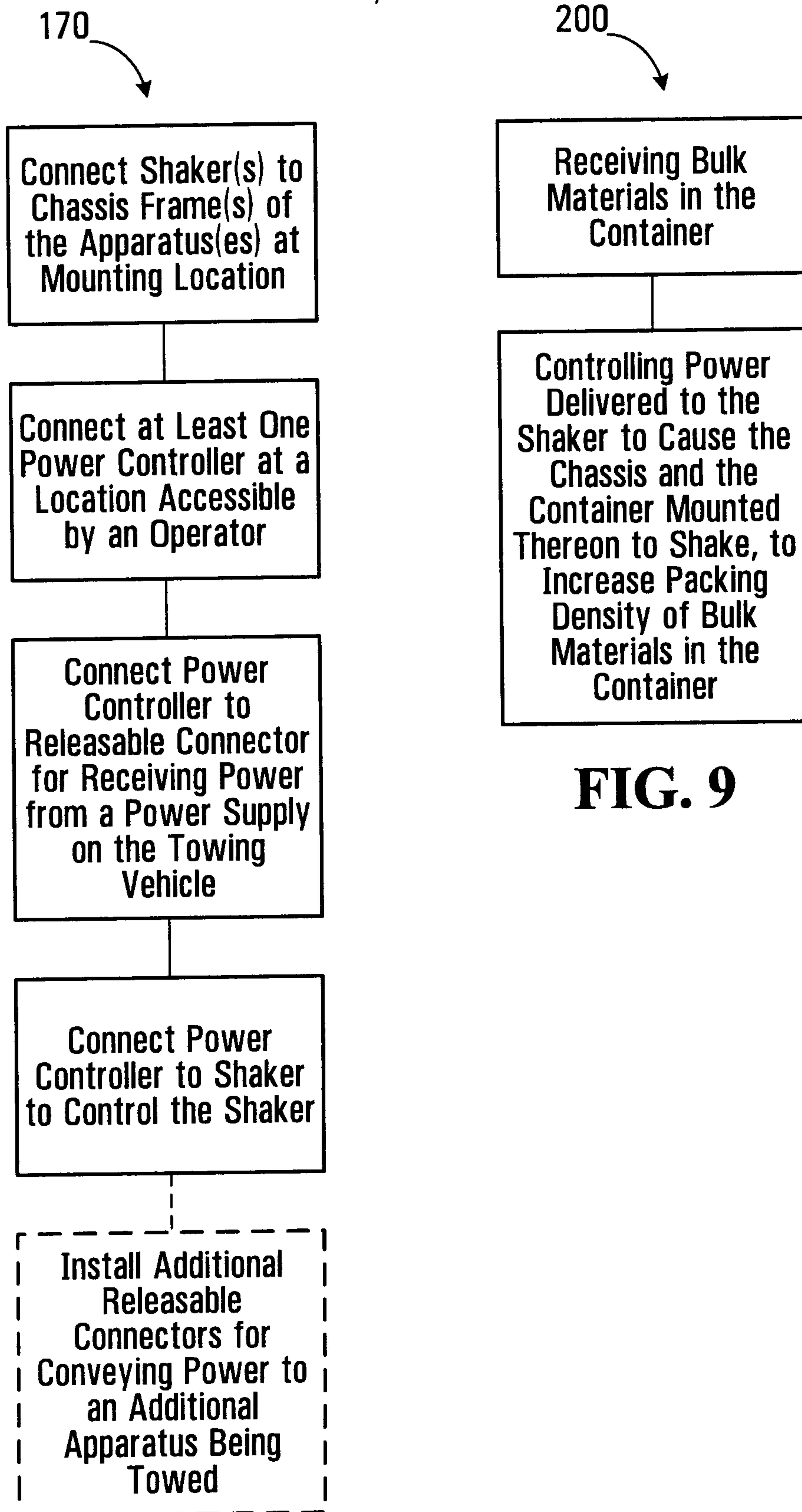


FIG. 6

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**FIG. 7**

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**FIG. 9****FIG. 8**

