(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 June 2005 (23.06.2005)

PCT

(10) International Publication Number
WO 2005/056441 A1

(51) International Patent Classification[7]: B65G 53/28, 65/34, 67/24

(21) International Application Number:
PCT/AU2004/001245

(22) International Filing Date:
13 September 2004 (13.09.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2003906937 15 December 2003 (15.12.2003) AU

(71) Applicant *(for all designated States except US)*: **CRT GROUP PTY LTD** [AU/AU]; 1 Chambers Road, Altona North, Victoria 3025 (AU).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **DAY, Graham** [AU/AU]; 12 Temple Road, Belgrave South, Victoria 3160 (AU).

(74) Agent: **F B RICE & CO**; 139-141 Rathdowne Street, Carlton, Victoria 3053 (AU).

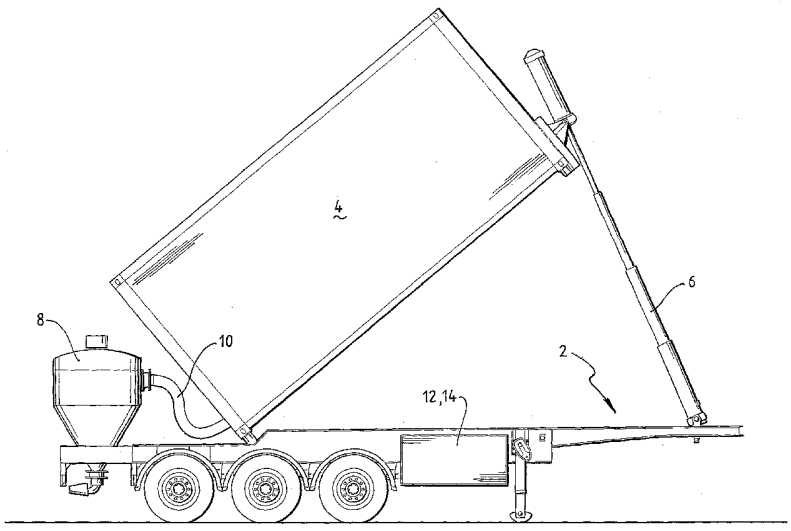
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** PNEUMATIC MATERIAL DELIVERY APPARATUS AND METHOD



(57) **Abstract:** Material delivery apparatus mounted on a vehicle (2) for delivering particulate or fine material from an unpressurized container (4) on the vehicle (2) to another location. The apparatus has a vessel (8) having an inlet valve to permit ingress of the particulate material to the vessel (8), an outlet valve to permit egress of the particulate material to the other location, a blower (14) for creating a current of air and a first valve (26) between the blower (14) and a port of the vessel (8). When the blower (14) produces the current of air the apparatus functions in a first mode whereby the particulate material is moved pneumatically from the container (4) to the interior of the vessel (8) and thereafter functions in a second mode whereby the particulate material is moved pneumatically from the interior of the vessel (8) to the other location.

WO 2005/056441 A1

Pneumatic Material Delivery Apparatus and Method

Field of the Invention

This invention relates to a pneumatic material delivery apparatus and method. More particularly, it relates to a method and apparatus for transferring particulate and/or fine material pneumatically from a first location, such as a bulk container on a transport vehicle, to a second location which may be either a further process or another container, such as a silo.

Background to the Invention

There presently exists a number of vehicles, such as trailers that each carry a container and have the facility for unloading the contents of the container. The contents is typically particulate or fine matter. However, most such trailers use rotary valves having a plurality of vanes, that have the potential to degrade the contents as it is being dispensed through these valves. Furthermore there is the potential for the valves to clog up with the material, when used for fine material, and therefore make the discharge process inefficient as well as time consuming in that the valves need to be freed of the clogged material. This takes time and increases the cost of maintaining the discharge apparatus.

There are existing material conveying systems that use an engine-driven compressor and hydraulic pump, which, with the assistance of gravity, discharge the particulate or fine material to a rotating, vaned valve to propel the material to another container or silo for storage.

The present invention seeks to overcome the above disadvantages by providing a facility for discharging the particulate or fine material from a container but does not use a rotating vaned outlet valve. The valves used in the present invention are operated solely by air. Furthermore the present invention provides an improved system for discharging the contents of a container mounted on a transport vehicle using a pressure and vacuum vessel that operates pneumatically under the action of an engine-driven Rootes-type blower configured to provide both vacuum and pressure.

Summary of the Invention

According to a first aspect of the invention there is provided material delivery apparatus mounted on a vehicle for delivering particulate or fine material from an unpressurized container on the vehicle to another location, the apparatus comprising:

a vessel having an inlet valve connected to the container to permit ingress of the particulate material to the vessel and an outlet valve to permit egress of the particulate material to the other location;

a blower for creating a current of air; and

a first valve disposed between the blower and a port of the vessel;

such that when the blower operates to produce the current of air the apparatus functions in a first mode whereby the particulate material is moved pneumatically from the container assisted by gravity to the interior of the vessel and thereafter functions in a second mode whereby the particulate material is moved pneumatically from the interior of the vessel to the other location.

A tubular means, such as a hose may be connected between the container and the inlet valve of the vessel such that, during the first mode, the particulate material travels through the tubular means under vacuum and assisted by gravity whereby the container is tilted.

The first valve disposed between the blower and vessel may be a two-way valve such that the first valve is disposed in a first position during the first mode whereby a vacuum is created between the vessel and an intake side of the blower to enable the particulate material to be moved from the container to the interior of the vessel. The first valve may be disposed in a second position during the second mode such that air is circulated from an outlet side of the blower through the valve and into the vessel to force the particulate material under pressure through the outlet valve of the vessel. Preferably the inlet valve is open and the outlet valve is closed during the first mode. Preferably the inlet valve is closed and the outlet valve is open during the second mode.

Preferably the apparatus uses a controller, such as a PLC, to operate the first valve, second valve, inlet valve and outlet valve in order to effect changing from the first mode to the second mode. This is preferably performed after a predetermined level of the material in the vessel is detected.

A second valve may be connected between the blower and the first valve, such that a first port of the second valve is connected by pipe means to the first valve, a second port is connected to the air intake side of the blower and a third port is

connected to the atmosphere. Preferably during the second mode, the port connected to the atmosphere is open to enable air to flow through the blower and to the vessel to assist in forcing the particulate material through the outlet valve. During the first mode the port connected to the atmosphere is preferably closed.

The outlet side of the blower may be connected to an outlet pipe, which is also preferably linked to the outlet valve of the vessel, leading to the other location. Thus in the second mode, pressurised air may also be applied to the particulate material as it leaves the outlet valve of the vessel to assist with moving the material to the second location. A bypass valve may be disposed between the outlet side of the blower and the outlet pipe, which bypass valve may have an aperture that is adjustable during the second mode. Preferably the aperture is set open to approximately 75 percent of its full open state during the second mode.

The other location may be a further process, such as a flow or conveyor system or be a further container or storage means.

The vehicle may include a trailer having mounted thereon the container and the vessel. The vessel may be located adjacent the rear of the trailer. A hoist mechanism may be used to tilt the container, thereby assisting the flow of particulate material during the first mode.

The apparatus may further comprise filter means located adjacent the port of the vessel. The apparatus may further comprise aeration means located inside the vessel adjacent the outlet valve for aerating the particulate material. The apparatus may further comprise vibration means attached to the hoist mechanism adjacent one end of the container for assisting in moving the particulate material to the tubular means. The apparatus may further comprise filter means located at the intake side of the blower.

The trailer may be extendible or retractable to accommodate varying lengths of containers. The trailer may have a moveable frame assembly fitted thereto so as to move the container along the trailer between a transportation position and an unloading position. The trailer may comprise a main portion and a rear portion attached to the main portion by hinge means, the main portion and rear portion fitting together when a container is carried in a transportation position and separating apart from the hinge means when the container is tilted and a support attached to the rear portion of the trailer contacts the ground. The container may be supported by the main portion of the trailer and the vessel may be supported by the rear portion of the trailer.

According to a second aspect of the invention there is provided a material delivery apparatus for delivering particulate or fine material from a first location to a second location, the apparatus comprising:

a vessel having an inlet valve to permit ingress of the particulate material to the vessel and an outlet valve to permit egress of the particulate material to the second location;

a blower for creating a current of air; and

a first valve disposed between the blower and a port of the vessel;

such that when the blower operates to produce the current of air the apparatus functions in a first mode whereby the particulate material is moved pneumatically from the first location assisted by gravity to the interior of the vessel and thereafter functions in a second mode whereby the particulate material is moved pneumatically from the interior of the vessel to the second location.

The apparatus may be fitted to a transportation vehicle, such as a trailer adapted to be hauled by a truck, and the first location may be an unpressurized container fitted to the transportation vehicle containing the particulate material.

The vessel may conveniently be located adjacent the rear of the trailer. The container on the trailer may be tilted using a hoist mechanism on the trailer such that the particulate material is assisted by gravity to enter the tubular means, connected to the rear of the container, during the first mode.

According to a third aspect of the invention there is provided a method of delivering particulate or fine material from a first location to a second location comprising the steps of:

providing a vessel having an inlet valve to permit ingress of the particulate material to the vessel and an outlet valve to permit egress of the particulate material to the second location;

creating a stream of air using a blower;

using the stream of air to create a vacuum such that the particulate material during a first mode is moved pneumatically from the first location assisted by gravity to the interior of the vessel and thereafter creating air pressure during a second mode such that the particulate material is moved pneumatically from the interior of the vessel to the second location.

The method may further comprise the step of operating a first valve located between the blower and the vessel in a first position to ensure the vacuum is created

and in a second position to ensure air pressure is maintained to pneumatically move the particulate material from the interior of the vessel to the second location.

According to a fourth aspect of the invention there is provided a method of delivering particulate or fine material from an unpressurized container mounted on a vehicle to another location comprising the steps of:

providing a vessel on the vehicle, the vessel having an inlet valve to permit ingress of the particulate material to the vessel and an outlet valve to permit egress of the particulate material to the other location;

creating a stream of air using a blower;

using the stream of air to create a vacuum such that the particulate material during a first mode is moved pneumatically from the interior of the container assisted by gravity to the interior of the vessel and thereafter creating air pressure such that during a second mode the particulate material is moved pneumatically from the interior of the vessel to the other location.

Brief Description of the Drawings

The invention will hereinafter be described in a preferred embodiment, by way of example only, with reference to the drawings wherein:

Figure 1(A) is a side view of an extendible trailer in a retracted position supporting a 20 foot container in an inclined discharge position for assisting the discharge of the contents of the container, the trailer also having a vacuum and pressure vessel linked to the container to pneumatically assist with the discharge of the contents into a further process;

Figure 1(B) is a side view of an extendible trailer in a retracted position supporting a 20 foot container in a running position;

Figure 2 shows the apparatus in a load cycle where a vacuum is created within the system;

Figure 3 shows the apparatus in a discharge cycle where positive pressure is applied in order to discharge the contents or particulate matter from the vessel;

Figure 4 is a schematic diagram of a two-way valve used in the system;

Figure 5 is a side view similar to Figure 1(A) and showing an exploded part-sectional view of a filter housing and its attachment to the top of the vacuum and pressure vessel;

Figure 6(A) is a side view of an extendible trailer in an extended position supporting a 30 foot container in a running position;

Figure 6(B) is a side view of an extendible trailer in an extended position supporting a 30 foot container in an inclined discharge position;

Figure 7(A) is a side view of an extendible trailer in a retracted position supporting a 30 foot container in a running position;

Figure 7(B) is a side view of an extendible trailer in a retracted position supporting a 30 foot container in an inclined discharge position;

Figures 8(A) and 8(B) are respectively side views of a 20 foot container in the running position and in an inclined discharge position, the trailer incorporating a frame assembly for moving the container along the trailer between the running position and a discharge position towards the rear of the trailer; and

Figures 9(A) and 9(B) are respectively side views of a 30 foot container in the running position and in an inclined discharge position, the trailer incorporating a frame assembly for moving the container along the trailer between the running position and a discharge position towards the rear of the trailer.

Detailed Description of the Preferred Embodiment

With reference to Figure 1(A) there is shown a trailer 2 adapted to be attached to a truck and has loaded thereon a container 4 containing particulate material, such as plastics in the form of polymers, bulk products or even very fine or powdery products. The container 4 is shown in a raised position, provided by a hydraulic hoist 6 mounted on the trailer 2, to assist under gravity with the movement of the particulate material into a vacuum and pressure vessel 8 which is mounted at the rear of the trailer 2. Thus under the action of gravity it assists in placing and discharging a particulate material ready for suction via a suction hose 10 connected between the vessel 8 and the container 4. The container 4 is 20 feet in length and the trailer 2 is shown in a fully retracted position. The trailer 2 can be extended in length to accommodate longer containers such as those of 30 feet and 40 feet long, as will be described hereinafter. In Figure 1(B) the trailer 2 is shown in a running position, that is, for movement on the road. The container 4 may be a standard bulk container or a dry box container with bulk liners, each of which can vary in size and cannot be pressurized.

With reference to Figure 2 there is a more detailed diagram showing the operation of the apparatus under a load (vacuum) cycle. An engine 12 operates a

blower (or compressor) 14 which is configured to provide a vacuum on its upstream side and air pressure on its downstream side such that an air stream is created for assisting in moving particulate material to a further process or storage container. Thus, through a series of pipes and valves, the blower 14 creates a vacuum throughout the system and displaces the particulate material from the container 4 into the vessel 8. Specifically, a second valve 16 , termed a vent valve, is linked to an air intake inlet 18 of the blower 14 via port 20. Via port 22 the blower 14 is linked through pipe 24 to a first valve, being a two-way valve 26, and finally through port 28 it is linked to the atmosphere through pipe 30. The two-way valve 26 is linked through pipe 32 to a port 34 located at the top of the vessel 8. The vacuum in pipe 24 is created by having port 28 closed and the two-way valve 26 in a closed position as shown whereby air in pipe 36 is blocked to the first valve 26. An inlet valve 38 to the vessel 8 remains open so that the contents of the container 4 can be discharged or sucked into the vessel 8. An outlet valve 40 to the pressure vessel 8 remains closed. A manual vacuum valve 42 is in a closed position during this part of the process. Thus negative air pressure builds up in pipe 24 via the action of the blower 14 such that the particulate material is sucked into the vessel 8 via the input valve 38 and slowly builds up as a pile 44 in the vessel 8. The vacuum extends throughout the unfilled portion of the vessel 8, through pipe 32, valve 26, pipe 24 and through the ports 22 and 20 of the valve 16 to the air intake side 18 of the blower 14. At the same time a pressure outlet side 19 of the blower 14 has discharged therethrough positive pressurised air such that it flows through a bypass valve 46 through to an outlet pipe 48 and into the further process or discharge container/silo into which the particulate material will eventually be discharged. Positive pressurised air also passes through pipe 36 but is unable to go any further due to the closed valve 26.

An on-board programmable logic controller (PLC) with a control panel, controls the operation of the valves such that on detection by a high level probe 50 of the level of the product in vessel 8 reaching a predetermined level, the PLC reverts the process from a load cycle to a discharge cycle (see Figure 3). Thus the PLC, through particular valving and piping, applies positive air pressure to the vessel 8 in order to start the process of discharging the particulate material within the vessel 8 into a further silo or container, for example that of a customer. The PLC opens the second valve 16 such that full pressurised air is able to be applied via the blower 14 to the outlet pipe 48 and also to the vessel 8. The two way valve 26 is opened to be in a position shown in

Figure 3 whereby the valve stem 52 and valve disc 54 are displaced to allow the air to flow from pipe 36 into pipe 32 and then into the top of the vessel 8. The outlet valve 40 is opened to allow the discharge of the particulate material whereby pressure is applied via the air at the top of the vessel 8 onto the pile 44 of particulate material. The valve 40 may be opened to suit particular conditions, while the inlet valve 38 remains closed. At the same time the bypass valve 46 is opened to approximately 75% of its full aperture to allow additional pressurised air from the blower 14 to be fed to the outlet pipe 48 (to a system) to assist the discharge process. Thus the pressure builds up on the top surface of the pile 44 of particulate material in the vessel 8 and is forced out through the valve 40 into the outlet pipe 48 and the air stream from the blower 14 forces it into the further process. A low pressure switch (not shown) operated by the PLC changes the cycle back to a load cycle when it senses a drop in pressure within the vessel 8. Thus a suitable pressure meter is used to detect the pressure within the vessel 8. A sight glass 51 is located at the top of the vessel 8 to enable an operator to check the level of particulate material in the vessel 8. An inspection hatch 53 allows the operator to inspect or have access to the interior of the vessel 8. As an alternative to the PLC controlling various components within the apparatus, a four-position pre-programmed switch may be used, particularly to assist an operator in different discharging conditions.

It is to be noted that all valves are operated by air and have a manual position stop that can be used by a particular operator. The system also operates in a fully automatic, manual, vacuum only, discharge only or load only modes.

Shown in Figure 4 is a more detailed schematic view of the two way valve 26. The air cylinder 56 actuated by the PLC moves the valve stem 52 and valve disc 54 between two positions. In the position shown with valve disc 54 against seat 55, the discharge cycle is in operation as described previously with reference to Figure 3, whereby pressurised air flows through the valve 26 from pipe 36 through arm 58 and then through arm 60 to the pipe 32 which then goes into the vessel 8. In the loading cycle the valve stem 52 is retracted so that the valve disc 54 sits against seat 62 to thereby block off the passage to pipe 36. In this mode a vacuum is created through pipe 32, arm 60, arm 64 and pipe 24 back to the blower 14 through the valve 16.

When the vessel 8 has been emptied after the discharge cycle (or sufficiently low pressure has been detected) the PLC controls all the valves to revert to the loading cycle again. Each of the inlets and outlets are carefully protected by filters which are

cleanable and replaceable to ensure that air is properly filtered and to ensure that there is no efflux of powdered or granular material into the atmosphere.

With reference to Figure 5, there is shown an alternative embodiment of the invention which includes aeration equipment, fine filters and vibrations devices to assist with discharge process, particularly in relation to fine powder material down to 0.5 micron particle size. The additional devices also improve the ease of operating the system and the filter purging devices can operate in both manual and automatic modes.

Specifically, a filter housing 70 is positioned on top of the vessel 8 between port 34 and pipe 32. The housing has a relatively large diameter and height to accommodate filter 72, in the shape of an inverted cone. The vacuum pipe 32 is fitted with a flexible hose 32A and cam locks 74 to enable easy access for cleaning purposes. Quick action toggle bolts 76 secure a lid to the filter housing 70 to enable access to filter 72 and associated filter purge to either clean or replace.

At the interior lower section of vessel 8, above the outlet valve 40, there is located an aeration device for aerating the particulate material, such as fine powder to assist in discharging the powder to the destination location. Air for the aeration device may be supplied from a separate air compressor incorporated with engine 12 that drives blower 14 and hydraulic pump (not shown). The aeration device can operate either in a manual discharge mode or an automatic discharge mode. The engine 12, blower 14 and hydraulic pump and compressor may be located on the underside of trailer 2 as illustrated in the various Figures or on the prime mover/truck driven by a Power Take Off unit.

A vibrator unit 78 is attached to the mast of hoist 6 adjacent the forward end of container 4 to assist in moving the particulate material or fine powder towards the suction hose 10 in the loading or vacuum mode. The vibrator unit is electrically driven from the power pack generator of the prime mover electrical system. At the air inlet 18 to blower 14 a large filter system is fitted, optionally with a 0.5 micron fine filter element to filter very fine particulate matter.

Figures 6(A) and 6(B) respectively show trailer 2 in an extended running position and an extended loading position accommodating a 30 foot length container. Each are similar to respective Figures 1(B) and 1(A) which show a 20 foot length container in the running and loading positions. In order to accommodate containers of various lengths , the trailer 2 is fitted with apparatus that enables beam 5 on the

underside of the trailer 2 to be extended or retracted and locked into a position suitable for carrying a container of a specific length.

In Figures 7(A) and 7(B) there is shown respectively trailer 2 in a retracted running position and a retracted loading position, again accommodating a 30 foot length container. However the trailer 2 is adapted to carry containers of lengths greater than 30 feet, such as those of 40 feet. This is made possible by a section 7 on the underside of the trailer 2 which is of such a length to enable beam 5 to be extended to support container lengths greater than 30 feet.

With reference to Figure 8(A) and 8(B), a 20 foot length container 4 is shown on a trailer 2 that incorporates a frame assembly that moves a container along the trailer 2 between a running position, as shown in Figure 8(A), and a discharge position as shown in Figure 8(B) where the end of the container 4 has been moved by the frame assembly to a position close to the rear of the trailer against stop 15. Such a trailer and frame assembly is disclosed in Australian Provisional Patent Application No. 2004900670 entitled "Method and System of Discharging a Product", filed on 12 February 2004 in the name of the present applicant, which is incorporated herein by reference. However the trailer 2 in Figures 8(A) and 8(B) is modified to enable it to be supported on a rear axle and rear wheels linked to the axle when raised into the discharge position. A rear portion 9, on which is mounted the vessel 8, is separated from the remainder of trailer 2 apart from a hinge joint 11. When the hoist 6 raises the trailer 2 and container 4 into the discharge position shown in Figure 8(B), the rear portion 9 starts to separate from the remainder of trailer 2 when a support 13 contacts the ground. This action keeps the vessel 8 slightly inclined which has been modified in shape to accommodate a repositioning of inlet valve 38 and hose 10 to correct for the change in angle and enhance the discharging of the particulate material.

Figures 9(A) and 9(B) are similar to Figures 8(A) and 8(B) respectively except showing the concept applied to a 30 foot length container. In Figure 9(A) the container 4 is against the stop 15.

The inclusion of a split trailer system lowers the centre of gravity of the container 4 whilst in the unloading or discharge position and enables an operator to work more safely at a lower level.

The present invention provides a method and apparatus for discharging the contents of a container supported by a trailer and allows for different types of bulk material, such as particulate, fine (down to 0.5 microns) or granular material to be

discharged from the container of the trailer substantially without any degradation of the material.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

CLAIMS:

1. Material delivery apparatus mounted on a vehicle for delivering particulate or fine material from an unpressurized container on the vehicle to another location, the apparatus comprising:

a vessel having an inlet valve connected to the container to permit ingress of the particulate material to the vessel and an outlet valve to permit egress of the particulate material to the other location;

a blower for creating a current of air; and

a first valve disposed between the blower and a port of the vessel;

such that when the blower operates to produce the current of air the apparatus functions in a first mode whereby the particulate material is moved pneumatically from the container assisted by gravity to the interior of the vessel and thereafter functions in a second mode whereby the particulate material is moved pneumatically from the interior of the vessel to the other location.

2. Material delivery apparatus as claimed in claim 1 further comprising tubular means connected between the container and the inlet valve such that during the first mode the material travels through the tubular means under vacuum and assisted by gravity whereby the container is tilted.

3. Material delivery apparatus according to claim 1 or claim 2 wherein the first valve is a two-way valve.

4. Material delivery apparatus according to claim 4 wherein the two-way valve is disposed in a first position during the first mode whereby a vacuum is created between the vessel and an intake side of the blower to enable the particulate material to be moved from the container to the interior of the vessel.

5. Material delivery apparatus according to claim 3 or claim 4 wherein the two-way valve is disposed in a second position during the second mode such that air is circulated from an outlet side of the blower through the first valve and into the vessel to force the particulate material under pressure through the outlet valve of the vessel.

6. Material delivery apparatus according to claim 5 wherein the inlet valve is open and the outlet valve is closed during the first mode.

7. Material delivery apparatus according to claim 5 wherein the inlet valve is closed and the outlet valve is open during the second mode.

8. Material delivery apparatus according to claim 6 or claim 7 further comprising a second valve connected between the blower and the first valve, the second valve having a first port connected by pipe means to the first valve, a second port connected to the intake side of the blower and a third port connected to atmosphere.

9. Material delivery apparatus according to claim 8 wherein during the second mode the third port is open to enable air to flow through the blower and into the vessel to assist in forcing the particulate material through the outlet valve.

10. Material delivery apparatus according to claim 9 wherein the third port is closed during the first mode.

11. Material delivery apparatus according to claim 10 wherein an outlet side of the blower is linked to an outlet pipe, the outlet pipe also linked to the outlet valve of the vessel and leading to the other location, so that pressurized air from the blower is applied to the material as it leaves the outlet valve to assist in moving the material to the other location.

12. Material delivery apparatus according to claim 11 further comprising a bypass valve located between the outlet side of the blower and the outlet pipe, the bypass valve having an aperture that is adjustable during the second mode.

13. Material delivery apparatus according to claim 12 wherein the bypass valve is set open to 75 percent of the full aperture of the bypass valve during the second mode.

14. Material delivery apparatus according to claim 6 or claim 7 further comprising a controller to operate the first valve, second valve, inlet valve and outlet valve in order to effect changing between the first mode to the second mode.

15. Material delivery apparatus according to any one of the previous claims wherein the other location is any one of a flow, conveyor system, further container or storage means.

16. Material delivery apparatus according to claim 15 wherein the vehicle includes a trailer having mounted thereon the container and the vessel.

17. Material delivery apparatus according to claim 16 wherein the vessel is located adjacent the rear of the trailer.

18. Material delivery apparatus according to claim 17 wherein a hoist mechanism is used to tilt the container thereby assisting the flow of particulate material during the first mode.

19. Material delivery apparatus according to claim 18 further comprising filter means located adjacent the port of the vessel.

20. Material delivery apparatus according to claim 19 further comprising aeration means located inside the vessel adjacent the outlet valve for aerating the particulate material.

21. Material delivery apparatus according to claim 20 further comprising vibration means attached to the hoist mechanism adjacent one end of the container for assisting in moving the particulate material to the tubular means.

22. Material delivery apparatus according to claim 21 further comprising filter means located at the intake side of the blower.

23. Material delivery apparatus according to claim 22 wherein the trailer is extendible and retractable to accommodate varying lengths of containers.

24. Material delivery apparatus according to claim 23 wherein the trailer has a moveable frame assembly fitted thereto so as to move the container along the trailer between a transportation position and an unloading position.

25. Material delivery apparatus according to claim 24 wherein the trailer comprises a main portion and a rear portion attached to the main portion by hinge means, the main portion and rear portion fitting together when a container is carried in a transportation position and separating apart from the hinge means when the container is tilted and a support attached to the rear portion of the trailer contacts the ground.

26. Material delivery apparatus according to claim 25 wherein the container is supported by the main portion of the trailer and the vessel in supported by the rear portion of the trailer.

27. A method of delivering particulate or fine material from an unpressurized container mounted on a vehicle to another location comprising the steps of:

providing a vessel on the vehicle, the vessel having an inlet valve to permit ingress of the particulate material to the vessel from the container and an outlet valve to permit egress of the particulate material to the other location;

creating a stream of air using a blower;

using the stream of air to create a vacuum such that the particulate material during a first mode is moved pneumatically from the interior of the container assisted by gravity to the interior of the vessel and thereafter creating air pressure such that during a second mode the particulate material is moved pneumatically from the interior of the vessel to the other location.

28. A method according to claim 27 further comprising connecting tubular means between the container and the inlet valve such that during the first mode the material travels through the tubular means under vacuum and assisted by gravity whereby the container is tilted.

29. A method according to claim 27 or claim 28 further comprising linking a port of the vessel and the blower through a first valve, wherein the first valve is disposed in a first position during the first mode whereby a vacuum is created between the vessel and an intake side of the blower to enable the particulate material to be moved from the container to the interior of the vessel.

30. A method according to claim 29 wherein the first valve is disposed in a second position during the second mode such that air is circulated from an outlet side of the blower through the first valve and into the vessel to force the particulate material under pressure through the outlet valve of the vessel.

31. A method according to claim 30 further comprising connecting a second valve between the blower and the first valve, the second valve having a first port connected by pipe means to the first valve, a second port connected to the intake side of the blower and a third port connected to atmosphere.

32. A method according to claim 31 further comprising controlling the first valve, second valve, inlet valve and outlet valve so as to effect changing between the first mode and second mode.

33. A method according to claim 32 wherein the vehicle includes a trailer having mounted thereon the container and the vessel.

34. A method according to claim 33 wherein the trailer is extendible and retractable to accommodate varying lengths of container.

35. A method according to claim 34 wherein the trailer has a moveable frame assembly fitted thereto so as to move the container along the trailer between a transportation position and an unloading position.

36. A method according to claim 35 wherein the trailer comprises a main portion and a rear portion attached to the main portion by hinge means, the main portion and rear portion fitting together when a container is carried in a transportation position and separating apart from the hinge means when the container is tilted and a support attached to the rear portion of the trailer contacts the ground.

37. A method according to claim 36 wherein the container is supported by the main portion of the trailer and the vessel in supported by the rear portion of the trailer.

38. Material delivery apparatus for delivering particulate or fine material from a first location to a second location, the apparatus comprising:

a vessel having an inlet valve to permit ingress of the particulate material to the vessel and an outlet valve to permit egress of the particulate material to the second location;

a blower for creating a current of air; and

a first valve disposed between the blower and a port of the vessel;

such that when the blower operates to produce the current of air the apparatus functions in a first mode whereby the particulate material is moved pneumatically from the first location assisted by gravity to the interior of the vessel and thereafter functions in a second mode whereby the particulate material is moved pneumatically from the interior of the vessel to the second location.

39. Material delivery apparatus according to claim 38 wherein the first location is an unpressurized container.

40. Material delivery apparatus according to claim 39 further comprising tubular means connected between the container and the inlet valve such that during the first mode the material travels through the tubular means under vacuum and assisted by gravity whereby the container is tilted.

41. Material delivery apparatus according to claim 40 wherein the first valve is a two-way valve.

42. Material delivery apparatus according to claim 41 wherein the two-way valve is disposed in a first position during the first mode whereby a vacuum is created between the vessel and an intake side of the blower to enable the particulate material to be moved from the container to the interior of the vessel.

43. Material delivery apparatus according to claim 41 or claim 42 wherein the two-way valve is disposed in a second position during the second mode such that air is circulated from an outlet side of the blower through the first valve and into the vessel to force the particulate material under pressure through the outlet valve of the vessel.

44. Material delivery apparatus according to claim 43 wherein the apparatus is fitted to a transportation vehicle.

45. Material delivery apparatus according to claim 44 wherein the transportation vehicle includes a trailer with the container and vessel supported by the trailer.

46. Material delivery apparatus according to claim 45 further comprising a second valve connected between the blower and the first valve, the second valve having a first port connected by pipe means to the first valve, a second port connected to the intake side of the blower and a third port connected to atmosphere.

47. Material delivery apparatus according to claim 46 wherein during the second mode the third port is open to enable air to flow through the blower and into the vessel to assist in forcing the particulate material through the outlet valve.

48. Material delivery apparatus according to claim 47 wherein an outlet side of the blower is linked to an outlet pipe, the outlet pipe also linked to the outlet valve of the vessel and leading to the other location, so that pressurized air from the blower is applied to the material as it leaves the outlet valve to assist in moving the material to the other location.

49. Material delivery apparatus according to claim 48 further comprising a bypass valve located between the outlet side of the blower and the outlet pipe, the bypass valve having an aperture that is adjustable during the second mode.

50. Material delivery apparatus according to claim 49 further comprising a controller to operate the first valve, second valve, inlet valve and outlet valve in order to effect changing between the first mode to the second mode.

51. Material delivery apparatus according to claim 50 wherein the second location is any one of a flow, conveyor system, further container or storage means.

52. Material delivery apparatus according to any one of claims 45 to 51 wherein the vessel is located adjacent the rear of the trailer.

53. Material delivery apparatus according to claim 52 wherein a hoist mechanism is used to tilt the container thereby assisting the flow of particulate material during the first mode.

54. Material delivery apparatus according to claim 53 further comprising filter means located adjacent the port of the vessel.

55. Material delivery apparatus according to claim 54 further comprising aeration means located inside the vessel adjacent the outlet valve for aerating the particulate material.

56. Material delivery apparatus according to claim 55 further comprising vibration means attached to the hoist mechanism adjacent one end of the container for assisting in moving the particulate material to the tubular means.

57. Material delivery apparatus according to claim 56 further comprising filter means located at the intake side of the blower.

58. Material delivery apparatus according to claim 57 wherein the trailer is extendible and retractable to accommodate varying lengths of containers.

59. Material delivery apparatus according to claim 58 wherein the trailer has a moveable frame assembly fitted thereto so as to move the container along the trailer between a transportation position and an unloading position.

60. Material delivery apparatus according to claim 59 wherein the trailer comprises a main portion and a rear portion attached to the main portion by hinge means, the main portion and rear portion fitting together when a container is carried in a transportation position and separating apart from the hinge means when the container is tilted and a support attached to the rear portion of the trailer contacts the ground.

61. Material delivery apparatus according to claim 60 wherein the container is supported by the main portion of the trailer and the vessel in supported by the rear portion of the trailer.

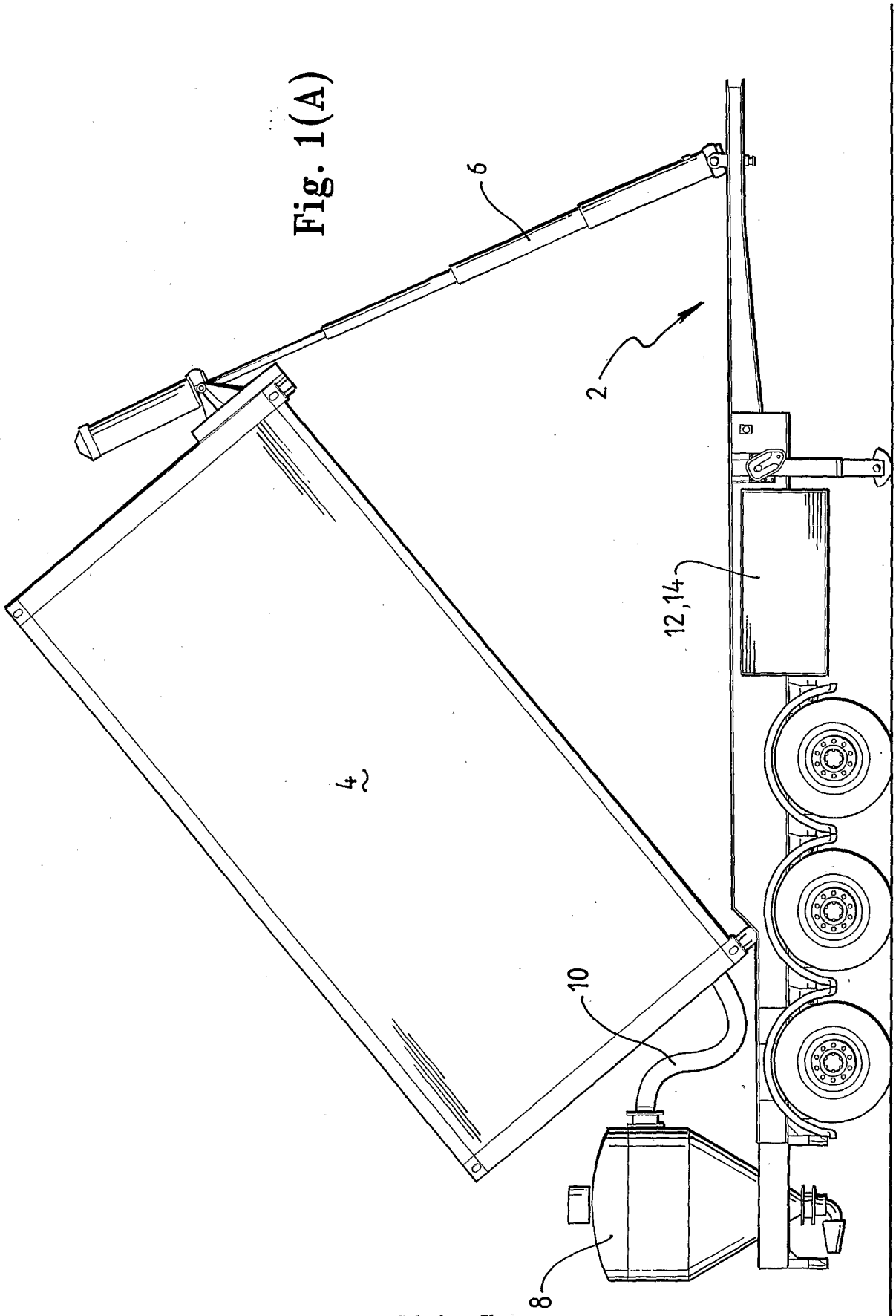
62. A method of delivering particulate or fine material from a first location to a second location comprising the steps of:

providing a vessel having an inlet valve to permit ingress of the particulate material to the vessel and an outlet valve to permit egress of the particulate material to the second location;

creating a stream of air using a blower;

using the stream of air to create a vacuum such that the particulate material during a first mode is moved pneumatically from the first location assisted by gravity to the interior of the vessel and thereafter creating air pressure during a second mode such that the particulate material is moved pneumatically from the interior of the vessel to the second location.

Fig. 1(A)



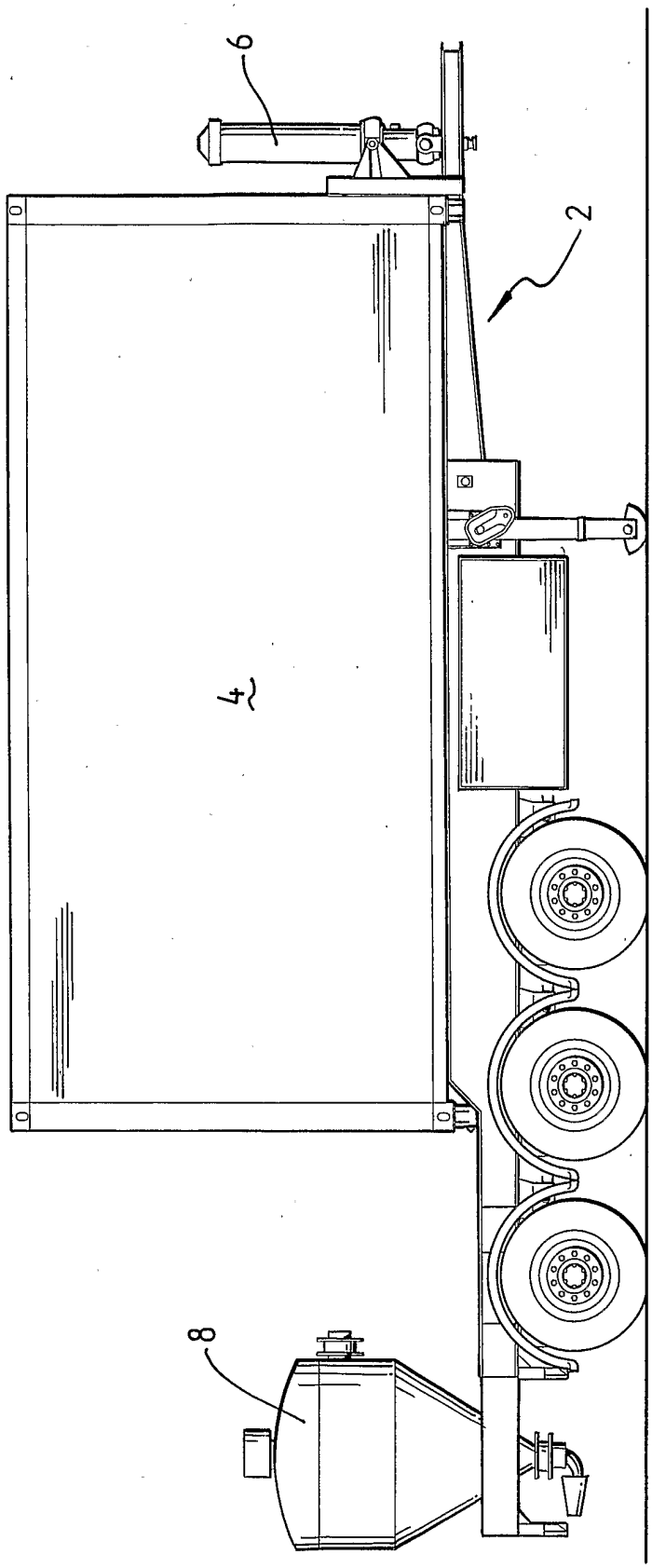


Fig. 1(B)

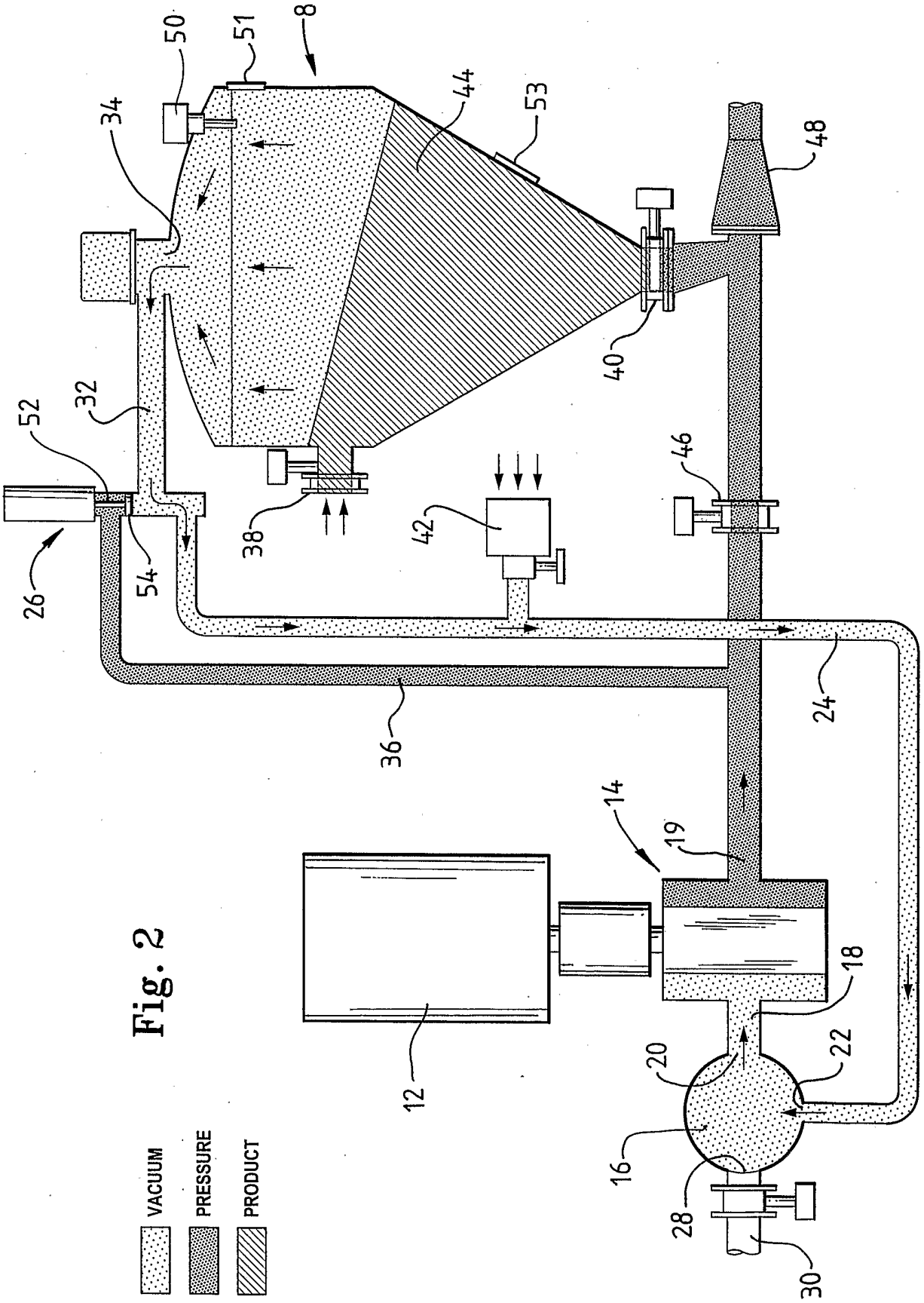

8
12
14
16
18
19
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
51
52
53
54
VACUUM
PRESSURE
PRODUCT

Fig. 2

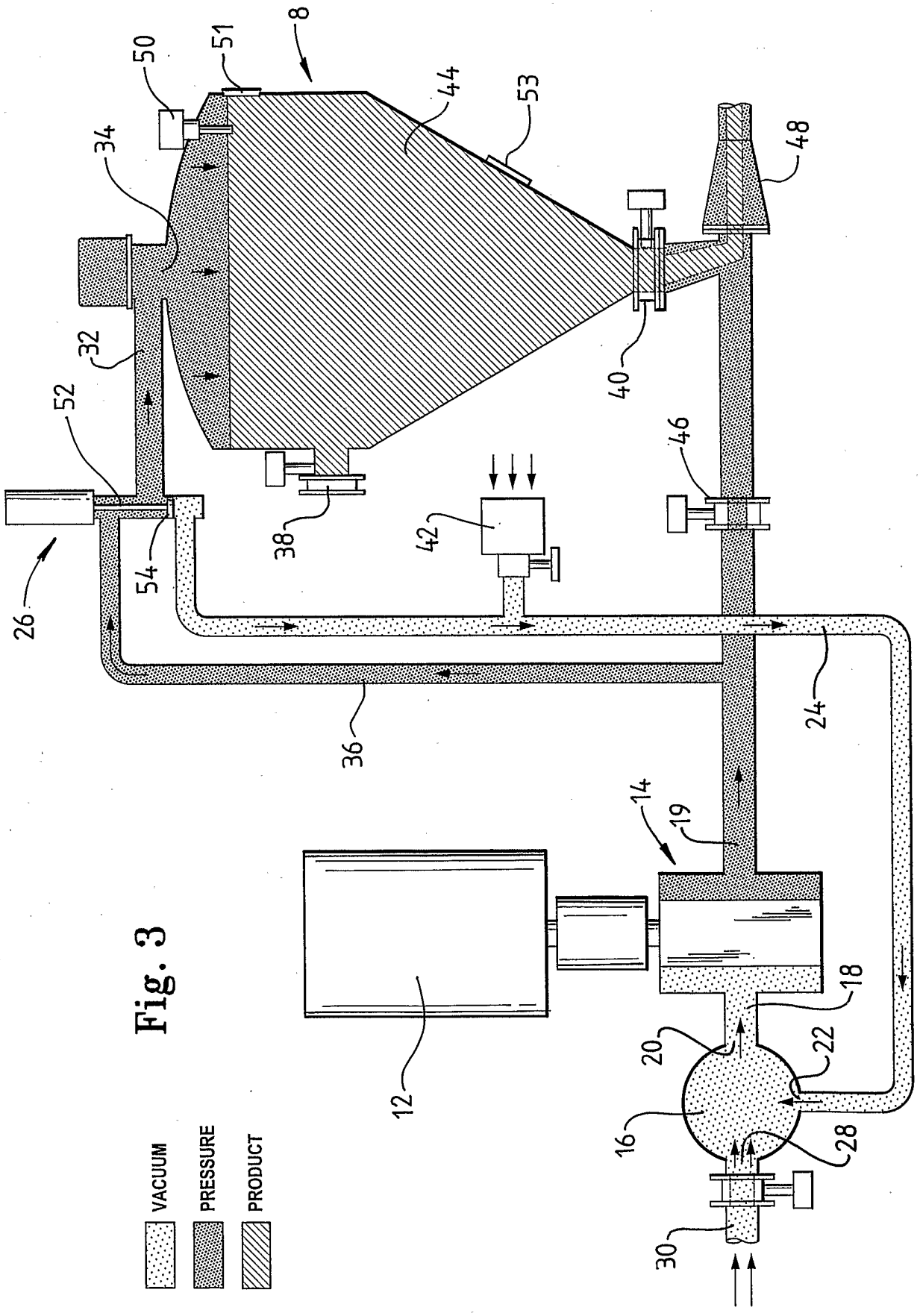

8
50
51
44
53
34
48
32
40
52
46
38
42
54
26
36
24
14
19
12
18
20
22
16
28
30
VACUUM
PRESSURE
PRODUCT

Fig. 3

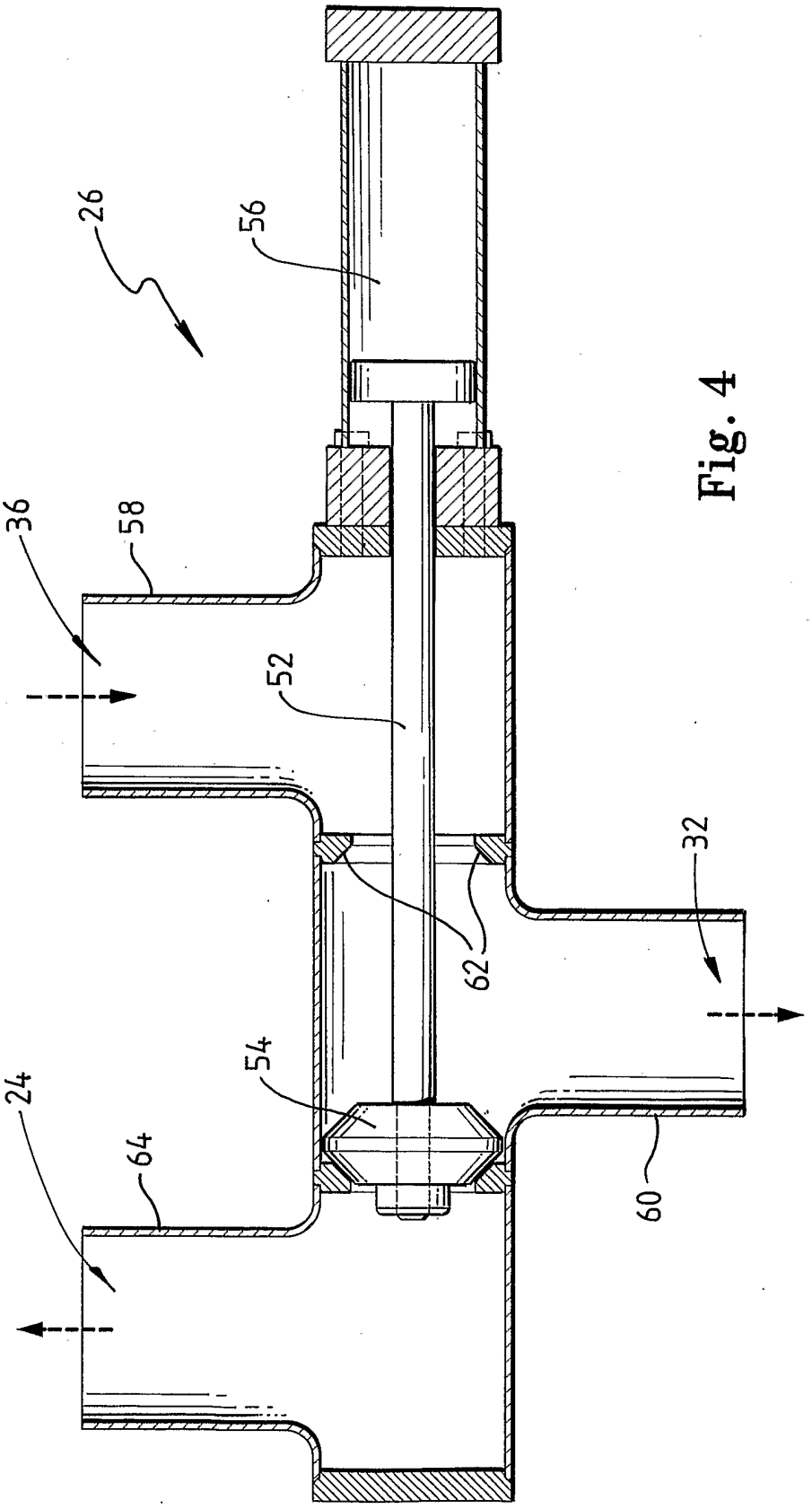


Fig. 4

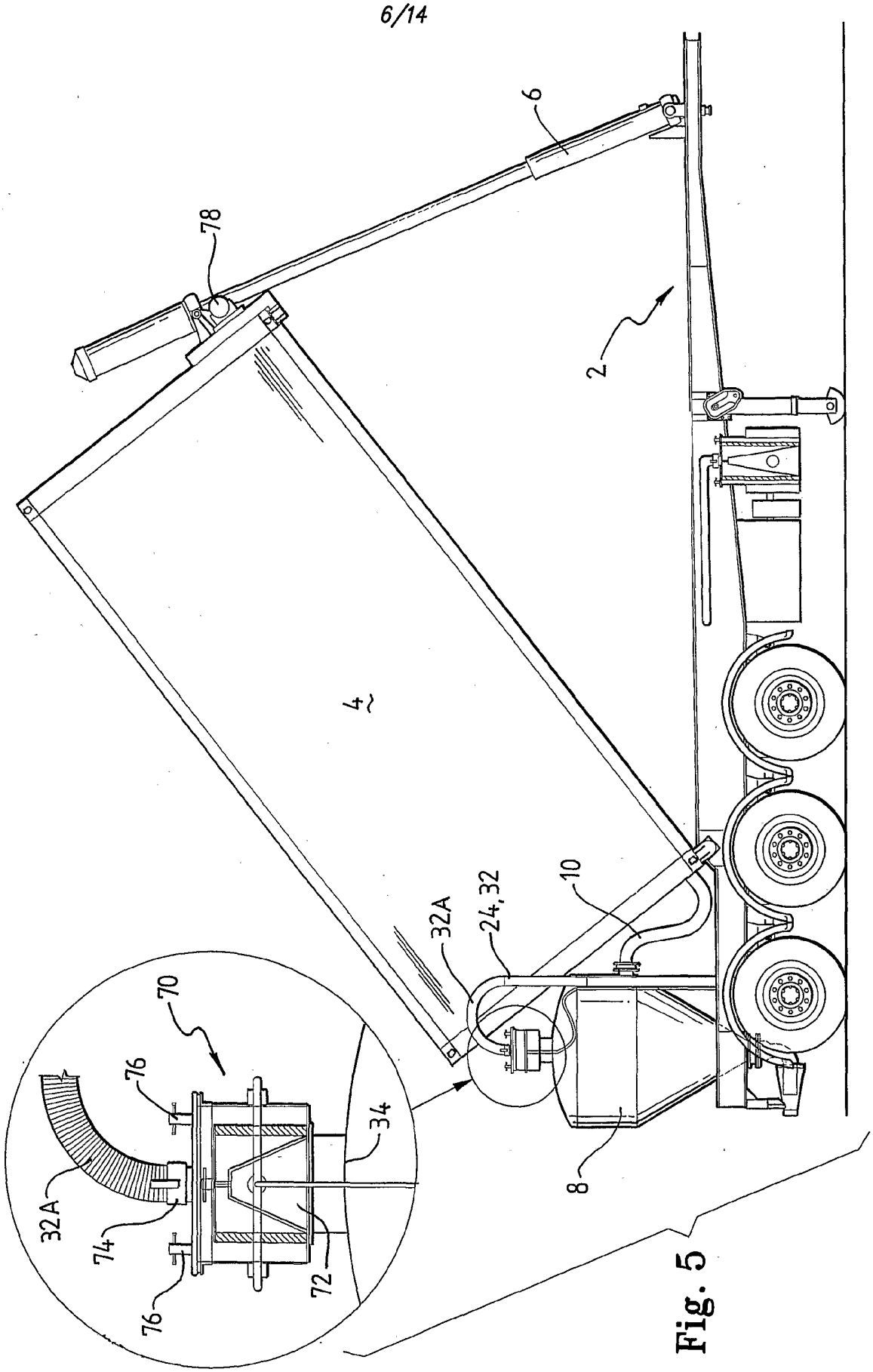


Fig. 5

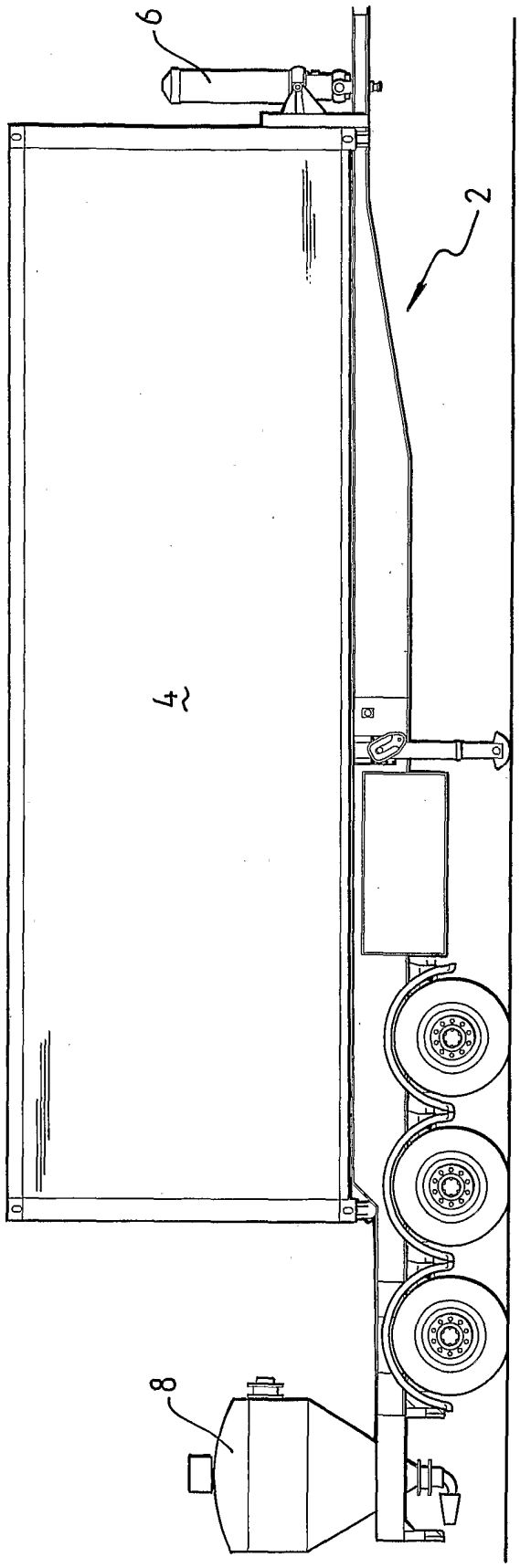


Fig. 6(A)

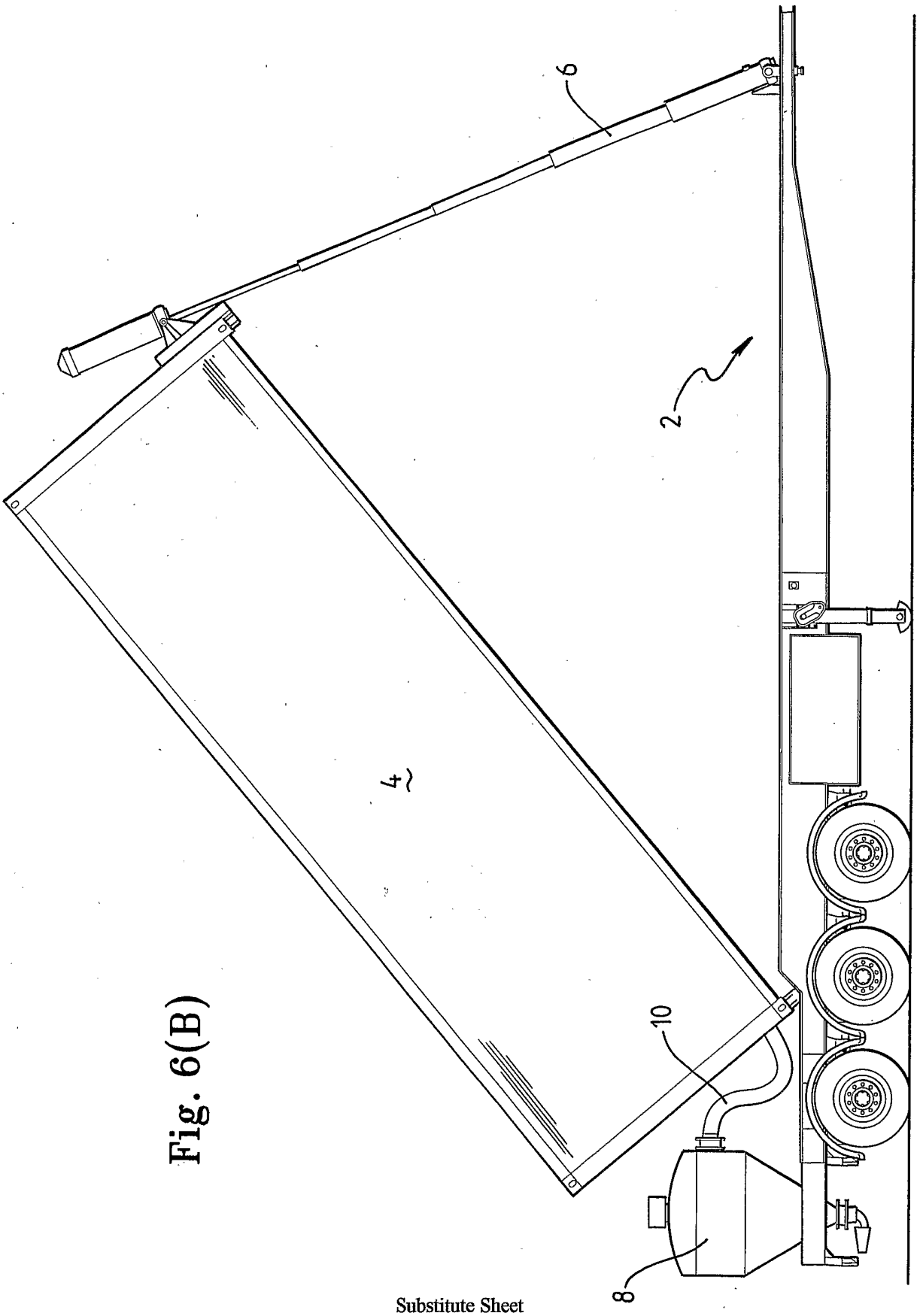


Fig. 6(B)

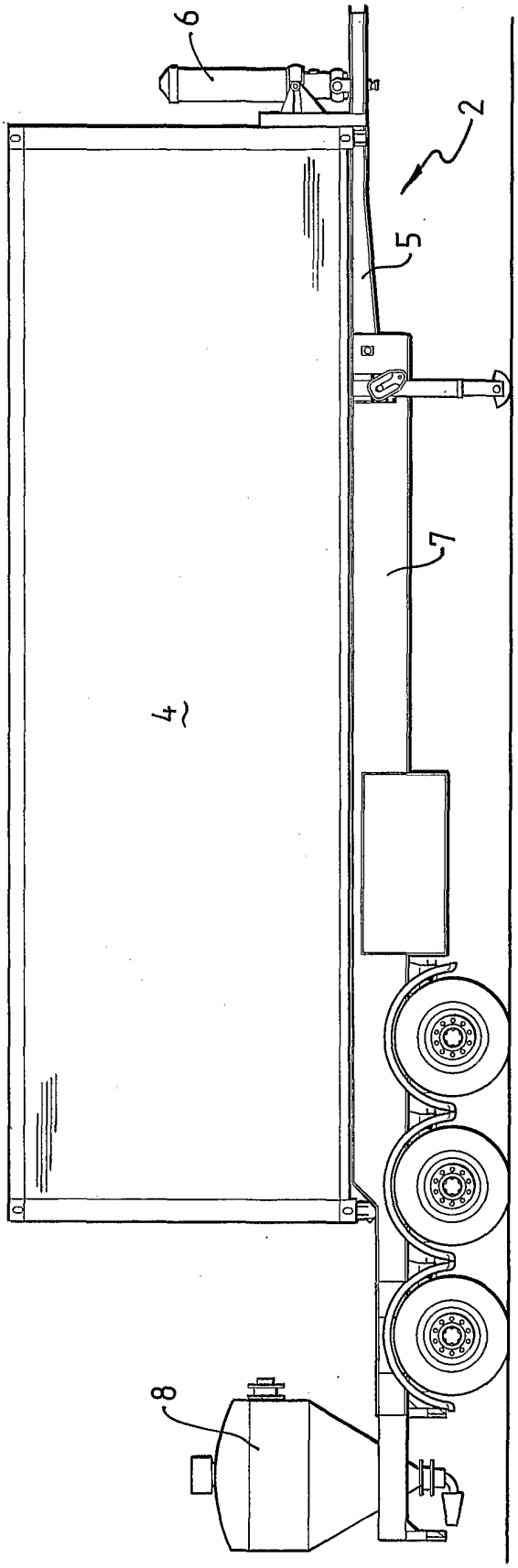


Fig. 7(A)

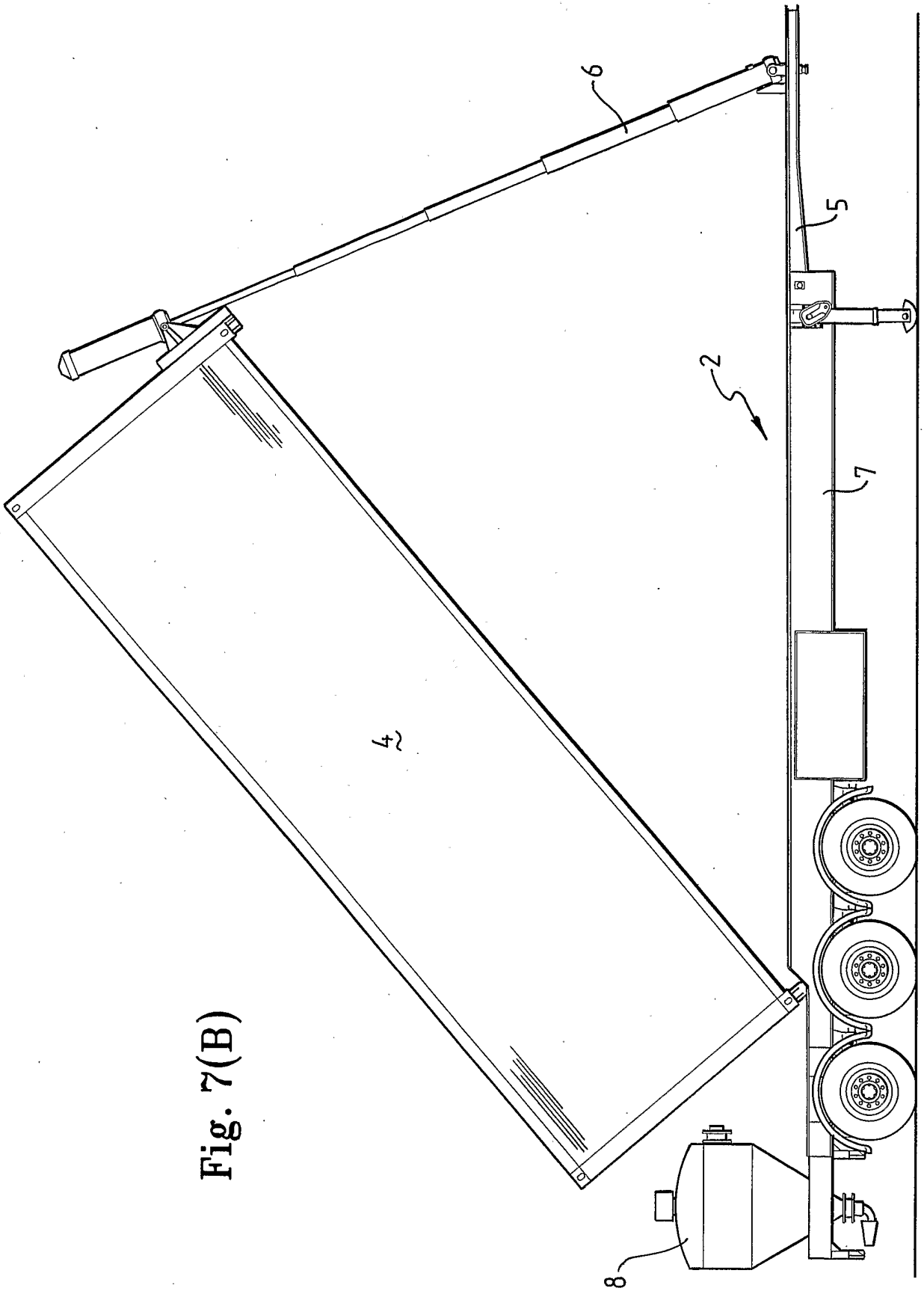


Fig. 7(B)

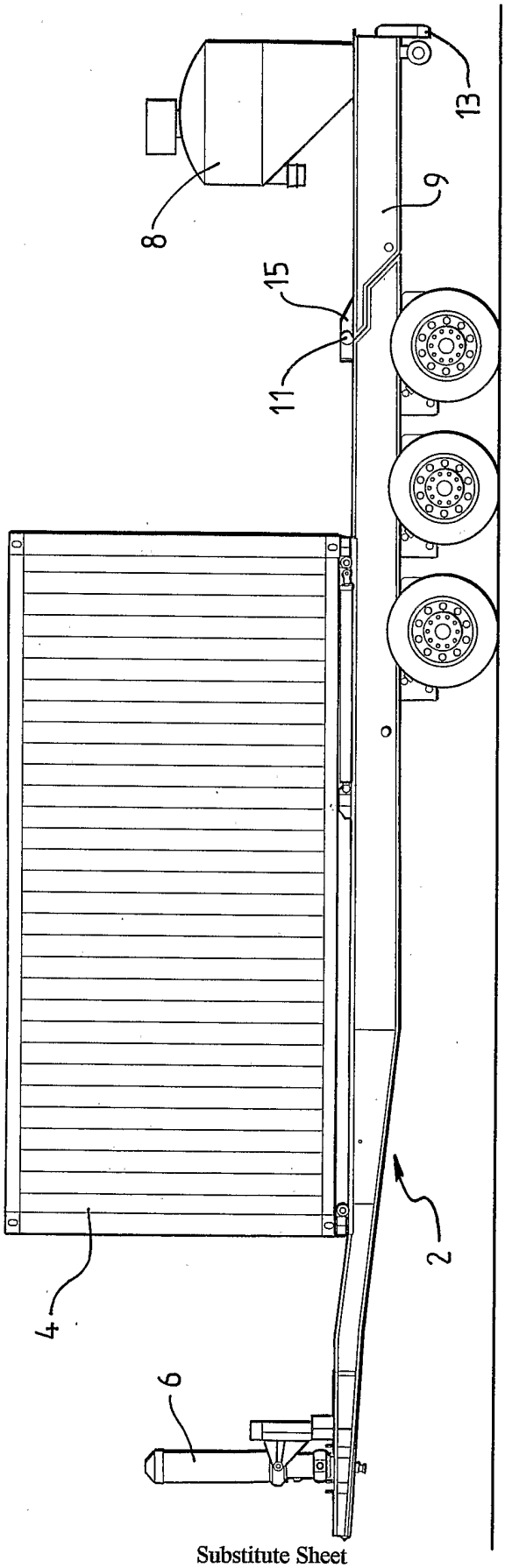


Fig. 8(A)

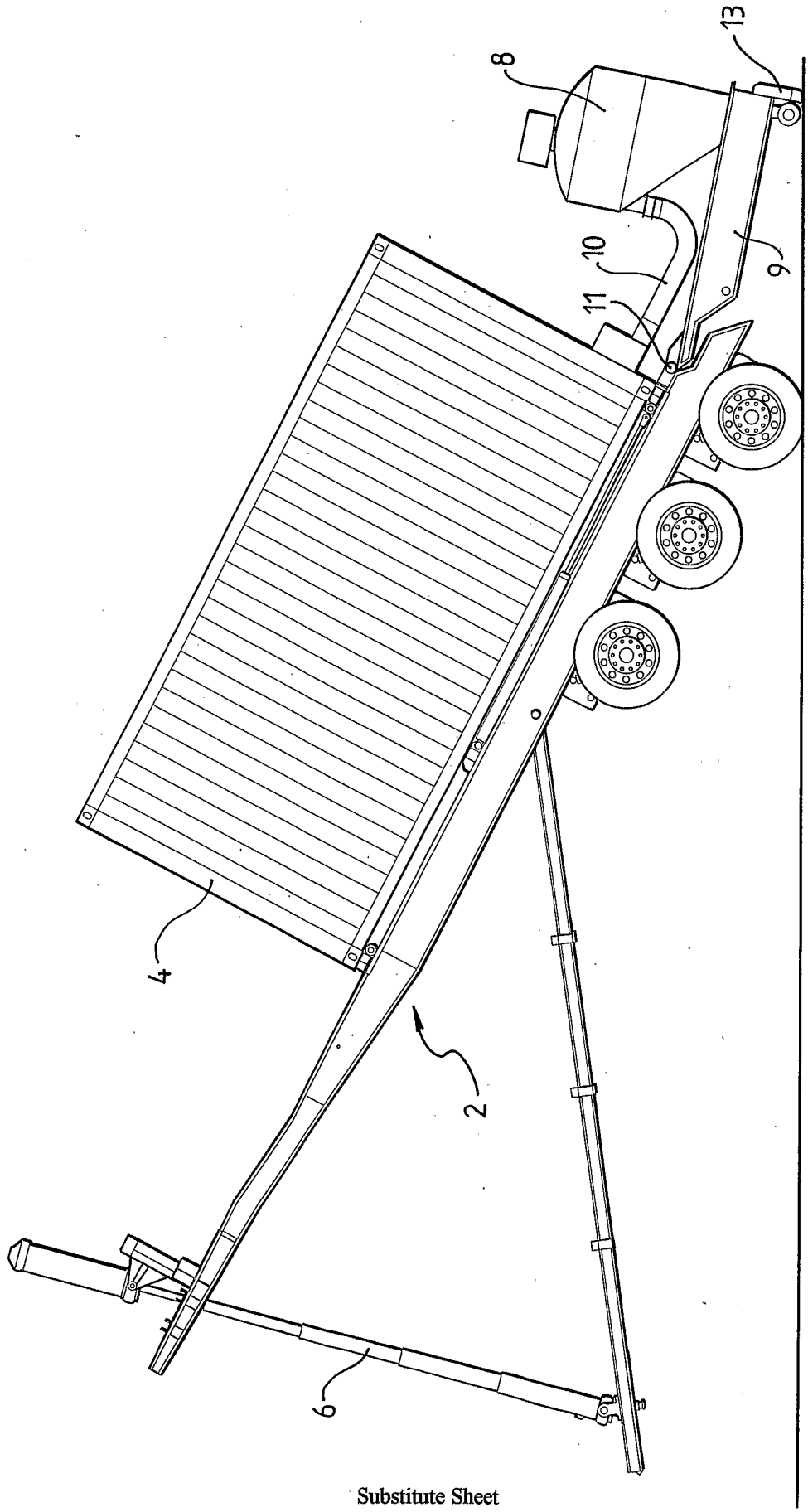


Fig. 8(B)

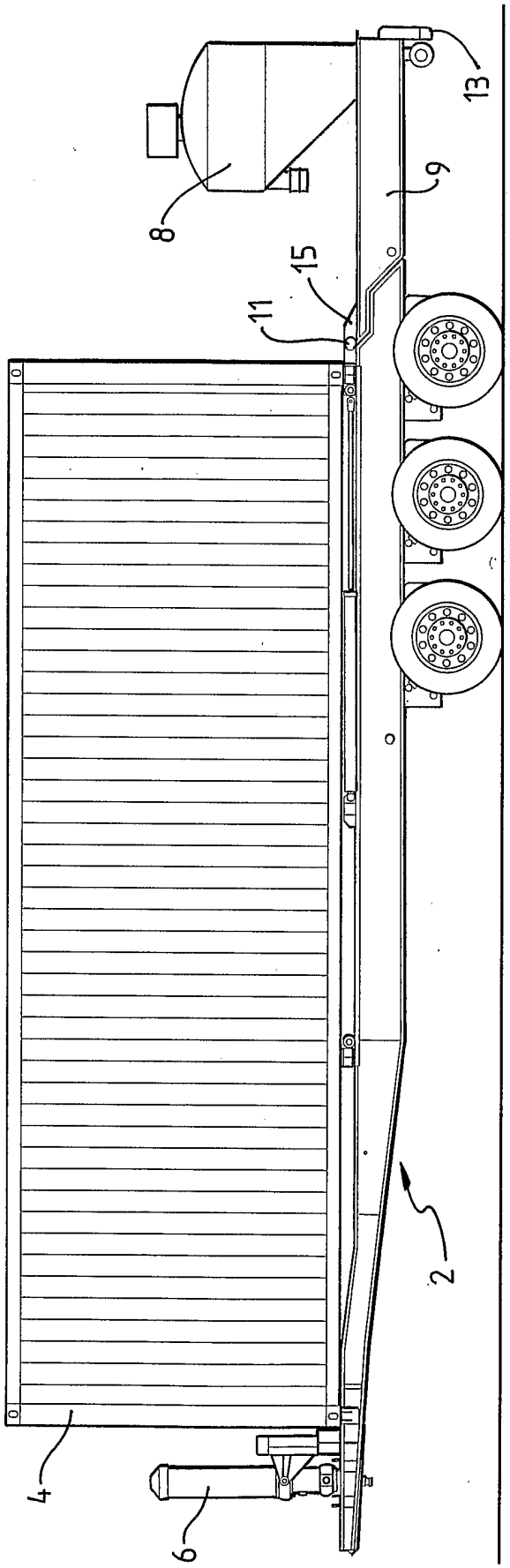


Fig. 9(A)

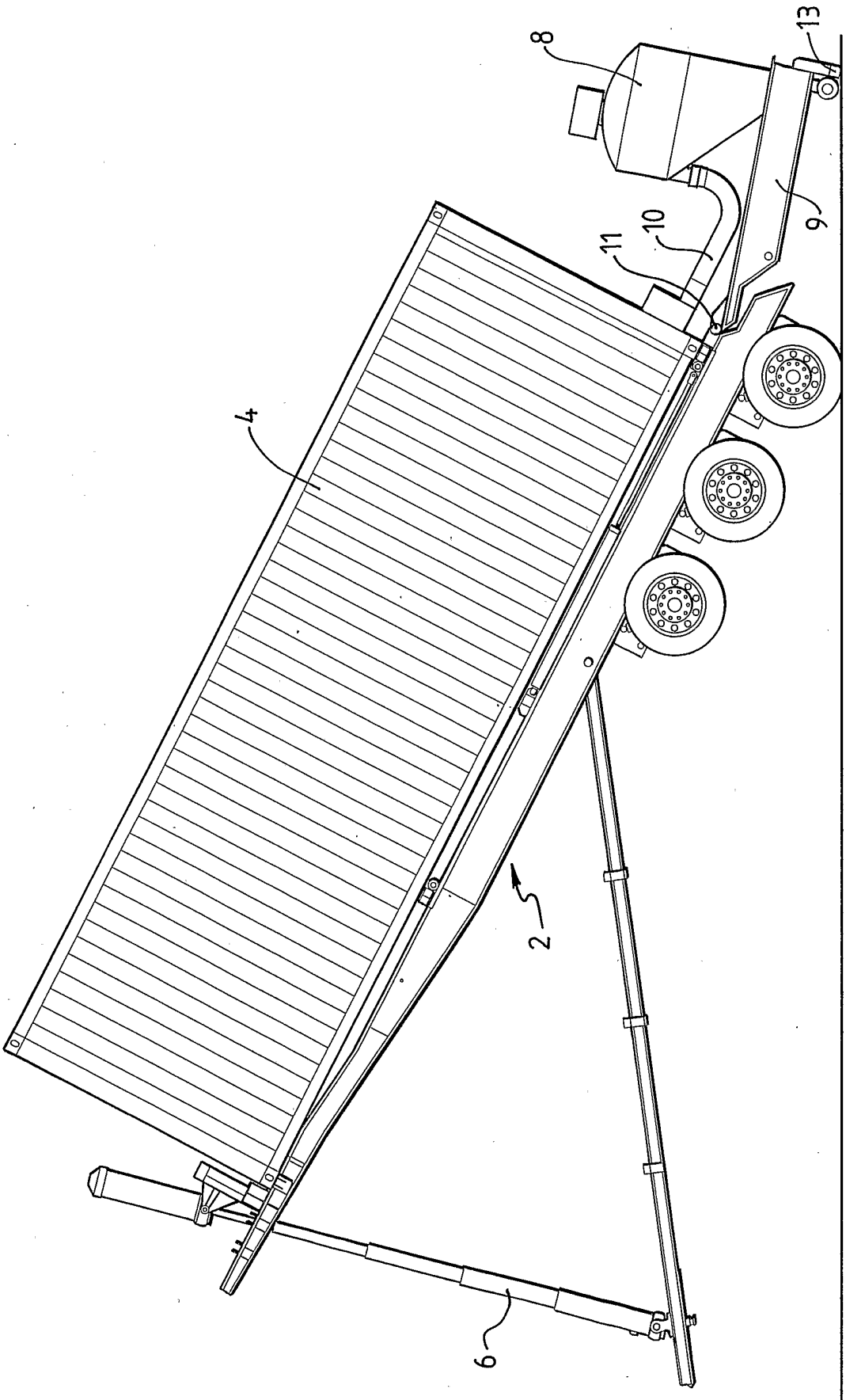


Fig. 9(B)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2004/001245

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: B65G 53/28, 65/34, 67/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Looked at cited arts on references cited in US 4016994, and related documents referenced by US 4016994

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI IPC B65G 53/-, 65/-, 67/- & keywords: air, pneumatic, fluid, pressure, blow, force, vacuum, suction, suck, negative, valve.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3069205 A (McIver et al) 18 December 1962 Whole document	1 – 62
X	US 4247228 A (GRAY et al) 27 January 1981 Whole document	1 – 62
X	US 4016994 A (WURSTER) 12 April 1977 Whole document	1 – 62
X	US 5035543 A (MEDEMBLIK et al) 30 July 1991 Whole document	1 – 62
X	US 3099497 A (ALBERT) 30 July 1963 Whole document	1 – 62

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 November 2004	0 8 NOV 2004
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **B. NGUYEN** Telephone No : (02) 6283 2306

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU2004/001245

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member
US	3069205	NONE
US	4247228	NONE
US	4016994	NONE
US	5035543	NONE
US	3099497	NONE

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX