

United States Patent ~~Application~~

~~20130161211~~ 9,248,772

~~Kind Code~~

~~A1~~

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~~June 27, 2013~~ February 2, 2016

~~PROPPANT STORAGE VESSEL AND ASSEMBLY THEREOF~~

Method of delivering, transporting, and storing proppant for delivery and use at a well site

Abstract

A ~~proppant storage vessel has a first container with an interior volume, and a second container supported in spaced relation above the first container. The first container has a bottom hatch affixed to a bottom wall thereof. The bottom hatch is movable between an open position and a closed position. The first container has an opening at a top wall thereof. The second container has bottom hatch formed on a bottom wall thereof. The bottom hatch of the second container is aligned with the opening of the first container such that a proppant in the second container can flow through the hatch thereof into the interior volume of the first container. Each of the containers includes first, second, third and fourth inclined surfaces positioned in the interior volume and extending from the respective side walls and end walls thereof toward the bottom hatch.~~ method of delivering proppant to a well site has the steps of transporting a load of proppant in a vessel to a desired location, moving the load of proppant from the vessel into a container so as to create a proppant-loaded container, unloading the proppant-loaded container into a pneumatic bulk trailer, and transporting the unloaded proppant in the pneumatic bulk trailer to well site. The container is placed onto a bed of a truck and moved in proximity to the vessel. The proppant-loaded container is placed onto a tilting mechanism and then tilted so that the proppant is discharged through a flow gate of a container into a hopper. The proppant in the hopper can then be conveyed to the pneumatic bulk trailer.

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Family ID: ~~48653494~~ 48654735

~~Appl. No.: 13/332,937~~ US 9,248,772 B2

Appl. No.: ~~13/14/332937~~ 310,648

Filed: ~~December 21, 2011~~ June 20, 2014

Prior Publication Data

Document Identifier

US 20140299225 A1

Publication Date

Oct 9, 2014

Related U.S. Patent Documents

Application Number

Filing Date

Patent Number

Issue Date

PCT/US2013/032819

Mar 18, 2013

13427140

Jan 7, 2014

8622251

13332937

Dec 21, 2011

8827118

Current U.S. Class: ~~2061/221~~; ~~220/565~~ 1

Current CPC Class: B65D 88/54 (20130101); B65D 90/008 (20130101); B65D 90/34 (20130101); B61B 1/005 (20130101); B65D 88/54 (20130101); B65G 65/32 (20130101); ~~B65D 90/14 20130101~~; ~~B65D 25/08 20130101~~; ~~B65D 90/10 20130101~~; ~~B65G 65/42 20130101~~; ~~B65D 88/022~~; B65G 65/42 (20130101); B65D 88/56 (20130101); B60P 1/6418 (20130101); B65G 57/20 (20130101); B65G 65/30 (20130101); B65G 67/24 (20130101); B60P 3/00 (20130101); B65G 57/09 (20130101); B65G 67/04 (20130101); B65G 57/02 (20130101); B65D 90/54 (20130101); B65D 88/022 (20130101); ~~B65D 88/542 20130101~~; ~~B65D 90G 67/02~~ (20130101); ~~B65D 90/12 20130101~~; B65G 65/40 (20130101); ~~34~~ (20130101); E21B 43/26 (20130101); B65G 65/00 (20130101); B65D

88/26 (20130101); E21B 43/267 (20130101); B65D 88/70 (20130101); B65D 88/12 (20130101); B65G 2203/0216 (20130101); B65G 57/00 (20130101); B65D 2588/54 (20130101); B65D 2588/12 (20130101)

Class at Publication: ~~206/221~~; 220/565

Current International Class: ~~B65D 25/08 20060101 B65D 025/08; B65D 88/32 20060101 B65D 088/32; B65D 90/12~~ B65D 88/56 (20060101); B65G 67/24 (20060101); B65G 65/30 (20060101); B65G 57/20 (20060101); B61B 1/00 (20060101); B65D 90/34 (20060101); B65D 090/12 90/00 (20060101); B65D 88/10 70 (20060101); B65D 088G 65/1023 (20060101); B60P 1/64 (20060101)

Field of Search: :141/2,1

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Parent Case Text

RELATED APPLICATIONS

[This application claims the benefit of, is a continuation of, and is a U.S. National Stage of International Patent Appln. No. PCT/US13/32819, filed on Mar. 18, 2013, which claims the benefit of U.S. patent](#)

application Ser. No. 13/427,140 filed Mar. 22, 2012, now U.S. Pat. No. 8,622,251 issued on Jan. 7, 2014, which is a continuation-in-part of U.S. patent application Ser. No. 13/332,937 filed on Dec. 21, 2011, all of which are incorporated herein by reference in their entireties.

Claims

~~1. A proppant storage vessel comprising: a container having a first end wall and a second end wall and a first side wall and a second side wall and a top wall and a bottom wall, said first and second end walls extending between opposite ends of said first and second side walls, said first and second end walls and said first and second side walls and said top and bottom walls defining an interior volume of said container; a bottom hatch formed on said bottom wall of said container, said bottom hatch movable between an open position and a closed position; a first inclined surface positioned in said interior volume, said first inclined surface extending from said first end wall toward said bottom hatch; a second inclined surface positioned in said interior volume, said second inclined surface extending from said second end wall toward said bottom hatch; a third inclined surface positioned in said interior volume, said third inclined surface extending from said first side wall toward said bottom hatch; and a fourth inclined surface positioned in said interior volume, said fourth inclined surface extending from said second side wall toward said bottom hatch.~~

~~2. The proppant storage vessel of claim 1, further comprising: a top hatch formed on said top wall, said top hatch movable between an open position and a closed position.~~

~~3. The proppant storage vessel of claim 1, each of said first and second end walls and said first and second side walls have a middle, said first inclined surface having an upper end affixed to said first end wall below the middle thereof, said second inclined surface having an upper end affixed to said second end wall below the middle thereof, said third inclined surface having an upper end affixed to said first side wall below the middle thereof, said fourth inclined surface having an upper end thereof affixed to said second side wall below the middle thereof.~~

~~4. The proppant storage vessel of claim 1, further comprising: a first support brace affixed to said first and second end walls and extending therebetween; and a second support brace affixed to said first and second side walls and extending therebetween.~~

~~5. The proppant storage vessel of Claim 1, further comprising: a first support member having one end affixed to said bottom wall and extending angularly upwardly therefrom, said first support member having an opposite end affixed centrally to said first inclined surface; and a second support member having one end affixed to said bottom wall and extending angularly upwardly therefrom, said second support member having an opposite end affixed centrally to said second inclined surface.~~

~~6. The proppant storage vessel of claim 1, each of said first and second and third and fourth inclined~~

~~surfaces having a bottom edge positioned adjacent a perimeter of said bottom hatch.~~

~~7. The proppant storage vessel of claim 1, said bottom hatch being hingedly affixed to said bottom wall, said bottom hatch residing against said bottom wall when in said closed position.~~

~~8. A proppant storage vessel comprising: a first container having an interior volume, said first container having a bottom wall, said bottom wall having a bottom hatch affixed thereto, said bottom hatch being movable between an open position and a closed position, said first container having an opening at a top wall thereof; and a second container supported in spaced relation above said first container, said second container having bottom hatch formed on a bottom wall thereof, said bottom hatch of said second container being aligned with said opening of said first container such that a proppant in said second container can flow through said hatch thereof into said interior volume of said first container.~~

~~9. The proppant storage assembly of claim 8, said first container having a top hatch hingedly affixed at an opening thereof, said top hatch of said first container movable between a closed position and an open position.~~

~~10. The proppant storage vessel of claim 9, said bottom hatch of said second container having a length dimension, said length dimension being slightly less than a distance between said first container and said second container.~~

~~11. The proppant storage assembly of claim 9, said top hatch of said first container extending in parallel relation to said bottom hatch of said second container when each of said top hatch of said first container and said bottom hatch of said second container are in the open position.~~

~~12. The proppant storage assembly of claim 8, further comprising: a first spacer positioned on said top wall of said first container and extending upwardly therefrom, said first spacer abutting said bottom wall of said second container; and a second spacer positioned on said top wall of said first container and extending upwardly therefrom, said second spacer abutting said bottom wall of said second container, said first spacer being in spaced relation to said second spacer.~~

~~13. The proppant storage assembly of claim 8, further comprising: a pad positioned against said bottom wall of said first container, said pad supporting said bottom wall of said first container a desired distance above an underlying surface.~~

~~14. The proppant storage assembly of claim 13, said bottom hatch of said first container having a length dimension, said length dimension being less than a desired distance between said bottom wall and the underlying surface.~~

~~15. The proppant storage assembly of claim 13, further comprising: a portable container having a surface positioned between said bottom wall of said first container and the underlying surface, said surface of said portable container being directly below said bottom hatch of said first container.~~

~~16. The proppant storage assembly of claim 8, each of said first and second containers comprising a first~~

~~end wall and a second end wall and a first side wall and a second side wall, said first and second end walls extending between opposite ends of said first and second side walls, said first and second end walls and first and second side walls and said top and bottom walls defining the interior volume of said container, each of said first and second containers having a first inclined surface positioned in the interior volume so as to extend from the first end wall toward the bottom hatch and a second inclined surface positioned in the interior volume and extending from the second end wall toward the bottom hatch and a third inclined surface positioned in the interior volume and extending from the first side wall toward the bottom hatch and a fourth inclined surface positioned in the interior volume and extending from the second side wall toward the bottom hatch.~~

~~17. The proppant storage assembly of claim 8, further comprising: a third container supported in spaced relation above said second container, said second container having a top hatch formed on a top wall thereof, said third container having a bottom hatch formed on a bottom wall thereof, said bottom hatch of said third container being aligned with said top hatch of said second container.~~

~~18. The proppant storage assembly of claim 8, each of said first and second containers being of an ocean freight container shape.~~

~~19. The proppant storage assembly of claim 8, said first container having a first side wall and a second side wall and a first end wall and second end wall each hingedly mounted to said bottom wall thereof.~~

~~20. The proppant storage assembly of claim 18, said first container having a first slot and a second slot affixed to said bottom wall thereof, said first and second slots suitable for receipt of forks of a forklift therein.~~ That claimed is:

1. A method of transporting proppant, the method comprising: a) vertically stacking a plurality of empty proppant containers in close proximity to a rail spur so that one of the plurality of empty proppant containers overlies another one of the plurality of empty containers thereby to reduce footprint of the area required adjacent the rail spur to store the plurality of empty proppant containers, each of the plurality of empty containers including at least a first end surface and at least a second different end surface and each of the first and second end surfaces having a plurality of upright structural support members thereon to enhance integrity of the container so that a large amount of weight can be stacked upon the container and so that heavy weight can be stored therein; b) filling the plurality of empty proppant containers with proppant from one or more proppant transporting rail vehicles thereby to produce a plurality of proppant filled containers; c) transferring the plurality of proppant filled containers with a loader onto one or more support platforms associated with one or more proppant transporting road vehicles.

2. The method of claim 1, wherein the plurality of proppant filled containers comprises a first plurality of proppant filled containers, and the method further comprising: filling a second plurality of empty proppant containers with proppant from one or more proppant transporting rail vehicles thereby to produce a second plurality of proppant filled containers; and vertically stacking the second plurality of proppant filled containers with a loader so that one of the plurality of proppant filled containers overlies another one of the plurality of filled containers to reduce the footprint of the area required for

storage of the proppant in close proximity to the rail spur.

3. The method of claim 1, wherein the support platform is a tiltable support platform, the method further comprising: tilting the support platform and one or more of the plurality of proppant filled containers located on the platform to discharge proppant from an opening adjacent an end of the one or more of the plurality of proppant filled containers.

4. The method of claim 1, further comprising: conveying the proppant from the one or more proppant transporting rail vehicles to the plurality of empty proppant containers on a first conveyor; and conveying the proppant from one or more of the plurality of proppant filled containers to one or more proppant transporting road vehicles on a second conveyor.

5. The method of claim 4, further comprising: channeling the proppant from the plurality of proppant filled containers to the second conveyor through a hopper.

6. The method of claim 1, further comprising: moving the plurality of empty proppant containers from the storage location, to the one or more proppant transporting rail vehicles and then to the one or more support platforms located on the one or more proppant transporting road vehicles.

7. The method of 1, wherein the one or more proppant transporting road vehicles comprises a plurality of proppant transporting road vehicles, and wherein the method further comprises: staging the plurality of proppant transporting road vehicles so that each of the plurality of proppant transporting road vehicles receives one or more of the plurality of proppant filled containers, delivers the container away from the one or more proppant transporting rail vehicles, thereby increasing the efficiency with which proppant is transferred from the one or more proppant transporting rail vehicles to the plurality of proppant transporting road vehicles.

8. The method of claim 1, wherein step b) further comprises: discharging the proppant from the one or more proppant transporting rail vehicles onto a conveyor; and conveying the proppant on the conveyor from the proppant transporting rail vehicle to an inlet in each of the plurality of empty proppant containers.

9. The method of claim 1 further comprising: after transferring the plurality of proppant filled containers to the one or more support platforms associated with the one or more proppant transporting road vehicles, returning another plurality of empty proppant containers to the proppant transporting rail vehicle to be filled proppant.

10. The method of claim 1, further comprising: positioning a conveyor proximate a proppant transporting rail vehicle to receive proppant from the proppant transporting rail vehicle and thereby convey the proppant away from the proppant transporting rail vehicle when the conveyor operates; positioning the plurality of empty proppant containers to receive proppant from the conveyor sequentially so that as one of the plurality of empty proppant containers is filled to a desired level, such one container then being removed in favor of another one of the plurality of empty proppant containers with the capacity to accept more proppant; after removal of proppant from the conveyor,

transporting each of the plurality of proppant tilled containers away from the proppant transporting rail vehicle.

11. The method of claim 10, further comprising: loading each of the plurality of proppant tilled containers onto a tiltable platform; providing a conveyor between the tiltable platform and one or more proppant transporting road vehicles; and tilting the platform to discharge the proppant from the container into the conveyor.

Description

~~CROSS-REFERENCE TO RELATED APPLICATIONS~~

~~{0001} Not applicable.~~

~~STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT~~

~~{0002} Not applicable.~~

~~NAMES OF THE PARTIES TO A JOINT RESEARCH AGREEMENT Not applicable.~~

~~INCORPORATION BY REFERENCE OF MATERIALS SUBMITTED ON A COMPACT DISC~~

~~{0003} Not applicable.~~

~~BACKGROUND OF THE INVENTION~~

~~{0004}~~ BACKGROUND

1. Field of the Invention

~~{0005}~~ The present invention relates to proppant storage containers. More particularly, the present invention ~~the relates to storage container assemblies whereby a product in one container can flow to an interior volume of a lower container. Additionally~~ relates to systems and methods for the delivery of proppant to a well site. More particularly, the present invention relates to containers ~~that are suitable for the transport, storage and dispensing of proppants therefrom.~~

~~{0006}~~ as part of a system of storing proppant prior to delivery to a well site.

2. Description of Related Art ~~Including Information Disclosed Under 37 CFR 1.97 and 37 CFR 1.98.~~

~~{0007}~~

Hydraulic fracturing is the propagation of fractures in a rock layer caused by the presence of pressurized fluid. Hydraulic fractures may form naturally, in the case of veins or dikes, or may be man-made in order to release petroleum, natural gas, coal ~~seam~~seam gas, or other substances for extraction. Fracturing is done from a wellbore drilled into reservoir rock formations. The energy from the injection of a highly-pressurized ~~fracking~~fracturing fluid creates new channels in the rock which can increase the extraction rates and ultimate recovery of fossil fuels. The fracture width is typically maintained after the injection by introducing a proppant into the injected fluid. Proppant is a material, such as grains of sand, ceramic, or other particulates, that prevent the fractures from closing when the injection is stopped.

~~{0008}~~ With the rise of hydraulic fracturing over the past decade, there is a steep climb in proppant demand. Global supplies are currently tight. The number of proppant suppliers worldwide has increased since 2000 from a handful to well over fifty sand, ceramic proppant and resin-coat producers.

~~{0009}~~ By the far the dominant proppant is silica sand, made up of ancient weathered quartz, the most common mineral in the Earth's continental crust. Unlike common sand, which often feels gritty when rubbed between the fingers, sand used as a proppant tends to roll to the touch as a result of its round, spherical shape and tightly-graded particle distribution. Sand quality is a function of both deposit and processing. Grain size is critical, as any given proppant must reliably fall within certain mesh ranges, subject to downhole conditions and completion design. Generally, coarser proppant allows the higher flow capacity due to the larger pore spaces between grains. However, it may break down or crush more readily under stress due to the relatively fewer grain-to-grain contact points to bear the stress often incurred in deep oil- and gas-bearing formations.

~~{0010}~~ Typically, in any hydraulic fracturing operation, a large amount of such proppant is required. Typically, it has been difficult to effectively store the proppant at the fracturing sites. Additionally, it has been found to be rather difficult to effectively transport the proppant to the desired location. Often, proppant is hauled to the desired locations on the back of trucks and is dumped onsite. Under such circumstances, the proppant is often exposed to adverse weather conditions. This will effectively degrade the quality of the proppant during its storage. Additionally, the maintenance of proppant in containers at the hydraulic fracturing site requires a large capital investment in storage facilities. Typically, the unloading of such storage facilities is carried out on a facility-by-facility basis. As such, there is a need to be able to effectively transport the proppant to and store the proppant in a desired location adjacent to the hydraulic fracturing location.

~~{0011}~~ Present methods of storing proppant for use at the well site has involved a significant investment in structural facilities. In particular, silos have been built in order to store proppant for use in the fracturing operation. Often, the silos can have a cost of several million dollars. Whenever such silos are used, there is a possibility of contamination of the proppant that is contained within the silo. Large storage facilities often mix various types and qualities of proppant. As such, lower quality proppant may be mixed with higher quality proppant so as to create an undesirable contaminated combination.

The availability of high quality proppant is always of a major concern during such fracturing operations. If the proppant is not available at the well site, then the fracturing operation can stall until such time that proppant is available. In other circumstances, the operators of the fracturing operation may be forced to use lower quality proppant in order to continue the operation. As such, there is a need to be able to have high quality proppant available at all times during the fracturing operation. It is also advantageous to provide a system which avoids the mixture of different types of proppant and to avoid the contamination of the proppant supply.

Under certain circumstances, railcars are used to deliver proppant to the fracturing location. The proppant is unloaded from the railcars into pneumatic bulk trailers. The pneumatic bulk trailers can then deliver the proppant to the well site. Often, the bulk materials train will have to remain on-site during the time the proppant remains in the bulk material train. As such, the train is not able to be used for other purposes. This adds additional cost to the fracturing operation. Ultimately, after the train is completely unloaded, a new bulk material train must be transported to the desired location and then serve as a storage facility. As such, a need is developed so as to quickly remove all of the proppant from the bulk material train and to store such proppant until such time as the proppant is needed.

In the past, various patents have issued relating to storage and transport facilities. For example, U.S. Patent Publication No. 2008/0179054, published on Jul. 31, 2008 to McGough et al., shows a bulk material storage and transportation system. In particular, the storage system is mounted on the trailer of a truck. The storage system includes walls that define an interior volume suitable for receiving the aggregate material therein. There are hoppers provided at the bottom of the container. These hoppers have inclined walls. The hoppers can extend so as to allow the material from the inside of the container to be properly conveyed to a location exterior of the container. Actuators are used so as to expand and collapse the container.

~~{0012}~~ U.S. Pat. No. 7,240,681, issued on Jul. 10, 2007 to L. Saik, describes a trailer-mounted mobile apparatus for dewatering and recovering formation sand. The trailer is mounted to a truck-towable trailer so as to receive sand therein. The container has a pair of sloping end walls. The back end of the container is suitably openable so as to allow the sand to be removed therefrom. A pneumatic or hydraulic ram is provided on the forward part of the container so as to allow the container to be lifted angularly upwardly so as to allow sand to be discharged through the gate at the rear of the container.

~~{0013}~~ U.S. Pat. No. 4,247,228, issued on Jan. 27, 1981 to Gray et al., describes a dump truck or trailer with a pneumatic conveyor. The container is mounted to a frame on wheels. A hydraulic ram tilts the container for dumping through a rear outlet. A pneumatic conveyor is carried by the frame with an intake at the rear of the container. A gate allows the solids to be dumped conventionally by gravity or to be blown to a storage facility by the pneumatic container. The container has a top hatch formed therein so as to allow the solids to be introduced into the interior of the container.

~~{0014}~~ U.S. Pat. No. 2,865,521, issued on Dec. 23, 1958 to Fisher et al., shows a bulk material truck that has an interior volume suitable for the receipt of bulk material therein. A pneumatic conveyor is utilized so as to allow the removal of such material from the bottom of the container. A pair of sloping walls are provided on opposite sides of the container so as to allow the bulk material within the container to be

passed toward the bottom of the container. A top hatch is provided on the top of the conveyer. The pneumatic conveyer is connected to the bottom of the container.

~~{0015} It is an object of the present invention to provide a proppant storage vessel that allows proppant to be easily transported and stored.~~

~~{0016} It is another object of the present invention to provide a proppant storage vessel that allows the proppant that is contained within the storage vessel to be easily and efficiently discharged through the bottom thereof.~~

~~{0017} It is another~~ [U.S. Pat. No. 4,995,522, issued on Feb. 26, 1991, to F. M. Barr, describes a bottom dumping bulk container apparatus for a bulk granulated material. The shipping container has a lower wall with a discharge opening. Doors are provided for the opening and closing of the discharge opening. The doors are actuated by an actuating structure which is mounted for vertical movement relative to the container. The actuating structure has upper portions which serve as conventional lifting connectors or receptacles at corners of the container. These cooperate with conventional hooks so that raising the actuating structure opens the door and lowering the actuating structure closes the door. This permits granulated material within the container to be dumped into a lower container or conveyance without requiring specialized lifting or opening equipment.](#)

[U.S. Pat. No. 6,401,983, issued on Jun. 11, 2002 to McDonald et al., provides a bulk cargo container for storing and transporting solid and liquid bulk materials. The bulk cargo container includes a vessel suitable for containing the bulk material and a supporting frame assembly having a generally horizontally-disposed support member attachment. The container portion is formed into at least one hopper having a discharge opening therein suitable for discharging bulk material contained within the vessel.](#)

[U.S. Pat. No. 4,138,163, issued on Feb. 6, 1979 to Calvert et al., discloses a bulk material container for the handling of flowable particulate materials. This container has a closed, generally rectangular parallelepiped structure with side walls, end walls and a roof. Conduits permit the introduction and withdrawal of particulate material to and from the container body. The lower base portion supports a vertical flexure panel at each corner thereof. The vertical flexure panel supports opposed pairs of longitudinal and transverse flexure panels between the tops thereof.](#)

[U.S. Pat. No. 4,909,556, issued on Mar. 20, 1990 to T. Koskinen, provides a transport container for the transport of bulk material. This transport container has a filling-hole in the upper part and an emptying device in the rear. For the loading and unloading, a side section is provided that can be opened. An emptying device, in the nature of a pneumatic pressure discharger, allows the material to freely flow from the containers through a check valve.](#)

[U.S. Pat. No. 7,967,161, issued on Jun. 28, 2011 to A. M. Townsend, provides a shipping container liner system for the shipping of bulk flowable materials. The system has a specially-adapted shipping container liner that is self-supporting without the need for rear-mounted rigid supportive bars to retain the liner within the shipping container during filling and discharge. The system has an arrangement of](#)

interior support baffles operating in conjunction with a plurality of exterior anchor straps adapted to distribute the cargo load throughout the length of the container.

U.S. Pat. No. 5,690,466, issued on Nov. 25, 1997 to Gaddis et al., shows slope plate for a particulate material truck box. The slope plate assembly includes a plurality of slope plate sections pivotally connected to the opposite side walls of the truck box so as to be movable between a raised inoperative position and a lowered operative position. In the lowered position, particulate material flows by gravity along the slope plate sections for discharge into an auger assembly residing below the floor of the truck box. In the raised position, bulk material or other cargo can be loaded into the truck box.

It is the object of the present invention to provide a ~~proppant storage assembly which allows for the effective storage of proppant at the fracturing site.~~

~~[0018] It is~~ system for the storage and transport of proppant that is mobile, scalable and flexible.

Another object to the present invention to provide a system for the storage and transport of proppant that can be located in proximity to the rail spur.

Another object of the present invention to provide a system for the transport and storage of proppant that can be rapidly implemented.

Another object of the present invention to provide a system for the storage and transport of proppant that occupies a small footprint.

The further object of the present invention to provide a system for the storage and transport of proppant that assures a continuous inventory of proppant to the fracturing operation.

Still another object of the present invention is to provide a system for the storage and transport of proppant that is movable and rechargeable at the drill site.

The further object of the present invention is to provide a system for the storage and transport of proppant that enhances the productivity of the proppant supplier.

The further object of the present invention to provide a system for the storage and transport of proppant that reduces driver fatigue.

Another object of the present invention to provide a system for the storage and transport of proppant that reduces liabilities.

The further object of the present invention to provide a system for the storage and transport of proppant that improves safety.

Further object of the present invention to provide a system for the storage and transport of proppant that is compliant with Department of Transportation regulations.

Still another object of the present invention to provide a ~~proppant storage assembly which allows proppant to be efficiently removed from a stacked configuration of containers.~~

~~[0019]~~ system for the storage and transport of proppant which improves the profits for the proppant supplier.

These and other objects and advantages of the present invention will become apparent from a reading of the attached specification and appended claims.

~~BRIEF SUMMARY OF THE INVENTION~~

~~[0020]~~ SUMMARY

The present invention is ~~a proppant storage vessel that comprises a container having a first end wall, a second end wall, a first side wall and a second side wall. The container also has a top wall and a bottom wall which serve to define an interior volume therein. A hatch is formed on the bottom wall of the container. The bottom hatch is movable between an open position and a closed position. A first inclined surface is positioned in the interior volume. The first inclined surface extends from the first end wall to the bottom hatch. A second inclined surface extends from the second end wall toward the bottom hatch. A third inclined surface extends from the first side wall toward the bottom hatch. A fourth inclined surface extends from the second side wall toward the bottom hatch.~~

~~[0021] A top hatch formed on the top wall. The top hatch is movable between an open position and a closed position.~~

~~[0022] Each of the first and second end walls and the first and second side walls have a middle. The first inclined surface has an upper end affixed to the first end wall below the middle thereof. The second inclined surface has an upper end affixed to the second end wall below the middle thereof. The third inclined surface has an upper end affixed to the first side wall below the middle thereof. The fourth inclined surface has an upper end thereof affixed to the second side wall below the middle thereof.~~

~~[0023] A first support brace is affixed to the first and second end walls and extends therebetween. A second support brace is affixed to the first and second side walls and extends therebetween. A first support member has one end affixed to the bottom wall and extends angularly upwardly. The first support member has an opposite end affixed centrally to the first inclined surface. A second support member has one end affixed to the bottom wall and extends angularly upwardly therefrom. The second support member has an opposite end affixed centrally to the second inclined surface. Each of the first, second, third and fourth inclined surfaces has a bottom edge positioned adjacent a perimeter of the bottom hatch. The bottom hatch is hingedly affixed to the bottom wall. The bottom hatch resides against the bottom wall when in the closed position.~~

~~[0024] The present invention is also a proppant storage assembly that comprises a first container having an interior volume and a second container supported in spaced relation above the first container. The~~

first container has a bottom wall having a bottom hatch affixed thereto. The hatch is movable between an open position and a closed position. The first container has an opening at a top wall thereof. The second container has bottom hatch formed on a bottom wall thereof. The bottom hatch of the second container is aligned with the opening of the first container such that a proppant in the first container can flow through the hatch thereof an apparatus for proppant storage. This apparatus comprises a container having a bottom wall, a top wall, a pair of side walls, and a pair of end walls. The pair of side walls extend between the pair of end walls and between the bottom wall and the top wall. The container has an interior volume. A hatch is positioned on the top wall. This hatch is openable so as to allow the proppant to be introduced into the interior volume of the first container. A flow gate is positioned on one of the end walls. The flow gate is openable so as to allow the proppant to flow outwardly of the interior volume of the container.

[0025] In particular, the first container has a top hatch hingedly affixed at the opening thereof. The top hatch of the first container is movable between a closed position and an open position. The bottom hatch of the second container has a length dimension. The length dimension is slightly less than a distance between the first container and the second container. The top hatch of the first container extends in parallel relation to the bottom hatch of the second container when each of the top hatch of the first container and the bottom hatch of the second container are in the open position.

[0026] A first spacer is positioned on the top wall of the first container and extends upwardly therefrom. The first spacer abuts the bottom wall of the second container. A second spacer is positioned on the top wall of the first container and extends upwardly therefrom. The second spacer abuts the bottom wall of the second container. The first spacer is in spaced relation to the second spacer. A pad is positioned against the bottom wall of the first container. The pad supports the bottom wall of the first container a desired distance above an underlying surface. The bottom hatch of the first container has a length dimension. This length dimension is less than a desired distance between the bottom wall and the underlying surface. As such, a portable conveyer can be placed thereunder. The portable container has a surface positioned between the bottom wall of the first container and the underlying surface. The surface of the portable container is directly below the bottom hatch of the first container.

[0027] Each of the first and second containers has a first end wall, a second end wall, a first side wall and a second side wall. A first inclined surface is positioned in the interior volume of the container so as to extend from the first end wall toward the bottom hatch. A second inclined surface is positioned in the interior volume of the container so as to extend from the second end wall toward the bottom hatch. A third inclined surface is positioned in the interior volume so as to extend from the first side wall toward the bottom hatch. A fourth inclined surface is positioned in the interior volume so as to extend from the second side wall toward the bottom hatch.

[0028] A third container can be supported in spaced relation above the second container. The second container has a top hatch formed on a top wall thereof. The third container has a bottom hatch formed on a bottom wall thereof. The bottom hatch of the third container is aligned with the top hatch of the second container. Each of the containers is ocean freight container.

~~[0029] In an alternative embodiment of the present invention, the first container has the first side wall, a second side wall, a first end wall and second end wall hingedly mounted to the bottom wall thereof. A first slot and a second slot are affixed to the bottom wall of the container. The first and second slots are suitable for the receipt of forks of a forklift therein.~~

~~[0030] The foregoing Summary of the Invention is intended to describe, in summary, the preferred embodiments of the present invention. However, this section is not intended, in any way, to limit the scope of the present invention. The scope of the present invention should be defined by the claims herein and their legal equivalents.~~

~~BRIEF DESCRIPTION OF THE SEVERAL VIEWS~~ In the apparatus of the present invention, at least one of the end walls is recessed inwardly of the end of the pair of side walls and inwardly at the bottom wall and inwardly at the top wall. This end wall has a generally convex shape. A proppant inlet is affixed to the end wall. The proppant inlet communicates with the interior volume of the container. The proppant inlet is suitable for allowing proppant to be introduced into the interior volume of the container. A vent also opens to the interior volume. This vent is formed at an upper portion of one of the pair of end walls.

A longitudinal member is positioned in the interior volume of the container. The longitudinal member has one end affixed to one of the pair of end walls and an opposite end affixed to the other of the pair of end walls. A first cross member is positioned in the interior volume of the container. The first cross member has one end affixed to one of the pair of side walls and an opposite end affixed to the other of the pair of side walls. A second cross member is positioned in the interior volume of the container and in spaced relationship to the first cross member. The second cross member has one end affixed to one of the pair of side walls and an opposite end affixed to the other of the pair of side walls. A flow gate is positioned on one of the end walls generally adjacent to the bottom wall. This flow gate is slidable between an open position and a closed position.

The present invention is also a method of delivering proppant that comprises the steps of: (1) transporting a load of proppant in a vessel to a desired location; (2) moving the load of proppant from the vessel into a container so as to create a proppant-loaded container; (3) unloading the proppant-loaded container into a pneumatic bulk trailer; and (4) transporting the unloaded proppant in the pneumatic bulk trailer to a well site.

The vessel is a hopper of a bulk material train. The step of transporting includes loading the hopper with proppant in a remote location and then transporting the loaded proppant in the hopper of the bulk material train to the desired location. The step of moving includes conveying the proppant from the hopper of the bulk material train into a hatch formed at the top of the container.

The container can be placed onto the bed of a truck. The truck is moved so that the container is adjacent to the vessel. As such, the empty container is available so that the proppant can be conveyed from the hopper of the bulk material train into the interior volume of the container.

The step of unloading includes placing the proppant-loaded container onto a tilting mechanism, tilting

the placed proppant-loaded container to an angle such that an end wall of the container faced downwardly at an angle, and discharging the proppant from the tilted container to a flow gate of the container. The proppant flows through the container of the flow gate into a hopper. This flowed proppant is conveyed from the hopper into the pneumatic bulk trailer. Air is injected into the container as the proppant flows through the flow gate. A plurality of the proppant-loaded containers can be stacked at the desired location prior to the step of unloading.

The present invention is also a method of delivering and storing proppant for use at the well site. This method includes the steps of: (1) transporting the load of proppant in a vessel to a desired location; (2) moving the load of proppant from the vessel into a plurality of containers so as to create a plurality of proppant-loaded containers; (3) stacking the plurality of proppant-loaded containers at the desired location so as to form a stack of the proppant-loaded containers; (4) lifting an upper most proppant-loaded container from the stack; (5) moving the upper most proppant-loaded container to a tilting mechanism; and (6) tilting the proppant-loaded container by the tilting mechanism so as to discharge the proppant from the container.

The discharged container can be transported to another stack of empty containers or to a position adjacent to the proppant-containing vessel. The proppant is discharged to a flow gate of the tilted proppant-loaded container into a hopper. The proppant from the hopper can be conveyed into a pneumatic bulk loader. The transported conveyed proppant in the pneumatic bulk trailer can then be transported to the well site.

BRIEF DESCRIPTION OF THE DRAWINGS

~~{0031} FIG. 1 is a side-elevational~~prospective view of the ~~proppant storage assembly in accordance with the preferred embodiment~~container apparatus as used in the system of the present invention.

~~{0032} FIG. 2 is an end view of the proppant storage assembly~~container apparatus as used in the system of the present invention ~~showing, in particular, the portable conveyer located at a bottom thereof~~

~~{0033} FIG. 3 is a transparent plan view of the proppant storage container in accordance with the preferred embodiment of the present invention.~~

~~{0034} FIG. 4 is a plan view showing of the proppant storage container of the present invention.~~

~~{0035} FIG. 5 is a cross-sectional view as taken from an end of the proppant storage container of the present invention.~~

~~{0036} FIG. 6 is cross-sectional view as taken across a side of the proppant storage container of the present invention.~~

~~{0037} FIG. 7 is a perspective view of an alternative embodiment of the proppant storage container.~~

FIG. 3 is an illustration of the system of the present invention.

DETAILED DESCRIPTION ~~OF THE INVENTION~~

~~[0038]~~

Referring to FIG. 1, there is shown the proppant storage ~~assembly~~apparatus 10 in accordance with the preferred embodiment of the present invention. The proppant storage ~~assembly~~apparatus 10 includes a ~~first container 12 having an interior volume 14 and a second container 16 having a interior volume 18.~~ The first container 12 is in spaced relationship to the second container 16. The first container 12 has a bottom wall 20. The bottom wall 20 has a bottom hatch 22 affixed thereto. The hatch 22 is movable between a closed position and an open position (illustrated in broken line fashion). The first container 12 has an opening 24 at a top wall 26 thereof. The second container 16 has a hatch 28 formed on a bottom wall 30 thereof. The bottom hatch 28 of the second container 16 is shown as aligned with the opening 26 of the first container 12 such that a proppant within the second container 16 can flow through the hatch 28 into the interior volume 14 of the first container 12.

~~[0039]~~ In particular, in FIGURE 1, it can be seen that the first container 12 has a hatch 32 extending over the opening 24 thereof. In particular, the hatch 32 is hingedly mounted to the top wall 26 of the first container 12 so as to be movable between a closed position and an open position (illustrated in broken line fashion). In particular, the bottom hatch 28 of the second container 16 will extend downwardly perpendicularly to the bottom wall 30. Similarly, the top hatch 32 of the first container 12 will extend upwardly in generally transverse relationship to the top wall 26. The hatches 28 and 32 will be in generally parallel relationship in this configuration. As such, the hatches 24 and 28 will form a unique and guided flowpath whereby the proppant in the interior volume 18 of the second container 16 can flow directly into the opening 24 and into the interior volume 14 of the first container 12. The length dimension of the hatches 28 and 32 will be less than the distance between the top wall 26 of the first container 12 and the bottom wall 30 of the second container 16.

~~[0040]~~ A first spacer 34 is positioned on the top wall 26 of the first container 12 and extends upwardly therefrom. The first spacer 34 abuts the bottom wall 30 of the second container 16. A second spacer 36 is positioned on the top wall 26 of the first container 12 and extends upwardly therefrom. The second spacer 36 abuts the bottom wall 30 of the second container 16. The first spacer 34 is in spaced relationship to the second spacer 36. The spacers 34 and 36 serve to assure a proper distance between the containers 12 and 16 whereby the hatches 28 and 32 can be properly opened so as to allow for the flow of proppant therebetween. A pad 38 is positioned against the bottom wall 20 of the first container 12. The pad 38 serves to support the first container 12 above an underlying surface 40 (such as the earth). It can be seen that the pad 38 is in the nature of a concrete structure that has a base 42 embedded into the earth. As such, the pad 38 is configured so as to rigidly support the containers 12 and 16 in their desired positions above the earth.

~~[0041]~~ Pad 38 support the container 12 in a suitable distance above the underlying surface 40 such that the hatch 22 can move from its closed position to its open position while allowing a certain amount of space therebetween. As a result, a portable conveyer can be placed below the bottom hatch 22 so as to allow the proppant container 12 having a bottom wall 14, a top wall 16, a pair of side walls 18 and 20

and a pair of end walls 22 and 24. The side wall 18 extends between the bottom wall 14 and the top wall 16. The side wall 20 also extends between the bottom wall 14 and the top wall 16 in generally spaced parallel relationship to the side wall 18. The end wall 22 extends between the bottom wall 14 and the top wall 16. Similarly, the end wall 24 extends between the bottom wall 14 and the top wall 16 and also between the side walls 18 and 20. The top wall 16 has a hatch 26 formed thereon. Hatch 26 is openable so as to allow proppant to be introduced into the interior volume of the container 12. A flow gate 28 is positioned on the end wall 22. The flow gate 28 is openable so as to allow the proppant to flow outwardly of the interior volume of the container 12.

It can be seen that the end wall 22 is recessed inwardly of an end of the pair of side walls 18 and 20 and inwardly of the bottom wall 14 and the top wall 16. As such, the outermost end 30 of the container 12 will provide a protective structure for the generally convex surface of the end wall 22. This convex shape of the end wall 22 facilitates the ability to funnel the proppant from within the interior volume of container 12 outwardly through the flow gate 28. The frame structure at the end 30 enhances the structural integrity of the container 12 at this end while protecting the mechanical structures associated with the flow gate 28. The flow gate 28 is slidable upwardly so as to open to the interior volume. An inlet 32 is generally positioned at the end wall 22 and opened through the end wall 22 to the interior volume of the container 12. This proppant inlet is suitable for allowing proppant and/or air to be introduced into the interior volume of the container. As such, when the container 12 is at a well site or other location, additional proppant can be introduced into the interior volume of the container 12 through the proppant inlet 32. Inlet 32 also allows air to be introduced into the interior volume of the container 12 so as facilitate the ability of the proppant within the container 12 to exit through the flow gate 28. The inlet 32 is in the nature of a tube that can be connected to a suitable hose. A vent 34 is also positioned at the end wall 22. Vent 34 opens to the interior volume of the container 12 so as to allow excess air pressure to exit outwardly of the container 18.

The container 10 is configured so as to contain 96,000 pounds of proppant therein. Since each railcar can transport 192,000 pounds of proppant, a pair of containers 12 can receive all of the proppant from the railcar. However, conventional shipping containers could lack the structural integrity to contain such a large weight. As such, the proppant storage apparatus 10 includes an interior structure which enhances the integrity of the container 12 for its intended purpose.

In particular, a longitudinal member 36 is positioned in the interior volume of the container 12. Longitudinal member 36 extends generally centrally of the interior volume of the container 12. The longitudinal member 36 has one end rigidly affixed to the end wall 22 and an opposite end rigidly affixed to the end wall 24. This connection will maintain the integrity of the end walls 22 and 24 in spite of the large weight of proppant urging thereagainst. A first cross member 38 is positioned within the interior volume ~~14 to be discharged therefrom.~~

[0042] A third container ~~44~~ of the container 12. The first cross member 38 has one end affixed to the side wall 18 and an opposite end affixed to the side wall 20. A second cross member 40 is also positioned in the interior volume of the container and is supported in generally spaced relationship above the top wall ~~46~~ of the second container 16. As can be seen, the third container has a bottom hatch ~~48~~ located on the bottom wall ~~50~~ thereof. The top wall 46 has a top hatch 52 hingedly connected

thereto. As a result, when the bottom hatch 48 is opened and the top hatch 52 is opened (as illustrated in broken line fashion), the proppant within the interior volume 54 of the third container 44 can flow directly into the interior volume 18 of the second container 16. Suitable spacers 56 serve to support the bottom wall 50 of the third container 44 a proper distance above the top wall 46 of the second container 16. Third container 44 also has a top hatch 58 that is movable between a closed position and an open position (illustrated in broken line fashion).

[0043] In the configuration shown in FIG. 1, volumes of proppants can be easily stored at the fracturing site. It is only necessary to stack each of the containers 12, 16 and 44 upon one another in the manner described in FIG. 1. Each of the containers 12, 16 and 44 has an exterior ~~configuration similar to that of~~ an ocean freight container. As such, these containers can be easily transported on the bed of a truck, on a freight train or on a ship to the desired location. Because of this stacking arrangement, special proppant storage facilities are not required at the fracturing site. Each of the hatches 28, 32, 48, 52 and 58 can be in a liquid-tight sealing relationship over the respective openings thereof when in the closed position. As such, the arrangement illustrated in FIG. 1 of the proppant storage assembly 10 can avoid any liquid intrusion into the parallel relationship to the first cross member 38. Each of the cross members 38 and 40 is positioned generally centrally with respect to the height of the container 12. The second cross member has one end affixed to the side wall 18 and an opposite end affixed to the side wall 22. The cross member 38 and 40 are configured so as to maintain the, integrity of the side walls 18 and 20 against the large weight of proppant contained within ~~each of the containers 12, 16 and 44.~~ Typically, a forklift, or other lifting device, can be utilized so as to properly stack the containers. the interior volume of the container 12.

FIG. 2 is an end view showing the proppant storage apparatus 10 of the present invention. In particular, the end wall 22 of the container 12 is illustrated as having a hatch 28 slidably received within guides 42 thereon. Suitable hydraulic or pneumatic mechanisms can be associated with the flow gate 28 so as to raise or lower the flow gate 28. In the lowered position, the flow gate 28 locks the flow of proppant from the interior volume of the container 12. In the raised position, the flow gate 28 will open to the interior volume of the container 12 so as to allow proppant to be discharged therefrom. The proppant inlet 32 and the vent 34 are illustrated as positioned on the end wall 22.

Within the concept of the present invention, ~~two containers, three containers, or more can be utilized in the construction of the proppant storage assembly 10. Each of the containers 12, 16 and 44 has an interior structure in the nature illustrated in FIGS. 3-6 herein, as will be described hereinafter. The present invention provides a suitably modular arrangement whereby a proppant storage facility can be easily constructed on-site. After the fracturing operation is completed, the containers can be easily removed from this stacked configuration and transported to another location. Similarly, if desired, the containers 12, 16 and 44 can be suitably replaced by another container so as to provide the desired proppant to the fracturing site.~~

[0044] FIG. 2 shows an end view of the proppant storage assembly 10 of the present invention showing of the present invention. In FIG. 2, it can be seen that the first container 12 is spaced from the second container 16. The second container 16 is suitably spaced from the third container 44. The bottom hatch 22 of the first container is openable so that the proppant within the first container 12 can be discharged

through the hatch 22 onto a portable conveyer 60. The portable conveyer 60 can be easily transported to a location below the hatch 22 of the first container 12 so as to allow the proppant from the containers to be transported to another location. Each of the containers 12, 16 and 44 is vertically aligned in a stacked orientation. The first container has a capacity for storing 100,000 pounds of proppant. The second container 16 and the third container 44 can store 30,000 pounds of proppant. As such, a very large amount of proppant can be provided to the fracturing site, in a simple easy and convenient manner.

[0045] FIG. 3 illustrates the interior construction of the first container 12. The top wall of the first container 12 has been removed for the purposes of illustration. The container 12 has a first end wall 70, a second end wall 72, a first side wall 74 and a second side wall 76. The end walls 70 and 72 extend between the side walls 74 and 76 so as to define the interior volume of the first container 12. A first inclined surface 78 extends from the first end wall 70 to the bottom hatch 22. A second inclined surface 80 extends from the second end wall 72 toward the bottom hatch 22. A third inclined surface 82 extends from the first side wall 74 toward the bottom hatch 22. Similarly, a fourth inclined surface 84 extends from the second side wall 76 toward the bottom hatch 22. Lower ends of each of the inclined surface 78, 80, 82 and 84 are aligned with the perimeter of the bottom hatch 22. The inclining of the side walls 78, 80, 82 and 84 serves to assure that the proppant contained within the interior volume thereof is suitably funneled toward the bottom hatch 22. Each of the inclined surface 78, 80, 82 and 84 is has a smooth surface so that a constant flow of proppant can occur.

[0046] FIG. 4 illustrates the bracing associated with the first container 12 so as to assure the structural integrity of the container. As can be seen, a first support brace 90 is affixed to the first end wall 70 and extends across the interior volume of the container 12 to the second end wall 72. The first support brace 90 is suitably welded to the end walls 70 and 72 so as to provide a rigid structural support therebetween. A second support brace 92 has one end affixed to the side wall 74 and an opposite end affixed to the side wall 76. The second support brace 92 extends transversely to the first support brace 90. The second support brace 92 provides a rigid support for the side walls 74 and 76. The first support brace 90 and the second support brace 92 structurally enhance the strength of the container 12 so as to as to withstand the weight of the proppant that is contained therein. The second support brace 92 can also include another support brace 94 extending between the side walls 74 and 76 in generally parallel relationship to the first support brace 90. Within the concept of the present invention, various other support braces, in the nature of angle irons, can be utilized so as to suitably support the structure of the container 12.

[0047] FIG. 5 illustrates a cross-sectional view of the container 12. As can be seen, the container 12 has the bottom hatch 22 located on the bottom wall 20 thereof. A top hatch 32 is hingedly mounted to the top wall 26 thereof. Hatch 32 serves to cover the opening 24 in the top wall 26. The bottom hatch 22 is hingedly mounted to the bottom surface of the bottom wall 20 and can be suitably latched to the bottom wall 20 so as to retain the proppant 100 therein. The container 12 has its side walls 74 and 76 extending vertically upwardly from the bottom wall 20. The first inclined surface 78 and the second inclined surface 80 are illustrated as funneling the proppant 100 toward the bottom hatch 22. The first inclined surface 78 has one end mounted adjacent to hatch 22 and an opposite end affixed to the side wall 74. In particular, the inclined surface 78 has its opposite end at the side wall 74 located below the

~~middle of the side wall 74. Similarly, the second inclined surface 80 extends from the hatch 22 toward the side wall 76 at a location below the middle of the side wall 76. The second support brace 92 is illustrated as extending across the interior volume 14 of the first container 12 between the side walls 74 and 76.~~

~~[0048] FIG. 6 shows another cross sectional view of the first container 12. First container 12 is illustrated also as having the top hatch 32 hingedly mounted to the top wall 26 and the bottom hatch 22 hingedly mounted to the bottom wall 20. The third inclined surface 82 extends from the bottom hatch 22 to the side wall 74. The fourth inclined surface 84 extends from the bottom hatch 22 toward the side wall 76. Each of the ends of the inclined surfaces 82 and 84 will be joined to the respective walls 74 and 76 at a location below the middle of each of the side walls 74 and 76. The first support brace 90 extends between the side walls 74 and 76 so as to provide structural integrity.~~

~~[0049] In FIG. 6, there is a first support member 102 that extends from the bottom wall 20 upwardly toward a location centrally of the third inclined surface 82. Another support member 104 extends from the bottom wall 20 upwardly toward a center of the fourth inclined surface 84. These support members 102 and 104 enhance the strength of the inclined surfaces 82 and 84 so as to withstand the weight and forces imparted thereto by the proppant 100.~~

~~[0050] FIG. 7 shows an alternative embodiment of the container 110 of the present invention. Container 110 includes a first end wall 112, a second end wall 114, a first side wall 116, and a second side wall 118. Each of the end walls 112 and 114 and each of the side walls 116 and 118 are illustrated as extending upwardly from a bottom wall 120.~~

~~[0051] Within concept shown in FIG. 7, each of the end walls 112 and 114 and each of the side walls 116 and 118 are hingedly mounted to the bottom wall 120. It can be seen that there are latch members 122, 124 and 126 that serve to secure the walls 112, 114, 116 and 118 in their upright configuration. Latch members 122 join the side wall 116 to the end wall 112. Latch members 124 join the side wall 116 to the end wall 114. Latch members 126 secure the end wall 114 to the side wall 118. An additional latch member (not illustrated) will secure the end wall 112 to the side wall 118. As such, the structure of the container 110 can be in a sand receiving orientation.~~

~~[0052] Importantly, since each of the walls 112, 114, 116 and 118 are hingedly secured to the bottom wall 120, the walls can be pivoted about the hinges so as to overlie the bottom wall 120 once the latch members 122, 124 and 126 are released. A handle 128 is provided on the end walls 112 and 114 so as to allow the container 110 to be moved, as desired. Wheels 130 extend downwardly from the bottom wall 120 so as to allow the container 110 to be rolled to a desired position.~~

~~[0053] In FIG. 7, there is a first slot 132 and a second slot 134 formed on the bottom of the bottom surface 120. Slots 132 and 134 allow for the receipt of the forks of a forklift therein. As such, the container 110 can be moved to a desired location in a simple and efficient manner.~~

~~[0054] it is advantageous to be able to stack several containers on top of one another. As such, the end surface 30 has structural uprights 44 and 46 thereon. Similarly, horizontal structural members 48 and 50~~

will extend between the structural uprights 44 and 46 at the top and bottom of the container 12. The structural members enhance the integrity of the container so that a large amount of weight can be stacked upon the container 12. Again, the structural members 44, 46, 48 and 50 enhance the integrity of the container 12 to the heavy weight supported therein.

FIG. 3 shows a system 60 of the present invention. The system 60 initially involves the transport of a load of proppant to a desired location in a vessel 62. The vessel 62 is in the nature of hoppers associated with a bulk material train 64. The bulk material train 64 is driven by an engine 66 located on a rail spur 68. As such, in the present invention, the bulk material is delivered by the bulk material train 64 to the desired location. The vessel 62 of the bulk material train 64 can be immediately unloaded at this desired location so that the engine 66 can return the bulk material train 64 for other railroad usages.

The rail spur 68 is illustrated as being located in an elevated location. As such, containers 70, 72, 74 and 76 can be located in proximity to the vessel 62 and adjacent to the bulk material train 64. Each of the containers 70, 72, 74 and 76 has a configuration similar to that shown herein in association with FIGS. 1 and 2.

The hatch on the top wall 78 of the container 70 is illustrated as being adjacent to a conveyer 80 associated with the vessel 62. In other words, the hopper of the bulk material train 64 is opened adjacent to the conveyer 80. The conveyer 80 extends between the gate of the vessel 62 and the hatch at the top wall 78 of the container 70. Once this hopper of the bulk material train 64 is unloaded into the vessel 70, the conveyer 80 can be moved forwardly along the bulk material train 64 so that another hopper can discharge its proppant content into the container 72 of truck 82. The containers 70 and 72 are supported on the bed of the truck 82. Similarly, a conveyer 84 allows the unloading of another hopper of the bulk material train 64 into the container 74. The container 76 can be maintained in proximity to another hopper of the bulk material train 64 so that further unloading can occur.

A container loader/unloader 86 is positioned so as to allow for the lifting and transport of the containers 70, 72, 74 and 76. In particular, in FIG. 3, it can be seen that the container loader/unloader 86 has removed the containers from the truck 88 and has placed containers 92 and 92 upon tilting mechanisms 94 and 96, respectively. The tilting mechanisms 94 and 96 include a support panel that is pivotally connected to a frame. A hydraulic mechanism can then pivot the plate upwardly so that the container 90 is tilted so that the end wall faces at an angle downwardly toward a hopper 98. The tilting mechanism 96 also includes a similar structure such that the end wall of the container 92 is directed downwardly toward the hopper 100. The tilting mechanisms 94 and 96 allow proppant to be discharged in a very fast, convenient and safe manner into the respective hoppers 98 and 100.

A conveyer 102 extends to the bottom of the hopper 98 and to the top of a pneumatic bulk trailer 104. As a result, the proppant that is discharged through the flow gate at the end wall of the container 92 into the hopper 98 is transported by the conveyer 102 into the pneumatic bulk trailer 104. Similarly, another conveyer 106 extends from the hopper 100 to another pneumatic bulk trailer 108 so as to discharge proppant into the pneumatic bulk trailer. When each of the pneumatic bulk trailers 108 has been filled with proppant, these pneumatic bulk trailers 104 and 108 can then transport the proppant

to the well site.

Flatbed trucks 110 and 112 are in line for receiving additional containers 114. Truck 112 is positioned adjacent to the container 114 so that the container loader/unloader 116 can place the containers onto the flatbed of the truck 112. Truck 112 can then move to another position adjacent to the bulk material train 64 for the further unloading of the hoppers associated therewith. As such, it can be seen that the staging of the various flatbed trucks allows for the efficient and effective removal of the proppant from the hoppers of the bulk material train 64.

In FIG. 3, the containers 114 are arranged in a stacked configuration. The containers 114, as illustrated in FIG. 3, are stacked in a five-high stack since the containers are empty. However, within the concept of the present invention, if it is possible to unload the bulk material train 64 faster than the bulk material trailers 104 and 108 are available, then the filled containers can also be arranged in a stack. Typically, the containers can only be stacked four-high in view of large weight supported therein. These containers can be stacked until such time as proppant is required or until such time as equipment is available for the unloading of such containers.

Each of containers as utilized in the system of the present invention is a specially designed 8 foot by 20 foot container that is capable of containing 96,000 pounds of proppant. The containers can be moved by flatbed, low bed and container chassis that are accessible and economical. The facilities, such as illustrated in FIG. 3, requires only 1.5 acres to manage 45 million pounds of proppant. Empty containers can be stacked five-high and full containers can be stacked three or four high. Lashing can be used to ensure safety. The containers associated with the present invention allow proppant to be removed in an efficient and effective manner. Air can be injected through the inlet so as to facilitate the flow of proppant outwardly at the flow gate. In this arrangement, it has been found that 90,000 pounds of proppant can be unloaded in fifteen minutes.

Each of the containers can be arranged as to store 360,000 pounds of proppant per 160 square feet of footprint. The unloading equipment can unload one railcar in less than twenty minutes or unload a 120 car unit train in less than 48 hours. Multiple railcars can be unloaded at the same time.

The arrangement of containers is scalable for as much or as little proppant as required. A WMS inventory control system can be utilized. In such a system, each container can be bar-coded and logged-in to track the amount of proppant on hand by the mesh size of the proppant. Once the containers are loaded, they can be easily and safely stacked up in yards. As such, air space is utilized as opposed to yard space. All that is required is a solid foundation and proper container handling equipment.

The proppant is unloaded from containers to pneumatic bulk trailers. As such, the proppant will stay dry and would be manipulated less than flat-stored proppant. When the proppant is ordered, the container-moving machines move the container to hydraulic chassis. Proppant is then dumped into the hoppers. An airbox is utilized so as to blow the proppant out of the container.

The process of the present invention ensures close proximity of the site to the rail spur. The process of

the present invention can be rapidly implemented when compared to silo facilities. Typically, such silo facilities can take up to two years to build. The number of containers is scalable for inventory requirements. A mini-stack of containers can be moved and recharged at the drill site so as to ensure continuous inventory for the fracturing operation. The system of the present invention can move the inventory closer to the production field than the prior art.

The present invention provides a lower overall cost per ton of proppant. In particular, the empty containers can be staged on-site at the mine. This serves to smooth out productivity for the proppant supplier. It also serves to improve throughput/profits for the proppant supplier. Any over supplies or leftover production can be stored on-site. This allows the company to negotiate better rates in exchange for helping the proppant supplier with their supply chain problems.

In contrast to prior systems where the pneumatic bulk trailer continually moves back and forth from the bulk material train to the well site, the present invention allows for the storage of such proppant in a location adjacent to the rail line. As a result, the truck drivers can have reduced fatigue. A safer work environment is promoted by the system of the present invention. A higher quality driver pool is maintained. Additionally, this system complies with Department of Transportation regulations.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof. Various changes in the details of the illustrated construction can be made within the scope of the appended claims without departing from the true spirit of the invention. The present invention should only be limited by the following claims and their legal equivalents.

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