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(54) **SYSTEM AND METHOD FOR DELIVERY OF OILFIELD MATERIALS**

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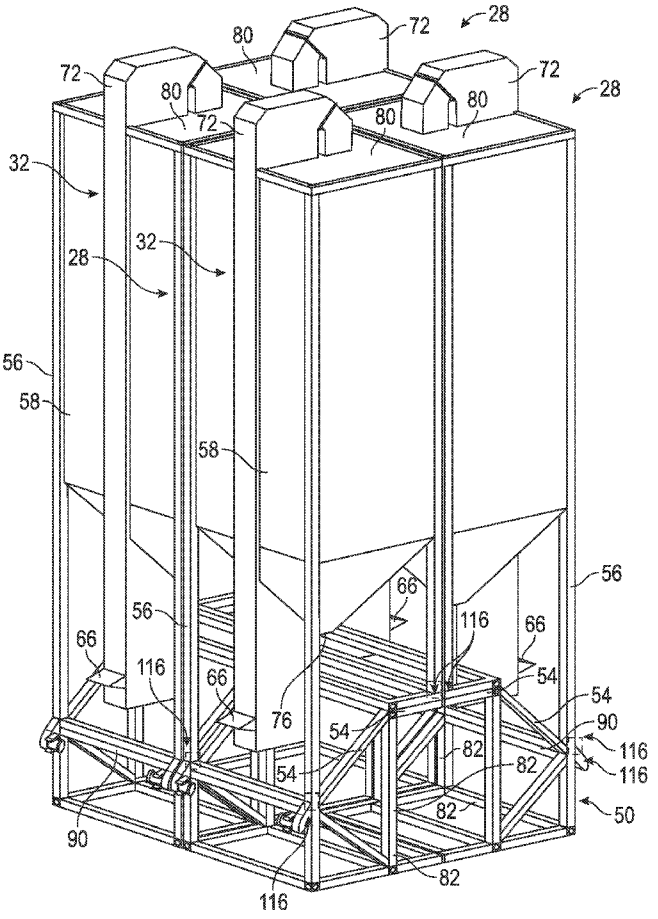
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(57) **ABSTRACT**

A system and methodology facilitates the handling of oilfield material. The oilfield material is stored in at least one silo which enables use of gravity to feed the oilfield material to a blender or other suitable equipment. Each modular silo is transportable and may be engaged with a support structure via a pivot connection. Once engaged, the silo is pivoted to a raised, upright position on the support structure. The oilfield material is then moved to an interior of the silo, and gravity may be used to feed the oilfield material to a blender or other equipment in a controlled manner.



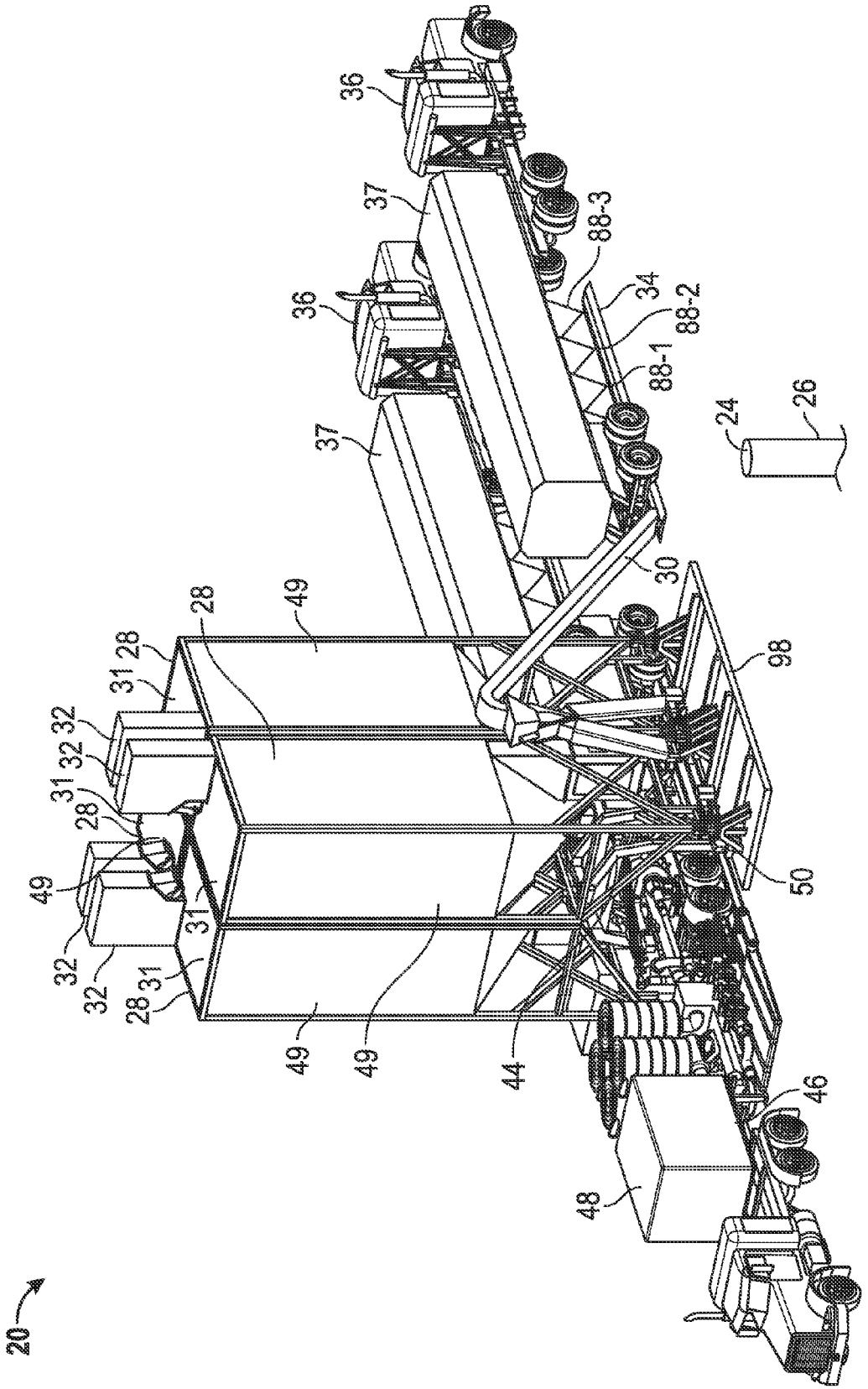


FIG. 1

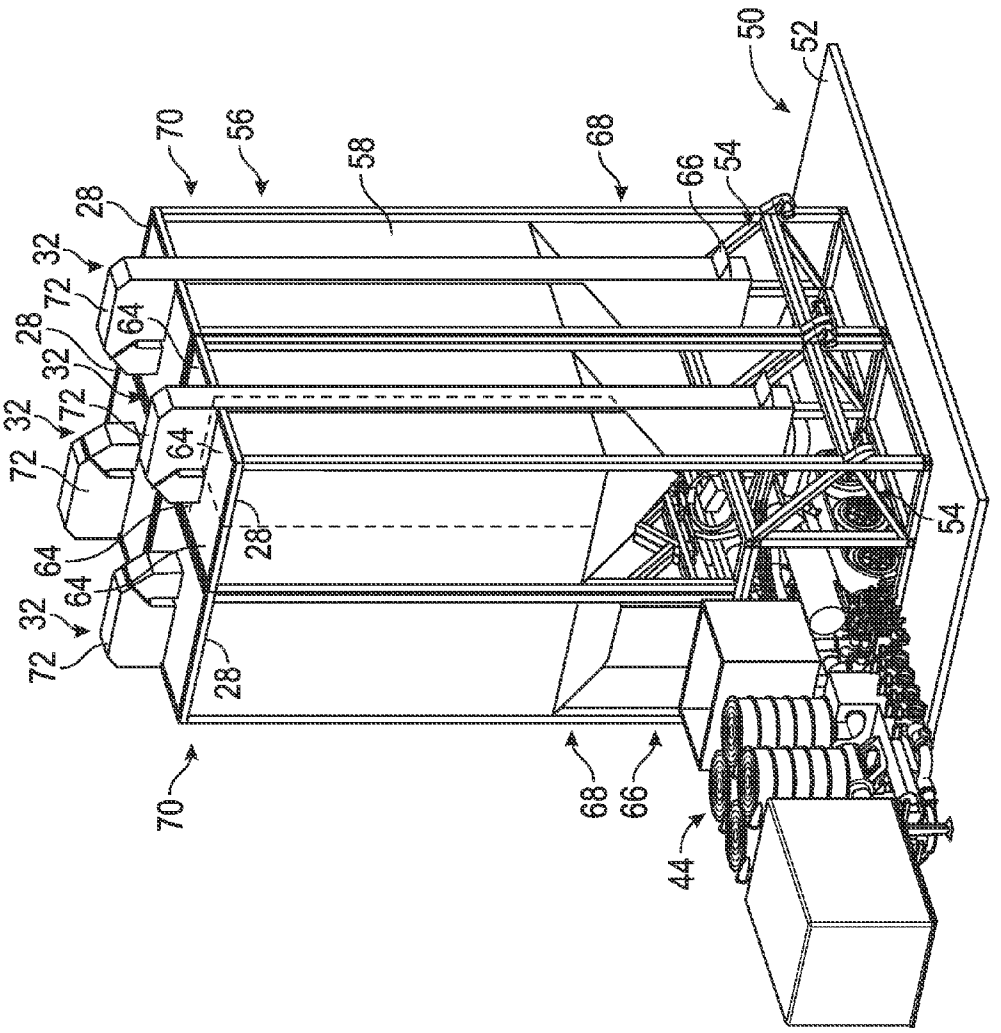

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FIG. 2

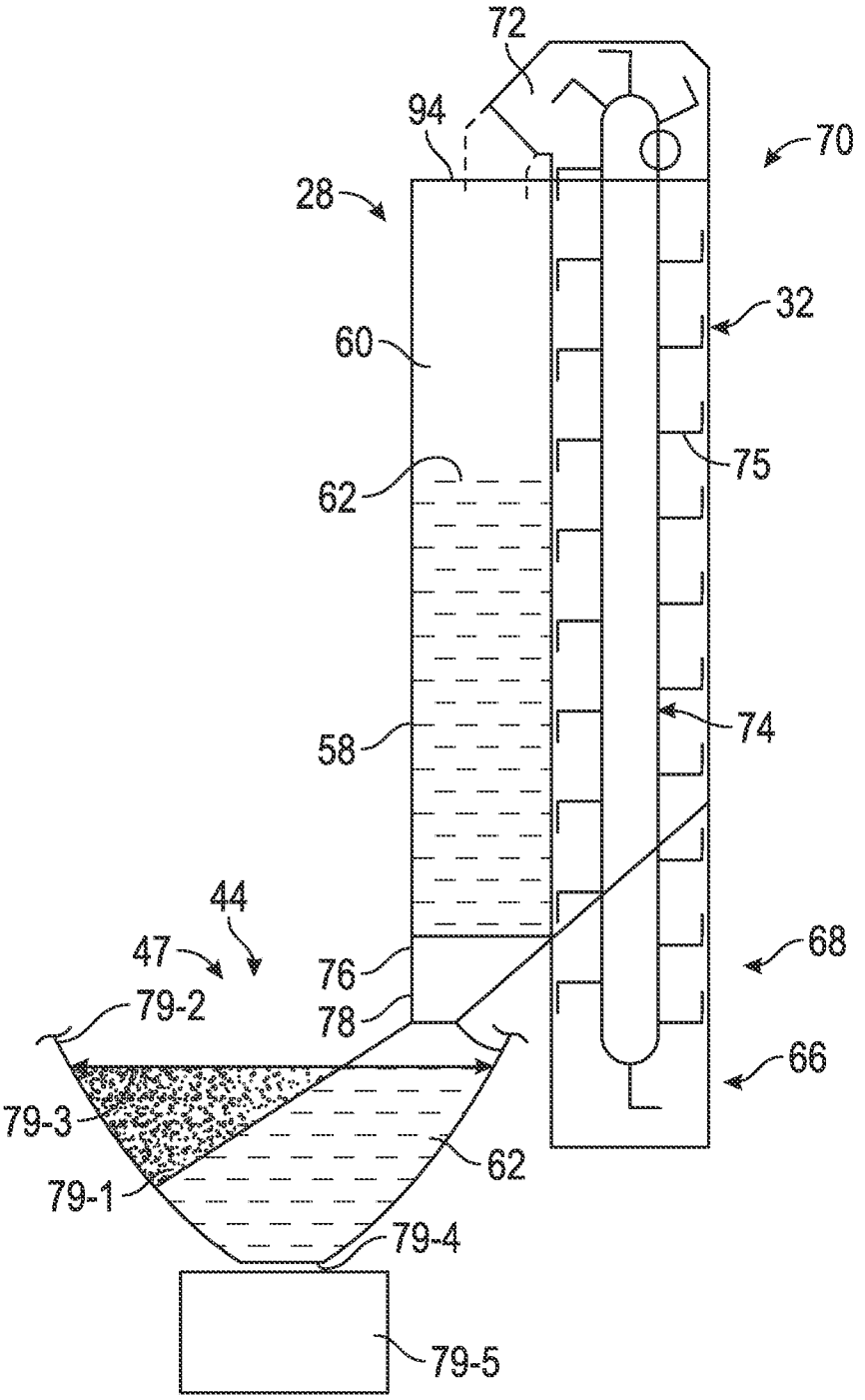


FIG. 3

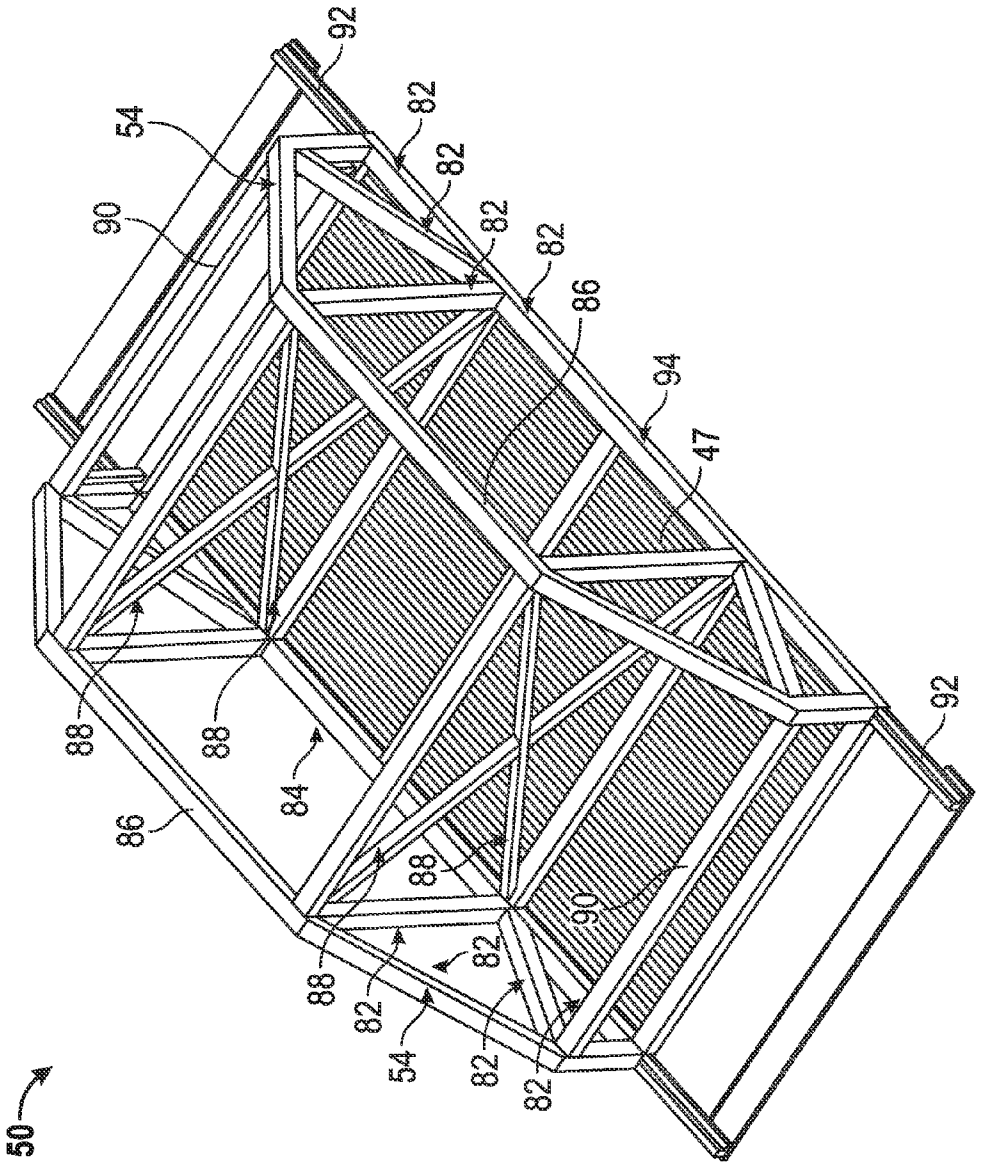


FIG. 4

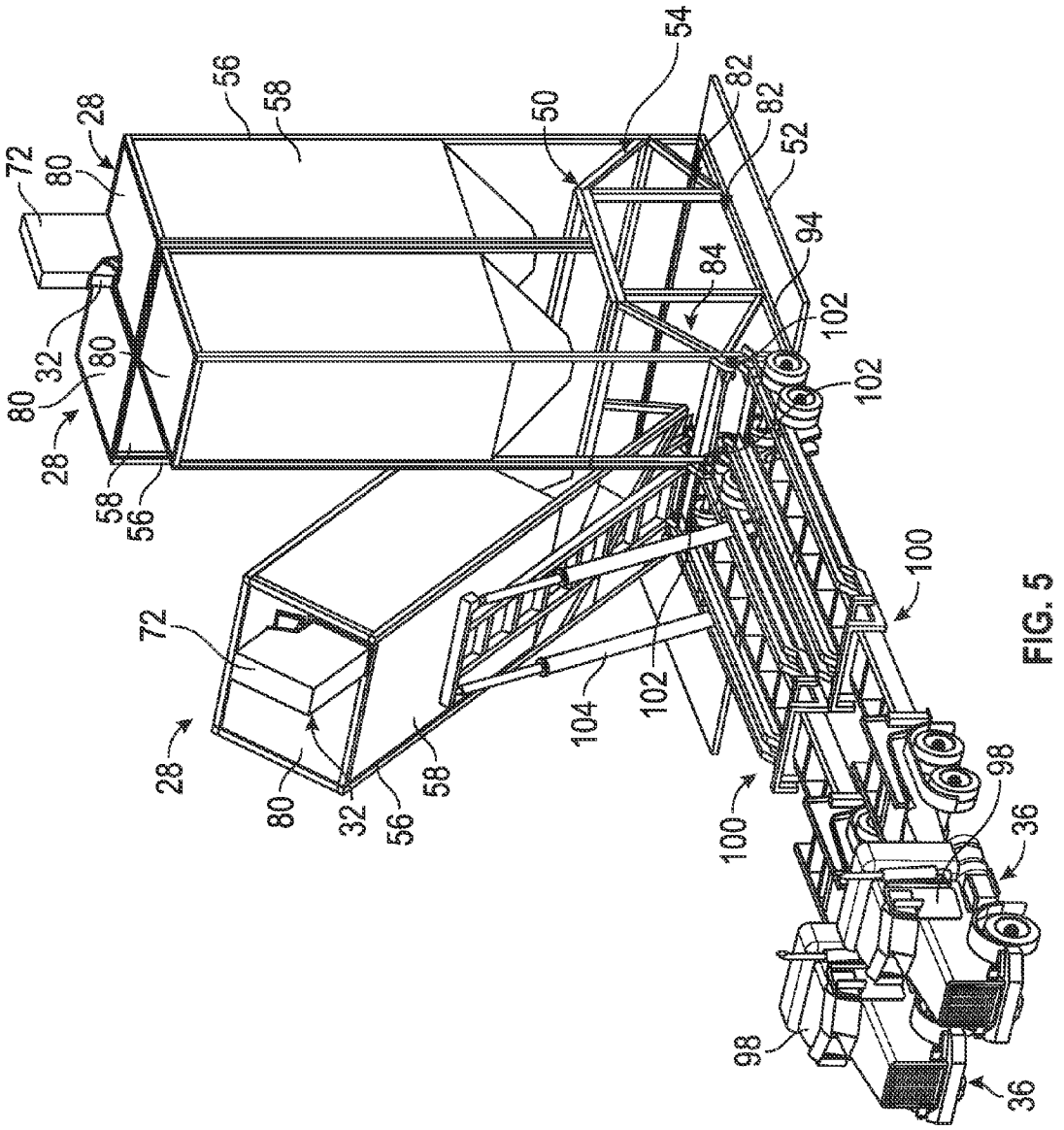

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FIG. 5

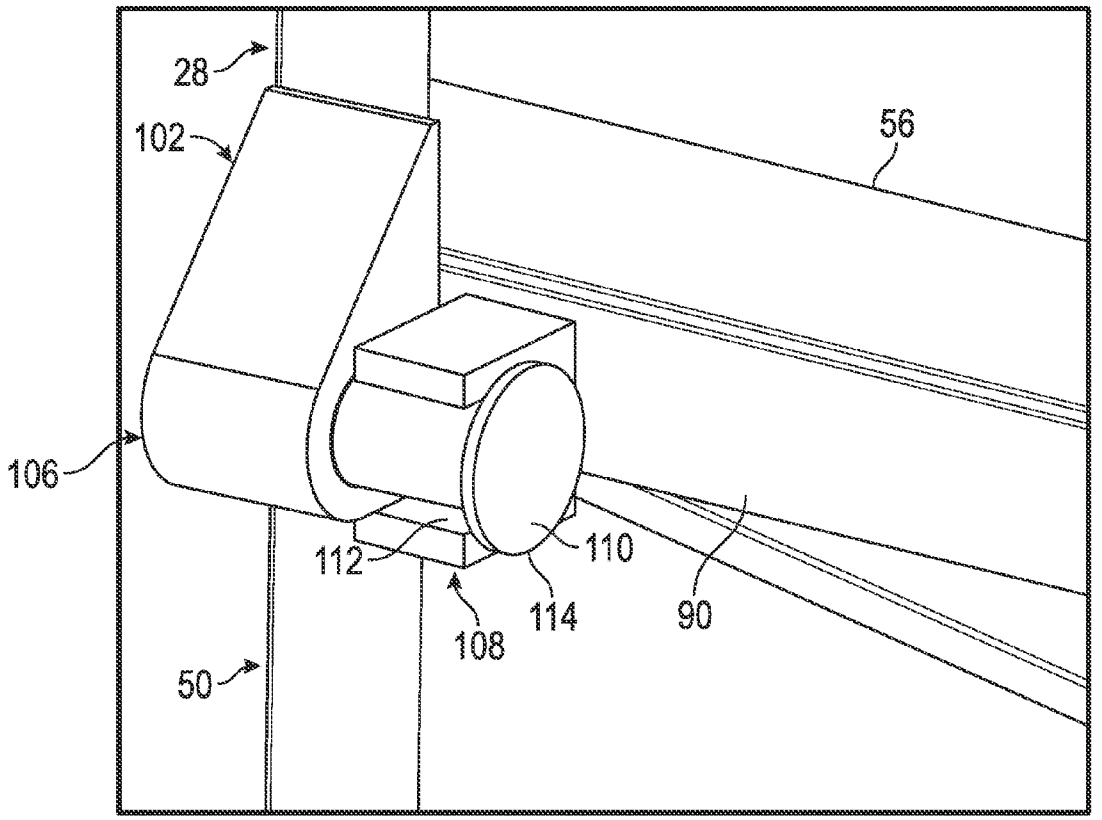


FIG. 6

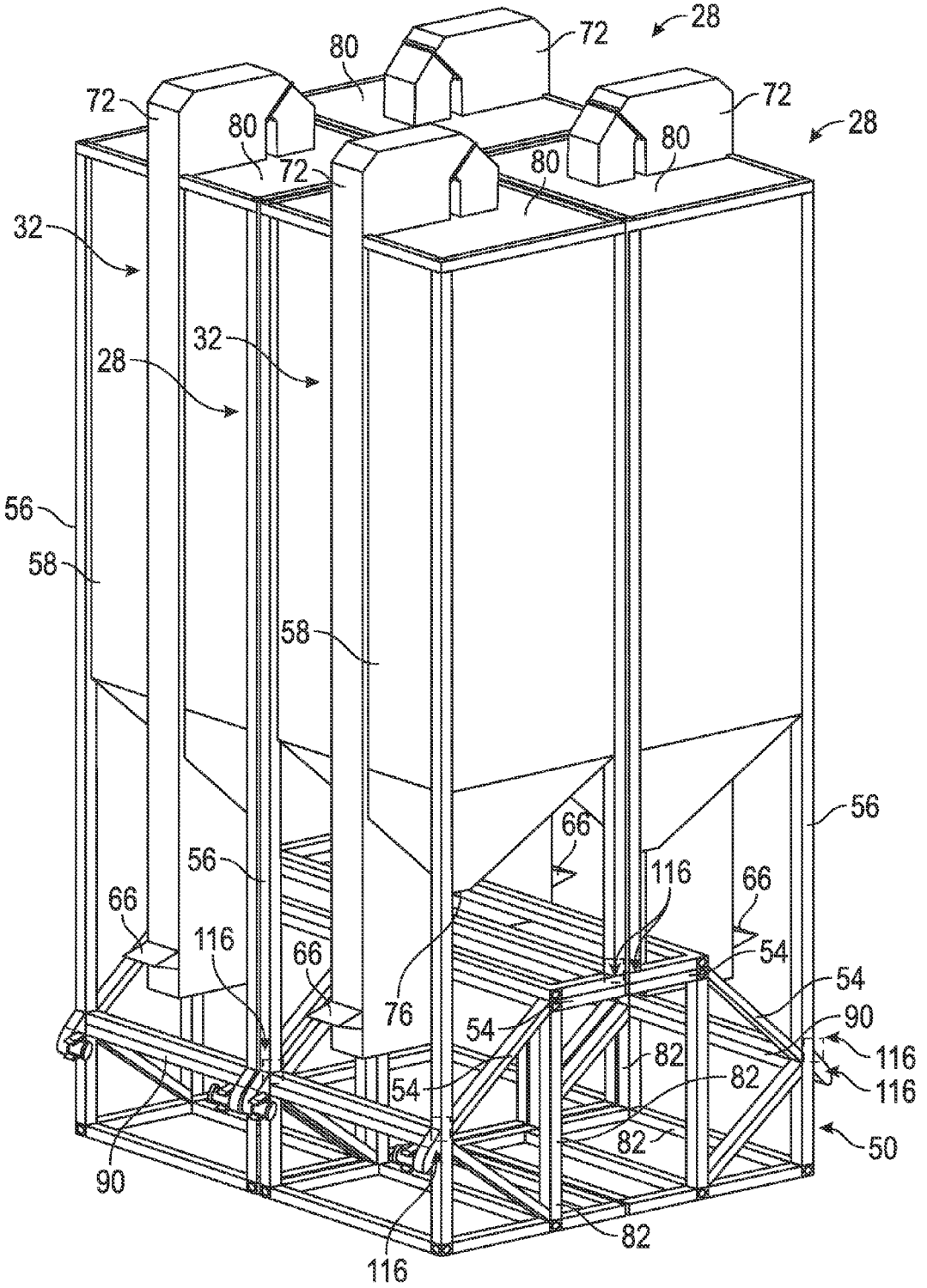

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FIG. 7

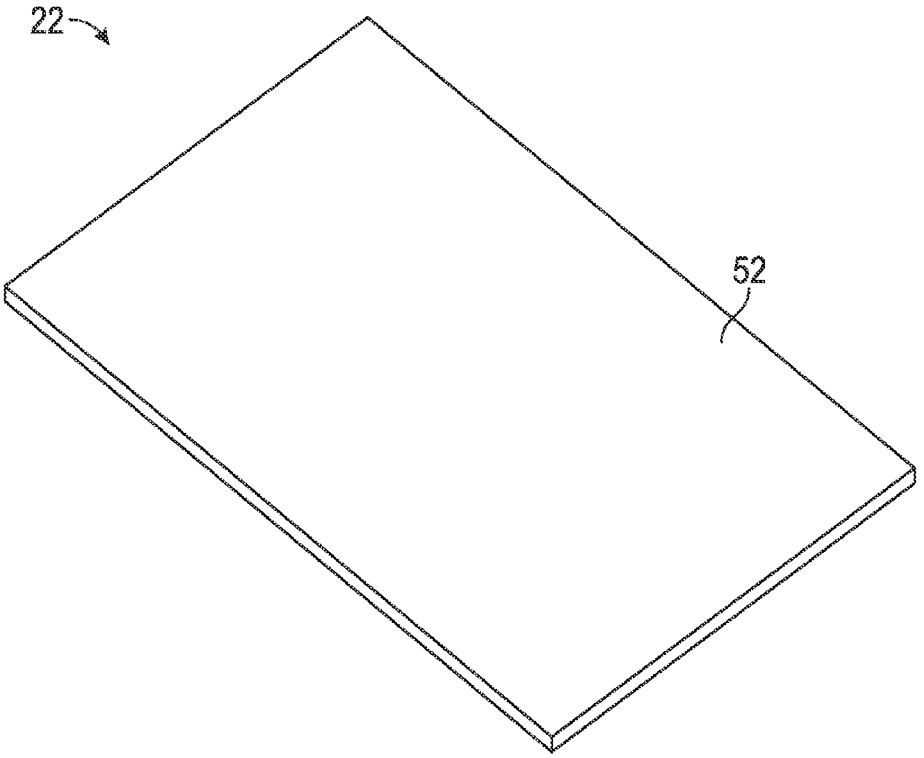


FIG. 8

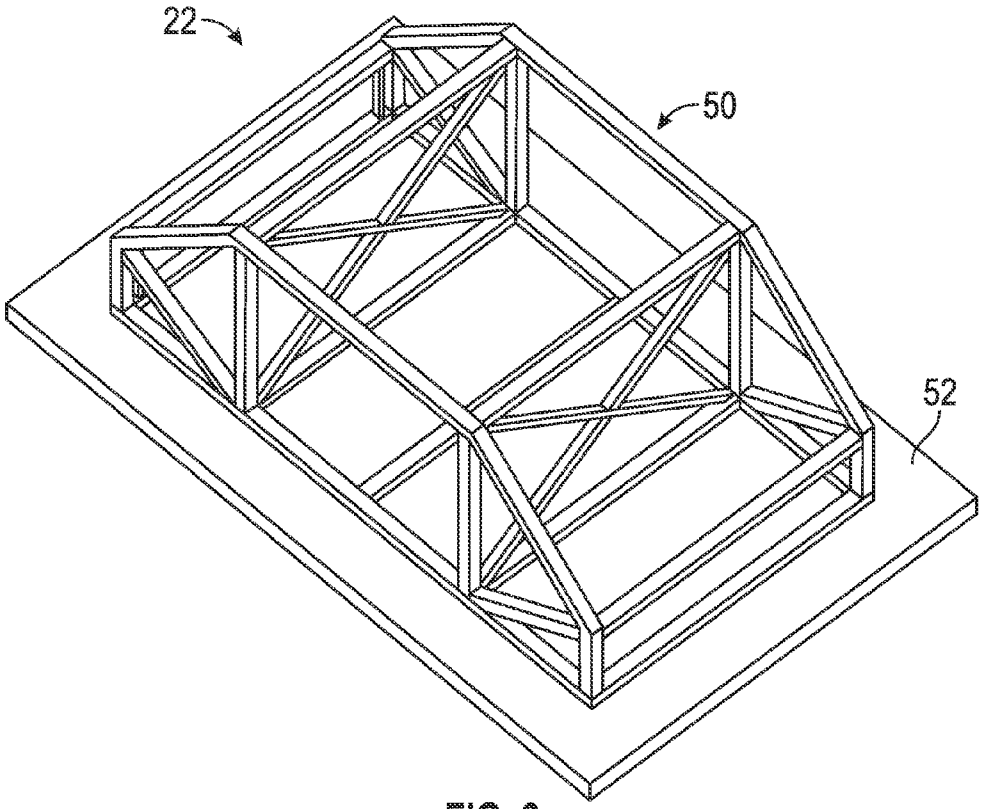


FIG. 9

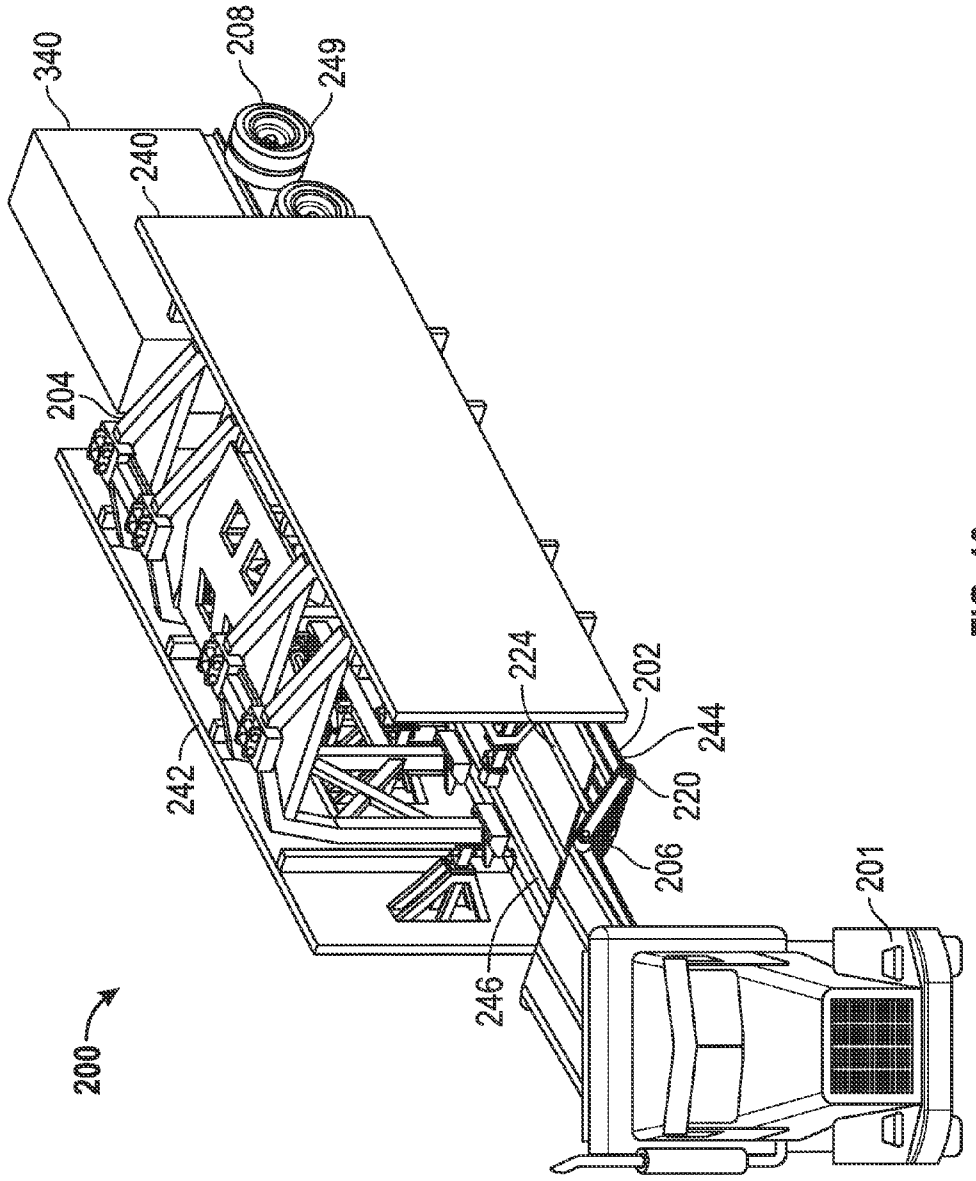


FIG. 10

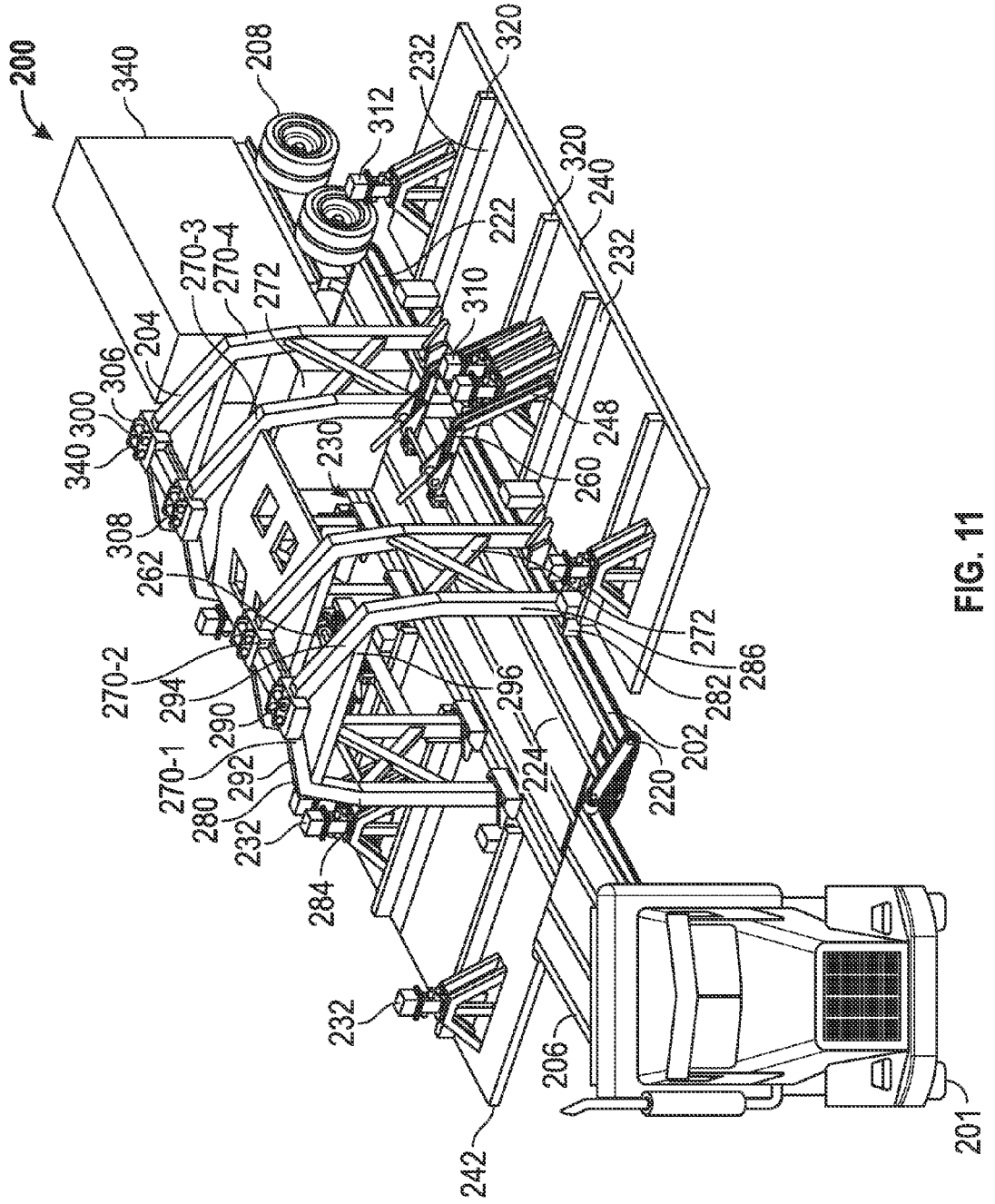

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FIG. 11

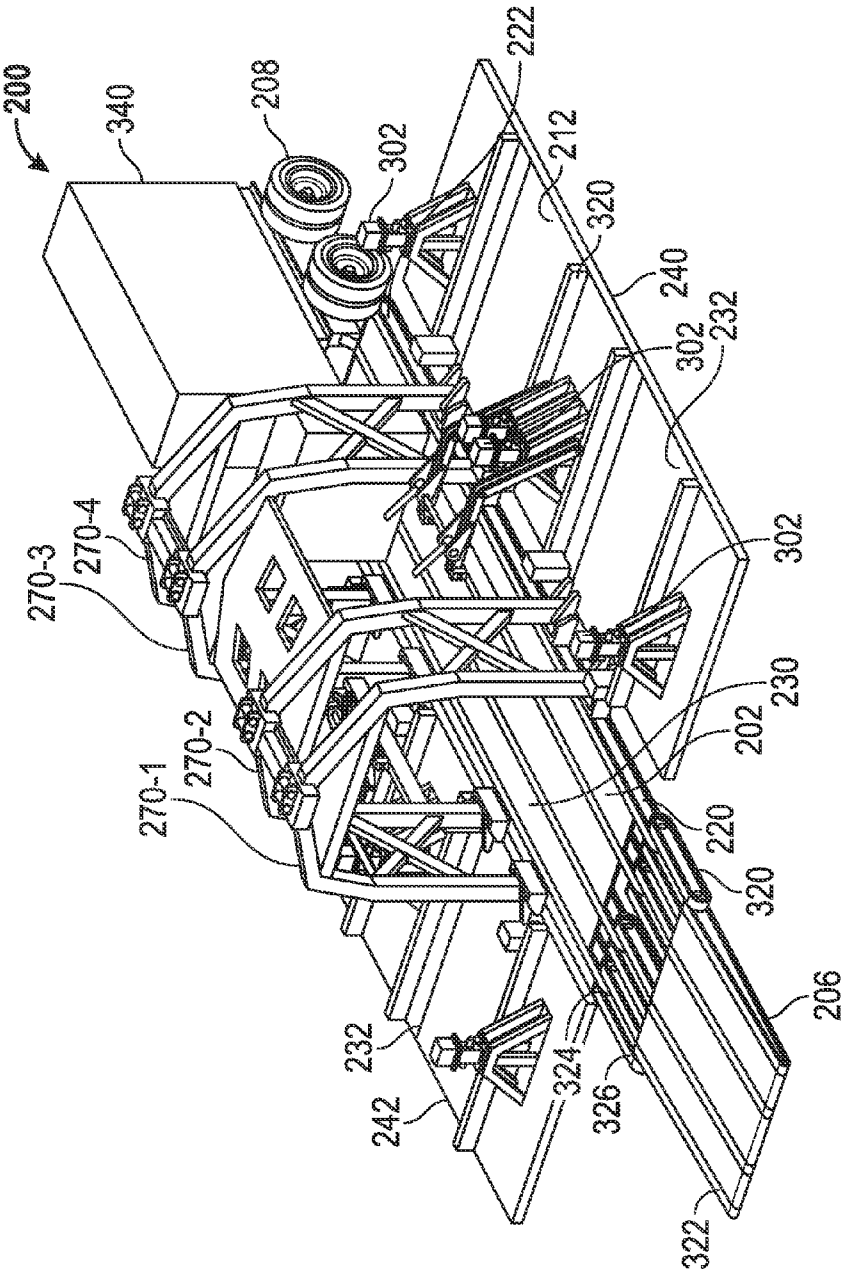

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FIG. 12

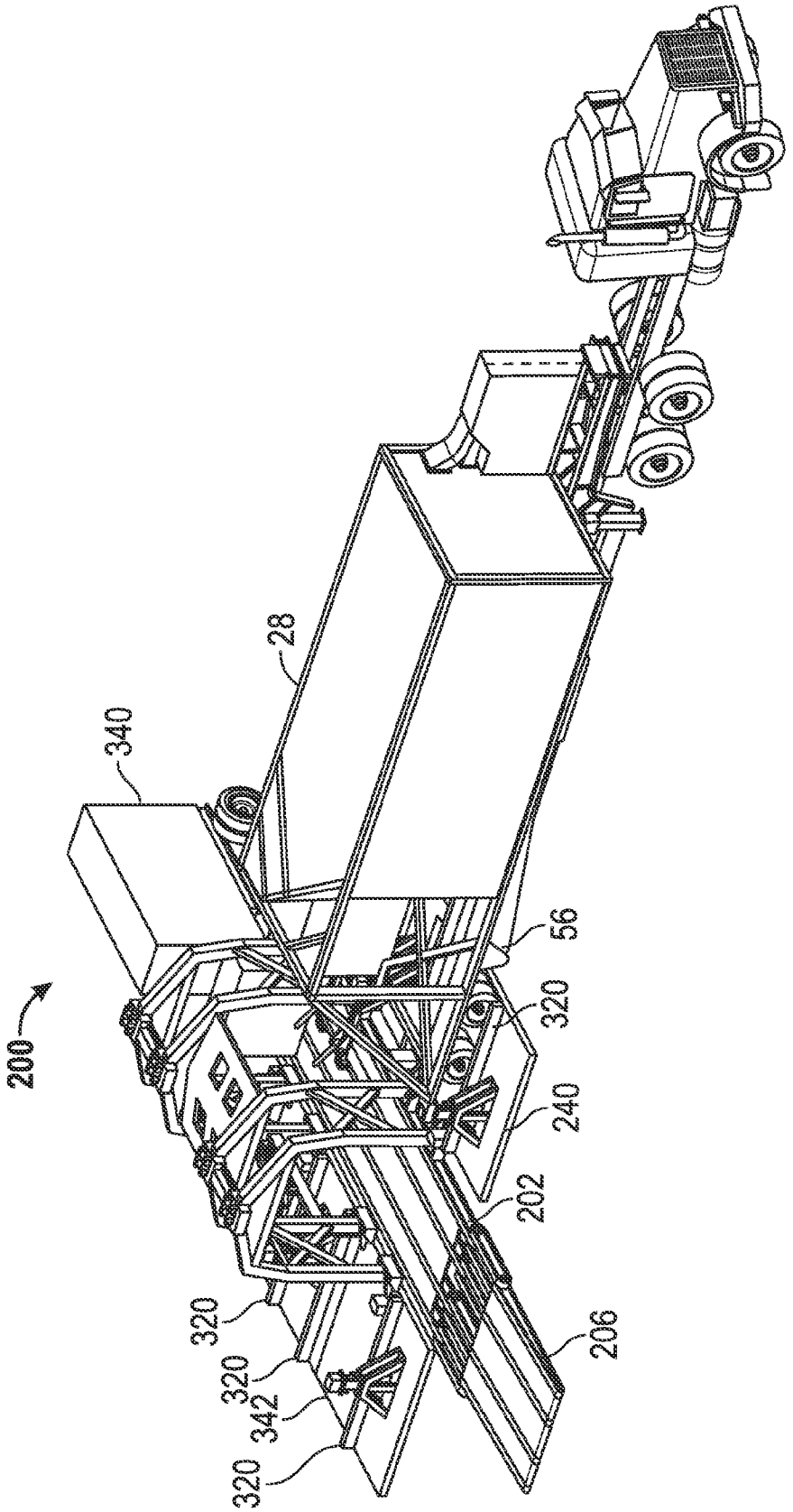


FIG. 13

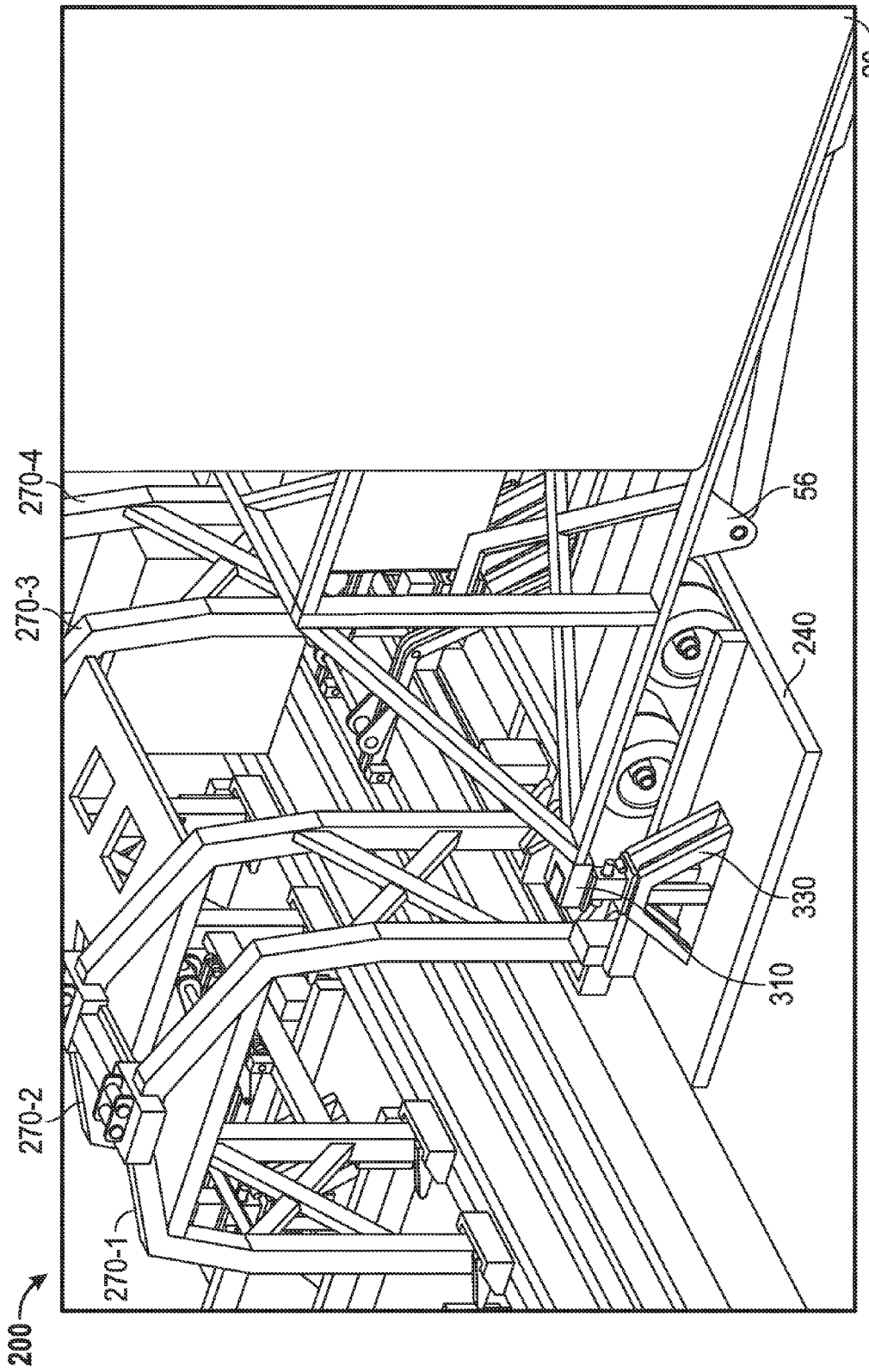


FIG. 14

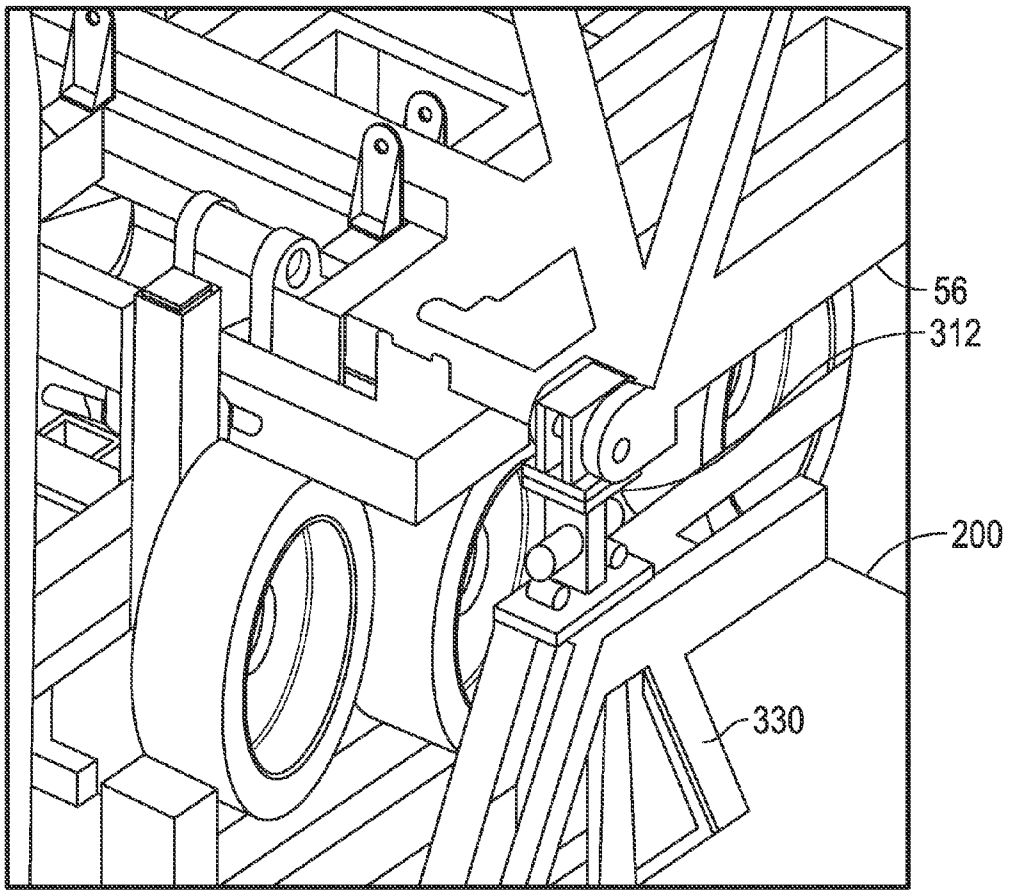


FIG. 15

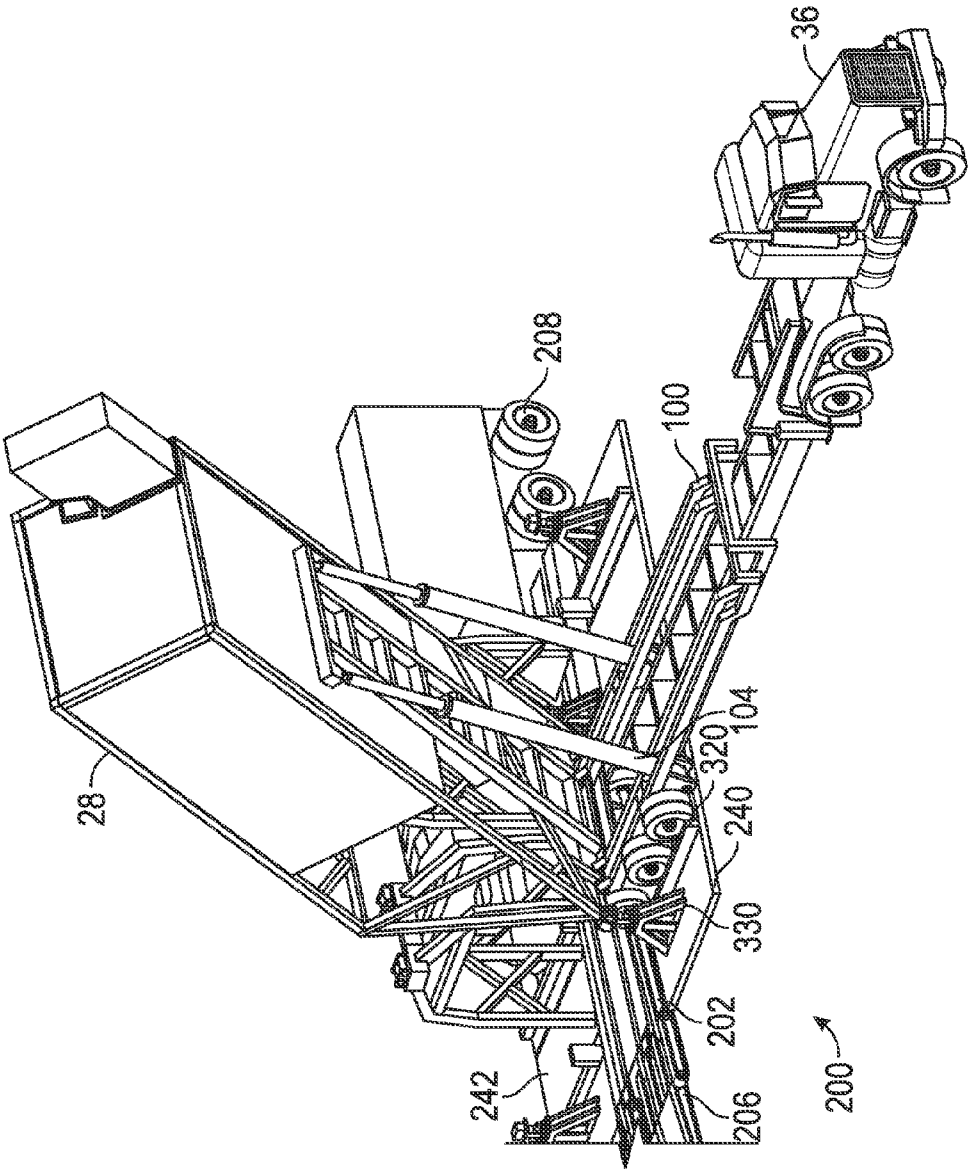


FIG. 16

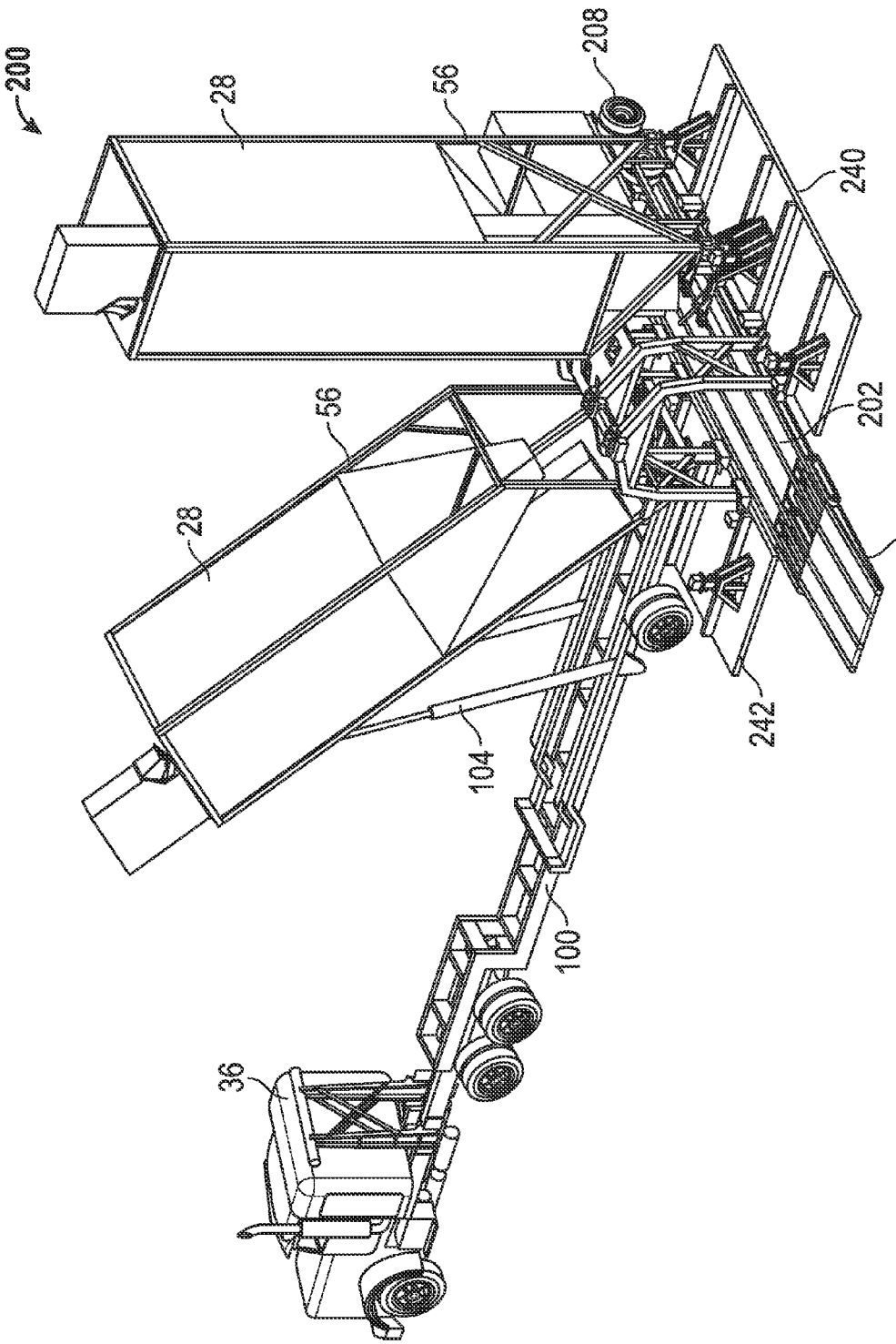


FIG. 17

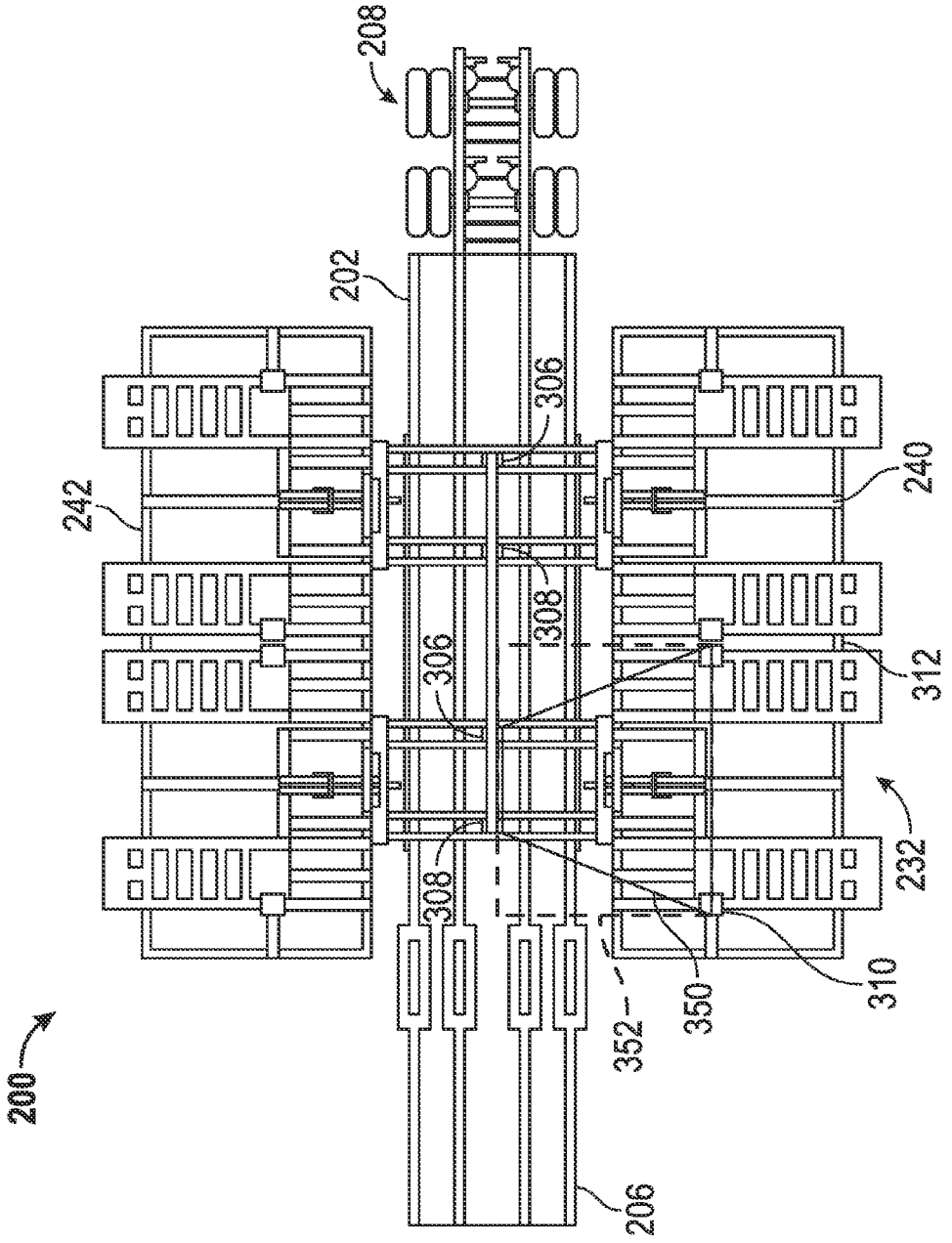


FIG. 18

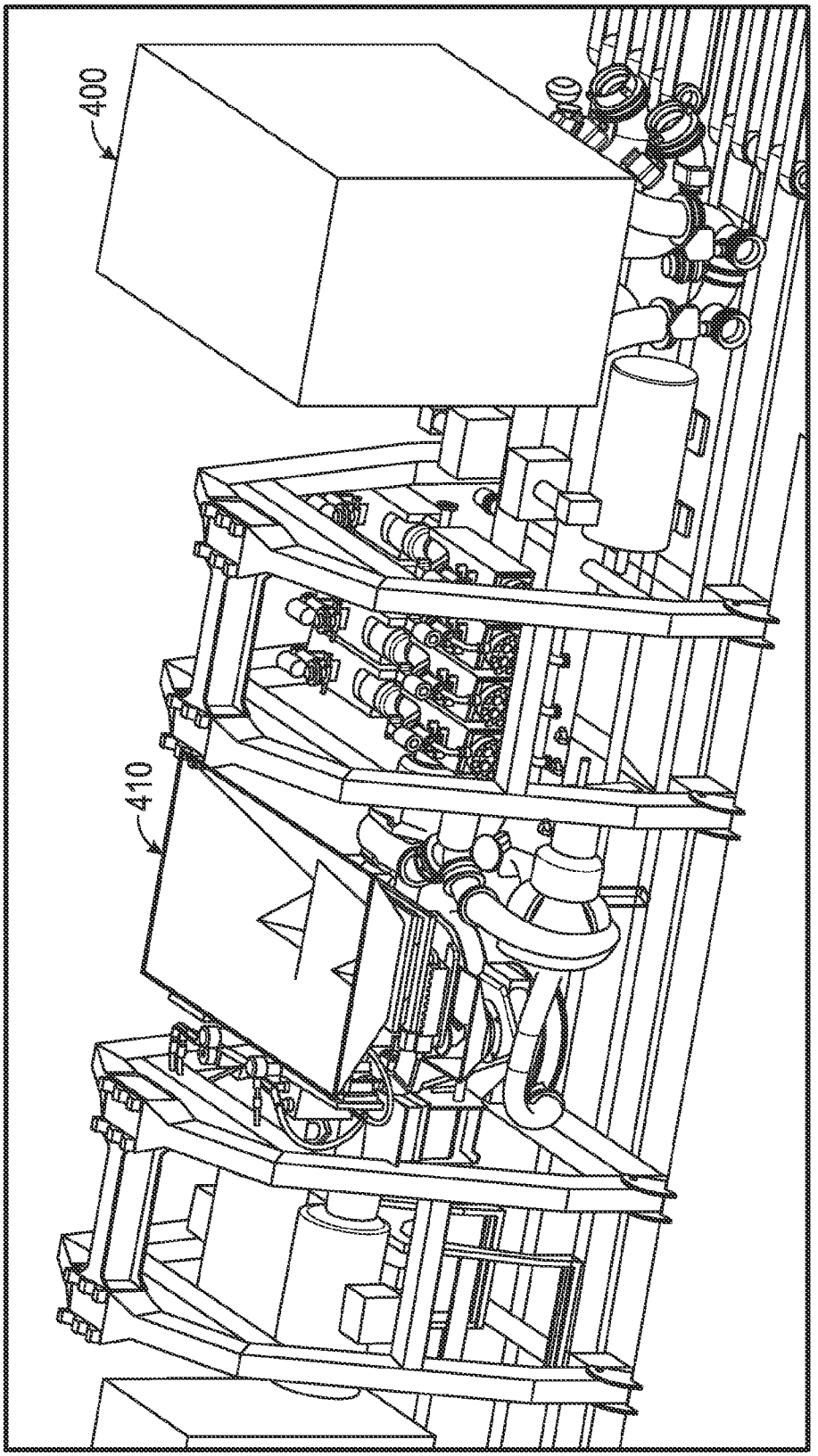


FIG. 19

SYSTEM AND METHOD FOR DELIVERY OF OILFIELD MATERIALS

INCORPORATION BY REFERENCE

[0001] The provisional patent applications identified by U.S. Ser. No. 61/682,734, filed on Aug. 13, 2012, U.S. Ser. No. 61/746,154, filed on Dec. 27, 2012, and U.S. Ser. No. 61/746,158, filed on Dec. 27, 2012 are hereby incorporated herein by reference in their entirety.

BACKGROUND

[0002] To facilitate the recovery of hydrocarbons from oil and gas wells, the subterranean formations surrounding such wells can be hydraulically fractured. Hydraulic fracturing may be used to create cracks in subsurface formations to allow oil and/or gas to move toward the well. The formation is fractured by introducing a specially engineered fluid, sometimes referred to as fracturing fluid or fracturing slurry, at high pressure and high flow rates into the formation through one or more wellbores. The fracturing fluids may be loaded with proppant which are sized particles that may be mixed with the liquids of the fracturing fluid to help form an efficient conduit for production of hydrocarbons from the formation to the wellbore. Proppant may comprise naturally occurring sand grains or gravel, man-made proppants, e.g. fibers or resin coated sand, high-strength ceramic materials, e.g. sintered bauxite, or other suitable materials. The proppant collects heterogeneously or homogeneously inside the fractures to prop open the fractures formed in the formation. Effectively, the proppant creates planes of permeable conduits through which production fluids can flow to the wellbore.

[0003] At the well site, proppant and other fracturing fluid components are blended at a low-pressure side of the system. The oilfield materials often are delivered from storage facilities to a blender by pneumatic systems which blow the oilfield materials. Water-based liquid is added and the resulting fracturing fluid is delivered downhole under high pressure. However, handling of the proppant prior to blending tends to create substantial dust as the proppant is moved to the blender via blowers. As a result, dust control devices, e.g. vacuums, are employed in an effort to control the dust. The variety of equipment used in the process also tends to create a large footprint at the well site, and operating the equipment is generally a manually intensive process.

SUMMARY

[0004] In general, the present disclosure provides a system and method which facilitate the handling of oilfield materials in a space efficient manner. The oilfield material is stored in at least one silo which may enable use of gravity to feed the oilfield material to a blending system or other suitable equipment. In many applications, the oilfield material is delivered to each silo without blowers. A mobile support structure is disclosed, which receives one or more modular silos at the wellsite. Each modular silo is transportable and may be engaged with a support structure that may be transported to the wellsite separately via a connection that allows for controlled movement of the modular silo during erection. Once engaged, the modular silo may be pivoted to a raised, upright position on the support structure. The oilfield material is then moved to an interior of the silo, and gravity may be used to feed the oilfield material to a blender or other equipment in a controlled manner.

[0005] However, many modifications are possible without materially departing from the teachings of this disclosure. Accordingly, such modifications are intended to be included within the scope of this disclosure as defined in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Certain embodiments of the disclosure will hereafter be described with reference to the accompanying drawings, wherein like reference numerals denote like elements. It should be understood, however, that the accompanying figures illustrate the various implementations described herein and are not meant to limit the scope of various technologies described herein, and:

[0007] FIG. **1** is an illustration of an example of a proppant delivery system positioned at a well site, according to an embodiment of the disclosure;

[0008] FIG. **2** is an illustration of another embodiment of a proppant delivery system in which a plurality of closed, modular silos are used for holding oilfield materials, according to an embodiment of the disclosure;

[0009] FIG. **3** is a schematic illustration of an example of a vertical conveyor system enclosed within a silo, according to an embodiment of the disclosure;

[0010] FIG. **4** is an illustration of an example of a support structure with silo receiving areas on which modular silos may be mounted in an upright orientation, according to an embodiment of the disclosure;

[0011] FIG. **5** is an illustration of a plurality of modular silos transported by over-the-road trucks and erected into position on the support structure, according to an embodiment of the disclosure;

[0012] FIG. **6** is an illustration of an example of a pivot connection used in pivoting a modular silo from a lateral position to an upright position on the support structure, according to an embodiment of the disclosure;

[0013] FIG. **7** is an illustration of a plurality of the modular silos positioned on the support structure with load cells mounted in appropriate locations to monitor the load, and thus the content weight, of each modular silo, according to an embodiment of the disclosure;

[0014] FIG. **8** is an illustration of an example of a mat system on which the support structure may be mounted at a well site, according to an embodiment of the disclosure;

[0015] FIG. **9** is an illustration of an example of the support structure positioned on the mat system illustrated in FIG. **8**, according to an embodiment of the disclosure;

[0016] FIGS. **10-12** depict various illustrations of installing a mobile support structure at a location according to an embodiment of the disclosure.

[0017] FIGS. **13-15** depict various illustrations of aligning a modular silo with connections of the mobile support structure at a location according to an embodiment of the disclosure.

[0018] FIGS. **16-17** depict various illustrations of erecting the modular silos onto the mobile support structure according to an embodiment of the disclosure.

[0019] FIG. **18** is a top plan view of the exemplary mobile support structure depicted in FIGS. **10-17**.

[0020] FIG. **19** is a perspective view of another embodiment of a mobile support structure constructed in accordance with the present disclosure having a blending system integrated into a support base of the mobile support structure and within a passage defined by a frame structure.

DETAILED DESCRIPTION

[0021] In the following description, numerous details are set forth to provide an understanding of some embodiments of the present disclosure. However, it will be understood by those of ordinary skill in the art that the system and/or methodology may be practiced without these details and that numerous variations or modifications from the described embodiments may be possible.

[0022] Unless expressly stated to the contrary, "or" refers to an inclusive or and not to an exclusive or. For example, a condition A or B is satisfied by anyone of the following: A is true (or present) and B is false (or not present), A is false (or not present) and B is true (or present), and both A and B are true (or present).

[0023] In addition, use of the "a" or "an" are employed to describe elements and components of the embodiments herein. This is done merely for convenience and to give a general sense of the inventive concept. This description should be read to include one or at least one and the singular also includes the plural unless otherwise stated.

[0024] The terminology and phraseology used herein is for descriptive purposes and should not be construed as limiting in scope. Language such as "including," "comprising," "having," "containing," or "involving," and variations thereof, is intended to be broad and encompass the subject matter listed thereafter, equivalents, and additional subject matter not recited.

[0025] Finally, as used herein any references to "one embodiment" or "an embodiment" means that a particular element, feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. The appearances of the phrase "in one embodiment" in various places in the specification are not necessarily referring to the same embodiment.

[0026] The present disclosure generally involves a system and methodology to facilitate handling of oilfield materials in a space efficient manner. In one embodiment, the oilfield materials may be carried to a wellsite by suitable trucks and loaded into at least one modular silo without using air to carry the oilfield material. By way of example, the oilfield materials may be moved into a plurality of modular silos by using vertical conveyors to move the oilfield material without blowers. In some embodiments, each modular silo comprises an outer housing defining an enclosed interior for receiving the oilfield material. A corresponding vertical conveyor is positioned within the enclosed interior and is used to lift the oilfield material from a silo inlet, e.g. a hopper, to an upper portion of the modular silo without utilizing airflow to carry the oilfield materials. Once the oilfield material is disposed within the upright modular silo, the outflow of oilfield material through a silo outlet may be gravity controlled so as to selectively release the desired amount of material into a blending system or other suitable equipment positioned underneath the modular silo.

[0027] According to an example, a vertical silo is designed as a modular silo which may be carried to the well site by an over-the-road truck before being mounted in a generally upright position on the support structure. Truck refers to a transport vehicle, such as an articulated truck having a trailer pulled by a tractor. In this example, the modular silo is carried by the trailer of the truck. However, the truck also may comprise a straight truck or other suitable truck designed to carry the modular silo and to transport the modular silo over public roadways. The support structure may be designed in a manner which allows the silo to be erected from its lateral position on the truck to an upright, e.g. vertical, position at the well site. However, it should be understood that in other embodiments, a crane may be used to lift the modular silo and place the modular silo onto a support structure. The use of upright silos provides an efficient solution for proppant delivery in many applications. Gravity effectively causes the oilfield material to flow downwardly to desired equipment, such as a blending system.

[0028] The support structure may be designed in a variety of forms and configurations to support individual modular silos or a plurality of modular silos. By way of example, the support structure may be constructed of struts arranged in an A-frame configuration or other type of configuration able to support and secure the at least one modular silo in the desired upright position. In at least some applications, the support structure is designed to engage each modular silo while the modular silo is positioned on the transport truck. This allows the modular silo to be pivoted upwardly directly from the truck to its operational, upright position. The support structure also may be constructed to support each modular silo at a sufficient height to enable oilfield material to be gravity fed through a bottom end feeder and into a portable blender positioned below. In some applications, load cells are incorporated into the support structure to monitor the loading caused by each modular silo which enables tracking of the amount of oilfield material in each modular silo. In one embodiment, the support structure is a mobile support structure implemented as a trailer having wheels and a gooseneck portion for connection to the truck. In this embodiment, the gooseneck portion may convert to a ramp to aid in positioning a blending system underneath the modular silos. In another embodiment, the blending system may be integrated on the deck of the mobile support structure.

[0029] In some embodiments, a conveyor, such as a mechanical belt conveyor, may be utilized to move oilfield material unloaded from a gravity dump transport into an intake hopper of a vertical conveyor enclosed within the modular silo. The mechanical belt conveyor can be backed over by a trailer hauling the oilfield material with multiple nozzles overlapping the mechanical belt conveyor, or other types of haulers may be used, such as tail dumps and live bottom trailers. By way of example, the vertical conveyor may comprise a bucket elevator or other type of vertical conveyor capable of conveying the oilfield material to an upper end of the modular silo a substantial distance, e.g. 30 to 70 feet, above the well site surface. The conveyor moving the oilfield material to the silo and the vertical conveyor may be enclosed to provide a dust free solution for handling oilfield material at much higher rates with greater energy efficiency and lower attrition than that achieved with existing pneumatic, e.g. blower, type conveyance systems. To increase storage capacity of the modular silo as compared to a cylindrical silo, the outer housing may have a substantially rectangular shape defining four corners (which may form pointed vertices or be rounded). The modular silo may be transported on a trailer having a gooseneck. As best shown in FIG. **5**, to further increase the storage capacity of the modular silo while still being capable of being transported by a truck, the vertical conveyor may extend beyond a top of the outer housing and be offset towards one of the corners so as to avoid the gooseneck of the trailer.

[0030] Depending on the parameters of a given fracturing process, a plurality of the modular silos may be grouped

together so that feeders of the plurality of modular silos provide oilfield material to a common area, e.g. to a truck mounted blending system having a proppant metering/rate control system, or other portable blender or blending system positioned beneath the modular silos. In order to reduce the space required at the wellsite for the plurality of the modular silos, the common area may be located below the outer housings of the modular silos. In this example, the outer housings of the modular silos overlap the common area. Additionally, some or all of the modular silos may be divided into compartments. In some applications, individual modular silos may have a plurality of internal compartments for holding different types of oilfield materials. Individual silos also may be divided into main storage compartments and secondary storage compartments located below the main storage compartments. In the latter example, the main storage compartment may be used to gravity feed oilfield material to an outlet feeder for distribution into the blending system. Some systems may utilize a belt feeder or other type of feeder system instead of gravity feed. The secondary storage compartment may be exposed to the internal vertical conveyor and proppant from the secondary storage compartment may continually be lifted and discharged into the main storage compartment. In some applications, the secondary compartments or other compartments of the modular silo may have separate features which enable independent filling of those particular compartments. Additionally, outlet feeders may be designed with controllable mechanisms, e.g. gates, which are adjustable to control the outflow of oilfield material.

[0031] The modular silos may be designed in a variety of sizes and shapes, including cylindrical shapes or rectangular shapes, selected to enable transport via a suitable over-the-road truck. By way of example, the modular silos may vary in size according to the proppant delivery plan for a given fracturing operation, but an example of a suitable modular silo may hold 2000-4000 cubic feet of oilfield material. In some systems, the modular silos are provided with sufficient clearance on the bottom side to form an unobstructed passage to enable a portable blending system, such as a truck mounted blending system, to be driven under a system of combined modular silos to receive oilfield material via gravity feed. For example, the portable blending system may be mounted on a truck trailer which is backed into position under the outlet feeders of a plurality of modular silos. In some embodiments, the modular silos may be designed as standalone silos and in other embodiments, the modular silos may be designed for placement on a framework/support structure which supports the modular silos at a desired height. In one embodiment the blending system may be skid mounted in order to be transported on a trailer to the wellsite and then placed under the silo system by a suitable mechanical device, such as a winch.

[0032] Each of these embodiments may utilize an enclosed, vertical conveyor to avoid blowing of the oilfield material, although in other embodiments a pneumatic fill tube can be used as a vertical conveyor. Each modular silo also may be filled by an integrated, oilfield material loading and delivery system utilizing an enclosed conveyor or other suitable system for moving oilfield material from an unload area to an inlet associated with the vertical conveyor at a lower end of the modular silo. In some applications, the vertical conveyor may be powered by a belt or other device driven by the enclosed conveyor system used to move oilfield material from the unload area to the inlet of the modular silo. This allows the system to be substantially automated. However, the individual motive systems, e.g., vertical conveyor and enclosed conveyor extending from the unload area, may be powered individually or collectively by a variety of sources, including various motors, engines, or other devices.

[0033] Referring generally to FIG. **1**, an embodiment of a proppant delivery system for forming a slurry suitable for fracturing formations, is illustrated in position at a well site. By way of example, the proppant delivery system may comprise many types of equipment, including vehicles, storage containers, material handling equipment, pumps, control systems, and other equipment designed to facilitate the fracturing process.

[0034] In the example of FIG. **1**, a proppant delivery system **20** is illustrated in position at a wellsite **22** having a well **24** with at least one wellbore **26** extending down into a reservoir/formation. The proppant delivery system **20** may comprise many types and arrangements of equipment, and the types or arrangements may vary from one fracturing operation to another. By way of example, the proppant delivery system **20** may comprise at least one modular silo **28**, e.g. a plurality of modular silos that may be transported over-the-road by trucks able to operate on public roadways. The modular silos **28** are designed to store oilfield material such as a proppant used to prop open fractures upon fracturing of the subterranean formation, or guar used to increase the viscosity of a hydraulic fracturing fluid. In the example illustrated, several modular silos **28** receive oilfield material via conveyors **30**, e.g. belt conveyors, and the oilfield material is lifted to an upper portion **31** of each modular silo **28** by corresponding vertical conveyors **32**. The conveyors **30** and the vertical conveyors **32** may operate by carrying the oilfield material instead of blowing the oilfield material to avoid erosion of components and dusting of the area. Additionally, the conveyors **30** and vertical conveyors **32** may be enclosed to further reduce dust as the oilfield material is delivered from an unload area **34** and into the modular silos **28**.

[0035] As illustrated, oilfield material transport trucks **36** may be used to deliver oilfield material to the unload area **34**. In this example, the trucks **36** are tractor-trailer trucks having trailers **37** which may be backed over a portion of a selected conveyor **30**. The trailers **37** can be gravity feed trailers or other types of trailers capable of moving the oilfield material to the wellsite **22**. The trailers may be operated to release the oilfield material onto a belt or other suitable carrier of the selected conveyor **30** for transfer to the associated modular silo or silos **28** along an enclosed pathway within the conveyor **30**.

[0036] In this example, the proppant delivery system **20** may comprise a variety of other components including water tanks (not shown) for supplying water that is mixed with the oilfield material to form the hydraulic fracturing fluid, e.g. proppant slurry, that may be pumped downhole into wellbore **26** via a plurality of pumps (not shown). By way of example, pumps may be truck mounted pumps, e.g. pumping systems mounted on truck trailers designed for over-the-road transport. The multiple pumps may be coupled to a common manifold (not shown) designed to deliver the hydraulic fracturing fluid to the wellbore **26**. The proppant delivery system **20** also may comprise a blending system **44** designed to blend oilfield material delivered from modular silos **28**. By way of example, the blending system **44** may be a portable blender, such as a truck mounted blender or a skid mounted blender. In the specific example illustrated, blending system **44** is mounted on a truck trailer **46** that may be driven, e.g. backed up, into a

common area **47** (shown in FIG. **3**) that is positioned underneath or proximate to the modular silos **28**. The proppant delivery system **20** also may comprise a variety of other components, such as a control facility **48** and/or other components designed to facilitate a given fracturing operation. In one embodiment, the common area **47** is located below the outer housings **49** of the modular silos **28**. In this embodiment, the outer housings **49** of the modular silos **28** overlap the common area **47**.

[0037] Referring generally to FIG. **2**, an embodiment of modular silos **28** coupled together into a cooperating unit is illustrated. In this example, a plurality of the modular silos **28**, e.g. four modular silos **28**, is coupled together on a modular support structure, or framework, **50** which may be mounted on a mat system **52** which may be placed upon a pad, such as a concrete pad, gravel or the like. The mat system **52** distributes the load from the modular silos **28** onto the ground. The modular silos **28** may be releasably mounted in a generally upright or vertical orientation on support structure **50**. Support structure **50** is constructed with a plurality of silo receiving regions **54** on which the individual modular silos **28** may be mounted in a generally upright or vertical orientation. The support structure **50** and the silo receiving regions **54** may be designed to elevate the modular silos **28** to a sufficient height so as to allow movement of portable blending system **44** to a position sufficiently beneath the modular silos **28** within the common area **47** in order to receive a controlled outflow of oilfield material. For example, the support structure **50** may be designed to allow a truck mounted blending system **44** to be driven, e.g. backed up, into position beneath the modular silos **28**, as illustrated. Additionally, the pad may be constructed in a variety of sizes and forms, including cement pads, compacted aggregate pads, pads constructed as portable structures, mixtures of these various structural elements, and/or other suitable pad types for supporting the plurality of modular silos **28**.

[0038] In the example illustrated, modular silos **28** each may be constructed with a silo frame **56** supporting the outer housing **49** which defines an enclosed interior **60** for holding oilfield material **62** (see also FIG. **3**). Depending on the fracturing operation, oilfield material **62** may comprise naturally occurring sand grains or gravel, man-made proppants, resin coated sand, high-strength ceramic materials, e.g. sintered bauxite, other solids such as fibers, mica, mixtures of different sized oilfield materials, mixtures of different types of oilfield materials, and/or other suitable oilfield materials. In some applications, selected modular silos **28** or each of the modular silos **28** may be divided into the compartments **64** designed to hold different types of oilfield materials **62** that may be selectively released from the modular silo **28** and blended via the blending system **44**. Each enclosed vertical conveyor **32** is designed to lift oilfield material (e.g., with or without blowing) from an inlet **66**, e.g. an inlet hopper, disposed at a lower portion **68** to an upper discharge portion **70** for release into enclosed interior **60** through a vertical conveyor head **72**. In some embodiments, the conveyor head **72** may have a pivotable or otherwise movable discharge which is selectively controllable to deliver the desired oilfield material to a corresponding desired compartment **64** within a given modular silo **28**.

[0039] With further reference to FIG. **3**, the vertical conveyor **32** may be positioned within enclosed interior **60** in a manner which limits escape of dust while providing a uniform modular unit that may be readily transported via an over-the-road truck, such as truck **36** with a suitably designed trailer. Vertical conveyor **32** also may be constructed in a variety of forms. For example, the vertical conveyor **32** may be constructed as a bucket elevator **74** having a plurality of buckets **75** conveyed in a continuous loop lifting oilfield material **62** from inlet **66** to upper discharge portion **70** for discharge into enclosed interior **60** via vertical conveyor head **72**. The outflow of oilfield material **62** to the blending system **44** may be through an outlet, e.g. a feeder **76**, and the amount of outflow through feeder **76** may be controlled by a suitable outflow control mechanism **78**. For example, the blending system **44** may include a hopper **79-1** having an inlet **79-2** positioned below the feeder **76**. In one embodiment, the outer housing **58** overlaps the inlet **79-2** of the hopper **79-1**. The inlet **79-2** of the hopper **79-1** may have a width **79-3** up to 12 feet, and desirably between 8 feet to 8.5 feet. The hopper **79-1** may also have an outflow control mechanism **79-4** which is similar to the outflow control mechanism **78**. By way of example, outflow control mechanisms **78** and **79-4** may comprise a controllable gate, e.g. hydraulic gate, control valve, or other flow control mechanism which is operated via control facility **48** or via another suitable control system. In this example, oilfield material **62** is gravity fed through feeder **76** and the amount of outflow is governed by the outflow control mechanism **78**. In one embodiment, the amount of oilfield material **62** discharged into a blender **79-5** of the blending system **44** may be regulated by both of the outflow control mechanisms **78** and **79-4**. In this instance, the outflow control mechanism **79-4** may be maintained in a fixed open position while the outflow control mechanism **78** is regulated in real-time by the control facility **48** to control an amount of oilfield material **62** discharged into the blender **79-5**. Because the feeder **76** is within the confines of the hopper **79-1**, as the hopper **79-1** fills with oilfield material **62**, the oilfield material **62** will bear against the feeder **76** and form a plug. In this manner, the outflow control mechanism **79-4** is self-regulating and the outflow control mechanism **78** and the control facility **48** may solely control the amount of oilfield material **62** discharged into the blender **79-5**.

[0040] Referring generally to FIG. **4**, an example of support structure **50** is illustrated. In this example, the support structure **50** comprises a plurality of struts **82** which are connected by suitable fastening methods to create a strong, stable structure for supporting at least one modular silo **28**. Fastening methods may utilize welds, bolt and nut fasteners, and/or other suitable types of fasteners. The struts **82** are connected to form at least one silo receiving region **54**. In the example illustrated, struts **82** are arranged to create a plurality of the silo receiving regions **54** designed to receive and support, for example, two modular silos **28**. However, support structure **50** may be constructed in a variety of configurations for supporting various numbers of modular silos **28** in many types of arrangements and configurations.

[0041] In the embodiment illustrated, struts **82** also are arranged to create support structure **50** with a drive under region or passage **84** which provides space for system equipment, such as portable blending system **44** as well as encompasses the common area **47**. By way of example, support structure **50** may be arranged so that silo receiving regions **54** are able to support modular silos **28** via silo frames **56** at a raised position which allows bottom feeders **76** to meter the outflow of oilfield material **62** down into the portable blending system **44** when the portable blending system **44** is positioned and/or driven into the passage **84**. As illustrated, upper

struts **86** may be used to connect silo receiving regions **54** and to provide an upper support for a portion of the modular silo frames **56**. The upper struts **86** may be placed at a sufficient height to enable a truck mounted portable blending system **44** to be driven, e.g. backed up, into drive under region or passage **84** for receiving oilfield material **62** from the modular silos **28**. In other embodiments, however, the upper struts **86** may be split and supported by additional vertical struts to allow separation of the silo receiving regions **54**. The separation of silo receiving regions **54** allows individual silos **28** or groups of silos **28** to be separated and to provide a space through which equipment, e.g. the portable blending system **44**, may be driven between the separated modular silos **28**.

[0042] Support structure **50** also may comprise a variety of additional features, including strengthening cross struts **88** which may be positioned at various locations throughout the structure of support structure **50** to enhance the strength of the support structure. The support structure **50** also may comprise pivot struts **90** to which pivot connectors (shown in FIG. **6**) may be attached, as discussed in greater detail below. The pivot struts **90** provide a strong region of the support structure **50** to which each modular silo **28** may initially be engaged and then pivoted against during erection of each modular silo **28** from a lateral position to an upright, operational position. In some applications, the pivot struts **90** are located at a height which matches corresponding pivot connectors of the modular silo frame **56** when the modular silo **28** is mounted laterally, e.g. horizontally, on a suitable over-the-road truck **36**.

[0043] Referring again to FIG. **4**, support structure **50** also may comprise or be connected with at least one expandable base **92** designed to stabilize the support structure **50** and the modular silos **28** when mounted in an upright position on the support structure **50**. In the example illustrated, a plurality of expandable bases **92** are movably connected with a base portion **94** of support structure **50**. The expandable bases **92** may be slidably received in base portion **94** for movement between a retracted position in base portion **94** and an extended position, as illustrated, to provide greater stability to the support structure **50**. The extension and contraction of expandable bases **92** may be performed by a variety of suitable actuators, including hydraulic actuators, e.g. hydraulic cylinders, electric actuators, e.g. stepping motors which operate a screw coupled to the expandable bases, and/or mechanical actuators, e.g. expandable bases which may be manually transitioned between positions. Additionally, transition of the expandable bases **92** between retracted and actuated positions may be facilitated by a variety of other types of moveable joints, including hinges and other types of pivots, couplers which enable quick connection and disconnection of the expandable bases **92**, and/or other suitable mechanisms. The number and orientation of expandable bases **92** also may be adjusted according to the parameters of a given application. The expandable bases **92** may be connected with the support structure **50** so as to provide a seismic base isolation to the support structure **50**. The expandable bases **92** may include additional slideable or foldable outriggers connected at a side of the expandable base **92** to further stabilize the support structure **50**.

[0044] In FIG. **5**, an example is illustrated in which a plurality of modular silos **28** are being placed into position on two of the support structures **50** positioned side-by-side. In this example, each individual modular silo **28** is transported to the well site **22** by a suitable truck **36**. As illustrated, the suitable truck **36** may comprise a tractor **98** pulling a trailer **100** appropriately sized to receive one of the silos **28** in a lateral, e.g. horizontal, orientation. In the example illustrated, the modular silo **28** is constructed such that vertical conveyor head **72** extends from closed top **80** of silo housing **58** generally along a side of the modular silo **28**. This enables transport of the modular silo **28** on a conventional gooseneck style trailer **92**, as illustrated.

[0045] Each truck **36** may be backed up to move the laterally positioned silo **28** into engagement with a corresponding silo receiving region **54** of support structure **50**. As discussed above, the support structure **50** may comprise pivot struts **90** or other suitable structures located at an appropriate height to receive and engage each modular silo **28** when in the lateral position on truck **36**. By way of example, the support structure **50** and the corresponding modular silos **28** may use pivot connectors **102** by which the silo **28** may be selectively engaged with the support structure **50**. The pivot connectors **102** are positioned to allow engagement and connection of each silo **28** with the support structure **50** while the silo **28** is in a lateral position on truck **36**. The pivot connectors **102** also are designed to maintain engagement of the modular silo **28** with the support structure **50** as the silo is pivoted from the lateral position to an operational upright, e.g. vertical, orientation.

[0046] The modular silos **28** may be pivoted or moved about pivot connectors **102** from the lateral position on truck **36** to the operational, upright position on the support structure **50** by a variety of mechanisms. For example, a ram **104** (shown in dashed lines) may be used to erect each silo **28** between the lateral and upright positions. The ram **104** may be a hydraulic or pneumatic ram positioned on trailer **100** to act against frame **56** of each modular silo **28** to pivot the modular silo **28** about pivot connectors **102** until the silo **28** is securely received in its upright position by silo receiving region **54**. The ram **104** may be designed to operate off a hydraulic (or pneumatic) system of truck **36**. In other applications, the ram **104** may be designed to pivot trailer **100** or a portion of trailer **100** upwardly while the modular silo **28** remains attached to the pivoting portion of the trailer **100**. Other techniques may utilize cranes, pulleys, and/or other mechanisms to pivot each modular silo **28** about the pivot connection as the modular silo **28** is transitioned from the lateral position to the operational, upright orientation.

[0047] The pivot connectors **102** are used to facilitate formation of the pivot connection between each modular silo **28** and the support structure **50** and may comprise a variety of individual or plural connector mechanisms. Generally, each pivot connector **102** comprises a pivot member **106** mounted to the silo **28** and a corresponding pivot member **108** mounted on the support structure **50**, e.g. mounted on pivot struts **90**, as illustrated in FIG. **6**. In the specific example illustrated in FIGS. **5** and **6**, each modular silo **28** is pivotably engaged with support structure **50** via a pair of the pivot connectors **102**. By way of example, each pivot member **106** may comprise a pin **110** rotatably, e.g. pivotably, received in a corresponding pin receiver **112** which forms part of corresponding pivot member **108**. Although pin **110** is illustrated as connected to frame **56** of modular silo **28** and pin receiver **112** is illustrated as connected to pivot struts **90** of support structure **50**, the pin **110** and pin receiver **112** can be reversed. Additionally, the pivot connectors **102** may comprise a variety of other structures designed to enable selective engagement of the modular silos **28** with support structure **50** and controlled movement of the modular silos **28** with respect to the support structure **50**.

Depending on the design of the pivot connectors **102**, a variety of retention features such as expanded pin head **114** may be used to maintain the pivotable connection between the modular silo **28** and support structure **50** during transition of the modular silo **28** from the lateral position to the upright position.

[0048] Referring generally to FIG. **7**, the support structure **50** and/or modular silos **28** may comprise other features for detecting and/or monitoring certain system functions. For example, various sensors **116** may be positioned on support structure **50** and/or on modular silos **28** to detect and/or monitor parameters related to the delivery of oilfield material **62** for a given fracturing operation. By way of example, sensors **116** may comprise load cells mounted at silo receiving regions **54** to monitor the loads applied by individual modular silos **28**. The loading data may be used to track the amount of oilfield material that remains in enclosed interior **60** of each modular silo **28**.

[0049] In FIGS. **5**, **7**, **8** and **9**, an operational example is illustrated to facilitate explanation of how an embodiment of the proppant delivery system may be constructed at a given wellsite **22**. In this example, the mat system **52** is initially constructed at well site **22** as shown in FIG. **8**. The mat system **52** **52** may be constructed in a variety of sizes and forms depending on the environment and on the size and parameters of a given fracturing operation. By way of example, the mat system **52** may comprise of a structural material formed of steel or another suitable structural material, and positioned on the pad to distribute the weight of the modular silos **28** to the ground, as illustrated in FIG. **8**.

[0050] Once the mat system **52** is in place, at least one support structure **50** may be assembled and/or positioned on the mat system **52**, as illustrated in FIG. **9**. The support structure **50** is oriented for receipt of modular silos **28** in a desired orientation at well site **22**. In the specific example illustrated, the support structure **50** is constructed and positioned to receive a plurality of the modular silos **28**, e.g. two, three or four modular silos **28**. After the support structure **50** is properly positioned, trucks **36** are used to deliver modular silos **28**. In one embodiment, the mat system **52** may be integrated into a base of the support structure **50**.

[0051] As illustrated in FIG. **5**, for example, an individual modular silo **28** may be mounted in a horizontal position on trailer **100** of truck **36**. As discussed above, each modular silo **28** may be designed as a modular unit used alone or in cooperation with other silos **28**. The modularity along with the design and sizing of the modular silos **28** enables transport of individual modular silos **28** over public highways via trucks **36**. When truck **36** and the corresponding modular silo **28** arrive at the well site **22**, the truck **36** is used to back modular silo **28** into engagement with a first support connection of the support structure **50** on the mat system **52**. For example, the first support connection of the support structure may include the pivot members **106**. The modular silo **28** is moved toward support structure **50** until pivot members **106** of silo frame **56** engage corresponding pivot members **108** of support structure **50** to form pivot connectors **102**. The pivot connectors **102** provide a connection between the modular silo **28** and the support structure **50** which allows the modular silo **28** to be securely erected in a controlled manner from a lateral, e.g. horizontal, position to an operational, upright position. By way of example, the hydraulic ram **104** depicted in FIG. **5** may be used to erect the modular silo **28** toward the upright position.

[0052] Trucks **36** are used to deliver subsequent modular silos **28** to support structure **50** until the desired number of modular silos **28** is positioned at the well site **22** as shown in FIG. **7**. Each of the modular silos **28** is pivoted to the upright position on silo receiving regions **54** of support structure **50**, as illustrated in FIG. **7**. After the modular silos **28** are mounted upright on support structure **50**, the modular silos **28** may be bolted or otherwise further secured to support structure **50**. In some applications, the modular silos **28** also may be tied to each other to further stabilize the assembly. In the example illustrated, support structure **50** supports modular silos **28** at a sufficient height to receive a portable blending system **44** in the drive under region or passage **84**. In this example, feeders of the modular silos **28** may be positioned to discharge the oilfield material into the passage **84**. Additionally, enclosed conveyor systems **30** may be connected to the inlet hoppers **66** of vertical conveyors **32**. At this stage, oilfield material **62** may be delivered to the well site **22** and loaded into modular silos **28** via conveyors **30** and vertical conveyors **32**.

[0053] It should be noted that in some applications, the external conveyor or conveyors **30** have a section with an exposed belt which allows oilfield material to be unloaded via gravity from appropriately designed gravity feed trucks which are backed over the exposed belt. The oilfield material fed onto the belt is then conveyed into an enclosed section of the conveyor **30** and transported along an incline for release into at least one inlet **66** of a corresponding modular silo **28**.

[0054] The arrangement and components of the proppant delivery system **20** may vary substantially depending on the parameters of a given fracturing operation. The modular silos **28** may be used individually or in groups of modular silos securely mounted on the support structure **50**. The modular silos may be mounted at a sufficient height to direct outflowing oilfield material through an outflow feeder positioned at the bottom of the enclosed interior and into the passage **84**. In other applications, the feeders may be positioned to direct outflow of oilfield material from a higher compartment within the modular silo **28**. In some applications, the modular silos **28** may comprise an enclosed interior divided into a plurality of compartments for holding different types of oilfield material that may be selectively metered to the blender system **44** for blending into a desired mixture which is then pumped downhole into the wellbore.

[0055] Additionally, various belt conveyors or other types of conveyors may be enclosed to deliver oilfield material from the unload area to the upright, modular silos **28**. The modular silos **28** also may incorporate a variety of vertical conveyors for lifting the oilfield material to an upper discharge region of the modular silos **28**. Various arrangements of upright modular silos **28** enable storage of a substantial quantity of oilfield materials that may be readily supplied for use in a fracturing operation. The upright arrangement of modular silos **28** also provides for an efficient use of well site space. In addition to the space efficiency, the enclosed system for storing and delivering oilfield material provides a clean well site substantially free of dust production. However, depending on the specifics of a given fracturing operation, various numbers and arrangements of modular silos **28**, conveyors **30** and **32**, blending systems **44**, and other well site equipment may be employed.

[0056] The support structure **50** and the mat system **52** also may be constructed in various forms and configurations depending on the parameters of the desired fracturing opera-

tion. For example, the support structure **50** may be constructed from many types of strut configurations, combinations of struts and other structural components, and/or structural walls or other devices to support the modular silos **28**. In some applications, the support structure **50** may be constructed as an A-frame or truncated A-frame. The support structure **50** also may be constructed as a single connected unitary support structure or as a plurality of sub support structures which may be separated to accommodate separation of individual modular silos **28** and/or separation of groups of modular silos **28**. Similarly, the mat system **52** may be constructed with a variety of materials and in a variety of configurations depending on the parameters of the fracturing operation and on the characteristics of the corresponding equipment, e.g. modular silos **28**, blending systems **44**, and other equipment which facilitate the hydraulic fracturing.

[0057] Shown in FIGS. **10-17**, is a mobile support structure **200** for supporting one or more modular silos **28** in accordance with the present disclosure. FIG. **10** shows the mobile support structure **200** in a transport configuration in which the mobile support structure **200** is configured to be transported on roadways by being pulled behind a truck **201**. FIG. **11**, on the other hand, shows the mobile support structure **200** in the process of being converted into an operational configuration for supporting one or more of the modular silos **28** while attached to the truck **201**. FIG. **12** shows the mobile support structure **200** in the operational configuration and detached from the truck **201**. In general, the mobile support structure **200** may be designed to comply with various state and federal regulations for transport over the highways. In this regard, the mobile support structure **200** may have a width and a height of less than about 14 feet and a length less than 53 feet.

[0058] In the example shown, the mobile support structure **200** is provided with a support base **202**, a frame structure **204**, a gooseneck portion **206** and a plurality of wheels **208** for supporting the support base **202**, the frame structure **204** and the gooseneck portion **206**. The gooseneck portion **206** of the mobile support structure **200** can be attached to the truck **201** such that the truck **201** can move the mobile support structure **200** between various locations such as wellsites. As will be explained in more detail below, the mobile support structure **200** is designed to be transported to a wellsite, and then set up to support one or more of the modular silos **28**. In the example shown, the mobile support structure **200** is designed to support up to four modular silos **28** (as shown in FIG. **1**). However, it should be understood that the mobile support structure **200** can be designed to support more or less of the modular silos **28** depending upon state and federal regulations determining the size of the mobile support structure **200** as well as the width and/or size of the modular silos **28**.

[0059] The support base **202** is provided with a first end **220**, a second end **222**, a top surface **224** and a bottom surface (not shown). The frame structure **204** is connected to the support base **202**. The frame structure **204** extends above the support base **202** to define a passage **230** generally located between the top surface **224** and the frame structure **204**. The frame structure **204** has at least one silo receiving region **232** sized and configured to receive at least one of the modular silo **28**. In the example shown, the frame structure **204** has four silo receiving regions **232** with each of the silo receiving regions **232** designed to support one of the modular silos **28**.

[0060] The gooseneck portion **206** extends from the first end **220** of the support base **202** and is configured to connect to the truck **210** as discussed above. The axles **208** can be located proximate to the second end **222** of the support base **202** as shown in FIG. **10**, for example. In the example shown in FIG. **10**, the mobile support structure **200** is provided with two axles. However, it should be understood that more than two axles can be used and positioned at various locations relative to the support base **202** to support the components of the mobile support structure **200**.

[0061] As shown in FIG. **10**, the mobile support structure **200** is also provided with a first expandable base **240** and a second expandable base **242** to provide further lateral support to the modular silos **28** to prevent the modular silos **28** from falling over. In the example shown, the support base **202** is provided with a first side **244** and a second side **246**. The first expandable base **240** is positioned on the first side **244** of the support base **202** and the second expandable base **242** is positioned on the second side **246** of the support base **202**.

[0062] The first and second expandable bases **240** and **242** may be movably connected to at least one of the frame structure **204** and the support base **202** via a mechanical linkage **248** so that the first and second expandable bases **240** and **242** may be selectively positioned between a travel position as shown in FIG. **10** and a support position as shown in FIG. **11**. In the travel position shown in FIG. **10**, the first and second expandable bases **240** and **242** extend substantially vertically and adjacent to the frame structure **204** so as to be within acceptable size limits for transporting the mobile support structure **200** on public roads and highways. However, in the support position shown in FIG. **11**, the first and second expandable bases **240** and **242** extend substantially horizontally from the frame structure **204** to provide additional lateral support for the modular silos **28**.

[0063] In one embodiment, the support base **202** is provided with a linkage (not shown) supported by the wheels **208** for moving the support base **202** in a vertical direction relative to the wheels **208** between a travel position in which the support base **202** is located above in a lower portion **249** of the wheels **208** (as shown in FIG. **10**) and a support position in which the support base **202** is positioned on the ground and at least a portion of the support base **202** is aligned with the lower portion **249** of the wheels **208**. When the support base **202** is positioned on the ground and the first and second expandable bases **240** and **242** are positioned in the support position, the support base **202** and the first and second expandable bases **240** and **242** may be coplanar. Further, the support base **202** and the first and second expandable bases **240** and **242** may be positioned on a pad to aid in stabilizing the support base **202** and the expandable bases on the ground at the wellsite prior to erecting the modular silos **28** onto the mobile support structure **200**. The support base **202** may provide support to the one or more silos in sub-optimal ground surface conditions.

[0064] The mechanical linkage **248** movably connecting the frame structure **204** and/or support base **202** with the first and second expandable bases **240** and **242** can be implemented in a variety of manners. For example, the mechanical linkage **248** may be provided with a first set of hinges connecting the first expandable base **240** to the frame structure **204** and a second set of hinges connecting the second expandable base **242** to the frame structure **204**. To automate the movement of the first and second expandable bases **240** and **242** between the support position and the travel position, the mechanical linkage **248** may be provided with a first set of actuators **260** and a second set of actuators **262**. The first set

of actuators **260** are connected to the frame structure **204** and the first expandable base **240**. The second set of actuators **262** are connected to the frame structure **204** and the second expandable base **242**. In general, the first set of actuators **260** and the second set of actuators **262** are configured to selectively move the first and second expandable bases **240** and **242** between the support position and the travel position. The first and second sets of actuators **260** and **262** can be constructed in a variety of manners and may include a hydraulic cylinder, a pneumatic cylinder, or a solenoid. In the example shown, the first set of actuators **260** is provided with two actuators and the second set of actuators **262** is also provided with two actuators. However, it should be understood that more or less actuators can be provided within the first and second set of actuators **260** and **262** depending upon the size of the actuators which are used.

[0065] Shown in FIG. **11** is a diagram of the mobile support structure **200** having the first and second expandable bases **240** and **242** positioned in the support position and showing the frame structure **204** more clearly than in FIG. **10**. The frame structure **204** is provided with a plurality of frames **270** which are interconnected with a plurality of struts **272**. In the example shown, the frame structure **204** is provided with four frames **270** (which are labeled in FIG. **11** with reference numerals **270-1**, **270-2**, **270-3** and **270-4**. However, it should be understood that frame structure **204** may include more than four frames **270** or less than four frames **270**. In the example shown, each of the frames **270** positioned in parallel and substantially identical in construction and function. For this reason, only one of the frames **270** will be described in detail hereinafter.

[0066] The frame **270-1**, for example, is provided with a top member **280**, a bottom member **282**, and two side members **284** and **286** that are connected to form a closed structure surrounding at least a portion of the passage **230**. The bottom member **282** is positioned within a passageway (not shown) extending through the support base **202** and is connected to the side members **284** and **286** to maintain the side members **284** and **286** a fixed distance apart. As shown in FIG. **11**, the side members **284** and **286**, and top member **280** may be shaped and connected to form an arch shape so as to increase the structural strength of the frame **270-1**. The top member **280** is provided with an apex **290** which may be centrally located between the side members **284** and **286**. The top member **280** includes a first leg **292** and a second leg **294** which are connected together at the apex **290**. The first leg **292** is connected to the side member **284** and the second leg **294** is connected to the side member **286**. The top member **280** may also be provided with a support beam **296** so as to increase the strength of the top member **280**. In particular, the support beam **296** reinforces the first leg **292** and the second leg **294** to prevent the first leg **292** from deflecting relative to the second leg **294** and vice-versa when the modular silos **28** are being supported. The frame **270-1** can be made of any suitably strong and durable material to be able to support the load from the modular silos **28**. For example, the top member **280**, a bottom member **282**, and two side members **284** and **286** may be constructed of pieces of tubular steel that are connected together using any suitable technique, such as mechanical fastening techniques utilizing combinations of bolts, plates and welds.

[0067] The frames **270-1** and **270-2** are connected by the struts **272** and are adapted to jointly support two modular silos **28**. Likewise, the frames **270-3** and **270-4** are connected by the struts and are adapted to jointly support two modular silos **28** as shown in FIG. **17**. In particular, the frames **270-1** and **270-2** form two silo receiving regions **232** of the mobile support structure **200**, and the frames **270-3** and **270-4** form two other silo receiving regions **232**. Within each of the silo receiving regions **232**, the mobile support structure **200** is provided with a first connection **300** and a second connection **302**. The first connection **300** within each of the silo receiving regions **232** is located at the apex **290** of the frames **270-1-4**. The second connection **302** within each silo receiving region **232** is located on either the first expandable base **240** or the second expandable base **242** and at a lower elevation than the first connection **300** to engage the silo frame **56** when the modular silo **28** is on the trailer **37**.

[0068] The first connection **300** within each of the silo receiving regions **232** includes a first connector **306** and a second connector **308** that are configured to attach to the silo frame **56** of the modular silos **28**. The second connection **302** within each of the silo receiving regions **232** includes a first connector **310** and a second connector **312** that are configured to attach to the silo frame **56** of the modular silos **28**. The first connector **310** and the second connector **312** of the second connection **302** are configured to connect to the silo frame **56** of the modular silo **28** when the modular silo **28** is positioned on the trailer **37** as discussed above. For example, as shown in FIG. **13**, the trailer **37** can be backed to align the silo frame **56** with the first connector **310** and the second connector **312** of the second connection **302**. As shown in FIGS. **13** and **14**, to aid in backing the trailer **37** to align the silo frame **56** with the first connector **310** and the second connector **312** of the second connection **302**, alignment guides **320** may be provided on the first expandable base **240** and the second expandable base **242** within each of the silo receiving regions **232**.

[0069] In any event, once the silo frame **56** of the modular silo **28** to be erected onto the mobile support structure **200** is connected to the second connection **302**, the modular silo **28** may be moved into the vertical position as discussed above using a ram, crane or other suitable mechanical assembly. When the modular silo **28** is in the vertical position, the silo frame **56** is connected to the frame structure **204** via the first connection **300** to maintain the modular silo **28** securely on the mobile support structure **200**.

[0070] Once the support base **202** and the first and second expandable bases **240** and **242** have been deployed to the support position, the truck **201** can be disconnected from the gooseneck portion **206** of the mobile support structure **200**. Once the truck **201** has been disconnected, the gooseneck portion **206** may be manipulated to lie on the ground and be generally co-planar with the support base **202**. In this configuration, the gooseneck portion **206** may form a ramp to aid the operator in positioning the blending system **44** within the passage **230** as shown in FIG. **1**. The gooseneck portion **206** may be provided with a first section **320** and a second section **322**. The first section **320** extends from the first end **220** of the support base **202**. The first section **320** has a first end **324** and a second end **326**. The first end **324** of the first section **320** is movably connected to the support base **208**, such as by the use of a set of hinges, voids and pins or other types of connectors which may be locked at more than one position. The second section **322** is movably connected to the second end **326** of the first section **320**. For example, the first section **320** may be a four bar linkage which can be locked in an elevated position to form the gooseneck, or a lowered position to form the ramp

[0071] Shown in FIG. **12** is the mobile support structure **200** in the operational configuration. In the operational configuration depicted in FIG. **12**, the modular silos **28** can be loaded onto the mobile support structure **200**, as shown for example, in FIGS. **1** and **13-17**, and the blending system **44** can be positioned within the passage **230**.

[0072] Shown in FIGS. **13-17** is an example in which a modular silo **28** is being placed into position on the mobile support structure **200**. In this example, each individual modular silo **28** is transported to the well site **22** by the truck **36**. As illustrated, the truck **36** may comprise the tractor **98** pulling the trailer **100** appropriately sized to receive one of the silos **28** in a lateral, e.g. horizontal, orientation.

[0073] Each truck **36** may be backed up to move the laterally positioned modular silo **28** into engagement with a corresponding silo receiving region **232** of the mobile support structure **200**. Additional guide rails may be designed into the first and second expandable bases **240** and **242** to aid in the alignment of the silo trailer to the silo receiving region **232**. Furthermore to aid in the proper alignment, the first and second expandable bases **240** and **242** may also serve as a reference elevation for the silo trailer.

[0074] As discussed above, the mobile support structure **200** may comprise the second connection **302** or other suitable structures located at an appropriate height to receive and engage each modular silo **28** when in the lateral position on the truck **36**. By way of example, the mobile support structure **200** and the corresponding modular silos **28** may use the first and second connectors **310** and **312** by which the modular silo **28** may be selectively engaged with the mobile support structure **200**. The first and second connectors **310** and **312** may be pivot connectors that are positioned to allow engagement and connection of each modular silo **28** with the mobile support structure **200** while the modular silo **28** is in a lateral position on the truck **36**. The first and second connectors **310** and **312** also are designed to maintain engagement of the modular silo **28** with the mobile support structure **200** as the modular silo **28** is pivoted from the lateral position to an operational upright, e.g. vertical, orientation.

[0075] The modular silos **28** may be pivoted or moved about the first and second connectors **310** and **312** from the lateral position on the truck **36** to the operational, upright position on the support frame **204** of the mobile support structure **200** by a variety of mechanisms. For example, the ram **104** may be used to erect each modular silo **28** between the lateral and upright positions. The ram **104** may be a hydraulic or pneumatic ram positioned on trailer **100** to act against frame **56** of each modular silo **28** to pivot the modular silo **28** about the first and second connectors **310** and **312** until the modular silo **28** is securely received in its upright position by the silo receiving region **232**. The ram **104** may be designed to operate off a hydraulic (or pneumatic) system of the truck **36**. In other applications, the ram **104** may be designed to pivot the trailer **100** or a portion of the trailer **100** upwardly while the modular silo **28** remains attached to the pivoting portion of the trailer **100**. Other techniques may utilize cranes, pulleys, and/or other mechanisms to pivot each modular silo **28** about the first and second connectors **310** and **312** as the modular silo **28** is transitioned from the lateral position to the operational, upright orientation.

[0076] The first and second connectors **310** and **312** are shown in more detail in FIGS. **14** and **15**. The first and second connectors **310** and **312** are used to facilitate formation of the connection between each modular silo **28** and the mobile support structure **200** and may comprise a variety of individual or plural connector mechanisms. Generally, each of the first and second connectors **310** and **312** are designed to permit controlled movement of the modular silo **28** relative to the mobile support structure **200**. The first and second connectors **310** and **312** may comprise a pivot member mounted to the silo **28** and a corresponding pivot member mounted on the mobile support structure **200**, e.g. mounted on struts **330**, as illustrated in FIGS. **14** and **15**. In the specific example illustrated in FIGS. **14** and **15**, each modular silo **28** is pivotably engaged with the mobile support structure **200** via a pair of the pivot members. By way of example, each pivot member may comprise a pin rotatably, e.g. pivotably, received in a corresponding pin receiver of the pivot member. Although pin may be connected to frame **56** of modular silo **28** and pin receiver may be connected to pivot struts **330** of support structure **50**, the pin and the pin receiver can be reversed. Additionally, the first and second connectors **310** and **312** may comprise a variety of other structures designed to enable selective engagement of the modular silos **28** with the mobile support structure **200** and controlled movement of the modular silos **28** with respect to the mobile support structure **200**. Depending on the design of the first and second connectors **310** and **312**, a variety of retention features such as an expanded pin head may be used to maintain the pivotable connection between the modular silo **28** and the mobile support structure **200** during transition of the modular silo **28** from the lateral position to the upright position.

[0077] The mobile support structure **200** may also be provided with other types of equipment to facilitate the handling of the oilfield material and/or the blending of the oilfield material to form the slurry as discussed above. For example, the mobile support structure **200** may be provided with a power generation system **340** that is supported by the wheels **208**. In this embodiment, the power generation system **340** may be utilized to generate electrical power which may be provided to the conveyors **30** and **32** as well as other equipment at the proppant delivery system **20**. The mobile support structure **200** may also be provided with a dry additives feeder, power sources, controls and controllers, a skid for supporting a blender system integrated into the support base **202**. Further, the mobile support structure **200** may be provided with weather proofing to protect from the harsh environmental conditions. Further, the mobile support structure **200** may be provided with various sensors **116** positioned on the frame structure **204** and/or on modular silos **28** to detect and/or monitor parameters related to the delivery of oilfield material **62** for a given fracturing operation. By way of example, the sensors **116** may comprise four load cells in each silo receiving region **232** and may be part of the connectors **306**, **308**, **310** and **312** to monitor the loads applied by individual modular silos **28**. The loading data may be used to track the amount of oilfield material that remains in enclosed interior **60** of each modular silo **28** for inventory management purposes.

[0078] Shown in FIG. **18** is a top plan view of the mobile support structure **200**. The connectors **306**, **308**, **310** and **312** may be arranged in a truncated triangle configuration **350**, such as a trapezoid to enhance the stability of the modular silo **28** supported within the silo receiving region **232**. Further, to aid in the support of the modular silo **28**, the combined horizontal area of the support base **202**, first expandable base **240** and second expandable base **242** is much larger than the horizontal area occupied by one of the modular silos **28** when

installed on the mobile support structure **200**. For example, a first horizontal area **352** occupied by one of the modular silos **28** when positioned in a vertical orientation is shown in FIG. **18**. As can be seen, the support base **202**, first expandable base **240** and the second expandable base **242** occupy a combined second horizontal area that is at least one and a half times as large as the first horizontal area **352** and may be eight or ten times as large as the first horizontal area **352**.

[0079] Shown in FIG. **19** is a second embodiment of a mobile portable structure **400**, which is similar in construction and function as the mobile portable structure **200**, with the exception that the mobile portable structure **400** has an integrated blending system **410**. The integrated blending system may be transported with the other components of the mobile portable structure **400** and provided on skids or tracks to be moved off of a support base **412** of the mobile portable structure **400**.

[0080] Although a few embodiments of the disclosure have been described in detail above, those of ordinary skill in the art will readily appreciate that many modifications are possible without materially departing from the teachings of this disclosure. Accordingly, such modifications are intended to be included within the scope of this disclosure as defined in the claims.

What is claimed is:

1. A method for handling oilfield material, comprising:
- transporting a silo in a first orientation to a desired location;
- transporting at least one support structure to the desired location separate from the silo, the at least one support structure having at least one connection for selective engagement with the silo;
- coupling the silo to the at least one connection of the at least one support structure; and
- erecting the silo to a second orientation.

2. The method of claim **1**, further comprising at least partially filling the silo with the oilfield material.

3. The method of claim **1**, wherein transporting the support structure to the desired location further comprises positioning the support structure on a mat system.

4. The method of claim **1**, wherein transporting the support structure to the desired location further comprises transporting a trailer integrated with the support structure.

5. The method of claim **1**, further comprising positioning a blender below the silo.

6. The method of claim **1**, further comprising transferring oilfield material from the silo directly into the blender via gravity.

7. The method of claim **1**, wherein the oilfield material is selected from a group consisting of: proppant, fiber, guar, fluid, and gel.

8. The method of claim **1**, further comprising moving the silo from the second orientation to the first orientation, and de-coupling the silo from the at least one connection of the support structure.

9. The method of claim **1**, wherein the silo comprises an enclosed interior for holding the oilfield material, the enclosed interior being divided into a plurality of compartments for holding a plurality of types of oilfield material.

10. The method of claim **1**, wherein transporting the silo further includes transporting the silo with a trailer, and disengaging the trailer from the silo.

11. The method of claim **1**, wherein partially filling the silo further comprises interfacing with oilfield material delivery transport trailers via a transloader.

12. The method of claim **1**, further comprising surveying the ground prior to erecting the silo.

13. The method of claim **1**, further comprising erecting a guar silo.

14. A method of handling oilfield material, comprising:
- transporting a silo in a first orientation to a desired location;
- transporting at least one support structure to the desired location separately from the silo, the at least one support structure having a frame structure defining a passage; and
- erecting the silo to a second orientation above at least one portion of the passage.

15. The method of claim **14**, wherein the silo is a first silo, and at least one portion of the passage is a first portion, and further comprising transporting a second silo to the desired location in the first orientation and erecting the second silo to the second orientation above a second portion of the passage.

16. The method as recited in claim **14**, wherein the support structure has a blender positioned within the passage.

17. The method of claim **14**, wherein the silo has a bottom and a feeder at the bottom of the silo, and wherein erecting the silo is defined further as erecting the silo to the second orientation such that the feeder is directed to discharge material into the at least one portion of the passage.

18. The method of claim **17**, further comprising the step of moving a blender into the passage and underneath the feeder.

19. A mobile silo system for handling oilfield material, comprising:
- a mobile support structure, comprising:
  - a frame structure defining a passage sized and adapted to receive an oilfield material mixer;
- a transportable silo having at least a portion supported by and extending above the frame structure, the transportable silo having a material discharge directed into the passage.

20. The mobile silo system of claim **19**, wherein the portion extending above the frame structure is an oilfield material storage portion adapted to receive the oilfield material.

21. The mobile silo system of claim **19**, wherein the mobile support structure further comprises a support base.

22. The mobile silo system of claim **19**, wherein the mobile support structure further comprise at least one first connection on the frame structure adapted to receive and support a first portion of a silo.

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