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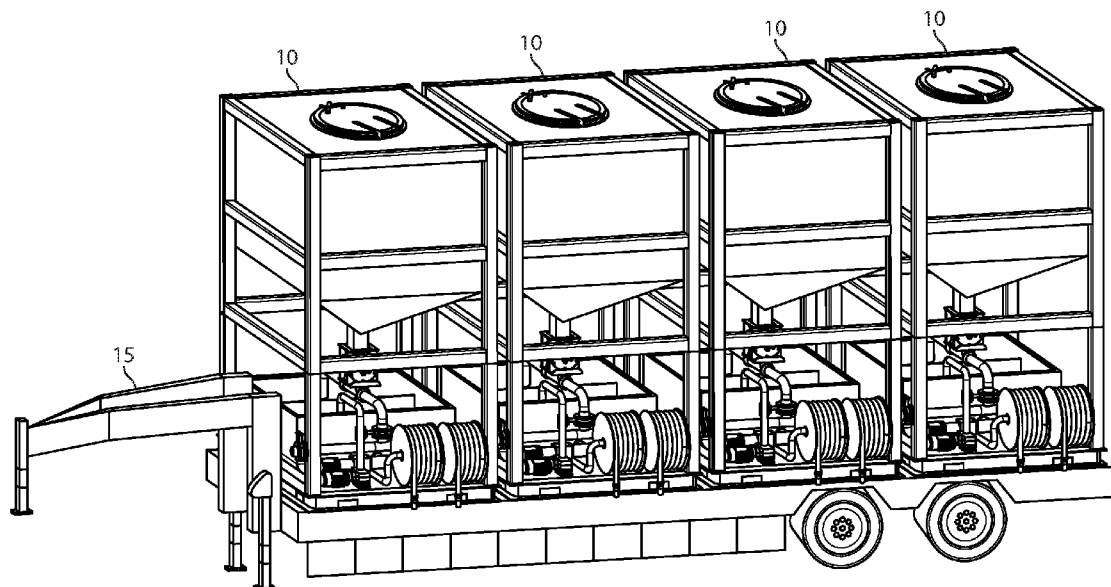


FIG. 5

(57) Abstract: The application is directed to a system and method for mixing fluid and dry material to produce fluid mixture compositions. The system may be provided on a portable platform for transport of the system for use at different locations or the system may be provided as a permanent installation. The system includes a first module for receiving fluid into the system and an optional second module attachable to the first module for providing dry material to be mixed with the fluid received into the system. The fluid mixture compositions produced by the system can be conveyed out from the system to one or more target locations.



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DRY ADDITIVE AND FLUID MIXING SYSTEM, ASSEMBLY AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

- 5 **[0001]** This application claims benefit of United States Provisional Patent Application Serial Number 62/617,164, filed on January 12, 2018, the content of which is hereby incorporated by reference in its entirety.

STATEMENT REGARDING FEDERALLY SPONSORED
RESEARCH OR DEVELOPMENT

- 10 **[0002]** Not applicable.

FIELD OF THE INVENTION

- 15 **[0003]** The application relates generally to the mixing of dry additives and fluids.

BACKGROUND OF THE INVENTION

- [0004]** On-site mixing of dry additives with fluids is a common operation in many industries, including for example, oilfield operations, mining, pulp industry, paper industry, pharmaceutical preparation, food preparation and processing, cosmetics industry, plastics industry, construction and agriculture. However, on-site mixing is not without its challenges. For example, many on-site mixing locations are remote and present logistical challenges such as long travel distances, limited transportation infrastructure, hostile climates and primitive or crude chemical storage conditions for dry additives and/or liquids. In an attempt to overcome such challenges batch mixing has been employed by producing batch mixtures at one location, i.e., a mixing facility, and then transporting the batch mixtures in tote tanks or bulk liquid trailers to a second location for use, e.g., a petroleum wellsite or a production facility. However, transportation costs for transporting batch mixtures to certain locations are high. Batch mixing has also been attempted on-site but relies heavily on the storage of dry products on location and often times there is no space available for such material storage. In addition, batch mixing can often be wasteful. For example, at the conclusion of a batch mixing operation it is not uncommon for fluid mixtures to remain in the bottom of the tanks or containers utilized.
- 20
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Depending on the type of fluid mixture, the mixture may have to be treated and/or transported to a safe disposal site. Also, during transit and depending on the chemistry of the mixture, a batch mixture may be subject to chemical reactions and temperature degradation thereby damaging the mixture before reaching its destination.

5 **[0005]** For many on-site mixing operations, batch mixing has largely been replaced by continuous mixing, which occurs when separate streams of ingredients are continuously fed and combined in some container, mixed, and the mixture removed continuously. Continuous mixing is often valuable in those operations that require the ability to mix dry additives and base fluids on the fly out in the field. However, in many industries, especially in the extraction
10 of oil and gas, and specifically in hydraulic fracturing operations, the use of liquid chemicals on-site in continuous mixing operations is also cost prohibitive. There have been attempts to create continuous mixing packages that are field transportable but such have several shortcoming including: (1) the large size of mixing units currently available (length, width, depth), (2) the substantial weight of units currently available, (3) the complexity of current
15 designs, which can make maintenance and operating such units challenging and adds costs depending on the location of operation, (4) component failures leading to the asset not being available to perform operations as necessary, (5) the inability to remotely operate the mixing units, (6) the lack of quality and control of the mixing process necessary to provide one or more required fluid mixtures and (7) supply chain challenges, e.g., bulk material needs to be
20 transported in large pneumatic trailers to the field.

[0006] Overcoming the above shortcomings is desired.

BRIEF SUMMARY OF THE INVENTION

[0007] The present application is directed to a system for producing fluid mixture compositions, including a first module providing one or more fluids; and a second module
25 attachable to the first module providing one or more dry additives to be mixed with the one or

more fluids in the first module to produce a fluid mixture composition; wherein the first module is operationally configured to modify the fluid mixture composition.

[0008] The present application is also directed to a portable system for mixing fluid and dry material, including a first module providing a fluid stream; a second module providing
5 dry material into the fluid stream to produce a fluid mixture composition; the first module being operationally configured to house the fluid mixture composition, modify the fluid mixture composition and direct the fluid mixture composition out from the system.

[0009] The present application is also directed to a system for mixing fluid and dry material, including a first module for receiving fluid into the system; and a second module
10 attachable to the first module for providing dry material to be mixed with the fluid in the first module producing a fluid mixture composition; wherein the first module includes a first mixer for producing the fluid mixture composition and a second mixer to facilitate further mixing of the fluid mixture composition; the first module being operationally configured to direct the fluid mixture composition out from the system via one or more outlets.

15 BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0010] Figure 1 is a perspective view of an embodiment of the system of this application.

[0011] Figure 2 is an illustration of four first modules on a flatbed trailer for transport.

[0012] Figure 3 is an illustration of six second modules on a flatbed trailer for transport.

20 [0013] Figure 4 is an illustration of two first modules and two second modules on a flatbed trailer for transport.

[0014] Figure 5 is an illustration of four systems on a flatbed trailer for transport.

[0015] Figure 6 is a perspective view of an embodiment of a first module of the present application.

25 [0016] Figure 7 is a perspective view of another embodiment of a first module.

[0017] Figure 8 is a perspective view of another embodiment of a first module.

[0018] Figure 9 is a perspective view of an embodiment of a second module of the present application.

[0019] Figure 10 is a bottom view of an embodiment of a second module.

5 [0020] Figure 11 is a perspective view illustration including the securing of an embodiment of a second module with an embodiment of a first module.

[0021] Figure 12 is a side view illustration including the securing of an embodiment of a second module with an embodiment of a first module.

[0022] Figure 13 is a side view of an embodiment of a second module.

10 [0023] Figure 14 is a side view illustration including the securing of an embodiment of a second module with an embodiment of a first module.

[0024] Figures 15A – 15F provide exemplary perimeter shapes of one or more vertical members of a first module.

[0025] Figure 16 is a side view of an embodiment of a second module.

15 [0026] Figure 17 is a side view of an embodiment of a second module.

[0027] Figure 18 is an illustration of multiple assembled systems in a stacked arrangement on the deck of a ship.

[0028] Figure 19 is an illustration of multiple assembled systems in a stacked arrangement in a warehouse.

20 [0029] Figure 20 is a perspective view of an embodiment of a first module.

[0030] Figure 21 is a perspective view of an embodiment of a first module.

[0031] Figure 22 is a perspective view of an embodiment of a mixing tub of the first module.

[0032] Figure 23 is a perspective view of another embodiment of a mixing tub.

[0033] Figure 24 is a front elevation view of an embodiment of a divider of a mixing tub.

[0034] Figure 25 is a front elevation view of another embodiment of a divider.

[0035] Figure 26 is another view of a first module.

5 [0036] Figure 27 is an in-line pump and power source set upon a removable support for attachment to a first module.

[0037] Figure 28 is another view of a first module.

[0038] Figure 29 is a perspective sectional view of a second basin of a mixing tub.

[0039] Figure 30 is a partial view of a mixing tub including a cross-beam suspending a
10 fluid mixer into the mixing tub.

[0040] Figure 31 is a perspective view illustrating a simplified second module stacked atop a simplified first module.

[0041] Figure 32 is a flowchart representing basic operation of a process control system of the present application.

15 [0042] Figure 33 illustrates a system fluid source and four individual systems interconnected as a cascade.

[0043] Figure 34 is a side view of another embodiment of the system including two first modules and two second modules.

DETAILED DESCRIPTION OF THE INVENTION

20 [0044] Before describing the invention in detail, it is to be understood that the present system, assembly and method are not limited to particular embodiments. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to be limiting. As used herein, the term “on-site” refers to one or more remote locations or destinations serving as the place for producing fluid mixture
25 compositions for a particular operations including, but not necessarily limited to temporary

operations. As understood by the skilled artisan, “ISO” is an acronym for International Organization for Standardization.

[0045] In one aspect, the application provides a portable or mobile system, assembly and method for batch or continuous mixing of one or more fluids and dry materials to produce one or more fluid mixture compositions. In one aspect, the application provides for variable mixing according to one or more particular properties of the one or more fluid mixture compositions to be produced. For example, the system may be programmed to mix one or more fluids and one or more dry materials via a first mixing action or procedure to produce one or more fluid mixture compositions defined by particular properties. The system may also be programmed to mix one or more fluids and one or more dry materials via one or more additional mixing actions or procedures following a first mixing to produce one or more fluid mixture compositions having one or more properties different than the fluid mixture compositions produced via the first mixing action.

[0046] In another aspect, the application provides a portable system for continuous mixing of one or more fluids and one or more dry additives on-site, the system comprising an assembly having separate compartments for holding dry additives and fluid mixture compositions. The compartments may vary in size and shape. In one aspect, the portable system is operationally configured for mobile mixing applications. In another aspect, the portable system may be installed for permanent use at a particular location.

[0047] In another aspect, the application provides a method for introducing a dry additive into a fluid stream in a way that ensures a predictable, highly accurate and consistent application of the dry additive to produce one or more particular fluid mixture compositions.

[0048] In another aspect, the application provides a system for mixing fluid and dry additive material in a manner effective to minimize dead spots in a mixing vessel where ingredients may stagnate rather than mix.

[0049] In another aspect, the application provides a system for mixing fluid and dry additive material to produce one or more fluid mixture compositions in a manner effective to control the output flowrate and output density of the fluid mixture compositions produced.

[0050] As described below, the present application is directed to a cost effective approach to storing, transporting and mixing dry material and fluid at a particular location compared to other known technologies. In particular, the present application is directed to an invention including a system made up of individual members that may be separately transported to one or more locations and cooperatively assembled to produce fluid mixture compositions comprising dry material and fluid on demand. In one implementation, individual members of the system may store and transport dry additive and/or fluid to one or more locations where after the dry additive and fluid may be mixed together. In another implementation, individual members may be transported to one or more locations and dry material and/or fluid may be delivered or fed to the individual members on-site for mixing dry additive and fluid. In yet another implementation of the system, one or more individual members may be used to transport dry material to one or more locations and be assembled on-site with one or more other individual members operationally configured to receive the dry material and one or more fluids at one or more flow rates to produce one or more volumes of fluid mixture compositions. As described herein, the system suitably provides for the transport, assembly, disassembly, interchangeability of individual members at one or more target locations.

[0051] One exemplary embodiment of a primary system **10** of this application is provided in **FIG. 1**. As shown, a primary system **10** (hereafter “system **10**”) may include at least a first individual member in the form of a mobile or transportable first module **100** and a second individual member in the form of a mobile or transportable second module **200** operationally configured to be assembled with the first module **100** for system **10** operation.

One advantageous feature of the present system **10** is the mobility of individual modules **100**, **200**. For example, first and second modules **100**, **200** may be transported as individual units as shown in the examples of **FIGS. 2 - 4**. In another mode, first and second modules **100**, **200** may be assembled for transport as shown in **FIG. 5**, which depicts multiple systems **10** side by side on a flatbed trailer **15**. As discussed below, the modules **100**, **200** are operationally configured for ease of transport, stackability and storage. In addition to flatbed trailers **15**, the modules **100**, **200** are also operationally configured for transport via closed shipping containers, semi-trailer truck enclosed cargo spaces, boxcars, and other shipping techniques. Accordingly, the first module **100** and/or second module **200** may be provided with a tracking device such as a GPS tracking unit utilizing the Global Positioning System, or equivalent, in order to track their precise location at any given moment during transport.

[0052] In basic system **10** operation, the first module **100** serves as a primary source of fluid and the second module **200** serves as a primary source of dry material or non-fluid material (hereafter referred to as “dry additive”) for mixing purposes. In one mode of operation, one or more dry additives may be fed from the second module **200** to the first module **100** whereby dry additive can be mixed with one or more fluids to produce a fluid mixture composition that may be directed out from the first module **100** to one or more target locations downstream and/or upstream as desired. In one particular implementation, a first module **100** may store or receive a desired volume of fluid, i.e., one or more fluids, and the second module **200** may store or receive a desired amount of dry additive, i.e., one or more dry additives, to be fed to the first module **100** where the dry additive and fluid are mixed to produce a fluid mixture composition. Thus, in one implementation, the system **10** may be operationally configured as a batch mixer operationally configured to produce a batch fluid mixture composition of a desired volume on-site. In another implementation, the system **10** may be operationally configured as a continuous mixer with particular feed rates effective to produce

one or more fluid mixture compositions in a continuous manner at a desired volumetric flow rate, e.g., over a particular period of time or intervals of time. As understood by the skilled artisan, continuous mixing typically produces higher volumes of fluid mixture compositions than batch mixing. For continuous mixing purposes, dry additive and fluid are fed to the first
5 module **100** at desired feed rates in amounts effective to produce one or more desired fluid mixture compositions. In one embodiment, dry additive is suitably fed to the first module **100** as fluid is fed to the first module **100**. However, it is further contemplated that for continuous mixing an amount of dry additive may be delivered to the first module **100** before and/or during and/or after fluid is fed to the first module **100**.

10 **[0053]** As understood by the skilled artisan, assembly, storage and transportability of the system **10** may be dictated according to the structural elements of the first module **100** and/or its corresponding second module **200**. As shown in **FIG. 1**, a first module **100** (or “mixing skid module”) suitably includes a base support effective to hold first module **100** component parts and/or equipment and support a second module **200** in a manner effective to
15 maintain the system **10** in an upright position on a support surface **17**, e.g., the ground (earth), a trailer bed, floor, container bed, ship deck, skid, man-made foundation, as shown in **FIG. 1**.

[0054] With reference to **FIG. 6**, one suitable first module **100** may be provided as a fully contained skid type member with a base support surface comprising a framework **105** and a first support surface **108** disposed across the framework **105** operationally configured as a
20 portable support platform or other platform type member effective to hold various component parts and/or equipment of the first module **100** as shown. The first support surface **108** may be provided as a sunken floor type member with a framework **105** providing an inner perimeter sidewall **109** operationally configured to contain liquid spills on the first support surface **108** within the first module **100**. In another embodiment, the first support surface **108** may be
25 provided as a removable planar type member placed atop the framework **105**. In another

embodiment, the framework **105** may include a grooved surface of a first depth along its perimeter for receiving a planar type first support surface **108** therein effective as a seat to support the first support surface **108** and prevent lateral movement of the first support surface **108** – in such embodiment the first support surface **108** may include a thickness substantially similar as the first depth thereby providing a smooth or continuous base support surface across the framework **105** and first support surface **108**. In another embodiment, a removable first support surface **108** may be secured to a framework **105** via one or more fasteners such as threaded fasteners. In still another embodiment, the framework **105** and first support surface **108** may be provided as a single unit, e.g., a first support surface **108** adhered to a framework **105**. In an embodiment comprising metal components, a first support surface **108** may be welded to a framework **105**. In still another embodiment, a base support surface of a first module **100** may be provided as a machined or molded one-piece member.

[0055] As further shown in **FIG. 6**, the first module **100** may also include one or more raised members for engaging and supporting a second module **200** apart from the component parts and/or equipment of the first module **100** in a stacked type configuration. As **FIG. 6** illustrates, one suitable first module **100** may include one or more raised members in the form of one or more elongated vertical members **115** operationally configured to receive a second module **200** in a stacked configuration upon the vertical members **115**. As shown in the simplified illustration of **FIG. 7**, in another embodiment one or more raised surfaces may include horizontal rail type support members **114** on opposing sides of the first module **100** operationally configured to receive a second module **200** in a stacked orientation thereon. In another embodiment as exemplified in **FIG. 8**, a raised horizontal rail type support member **114** may be provided along the perimeter of the framework **105** operationally configured to receive a second module **200** in a stacked orientation thereon. In such embodiment, the first module **100** may further include one or more planar type radial triangular type supports

disposed between the rail type support member **114** and the first support surface **108** as provided in United States Patent Number D688349, titled “Proppant Vessel Base,” issued on August 20, 2013, which is herein incorporated by reference in its entirety. Suitably, the one or more elongated vertical members **115**, the horizontal rail type support members **114** and radial
5 supports provide structural support to the system **10**.

[0056] Turning to **FIG. 9**, the second module **200** includes a support framework **205** operationally configured to engage the first module **100** during system **10** assembly and operation as shown in **FIG. 1**. One suitable second module **200** may include a rectangular framework **205** with horizontal and vertical sections operationally configured to provide
10 structural support for one or more dry additive storage containers **206** secured to the framework **205**. In another embodiment, the framework **205** may including additional bracing members such as diagonal bracing members as known in the field of box type frames. As shown, one suitable framework **205** may include a rectangular perimeter substantially similar as, or the same as, the perimeter defined by the one or more vertical members **115** or horizontal rail type
15 support members **114** of a corresponding first module **100**. As shown in **FIG. 9**, the framework **205** suitably includes one or more engagement surfaces **207** effective to contact the one or more vertical members **115** and/or horizontal rail type support members **114** of a corresponding first module **100** during assembly of the system **10**. In addition, it is further contemplated that the perimeters of the frameworks **105**, **205** may be provided in shapes other than rectangular
20 configurations. For example, frameworks **105**, **205** may include non-rectangular multi-sided perimeters, e.g., triangular, hexagonal, as well as circular, oval, and one or more irregular shapes. It is also contemplated that the frameworks **105**, **205** may be provided with differing perimeter shapes. Likewise, the frameworks **105**, **205** may be sized and/or shaped to meet the spacing demands at a particular location for intended operation of the system **10**.

[0057] Without limiting the mode of assembly of the first and second modules **100**, **200**, a second module **200** as shown in **FIG. 9** may be secured to the first module **100** via one or more locks, clamps, sleeves, rope, chain, bungee cords, tape, tie-wraps, bridge fittings, threaded fasteners, and combinations thereof, as desired or as otherwise required. In another embodiment, the one or more vertical members **115**, or horizontal rail type support members **114**, and the framework **205** may be constructed to include corner castings or corner fittings **30** and **32** for securing the second module **200** to the first module **100** via horizontal connectors and/or twist locks **12** as known in the art of ISO container chassis connections (see **FIG. 11**).

[0058] In another embodiment, corner fittings **30** and **32** may be provided as separate component parts releasably attachable to the one or more vertical members **115**, or horizontal rail type support members **114** and the framework **205**. Appositely, once the system **10** is assembled the corner fittings **30** and **32** and twist locks **12** are operationally configured to prevent any undesired vertical and/or lateral movement of the second module **200** in relation to the first module **100**.

[0059] Suitable corner fittings **30**, **32** and twist locks **12** are commercially available from sources including, but not necessarily limited to TANDEMLOC, Inc, Havelock, North Carolina, U.S.A. As understood by the skilled artisan, at the time of this application other commercial sources of corner fittings **30**, **32** and/or twist locks **12** may be found via the World Wide Web at www.Alibaba.com.

[0060] In another mode of attachment, the one or more vertical members **115** may be operationally configured to act as male members for mating with corresponding female openings **220** (see **FIG. 10**) of the framework **205** of the second module **200**. In such embodiment, the one or more vertical members **115** are effective as guides for aligning the second module **200** with the first module **100** as the second module **200** is being assembled with the first module **100**. In one simplified embodiment, the one or more vertical members

115 and the corresponding vertical sections **230** of the framework **205** may include one or more corresponding vertically aligned holes for receiving a quick release pin there through for adjusting the distance between the first and second modules **100**, **200**. Such mechanical connection is well-known to persons of ordinary skill in the art. For exemplary purposes, a simplified quick release pin configuration suitable for the present application is described in United States Patent Number 3,855,946, titled “Adjustable Leg Structure,” issued on December 24, 1974; and United States Patent Number 6,053,477, titled “Self Levering Vehicle Jack,” issued on April 25, 2000, each of which is herein incorporated by reference in its entirety. In still another embodiment, the one or more vertical members **115** may be provided as telescoping members as described in United States Patent Number 5,101,215, titled “Telescoping Lightweight Antenna Tower Assembly and the Like,” issued on March 31, 1992, herein incorporated by reference in its entirety. In another embodiment, a lock may be employed as described in United States Patent Number 4,596,484, titled “Lock for Telescoping Tubular Support,” issued on June 24, 1986, which is herein incorporated by reference in its entirety.

[0061] As shown in **FIG. 12**, another suitable vertical member **115** may be include a stepped member having (1) a first male type section **118** defined by a first outer width or outer diameter providing an abutment surface **119** for an engagement surface(s) **207** of the framework **205** and (2) a second male type section **120** defined by a second outer width or outer diameter extending out from the abutment surface **119** for mating with a female opening **220** of a vertical section **230** of the framework **205**. In another embodiment, the one or more vertical members **115** may be provided as hollow members with openings **116** at the distal ends as shown in **FIG. 6** operationally configured to receive male type vertical members **223** (**FIG. 13**) of the second module **200**. In such embodiment, the one or more vertical members **223** are effective to prevent any undesired lateral movement of the second module **200** in relation to

the first module **100** during system **10** assembly. One non-limiting mode of attachment in regard to vertical members **223** is provided in United States Patent Number 6,366,313, titled “Height-Adjustable Support Assembly, Particularly Suited for Food Processing Equipment,” issued on April 2, 2002, which is herein incorporated by reference in its entirety.

5 **[0062]** In another embodiment the system **10** may include an elongated connector **20** operationally configured to mate with a female opening **220** of framework **205** and a female opening **116** of a hollow vertical member **115** for securing the second module **200** with the first module **100** (see **FIG. 14**). In another embodiment, the second module **200** may be secured to the one or more vertical members **115** via an elongated connector **20** using a releasable pin as
10 described in U.S. Patent Number 6,158,705, titled “Vehicle Stabilization and Support Tool,” issued on December 12, 2000, which is incorporated herein by reference in its entirety.

[0063] With reference again to **FIG. 8**, in another embodiment the raised horizontal rail type support members **114** or the one or more vertical members **115** may include raised corner members **35** operationally configured to align and receive a framework **205** therein for
15 system **10** assembly. In this embodiment, one or more apertures **217** located along the framework **205** (see **FIG. 9**) may be aligned with one or more apertures **37** of the corner plates in a manner effective for securing the first and second modules **100**, **200** via one or more fasteners including, but not necessarily limited to threaded bolts, locking pins, and combinations thereof. The raised corner members **35** may also be used as lift eye type members
20 for lifting and/or transporting the first module **100**.

[0064] In one embodiment, the raised horizontal rail type support members **114** and the one or more vertical members **115** described above may be releasably attached to the framework **105** and/or releasably attached to the first support surface **108**. Likewise, the male type vertical members **223** may be releasably attached to the framework **205**. In another
25 embodiment, the raised horizontal rail type support members **114** may include one or more

vertical members **115** described herein that are permanently attached to framework **105** and/or the first support surface **108**. Likewise, the one or more vertical members **223**, may be permanently attached to the framework **205**. In one embodiment, the horizontal rail type support member **114** and opposing vertical sections **115A**, **115B** may be provided as a single member, e.g., single member as three sides of a rectangle. In another embodiment, the opposing vertical sections **115A**, **115B** of a raised horizontal rail type support member **114** may be releasably or permanently attached to the support member **114**.

[0065] Without limiting the mode of releasable type attachment, the raised horizontal rail type support members **114** and the one or more vertical members **115** may be releasably attached to the framework **105** and/or to the first support surface **108** and male type vertical members **223** may be releasably attached to framework **205** via set pins, clamps, twist locks **12** as described above. In another embodiment, the frameworks **105**, **205** may include one or more threaded female openings for receiving threaded sections of corresponding vertical members **115**, **223** therein. In another embodiment, vertical members **115**, **223** may include threaded rod members extending out for mating with threaded female openings on the corresponding frameworks **105**, **205** – similar as furniture legs and the like known in the art that are equipped with threaded sections and/or threaded rod members. Non-limiting examples of threaded connections for use herein are provided in United States Patent Number 5,561,950, titled “Method and Apparatus for Adjustable Pier Block,” issued on October 8, 1996; and United States Publication Number 20050056760, titled “Adjustable Beam Support,” published on March 17, 2005; each of which is incorporated herein by reference in its entirety. As understood by the skilled artisan, the height of the system **10** may vary according to the depth of mated threading achieved via threaded attachment. As such, threaded connections may be operationally configured to adjust or vary the height of the system **10**. Still another embodiment of a vertical member **115**, **223** contemplated for use herein is described in United

States Patent Number 6,213,452, titled “Railing Support Post,” issued on April 10, 2001, which is incorporated herein by reference in its entirety.

[0066] Even though the exemplary vertical members **115** of **FIG. 6** are shown as elongated four-sided rectangular members, in another embodiment vertical members **115** may include another multi-sided configuration, e.g., three-sided, four-sided, five-sided, six-sided, and so forth. In another embodiment, the one or more vertical members **115** may be provided as cylindrical members and/or elongated members of another circular or curved perimeter shape and/or elongated members defined by irregular outer surface configurations. Exemplary perimeter shapes of the one or more vertical members **115** are provided in **FIGS. 15A – 15F**.

Other perimeter shapes of the one or more vertical members **115** are described in the above mentioned Provisional Application Serial Number 62/617,164, the content of which is hereby incorporated by reference in its entirety. As such, even though interchangeability of the first and second modules **100, 200** may be desirable for many system **10** users, it is contemplated that one or more female openings may include a size and shape effective for mating with a particular size and/or shape vertical member **115**, thereby dictating interchangeability of first and second modules **100, 200**. Such matching of modules **100, 200** may be effective for reducing module theft by minimizing the interchangeability of modules **100, 200** amongst independent system **10** users provided with distinct type vertical member **115** sizes and/or shapes. Moreover, the system **10** may include one or more locks for securing the first and second modules **100, 200**.

[0067] With reference again to **FIG. 6**, in one suitable embodiment the framework **105** may be configured to be lifted for transport via lifting equipment including, but not necessarily limited to mechanical lifts such as various types of forklifts, overhead cranes and hoists. For example, the framework **105** may include a height effective for providing (1) a first set of pockets **110, 111** along one or both sides of the first module **100** and/or (2) a second set of

pockets **112**, **113** along one or both ends of the first module **100** for receiving individual forks of a forklift, or other type of lift, in a manner effective to transport the first module **100** or an assembled system **10** to one or more on-site locations or other locations as shown in **FIGS. 2 – 5, 18 and 19**.

5 **[0068]** Similar as the first module **100**, the framework **205** of the second module **200** may be operationally configured to be lifted for transport via lifting equipment including, but not necessarily limited to mechanical lifts such as various types of forklifts, overhead cranes and hoists. As shown in **FIG. 9**, the framework **205** may include a height effective for providing (1) a first set of pockets **210**, **211** along one or both sides of the second module **200**
10 and/or (2) a second set of pockets **212**, **213** along one or both ends of the second module **200** for receiving individual forks of a forklift, or other type of lift, in a manner effective to transport the second module **100**. The framework **205** may also include one or more lift eyes **215**, handles, hook members, or the like for lifting and transporting the second module **200**.

[0069] A first module **100** may also be equipped with wheels or casters for moving the
15 first module **100** or an assembled system **10** across one or more surfaces, e.g., an on-site location for system **10** operation. In one embodiment, wheels or casters may be attached to the sides of the framework **105**. In another embodiment, wheels or casters may be attached to the base surface **106** of the framework **105**. In one particular embodiment, wheels or casters may include cylindrical threaded members for attachment to threaded female members of the
20 framework **105**. Similar as discussed above, the threaded members may be effective to vary the height of the system **10**. Non-limiting examples of wheels or casters for use herein include, but are not necessarily limited to the teachings of United States Patent Number 4,491,452, titled “Load Transporting Apparatus,” issued on January 1, 1985; United States Patent Number 3,697,032 titled “Scaffolding,” issued on October 10, 1972; United States Patent Number
25 7,228,936 titled “Mobile Scaffolding Braking System,” issued on June 12, 2007; and United

States Patent Number 2,618,496 titled “Adjustable Supporter Leg,” issued on November 18, 1952; United States Patent Publication Number 20060103094, titled “Pallet Cart,” published on May 18, 2006; and United States Patent Number 4,281,843, titled “Tool Carrier,” issued on August 4, 1981; each of which is herein incorporated by reference in its entirety.

5 **[0070]** The system **10**, or first module **100** alone, may also be operationally configured to be made level when located upon an uneven support surface. In one simplified embodiment including a system **10** as shown in **FIG. 1** including a base surface **106** resting against a support surface **17**, one or more durable leveling members may be placed underneath the framework **105** at one or more locations as desired in order to level a first module **100** or the system **10** when located on an uneven support surface **17**. Suitable leveling members may include, but are not necessarily limited to planar structures and/or wedges constructed from metal, wood, plastic, rubber, stone, and combinations thereof effective for supporting the weight of a first module **100** or system **10**. Non-limiting examples of leveling members for use herein are described in United States Patent Number 5,249,767, titled “Table Leveling Wedge” issued on 10 October 5, 1993; United States Patent Number 4,776,548, titled “Leveling Device” issued on 15 October 11, 1988; and United States Patent Number 6,793,041, titled “Ladder Leveling Device,” issued on September 21, 2004; each of which is herein incorporated by reference in its entirety.

[0071] In another embodiment, the base surface **106** of the framework **105** may include one or more adjustable levelers operationally configured to level the first module **100** or system 20 **10**. Non-limiting examples of levelers for use herein are described in United States Patent Number 5,881,979, titled “Telescoping Leveler,” issued on March 16, 1999; and United States Patent Number 2,010,299, titled “Table Leveler,” issued on August 6, 1935; each of which is herein incorporated by reference in its entirety. As understood by persons of ordinary skill in the art, telescoping type levelers are operationally configured to adjust or vary the height of the 25 system **10**. In another embodiment, the system **10** may include a separate base member with

built in leveling operation and/or wheels for transport. Non-limiting examples of base members for use herein are described in United States Patent Number 4,216,933, titled “Portable Scaffold Support Base,” issued on August 12, 1980; and United States Patent Number 5,022,490, titled “Safety Base for Scaffolding,” issued on June 11, 1991; each of which is herein incorporated by reference in its entirety.

[0072] With further reference to **FIG. 9**, a framework **205** may be provided as an open frame configuration for securing one or more dry additive storage containers **206** therein as shown. In another embodiment, one or more dry additive storage containers **206** may be housed within a framework comprised of a walled enclosure or assembly of walled members operationally configured to enclose one or more dry additive storage containers **206**. Without limiting the invention, a suitable storage container **206** may include a storage tank, storage bin, and the like effective for housing one or more dry additives therein while preventing or otherwise minimizing exposure of the one or more dry additives to moisture and/or the external environment.

[0073] With reference to **FIG. 16**, the framework **205** may be sized to secure substantially all of the one or more dry additive storage containers **206** within the boundary of the framework **205**. In another embodiment, the framework **205** may be sized to secure the one or more dry additive storage containers **206** entirely within the boundary of the framework **205** as depicted in **FIG. 17**. In an embodiment of the system **10** incorporating a second module **200** as shown in **FIG. 17**, the system **10** may be stacked for transportation and/or storage as shown in **FIGS. 18** and **19**. Also, systems **10** may be stacked during operation as desired or as otherwise may be required at a location with limited space. As such, the stackability of systems **10** is advantageous for minimizing the mixing operation footprint at various worksites. The framework **205** as depicted in **FIG. 16** may also be stackable depending on the configuration of the base surface **106** of the framework **105**.

[0074] As shown in **FIGS. 6** and **7**, the one or more vertical members **115** and the raised horizontal rail type support members **114** are suitably located along the perimeter of the framework **105** in a manner effective to enclose the various component parts and/or equipment of the first module **100**. Suitable first module **100** component parts and/or equipment include mechanical and/or structural items operationally configured for receiving fluid from one or more external sources, receiving dry additive from a second module **200** and/or one or more external sources, mixing fluid and dry additive to produce fluid mixture compositions and conveying fluid mixture compositions out from the first module **100** to one or more target locations and/or containers.

[0075] The materials of construction of (1) the frameworks **105**, **205**, (2) the one or more vertical members **115** and (3) the raised horizontal rail type support members **114** and male type vertical members **223** are operationally configured to provide structural integrity of the first and second modules **100**, **200** during system **10** operation. Suitable materials of construction of each may include, but are not necessarily limited to plastics, woods, metals, composite materials, and combinations thereof. Suitable metals include, but are not necessarily limited to stainless steel, mild steel, aluminum, and combinations thereof.

[0076] With reference to **FIG. 7**, in one embodiment the first module **100** may include at least one open top single basin container, tub or vat (hereafter “mixing tub **130**”) of a desired maximum volume for receiving, storing and mixing one or more fluids and/or one or more dry additives therein. In another embodiment a single mixing tub **130** may include two or more separate basins for receiving fluid and/or receiving dry additive for storage and/or mixing purposes. In another embodiment, two or more single basin mixing tubs **130** may be employed to provide multiple basins of the system **10**. Of note, the present system **10** may be built to scale, as such a mixing tub **130** may be provided with one or more basins of particular maximum volumes effective to hold desired or required volumes of fluid mixture compositions

during system **10** operation. In other words, the system **10** may be modeled mathematically to produce one or more predetermined fluid mixture compositions. Also, the total weight of the present system **10** may vary according to the size of the system **10**, the one or more materials of construction and the amount of each such material(s) present, e.g., the wall thickness of the mixing tub **130**, the thickness of the frameworks **105**, **205** and the size and/or type of components and/or equipment employed.

[0077] Turning to **FIGS. 20** and **21**, in one suitable embodiment a mixing tub **130** may be divided into individual basins via one or more wall members or dividers **133** of permanent installation or removable installation. For example, a mixing tub **130** of a known maximum volume may include a permanent divider **133** effective to provide individual basins of the same or different maximum volumes according to the layout, shape and/or position of the divider **133**. For example, a divider **133** may include a planar member as shown or a curved member or other shape as desired. Turning to **FIG. 22**, in an embodiment comprising a removable divider **133** one suitable mixing tub **130** may include perimeter wall members or sidewalls **134** with a plurality of vertically spaced channels **135** disposed thereon for adjusting the location of the divider **133** by inserting and removing the divider **133** according to Directional **Arrow A** - the channels **135** allowing for the volume of individual basins to be adjusted as desired for one or more particular system **10** operations. Suitably, the channels **135** are located along opposite sidewalls **134** at a depth effective to receive a portion of the distal ends of the divider **133** therein in a manner to prevent fluid flow around the distal ends. In addition, the mixing tub **130** may also include corresponding channels **137** on the floor **136** of the mixing tub **130** that are set at a depth operationally configured to receive a portion of the bottom edge of a divider **133** therein in a manner effective to prevent fluid from flowing under the divider **133**. It is further contemplated that the mixing tub of **FIG. 22** may include two or more removable dividers **133** in a particular operation. In another embodiment, one or more baffles **138** may

be disposed in one or more basins in a manner effective to dictate and/or control the directional flow of fluid as desired, e.g., a serpentine flow path as shown in **FIG. 23**. Similar as the one or more dividers **133**, one or more baffles **138** may be permanently attached or removably attached to a mixing tub **130**. As understood by the skilled artisan, the channels **135**, **137** and/or the opposing ends and bottom edge of removable dividers **133** and removable baffles **138** may include gasket material and/or other sealing materials and/or fluid sealing materials, e.g., liquid rubber, silicone sealants, effective to prevent the flow of fluid between adjacent basins around the ends or under the bottom edge of the divider(s) **133**.

[0078] A mixing tub **130** of this application may include sidewalls **134** of desired height defining a perimeter shape similar as, or different from, the perimeter of the corresponding framework **105**. For example, a first module **100** may include a rectangular framework **105** and a rectangular mixing tub **130** as shown in **FIGS. 20** and **21**, where the length of the perimeter of the mixing tub **130** is less than the perimeter of the framework **105**. In this particular embodiment, the mixing tub **130** includes two separate basins, a first basin **140** and a second basin **145** defined by a divider **133**. As understood by the skilled artisan, the location of the divider **133** in addition to its size configuration, e.g., the height and/or thickness of the divider **133** and the height of the sidewalls **134** determines the maximum volume of the first and second basins **140**, **145** whereas the maximum volume of the mixing tub **130** is determined according to the dimensions of the mixing tub **130** less the size of the one or more dividers **133** and/or one or more baffles **138** employed. As stated, the system **10** may be built to scale. As such, in one non-limiting example of a system **10** operationally configured for oil and gas extraction operations, a suitable first basin **140** may include a maximum volume of about 358.0 liters (about 3.0 barrels) and a second basin **145** may include a maximum volume of about 835.0 liters (about 7.0 barrels).

[0079] As discussed below, the height of the sidewalls **134** is suitably greater than the height of the divider **133** allowing fluid to flow from the first basin **140** to the second basin **145** over the divider **133** once the volume of fluid directed into the first basin **140** is greater than the fluid volume of the first basin **140**. Depending on the intended operation of the system **10**, the height and/or thickness of the divider **133** in relation to the height of the sidewalls **134** may vary, which varies the volume of the first and second basins **140**, **145**. In an embodiment including removable dividers **133**, dividers **133** of varying height and/or thickness may be interchanged as desired or as otherwise required for one or more particular system **10** operations. Without limiting the invention, one suitable divider **133** may include a height from about 0.1 to about 0.95 percent the height of the corresponding sidewalls **134**. As depicted in the embodiment of **FIGS. 20** and **21**, a suitable divider **133** may include a height of or about 0.75 percent the height of the sidewalls **134**. Likewise, baffles **138** used herein may include a height less than, greater than or equal to the height of corresponding sidewalls **134**.

[0080] A mixing tub **130**, dividers **133** and baffles **138** of this application may be constructed from one or more materials durable for one or more system **10** operations and/or as may be required by law or regulation. Suitable materials of construction may include, but are not necessarily limited to those materials resistant to chipping, cracking, excessive bending and reshaping as a result of ozone, weathering, heat, moisture, other outside mechanical and chemical influences, as well as impacts. In particular, a mixing tub **130** of this application may be constructed from materials including, but not necessarily limited to metals, plastics, fiberglass, plexiglass, filled composite materials, and combinations thereof. In an embodiment of a system **10** operationally configured for oil and gas related hydraulic fracturing operations, a mixing tub **130** is suitably constructed from one or more metals. Suitable metals include, but are not necessarily limited to stainless steel, mild steel, aluminum, and combinations thereof. Metals such as titanium are contemplated but may not be feasible based on material cost.

[0081] In another embodiment, one or more dividers **133** may include apertures **28** there through operationally configured to allow fluid to flow from a first basin **140** to an adjacent second basin **145** – see **FIG. 24** depicting a plurality of apertures **28** disposed near the upper edge **139** of the divider **133**. In still another embodiment, one or more dividers **133** may include one or more screen members **29**, e.g., mesh screen material or the like, defining the upper section of the divider **133** or located near the upper edge **139** of a divider **133** as shown in the simplified embodiment of **FIG. 25**. In another embodiment, one or more dividers **133** may include a combination of one or more apertures **28** and one or more screen members **29**. As described below, the one or more apertures **28** and/or one or more screen members **29** may influence mixing of the fluid mixture composition during transfer from the first basin **140** to the second basin **145**. Also, the one or more apertures **28** and/or one or more screen members **29** may be operationally configured to filter or trap certain sized solids from flowing into the second basin **145**.

[0082] Although the apertures **28** of **FIG. 24** are shown as circular through holes aligned in multiple rows and having a uniform size relative the size of the divider **133**, other uniform or non-uniform shape and size apertures **28** may be disposed in one or more arrangements or arrays along a divider **133**. For operations such as the on-site extraction of oil and gas, apertures **28** may range in size from about 2.0 mm to about 50.0 mm (about 0.0787 inches to about 1.96 inches). Likewise, the United States (“U.S.”) mesh size of one or more screen members **29** may vary as desired for a particular operation. For operations such as the on-site extraction of oil and gas, a mesh range as shown in the Table 1 (“Mesh to Micron Conversion” table) below may be employed, although other mesh sizes may be used. For factory based food processing operations, a suitable mesh range may be from about U.S. standard 30-mesh to about 80-mesh.

[0083] Table 1

U.S. Mesh Size	Inches	Microns	Millimeters
3	0.2650	6730	6.730
4	0.1870	4760	4.760
5	0.1570	4000	4.000
6	0.1320	3360	3.360
7	0.1110	2830	2.830
8	0.0937	2380	2.380
10	0.0787	2000	2.000
12	0.0661	1680	1.680
14	0.0555	1410	1.410
16	0.0469	1190	1.190
18	0.0394	1000	1.000
20	0.0331	841	0.841
25	0.0280	707	0.707
30	0.0232	595	0.595
35	0.0197	500	0.500

[0084] In a first mode, the first and second basins **140**, **145** are fluidly communicated within the mixing tub **130**. Said another way, fluid flow between the first and second basins **140**, **145** may be confined within the mixing tub **130** via the flow of fluid over the divider **133** and/or through the one or more apertures **28** and/or screen members **29** from the first basin **140** to the second basin **145**. Such fluid flow between basins **140**, **145** may be referred to herein as “internal fluid transfer.” Such fluid flow between basins **140**, **145** may also be referred to herein as “spillover fluid transfer.”

[0085] In another mode, the first and second basins **140**, **145** may be fluidly communicated via one or more conduits external of the mixing tub **130**. For example, the first module **100** may include one or more conduits (1) in fluid communication with the first basin **140** at a first end and (2) in fluid communication with the second basin **145** at an opposing second end of the one or more conduits. In one suitable embodiment, the first module **100** may include one or more pumps in fluid communication with the one or more conduits for directing fluid from the first basin **140** to the second basin **145** via the one or more conduits. Such fluid flow between basins **140**, **145** may be referred to herein as “external fluid transfer.” Such fluid flow between basins **140**, **145** may also be referred to herein as “pumped fluid transfer.” Such fluid flow between basins **140**, **145** may also be referred to herein as “shear mixing fluid transfer” as discussed below.

[0086] In order to monitor and/or control the fluid volume of the mixing tub **130**, the first and second basins **140**, **145** may include one or more fluid volume or fluid level sensors **50** installed within the basins **140**, **145** for monitoring the fluid level of each basin **140**, **145** during system **10** operation (see **FIG. 29**). In one embodiment, one or more fluid level sensors **50** may be secured to one or more sidewalls **134** and/or one or more dividers **133**. In another embodiment, one or more fluid level sensors **50** may be installed as part of a removable sensor system. Suitable fluid level sensors **50** include, but are not necessarily limited to float-type switches, hydroelectric switches, pressure sensors/probes, and fluid level sensors/probes. In a similar manner, the first basin **140** and/or the second basin **145** may also include one or more temperature sensors **52** operationally configured to monitor the temperature of fluid within the mixing tub **130**. Suitable temperature sensors **52** include, but are not necessarily limited to temperature switches, digital temperature switches or transmitters, thermocouple sensors, thermocouple probes, resistance temperature detectors (“RTD”) PT100 sensors and probes, temperature transmitters with an integral sensor, temperature transmitters with thermocouple

input, temperature transmitters with an RTD input, programmable temperature transmitters with RTD or a thermocouple input, thermowells for RTDs, thermocouples, thermometers, thermocouple extension wire, RTD extension wire, and combinations thereof.

[0087] For proper sensor operation, the first module **100** suitably includes one or more electrical connections between the fluid level sensors **50**, temperature sensors **52** and a process control system described below. As understood by the skilled artisan, suitable electrical connections include, but are not necessarily limited to electrical plugs, quick connects and hardwire techniques such as wire splices, soldered connections, and crimp splices. For example, in one embodiment, one or more sidewalls **134** of the first and second basins **140**, **145** may include one or more wiring access ports **54** for receiving the electrical connections of the system **10** for sensor operation (see **FIG. 26**).

[0088] As shown in the embodiment of **FIG. 26**, for providing external fluid transfer the first module **100** may include a mixing tub conduit **150** (also referred to herein as a “bypass line”) having a first end in fluid communication with a first basin **140** and a second end in fluid communication with the second basin **145**. In particular, the mixing tub conduit **150** may include at least a first bend **151A** or turn whereby part of the mixing tub conduit **150** extends upward for attachment to an outlet **152** or drain located in the floor **136** of the first basin **140**. As such, the first support surface **108** suitably includes a first opening effective for the mixing tub conduit **150** to extend there through for fluid communication with an outlet **152**. As further shown in **FIG. 26**, the remaining mixing tub conduit **150** extends to a point out beyond the perimeter of the mixing tub **130** in a manner effective for the an opposing second end **154** of the mixing tub conduit **150** to feed the second basin **145** with fluid originating in the first basin **140**. In one embodiment, the section of the mixing tub conduit **150** extending out beyond the perimeter of the mixing tub **130** may include a “C-shape” or the like effective to dispense fluid originating in the first basin **140** into the second basin **145**. As shown in **FIG. 26**, the conduit

150 may include three ninety-degree bends **151B**, **151C** and **151D** effective for positioning an open second end **154** of the mixing tub conduit **150** at point above the second basin **145**. In one embodiment, the second end **154** of the conduit **150** may extend down into the mixing tub **130** as shown in **FIGS. 20** and **21**. In another embodiment, the second end **154** of the mixing tub conduit **150** may terminate at a point above the sidewalls **134** of the mixing tub **130** as shown in **FIG. 7**. Similar as mentioned above, the first support surface **108** suitably includes a second opening effective for receiving a section of the mixing tub conduit **150** there through.

[0089] The length of the mixing tub conduit **150** may vary as desired or as otherwise required. As understood by the skilled artisan, a minimum length of mixing tub conduit **150** may be accomplished by providing a linear mixing tub conduit **150** bending in-line as shown in **FIG. 21**, for example, see the location of the outlet **152** in the first basin **140** and the second end **154**, as well as minimizing the distance the mixing tub conduit **150** extends out beyond the perimeter of the mixing tub **130**.

[0090] With further reference to **FIG. 21**, the first module **100** may include a first pump **155** in fluid communication with the first basin **140** via the mixing tub conduit **150**. Suitably, the first pump **155** is operationally configured to direct fluid out from the first basin **140** through the mixing tub conduit **150**, through the first pump **155** and out through the second end **154** of the mixing tub conduit **150** into the second basin **145**. As described below, where the fluid in the first basin **140** includes a fluid mixture composition, the first pump **155** may be operationally configured to act on the fluid flowing there through in a manner effective to modify the fluid mixture composition. As discussed below, a suitable first pump **155** is operationally configured to mix and/or shear the fluid mixture composition received from the first basin **140**. One suitable first pump **155** may include a conditioning pump. Another suitable first pump **155** may include a shear mixer. A suitable conditioning pump is commercially available from SPX FLOW, Inc., Charlotte, North Carolina, U.S.A. under the

brand Waukesha Cherry-Burrell. A suitable shear mixer is commercially available from SPX FLOW, Inc., Charlotte, North Carolina, U.S.A. under the brand Waukesha Cherry-Burrell.

[0091] Referring to **FIG. 20**, a ninety-degree bend **151B** may be effective to direct the mixing tub conduit **150** directly into an inlet of the first pump **155**. In another embodiment, a
5 first pump **155** may be provided with an inlet **38** for side entry of fluid (see **FIG. 27**) thereby requiring a different arrangement of the mixing tub conduit **150** for feeding fluid into the first pump **155**.

[0092] The first pump **155** may be electrically driven, hydraulically driven, or direct driven from one or more external power sources. As shown in **FIG. 21**, the first module **100**
10 may include a power source **156** located on the base support of the first module **100** operationally configured to power the first pump **155**. Suitable power sources **156** include, but are not necessarily limited to electric induction motors, hydraulic drive motors, and pneumatic drive motors. As understood by persons of ordinary skill in the art of pumps, a first pump **155** and power source **156** may be connected in-line aligning the shafts for operation. As
15 understood by persons of ordinary skill in the art of pumps, a power source **156** may also be operably communicated with a first pump **155** via a coupler **39** or “coupler box” as shown in **FIG. 27**. In addition, rather than fixing the first pump **155** and/or power source **156** directly to first support surface **108** of the first module **100**, a first pump **155** and power source **156** may be provided on a removable support **40** (see **FIG. 27**) for mounting to the first support surface
20 **108** of the first module **100**.

[0093] The flow rate of the fluid mixture composition flowing through the mixing tub conduit **150** may be metered by one or more flow meters including, but not necessarily limited to, electromagnetic flow meters. Suitable flow meters may be positioned at any point along the mixing tub conduit **150**, including a vertical or horizontal section of the mixing tub conduit
25 **150**. As such, the system **10** is operationally configured to adjust the flow rate of fluid mixture

compositions being fed into the second basin **145** by adjusting the speed of the first pump **155**, for example, if the metered flow rate within the mixing tub conduit **150** is not as programmed.

[0094] Although it is contemplated that fluid and dry additive may be fed directly to the second basin **145** thereby bypassing the first basin **140**, herein the mixing of fluid and dry additive via the system **10** is discussed in terms of a first basin **140** being the initial basin for receiving fluid to be used by the system **10**. As such, in one embodiment an external hose or other conduit may be used to feed fluid directly into the first basin **140**. In another embodiment, fluid may be fed into the first basin **140** by emptying one or more containers of fluid directly into the first basin **140** via pouring or via one or more container spigots. As discussed below, the first module **100** includes an assembly of fluid lines for delivering fluid from one or more external sources directly to the first basin **140**.

[0095] In order to provide fluid for system **10** operation, the system **10** suitably includes at least one main supply line (hereafter “main line **147**”) in the form of a conduit operationally configured to receive supply fluid from one or more external sources via one or more fluid conduits for system **10** operation. As depicted in **FIGS. 20, 21 and 26**, the main line **147** is provided as a conduit with at least a first fluid inlet **157** at one end and a first fluid outlet **158** at an opposing second end. As shown, the first fluid inlet **157** is located near an edge of one side of the framework **105** and the first fluid outlet **158** is located near an edge of an opposing side of the framework **105**. However, the main line **147** may be configured along the first module **100** in a different arrangement as desired or as may be otherwise required for one or more particular system **10** operations.

[0096] In one embodiment, fluid may be directed to the first fluid inlet **157** under pressure via gravity, e.g., a water tower or a fluid storage container located at a higher elevation than the first fluid inlet **157**. In another embodiment, fluid may be directed to the first fluid inlet **157** via one or more fluid transfer pumps located external the system **10** and/or provided

as part of the first module **100**. Suitable fluid transfer pumps include positive-displacement pumps and nonpositive-displacement pumps, i.e., centrifugal pumps. For operations such as the on-site extraction of oil and gas, suitable pumps include, but are not necessarily limited to pumps commercially available from Gardner Denver of Houston, Texas, U.S.A. In one embodiment for on-site extraction of oil and gas, fluid may be directed to the first fluid inlet **157** via a centrifugal pump such as a 4x5 or a 5x6 centrifugal pump commercially available from Gardner Denver.

[0097] Suitably, the first fluid inlet **157** is defined by a fluid flow control member such as a flow control valve or other shut-off mechanism operationally configured to (1) fluidly communicate with an external fluid conduit such as a pipe or hose, (2) dictate or control entry of fluid into the main line **147** of the system **10** and (3) dictate or control the rate of fluid flowing into the main line **147** of the system **10**. The flow rate of supply fluid into the first fluid inlet **157** may also be metered by one or more flow meters including, but not necessarily limited to, electromagnetic flow meters and/or turbine flow meters. Suitable flow meters may be positioned at any upstream position along the main line **147** and mounted in any orientation as desired or otherwise required for a particular operation. In one particular embodiment, the first fluid inlet **157** may include a metered valve. As such, the system **10** is operationally configured to adjust the flow rate of supply fluid into the first fluid inlet **157** by adjusting the fluid flow control member as desired.

[0098] Likewise, the first fluid outlet **158** also includes a fluid flow control member such as a flow control valve or other shut-off mechanism operationally configured to (1) dictate or control the discharge of supply fluid out from the main line **147** of the system **10** and (2) dictate or control the rate of supply fluid flowing out from the main line **147** of the system **10**. The flow rate of supply fluid out through the first fluid outlet **158** may also be metered by one or more flow meters including, but not necessarily limited to, electromagnetic flow meters

and/or turbine flow meters. Suitable flow meters may be positioned at any downstream position along the main line **147** and mounted in any orientation as desired or otherwise required for a particular operation. In one particular embodiment, the first fluid outlet **158** may include a metered valve. As such, the system **10** is operationally configured to adjust the flow rate of supply fluid into the first fluid outlet **158** by adjusting the fluid flow control member as desired.

[0099] Suitable metered valves include, but are not necessarily limited to butterfly valves, ball valves, gate valves, and check valves. Suitable flow control valves may be manually operated (see the handles **17** and **18** in **FIGS. 20**) or remotely operated via an actuator, e.g., an electric actuator, pneumatic actuator, or hydraulic actuator, in communication with a particular valve.

[0100] Suitably, the first fluid outlet **158** is operationally configured to fluidly communicate with one or more fluid conduits for discharging supply fluid out from the system **10**. In one embodiment, a first fluid outlet **158** may be fluidly connected to one or more conduits for discharging supply fluid not used by the system **10** to one or more locations, such as discharge ponds, fluid tanks, truck tanks, and other storage and/or transport fluid containers. In an embodiment where the supply fluid includes water drawn directly from a natural source such as an ocean, lake, river, and the like, any water not used by the system **10** may be discharged back directly to its source. As discussed below, a first fluid conduit **158** may also be fluidly connected to a first fluid inlet of a second system **10**.

[0101] As shown in **FIG. 20**, the first module **100** includes at least a first fluid mixing line **160** (“mixing line **160**”) in fluid communication with the main line **147** that extends over the mixing tub **130**, the mixing line **160** being operationally configured to convey fluid from the main line **147** into the first basin **140** via an outlet **161** of the mixing line **160** positioned above the first basin **140**. With particular reference to **FIG. 28**, a mixing line **160** may be

connected at a non-terminal section of the main line **147** via a side outlet **149**. In one embodiment, the main line **147** may include a “tee” fitting or connector providing a side outlet for mixing line **160** connection. In another embodiment, the main line **147** may include a multiport three way valve providing a side outlet for mixing line **160** connection. In the

5 embodiment of **FIG. 28**, the mixing line **160** is fluidly connected to a side outlet **149** via a fluid flow control member such as a flow control valve or other shut-off mechanism operationally configured to control the flow of fluid from the main line **147** into the mixing line **160** (hereafter referred to as “supply valve **165**”). In one particular embodiment, the supply valve **165** may include a manually operated valve. In another embodiment, the supply valve **165** may be

10 remotely controlled via a power operated actuator **166** as shown. Herein, an actuated valve **165** may also be referred to as a metering valve. One suitable actuated valve or metering valve includes, but is not necessarily limited to a butterfly valve operationally configured to control the volume and rate of fluid entering the mixing line **160**. An actuated supply valve **165** may be electrically operated, hydraulically operated or pneumatically operated as understood by

15 persons of ordinary skill in the art. A power source such as an air pressure supply is suitably located on or nearby the existing system **10**. As an example, the power source for a pneumatically operated supply valve **165** may include a compressor situated near the system **10** with an air hose for providing the required air. An electric actuator is suitably electrically connected to an electrical generator, which may also be situated near the system **10**, with an

20 electrical power supply cable for providing the required electrical power to run the electric actuator. As understood by the skilled artisan, actuators may include integral controls operationally configured to provide feedback signals to the system **10** controls. As such, an actuated supply valve **165** may be monitored and operated via system **10** controls as discussed below.

[0102] With reference to **FIGS. 20, 21, 26 and 28**, the mixing line **160** may further include an inlet for receiving dry additive therein. In one embodiment of system **10** operation, the mixing line **160** may include a top fed mixing head member **168** in communication with a storage container **206** of a second module **200**, the mixing head member **168** being
5 operationally configured to receive dry additive from the storage container **206** and control the amount of dry additive entering the mixing line **160** wherein the dry additive is mixed with fluid flowing through the mixing line **160** toward the outlet **161**. As such, the mixing line **160** is a first mixer of system **10** fluid.

[0103] In one embodiment, the mixing head member **168** may be provided as an
10 integral part of the mixing line **160**. In another embodiment, the mixing head member **168** may be releasably attached to the mixing line **160** via a connection such as a “tee” fitting or connector. Releasability allows for cleaning and maintenance of the mixing head member **168** without having to remove the entire mixing line **160** from the first module **100**.

[0104] A suitable mixing head member **168** is operationally configured for accurate
15 metering of dry additive housed within a storage container **206** during system **10** operation. In other words, a suitable mixing head member **168** is operationally configured to measure a specific volume of dry additive and effectively discharge the dry additive into the mixing line **160**. A suitable mixing head member **168** may be manually operated and/or remotely operated. One suitable mixing head member **168** may include a valve for controlling the flow of dry
20 additive into the mixing line **160**. For example, a mixing head member **168** may include a knife gate valve operationally configured to proportion a desired amount of dry additive entering the mixing line **160**. Without limiting the invention, one suitable mixing head member **168** may include a remotely controlled volumetric feeder with one or more flow meters that are monitored and operated via system **10** controls. One suitable volumetric feeder includes a
25 volumetric screw feeder. In one embodiment, a mixing head member **168** may be in wireless

communication the system **10** controls. In another embodiment, a mixing head member **168** may be communicated with the system **10** controls via an electrical connection on the first module **100**. Without limiting the invention, a suitable commercial source of volumetric feeders includes, but is not necessarily limited to Acrison, Inc. of Moonachie, New Jersey, U.S.A. Exemplary volumetric feeders include, but are not necessarily limited to those provided below in Table 2.

[0105]

Table 2

1. Single Auger Metering system Model 101/130 Series.
2. Dissimilar Speed double concentric auger metering mechanism, Model 105/140 Series.
3. Dissimilar Speed Dual Auger / Agitator metering mechanism, Model 1015 Series.
4. Dissimilar Speed Triple Auger/Agitator Metering Mechanisms - Model BDF Series.
5. Dual Independent Metering Augers for Both Continuous & Batching Applications - Model BDFX-1.5-2.
6. Self-Emptying Single Auger/Agitator Metering Mechanisms - Model 170 Series.
7. Self-Emptying Dual Auger/Agitator Metering Mechanisms - Model 170 Series.
8. Micro-Ingredient Volumetric Feeder for Very Low Feed Rates - Model 170-MI-5.
9. Dissimilar Speed Double Concentric Auger Feeder with Flow Inducing Hopper - Model 120.
10. Volumetric Feeders for Metering Fiberglass - Single Auger Mechanisms - Models V101 and V130.
11. Specifically Designed to Meter Strand-Type Materials - Model 905-18 Series.

[0106]

As understood by the skilled artisan, the mixing head member **168** suitably includes an engagement surface **169** operationally configured as a seat for receiving a

corresponding outlet **208** of a storage container **206** thereon in a manner effective to prevent dry additive from exiting of the system **10** at the point of attachment. As such, the engagement surface **169** and/or outlet **208** may be provided with one or more seals or gasket material. In another embodiment, the engagement surface **169** and outlet **208** may include a machine fit
5 operationally configured to prevent loss of dry additive from the system **10** at the point of attachment. As also understood by the skilled artisan, the mixing head member **168** and outlet **208** may be secured via one or more fasteners via corresponding through holes of each. Suitable fasteners include, but are not necessarily limited to threaded nut/bolts.

[0107] As discussed below, the present system **10** may be configured to produce fluid
10 mixture compositions of varying thicknesses or viscosities for one or more particular uses. As understood by the skilled artisan, some fluid mixture compositions may be more flowable than others. As such, a first module **100** may be operationally configured to discharge fluids of varying viscosities out from the second basin **145** as desired. For example, a second basin **145** may be provided with one or more outlets in the sidewall **134** of the mixing tub **130**
15 operationally configured for discharging fluid mixture compositions of a varying viscosities or ranges of viscosities. As shown in the simplified illustration of **FIG. 29**, a second basin **145** may include a first outlet **125** operationally configured for discharging fluid mixture compositions of low viscosities, e.g., up to about 4.0 mPa s. The second basin **145** may include one or more additional outlets, e.g., second outlet **126**, for discharging fluid mixture
20 compositions of higher viscosities, e.g., greater than about 4.0 mPa s. As shown, the second outlet **126** includes a larger diameter than the first outlet **125** for handling thicker discharge of fluid mixture compositions. However, the one or more discharge outlets **125**, **126** are not necessarily limited to any particular size or arrangement, but rather are provided in number, size, shape and location effective for the discharge of one or more particular fluid mixture
25 compositions to be fed into the second basin **145**. Also, the one or more discharge outlets **125**,

126 may each include a cover similar as known drain covers. Likewise, the outlet **152** of the first basin **140** may also include a drain cover. Suitable drain covers may be operationally configured to filter or trap certain sized solids from flowing out from the first and/or second basins **140, 145**.

5 **[0108]** With reference now to **FIG. 28**, the first module **100** further includes a low viscosity conduit **173** in fluid communication with the first outlet **125** for discharging fluid mixture compositions out from the second basin **145**. A low viscosity conduit **173** may be configured as desired and may include an outlet effective for fluid connection with one or more external sources such as fluid storage tanks and the like. A low viscosity conduit **173** may also include an outlet operationally configured to discharge fluid mixture compositions directly to one or more natural formations or other locations, such as bodies of water, dry land, farm crops. As shown in **FIG. 28**, a low viscosity conduit **173** may be fluidly communicated with a first hose reel **175** including a first hose **176** in fluid communication with the first hose reel **175** for discharging fluid mixture compositions out from the system **10** through an outlet **177** of the first hose **176**. As understood by the skilled artisan, a first hose **176** may include a length according to its outer diameter and reel size and may be unwound a distance as desired during operation – a distance up to its entire length. One non-limiting first hose reel **175** may include a spring-driven hose reel for ease of rewind. In one suitable mode of operation, the first hose **176** may be fluidly communicated with a pump operationally configured to draw low viscosity fluid mixture compositions out from the second basin **145**. For example, for operations such as on-site extraction of oil and gas, a first hose **176** may be fluidly communicated with a pump of a trailer or truck mounted fracturing blender or a hydration unit. One non-limiting pump may include a positive displacement pump.

20 **[0109]** Suitably, a first module **100** may further include a high viscosity conduit in fluid communication with the second outlet **126** for discharging fluid mixture compositions out from

the second basin **145**. Like the low viscosity conduit **173**, the high viscosity conduit **174** may be configured as desired and may include an outlet effective for fluid connection with one or more external sources such as fluid storage tanks and the like. A high viscosity conduit **174** may also include an outlet operationally configured to discharge fluid mixture compositions
5 directly to one or more natural formations or other locations, such as bodies of water, dry land, farm crops or be fluidly communicated with a pump operationally configured to draw high viscosity fluid mixture compositions out from the second basin **145**.

[0110] As shown in **FIG. 28**, a first module **100** may further include a discharge pump **178** in fluid communication with the second outlet **126** and high viscosity conduit **174**
10 operationally configured to facilitate the discharge of thicker or heavier fluid mixture compositions not desired for discharge via the first outlet **125**. In this embodiment, the discharge pump **178** is fluidly communicated with a second hose reel **180** via conduit **179** as shown in **FIG. 26**. The second hose reel **180** may be of similar construction as the first hose reel **175** including a second hose **182** for discharging fluid mixture compositions out from the
15 system **10**. A suitable discharge pump **178** for high viscosity fluids or fluid mixture compositions includes, but is not necessarily limited to a progressive cavity pump. In one embodiment, a discharge pump **178** may be solely responsible for the discharge of fluid mixture compositions out from the second basin **145** via the outlet **183** of the second hose **182**. In another embodiment, one or more external pumps, similar as described above in relation to the
20 low viscosity conduit **173**, may be fluidly communicated with the second hose **182** for the discharge of fluid mixture compositions from the system **10**.

[0111] Suitably, the first and second hose reels **175**, **180** each include a base section for releasable securement to the first support surface **108**. For example, the first support surface **108** may include through holes for receiving fasteners there through, e.g., nut/bolt fasteners,
25 threaded fasteners for mating with threaded through holes. Exemplary hose reels **175**, **180** for

use as part of the system **10** are commercially available from sources including, but not necessarily limited to Reelcraft Industries, Inc., Columbia City, Indiana, U.S.A. and Hannay Reels Inc., Westerlo, New York, U.S.A.

[0112] The one or more materials of construction of the first and second hoses **176**, **182** may vary according to the system **10** operation. Suitable hoses **176**, **182** may include common rubber hoses and industrial hoses including, but not necessarily limited to chemical suction and discharge hoses operationally configured for the transfer of corrosive fluids, acids, alkaline fluids, chemicals, solvents, petroleum products, and combinations thereof. Although the first and second hoses **176**, **182** are not necessarily limited to any particular size, first and second hoses **176**, **182** provided for the extraction of oil and gas, e.g., hydraulic fracturing operations, may include an inner diameter of about 3.81 cm (about 1.50 inches) and a length of about 30.48 meters (about 100.0 feet). As understood by the skilled artisan, the size and/or type of hose utilized may vary according to the system **10** operation and/or the target industry of system **10** application.

[0113] Still referring to **FIG. 28**, the first module **100** may include a power source **185** located on the base support of the first module **100** operationally configured to power the discharge pump **178**. A suitable power sources **185** for the discharge pump **178** may include a power source **185** similar as described above in relation to a power source **156** for powering a first pump **155**. Likewise, a power source **185** and discharge pump **178** may be provided on a removable support for mounting to the first support surface **108** of the first module **100** as described above.

[0114] To control the flow of fluid out from the second basin **145**, the first and second outlets **125**, **126** may be fitted with valves as desired. Suitable valves include, but are not necessarily limited to butterfly valves controlled by an electric actuator, a pneumatic actuator, or a hydraulic actuator as described above. As such, any valves located at the first and second

outlets **125**, **126** are suitably communicated with the system **10** controls for opening and closing such valves.

[0115] To facilitate additional mixing of a fluid mixture composition contained within the second basin **145**, a first module **100** may further be provided with one or more stirring members. As shown in **FIG. 30**, the mixing tub **130** may include at least one cross-beam **45** or similar construction operationally configured to suspend at least one fluid mixer **47** over the second basin **145**. As shown in this embodiment, the fluid mixer **47** includes a cylindrical stem **48** with one or more paddle members **49** effective to agitate a fluid mixture composition in the second basin **145** and eliminate or minimize dead spots in the fluid mixture composition. As understood by the skilled artisan, the length of the stem **48** may be dictated according to the dimensions of the second basin **145** of the mixing tub **130**. Likewise, the dimensions of the one or more paddle members **49** may be dictated according to the dimensions of the second basin **145** and/or the viscosity of one or more fluid mixture compositions to be produced by the system **10**. Exemplary paddle members **49** for use herein are described in United States Patent Number 7,524,386, titled “Method for Wet Mixing Cementitious Slurry for Fiber-Reinforced Structural Cement Panels,” issued on April 28, 2009, which is herein incorporated by reference in its entirety. A suitable fluid mixer **47** is commercially available from AIM Blending Technologies, Pleasanton, California, U.S.A. In addition, the paddle members **49** may be pneumatically, electrically or hydraulically driven at variable speeds ranging from about 1.0 rotations per minute (RPM) up to about 400.0 RPM.

[0116] In one embodiment, one or more cross-beams **45** may be provided as fixed members of a mixing tub **130**. In another embodiment, one or more cross-beams **45** may be provided as removable members for resting atop adjacent or opposing sidewalls **134** of a mixing tub **130**. In another embodiment, one or more cross-beams **45** may be releasably secured to a mixing tub **130** via one or more fasteners. In still another embodiment, the

sidewalls **134** may include openings there through for receiving opposing ends of cross-beams **45** allowing cross-beams **45** to rest within an upper portion of the second basin **145**.

[0117] As stated above, a framework **205** of the second module **200** may be provided as an open frame configuration for securing one or more dry additive storage containers **206**.

5 With reference to **FIG. 13**, one suitable dry additive storage container **206** may be provided as a gravity bin in the form of a hollow vessel with an inlet provided as a sealable hatch **225** along the upper portion of the container **206** for feeding dry additive into the storage container **206** and an outlet **208** for discharging of the dry additive located at the bottom of the storage container **206**. As shown, a suitable storage container may include a tapered discharge section
10 **209** effective for discharge of dry additive or other materials out through the outlet **208**. The size and/or shape of the hatch **225** may vary, but a suitable hatch **225** is large enough to provide for delivery of dry additive into the storage container **206** at a desired rate and provide for ease of entry into the storage container for cleaning and/or maintenance purposes.

[0118] In another embodiment, as shown in **FIG. 31**, one or more dry additive storage
15 containers **206** may be provided as hollow cylindrical vessels with a tapered conical discharge section **209**. One particular dry additive storage containers **206** may include a cylindrical pressure vessel. A sealable hatch **225** may be located along the top of the dry additive storage container **206** and/or along a sidewall section of a dry additive storage container **206** – both types are illustrated in the simplified embodiment of **FIG. 31**. A suitable framework **205**, dry
20 additive storage container **206** and sealable hatch **225** for use herein are described in United States Patent Number 8,585,341, titled “Proppant discharge system and a container for use in such a proppant discharge system,” issued on November 19, 2013, which is herein incorporated by reference in its entirety.

[0119] Dry additive storage containers **206** (or “storage containers **206**”) may be
25 constructed from one or more materials durable for system **10** operation as desired and/or as

may be required by law or regulation. Suitable materials of construction include, but are not necessarily limited to those materials resistant to chipping, cracking, excessive bending and reshaping as a result of ozone, weathering, heat, moisture, other outside mechanical and chemical influences, as well as impacts. In particular, a storage container **206** may be constructed from materials including, but not necessarily limited to metals, plastics, fiberglass, plexiglass, filled composite materials, and combinations thereof. In an embodiment of a system **10** operationally configured for oil and gas related hydraulic fracturing operations, a storage container **206** is suitably constructed from one or more metals. Suitable metals include, but are not necessarily limited to stainless steel, mild steel, aluminum, and combinations thereof.

[0120] In one or more embodiments, it may be desirable to monitor second module **200** operations to ensure that one or more predetermined parameters are met. As such, a second module **200** may be provided with one or more monitoring systems effective for monitoring (1) the temperature of the dry additive within a storage container **206**, (2) the humidity within a storage container **206**, and (3) the volume of dry additive within a storage container **206**. For example, storage containers **206** may include one or more sensors effective for monitoring the temperature, humidity or moisture, and the volume of dry additive located within a storage container **206**.

[0121] In one embodiment, one or more sensors may be disposed along the inner surface of the storage container **206**. In another embodiment a suitable temperature sensor may include, but is not necessarily limited to a suspended vertical member having one or more temperature sensors along its length such as a temperature cable effective to detect hot spots. Exemplary temperature sensors for use herein are described in United States Patent Number 4,583,300, titled "Automatic Grain Drying System," issued on April 22, 1986; and United States Patent Number 6,732,580, titled "Level Sensor and Control," issued on May 11, 2004; each of which is herein incorporated by reference in its entirety.

[0122] One or more moisture sensors may also be disposed along the inner surface of the storage container **206** in a manner effective to detect moisture therein. A suitable type of moisture sensor includes, but is not necessarily limited to digital microwave moisture measurement sensors commercially available from Hydronix America, Harbor Springs, Michigan, U.S.A. Another suitable moisture sensor includes a moisture test sensor commercially available from PCE Instruments (PCE Americas Inc.), Jupiter, Florida, U.S.A.

[0123] A storage container **206** may include one or more volume level sensors positioned at different levels within the storage container **206** allowing users to identify the volume of dry additive available at any given time during system **10** operation, e.g., a maximum capacity sensor, a half-full sensor and a low level sensor. Non-limiting examples of volume level sensors for use with storage containers **206** of this application are described in United States Patent Number 7,147,361, titled “Methods for Injecting Dry Bulk Amendments for Water and Soil Treatment,” issued on December 12, 2006; and United States Patent Number 6,732,580, titled “Level Sensor and Control,” issued on May 11, 2004; each of which is herein incorporated by reference in its entirety.

[0124] In another embodiment, a storage container **206** may be provided with one or more heating members effective to minimize or otherwise eliminate any humidity within the storage container **206**. For example, a storage container **206** may be provided with an opening or “air gap” in fluid communication with a heating member attached thereto for directing heated dry air through the air gap into the storage container **206**.

[0125] As understood by the skilled artisan, one anticipated problem in regard to the mixing of fluids and dry additives includes the introduction of undesired air into a fluid mixture composition. Air entrained in a particular mixture may cause the overall volume of a fluid mixture composition in the mixing tub **130** to be greater than expected. Additionally, air entrained in a particular mixture may cause the measured density of a particular fluid mixture

composition to be lower than expected. As such, the system **10** may include one or more gas sensors at one or more of (1) the first fluid inlet **157**, (2) the main line **147** and (3) the mixing line **160**. One suitable gas sensor is operationally configured to detect one or more acid gases or vapors. In one particular embodiment, the system **10** may include one or more gas sensors operationally configured to detect gases or vapors of acetic acid, acetone, acetylene, alcohol, ammonia, aromatic isocyanates (toluene diisocyanate (TDI) and methylene diphenyl diisocyanate (MDI)), arsine, bromine, carbon dioxide, carbon monoxide, chlorine, chlorine dioxide, diborane, dimethylamine, ethylene oxide, fluorine, formaldehyde, germane, glutaraldehyde, hydrazine, hydrocarbons, hydrogen, hydrogen bromide, hydrogen chloride, hydrogen cyanide, hydrogen fluoride, hydrogen peroxide, hydrogen selenide, hydrogen sulfide, iodine, mercury, methane, nitric oxide, nitrogen dioxide, nitrogen oxides, non-methane hydrocarbons (NMHC), oxygen, ozone, particulate matter, peracetic acid, perchloroethylene, phosgene, phosphine, silane, sulfur dioxide, and volatile organic compounds (VOCs). In one particular embodiment, one or more gas sensors are suitably located at or near the top of the storage container **206**.

[0126] As described above, the system **10** may require power in the form of one or more of hydraulic power, pneumatic power and electrical power. For example, hydraulic power may be provided to drive the one or more fluid transfer pumps located external the system **10** and/or the pumps provided as part of the first module **100**. Pneumatic power may be provided to drive the various valves of the system **10**. Electrical power is suitably provided for driving electrical system **10** devices such as electrical motors, screw feeders of the second module **200**, light sources on or near the first and/or second modules **100**, **200**, one or more alarms on or near the system **10** such as visual and/or audible alarms, and the system **10** controls. The required power may originate from one or more sources, e.g., separate sources for hydraulic power, pneumatic power and electrical power. For permanent system **10** installation

such as in an industrial facility, the system **10** may make use of hydraulic power, pneumatic power and electrical power built into the facility. In an embodiment of the system **10** for mobile on-site operation, hydraulic power, pneumatic power and electrical power may be provided via separate mobile sources of hydraulic power, pneumatic power and electrical power. In another
5 embodiment for mobile on-site system **10** operation, a single mobile power generator such as a power module or power system may be provided for housing each of a hydraulic power source, a pneumatic power source and an electrical power source. One suitable power system for use is described in United States Publication No. 2018/0298731 (Application No. 15/955,521), titled "Power System and Method," published October 18, 2018, herein incorporated by
10 reference in its entirety.

[0127] Running, monitoring, recording and supervising system **10** operation may be performed manually and/or via a process control system. A safety instruments system may also be employed that is designed to help prevent certain unwanted events from occurring. In one embodiment, a safety instruments system may be integrated as part of a process
15 control system. In general, one suitable process control system may include an engineered set of hardware and software controls for centralized computer based oversight of system **10** operations.

[0128] A suitable process control system may be operated either (1) locally, i.e., near where the process is being performed, or (2) remotely, i.e., spaced apart from where the process
20 is being performed. Remote control implies the need for some communication means between a local control system located near where the system **10** operation is being performed and a remote control system spaced apart from such location. To facilitate installation and to preclude overly obstructing an on-site area between the local and remote control systems, such communication should be relatively simple and compact; but also capable of handling

sufficient quantities and rates of data transmission in both directions between the local and remote control systems.

[0129] The process control system of the present invention is generally identified in **FIG. 32** by the reference numeral **400**. In simplified operation, a process control system **400** includes a computerized system operationally configured to (1) control the flow of fluid into the system **10** via the first fluid inlet **157**, (2) control the flow of fluid out from the system **10** via the first fluid outlet **158**, (3) control the flow of fluid into the first basin **140**, (4) control the flow of dry additive out of the storage container **206** into the mixing line **160**, (5) control the transfer of fluid mixture compositions between the first basin **140** and the second basin **145**, (5) control the flow of fluid mixture compositions out from the second basin **145** in a manner effective to produce a desired fluid mixture composition to one or more target locations for further use. A process control system **400** may also be operationally configured to control one or more power sources, light sources of the system **10**, either external of the system **10** and/or part of the module **100**, **200** build.

[0130] Suitably, the process control system **400** includes an interface such as electrical control circuitry **401** in communication with the various component parts of the first and second modules **100**, **200**, e.g., pumps, valves, sensors, power sources, as well as external equipment such as pumps, power sources and computer databases. As discussed below, the process control system **400** may be operated via one or more control centers **402** housing computer hardware **405** including one or more computer programs in communication with the control circuitry **401** of the system **10** for automatically monitoring, controlling and adjusting the flow of the fluid supplied into the system **10**, the rate of mixing dry additive and fluid, the transfer of fluid mixture compositions between basins **140**, **145**, and the fluid discharge rate out from the system **10**. More particularly, the process control system **400** may be programmed to (1) open and close a fluid flow control member such as a flow control valve or other shut-off

mechanism of the first fluid inlet **157**, (2) open and close a fluid flow control member such as a flow control valve or other shut-off mechanism of the first fluid outlet **158**, (3) open and close a flow control valve or other shut-off mechanism operationally configured to control the flow of fluid from the main line **147** into the mixing line **160**, (4) open and close the mixing head member **168**, (5) control operation of the power source **156** and first pump **155**, (6) control operation of the fluid mixer **47**, (7) control operation of the power sources **185** and discharge pump **178**, (8) open and close a flow control valve or other shut-off mechanism of the first outlet **125** of the second basin **145**, (9) monitor the volume of fluid mixture compositions in the first and second basins **140**, **145**, (10) monitor the temperature of fluid mixture compositions in the first and second basins **140**, **145**, (11) monitor the volume of dry additive in the storage containers **206**, (12) monitor the humidity within the storage containers **206**, (13) monitor the temperature within the storage containers **206**, (13) communicate with one or more system **10** tracking devices and the Global Positioning System, or equivalent, (14) control one or more light sources of the system **10**, (15) communicate with one or more system **10** alarms, (16) communicate with any flow meters disposed within the various conduits, inlets and outlets and (17) communicate with one or more gas sensors of the system **10**.

[0131] Suitably, the computer hardware **405** used requires little or no hardware modification, the only modifications needed are contemplated to be software changes applicable to the particular requirements of a particular process to be controlled or monitored. Suitable computer hardware may include a local control computer, an interface operationally configured for communicating computer hardware **405** to the system **10** and cable for electrically connecting the computer hardware **405**, interface **425** and the system **10**. As mentioned above, local controls may be housed within one or more control centers **402**. For facility operations, one exemplary control center **402** may include one or more rooms dedicated to process control system **400** use. For on-site operations, one or more mobile structures may

be employed for housing the local controls such as the computer hardware **405**. In oil and gas extraction operations, a suitable control center **402** may include a data van or equivalent as understood by persons of ordinary skill in the art. One or more other control centers **410** may be included for remote system **10** operation.

5 **[0132]** For operation of a system **10** as shown in **FIG. 1** effective for producing a particular fluid mixture composition, the following parameters are suitably determined prior to system **10** operation: (1) the type of dry additive to be used, (2) the type of one or more fluids to be used, and (3) the volume of one or more fluids and dry additive to be used. In a batch operation, the volume of fluid and dry additive may be predetermined to provide a
10 predetermined volume of a fluid mixture composition. In a continuous operation, parameters such as (1) the constant volume and rate of fluid flow from the main line **147** into the mixing line **160** and (2) the constant volume and rate of dry additive fed into the mixing line **160** are required for providing a predetermined fluid mixture composition to one or more locations downstream of the system **10**.

15 **[0133]** In terms of continuous system **10** operation, two scenarios of operation are contemplated. In a first simplified scenario, including the production of a low viscosity fluid mixture composition as defined above, and with knowledge of the size of the various conduits and basins **140**, **145** of the system **10**, the process control system **400** may be programmed to open the first fluid inlet **157** and the supply valve **165** to allow a constant flow rate of fluid,
20 e.g., water, to be conveyed to the first basin **140** via the mixing line **160**. The process control system **400** is also suitably programmed to feed a volume of dry additive from the storage container **206** into the mixing line **160** at a rate effective to provide a desired fluid mixture composition in the first basin **140**. Suitably, the flow of fluid and dry additive is constantly metered whereby the process control system **400** is programmed to adjust the flow of fluid
25 and/or dry additive as may be required to produce the desired fluid mixture composition. Over

time, once the fluid mixture composition fills the first basin **140**, the fluid mixture composition naturally begins to spill over the divider **133** into the second basin **145** whereby the fluid mixture composition may further mix during transfer from the first basin **140** to the second basin **145** and may be discharged from the system via the low viscosity conduit **173** as described above. This scenario is an example of internal fluid transfer.

[0134] In a second simplified scenario, including the production of a high viscosity fluid mixture composition as defined above, the volume of fluid mixture composition conveyed into the first basin **140** is suitably measured via one or more fluid level sensors **50** of the first basin **140**. Once the volume of the fluid mixture composition (or “first fluid mixture composition”) reaches a predetermined level within the first basin **140**, the process control system **400** is programmed to activate the first pump **155** in order to transfer the fluid mixture composition to the second basin **145** via the mixing tub conduit **150**. As described above, the first pump **155** is suitably operationally configured as a second mixer of the system **10** fluid to create at least a sufficiently-high shear rate to facilitate further mixing of the fluid and dry additive, i.e., “modify” the fluid and dry additive, effective for producing a flowable or pumpable fluid mixture composition in the second basin **145** (or “second fluid mixture composition”) that may thereafter be discharged via the high viscosity conduit **174** as describe above. This scenario is an example of external fluid transfer.

[0135] During system **10** operation, quality control tests of the supply fluid, dry additives, and fluid mixture composition may be performed on-site or at a separate remote location for monitoring the quality of the fluid mixture composition being produced by the system **10**. In regard to the fluid mixture composition, an operator may take one or more samples of the fluid mixture composition directly from the first and/or second basins **140**, **145** for testing. The results of such testing may be used to reprogram the process control system **400** to adjust the flow rates and/or volumes of the fluid supply and/or dry additive

of the system **10**. For external fluid transfer operations, the viscosity of the fluid mixture composition in the second basin **145** may be sampled and measured, whereby the process control system **400** may be reprogrammed to adjust the speed of the first pump **155**.

[0136] In another embodiment a first fluid outlet **158** of a first system **10** may be fluidly communicated with a first fluid inlet **157** of a second system **10** via a fluid conduit **23** for mixing operation of the second system **10**. As such, the present application is further directed to a system comprising a plurality of individual systems **10** fluidly assembled via the first fluid inlet **157** and first fluid outlet **158** of each system **10** using interconnecting fluid conduits **23** for conveying supply fluid from one or more common fluid sources to one or more of the individual systems **10** assembled together.

[0137] In the simplified example of **FIG. 33**, which depicts a total of four individual systems **10** interconnected as a cascade, a first upstream individual system **10** is fluidly communicated with a fluid source **25** via a fluid conduit **26** in fluid communication with its first fluid inlet **157**. As further shown, a first fluid conduit **23** is fluidly connected to the first fluid outlet **158** of the first upstream individual system **10** and the first fluid inlet **157** of a second adjacent individual system **10**, with each successive individual system **10** fluidly communicated in a similar manner. In one embodiment, each of the four individual systems **10** may be utilized for mixing purposes. In another embodiment, less than all of the individual systems **10** may be utilized for mixing purposes. For example, there may be a desire to operate only the third individual system **10**, e.g., according to its location or proximity to something. In such embodiment, the first fluid inlet **157** and first fluid outlet **158** of each of the first two upstream systems **10** are set to an open position while the first fluid inlet **157** of the third system **10** is set to an open position and the outlet **158** of the third system **10** is set to a closed position. Such arrangement allows supply fluid to pass through the first two upstream systems **10** into

the third system **10** for mixing operations. By setting the outlet **158** of the third system to a closed position, supply fluid is prevented from flowing to the fourth system **10**.

[0138] As stated above, an individual system **10** may be built to scale to handle a particular mixing operation. However, in a scenario making use of first modules **100** of a known size, the ability to combine a plurality of individual systems **10** as shown in **FIG. 33** is effective to scale up a mixing operation of the system **10** to meet one or more fluid volume mixing demands.

[0139] In another embodiment, rather than combine a plurality of systems **10** as shown in **FIG. 33**, a plurality of individual systems **10** may be employed as standalone units for mixing operations. In an embodiment including a plurality of individual systems **10**, each of the individual systems **10** may draw supply fluid from a common source. In another embodiment, a plurality of individual systems **10** may be able to optionally draw supply fluid from one or more separate sources.

[0140] In another embodiment, a fluid mixture composition may be produced by utilizing a first module **100** alone or without use of a second module **200**. For example, where a second module **200** malfunctions or otherwise is unavailable, dry additive may be manually fed to the first module **100**. As such, the process control system **400** may be programmed to calculate manual feed rates of dry additives.

[0141] As described herein, the supply fluid and dry additive used may vary according to one or more desired fluid mixture compositions. At a minimum, the supply fluid and fluid mixture compositions produced are flowable through each of the conduits, pumps, valves, blenders, hoses, inlets and outlets of the first module **100**. In one aspect, suitable dry additives include materials soluble in one or more target fluids. In another aspect, suitable dry additives include materials effective to be conveyed out from the second module **200** into the mixing line **160**. Because certain dry additives may be more concentrated per volume depending on

the source of the dry additive, such may be factored in when calculating the volume of dry additive to be used in producing one or more fluid mixture compositions.

[0142] In still another embodiment, the first and second modules **100**, **200** may be configured in any number of functional arrangements. For example, multiple first modules **100** may be stacked whereby the uppermost first module **100** makes use of a second module **200** as described above. An additional second module **200** may be set adjacent the main second module **200** and a chute or conduit **60** may be provided to convey dry additive in adjacent storage container **206** with the mixing line **160** of the bottom first module **100** as shown in **FIG. 34**. As shown, the bottom first module **100** may include vertical members **115** or raised horizontal rail type support member **114** of a length effective to provide clearance for the conduit **60**.

[0143] The invention will be better understood with reference to the following non-limiting example, which is illustrative only and not intended to limit the present invention to a particular embodiment.

[0144] EXAMPLE 1

[0145] In a first non-limiting example, a system **10** as shown in **FIG. 1** operationally configured for oil and gas extraction operations may be provided having the dimensions as shown in Table 3 below.

[0146] Table 3

(1) First Module 100	
Framework 105 Width: about 1.93 meters (about 76.0 inches)	
Framework 105 Length: about 2.54 meters (about 100.0 inches)	
Height from the bottom of the Framework 105 to the top of the Vertical	
Members 115 : about 1.55 meters (about 61.2 feet)	
(2) Second Module 200	

Framework **205** Width: about 1.93 meters (about 76.0 inches)

Framework **205** Length: about 2.54 meters (about 100.0 inches)

Framework **205** Height: about 2.22 meters (about 87.25 inches)

- (3) Storage Container **206** Volume: about 7.79 cubic meters (about 275.0 cubic
5 feet).

[0147] In still another aspect, the present application is directed to a system for
producing fluid mixture compositions, including a first module for providing fluid; and a
second module attachable to the first module for providing dry additive to be mixed with the
fluid; the system being operationally configured to mix fluid and dry additive to produce a fluid
10 mixture composition and optionally modify the fluid mixture composition.

[0148] The present application is also directed to a system and method for mixing fluid
and dry material, including system having a first module for providing a fluid stream; a second
module for providing dry material into the fluid stream to produce a fluid mixture
composition; the first module being operationally configured to house the fluid mixture
15 composition, modify the fluid mixture composition and direct the fluid mixture composition
out from the system.

[0149] The present application is also directed to a system and method for mixing fluid
and dry material, including a system having a first module; and a second module attachable to
the first module; wherein the first module is operationally configured to provide a fluid stream
20 and the second module is operationally configured to provide dry additive into the fluid stream
to produce a fluid mixture composition; the first module being operationally configured to
house the fluid mixture composition, modify the fluid mixture composition and direct the fluid
mixture composition out from the system. The first module can be operated alone or
independent of the second module and vice versa.

[0150] It is believed that the present application and advantages will be understood by the forgoing description. Persons of ordinary skill in the art will recognize that many modifications may be made to the present application without departing from the spirit and scope of the invention. The embodiment(s) described herein are meant to be illustrative only
5 and should not be taken as limiting the invention, which is defined in the claims.

I claim:

1. A system for producing fluid mixture compositions, including:
a first module providing one or more fluids; and
a second module attachable to the first module providing one or more dry additives to
be mixed with the one or more fluids in the first module to produce a fluid
mixture composition;
wherein the first module is operationally configured to modify the fluid mixture
composition.
2. The system of claim 1 wherein the first module includes a tub for receiving a fluid
mixture composition.
3. The system of claim 2 wherein the tub includes a first basin for receiving a fluid
mixture composition.
4. The system of claim 3 wherein the tub includes a second basin for receiving the fluid
mixture composition from the first basin.
5. The system of claim 3 wherein the tub includes a second basin for receiving a
modified fluid mixture composition from the first basin.
6. The system of claim 1 wherein the first module includes one or more fluid outlets for
discharging the fluid mixture composition from the system.
7. The system of claim 1 wherein the second module includes a container for housing
one or more dry additives.
8. The system of claim 1 wherein the first module includes a portable support platform.
9. A portable system for mixing fluid and dry material, including:
a first module providing a fluid stream;
a second module providing dry material into the fluid stream to produce a fluid
mixture composition;

the first module being operationally configured to house the fluid mixture composition, modify the fluid mixture composition and direct the fluid mixture composition out from the system.

10. The system of claim 9 wherein the first module includes a tub including a divider defining a first basin for receiving the fluid mixture composition and a second basin for receiving a modified fluid mixture composition from the first basin.
11. The system of claim 10 wherein the fluid mixture composition is transferrable from the first basin to the second basin over the divider and via an external conduit in fluid communication with the first basin and the second basin.
12. A system for mixing fluid and dry material, including:
 - a first module for receiving fluid into the system; and
 - a second module attachable to the first module for providing dry material to be mixed with the fluid in the first module producing a fluid mixture composition;wherein the first module includes a first mixer for producing the fluid mixture composition and a second mixer to facilitate further mixing of the fluid mixture composition; the first module being operationally configured to direct the fluid mixture composition out from the system via one or more outlets.
13. The system of claim 12 wherein the first module may be operated independent of operation of the second module.

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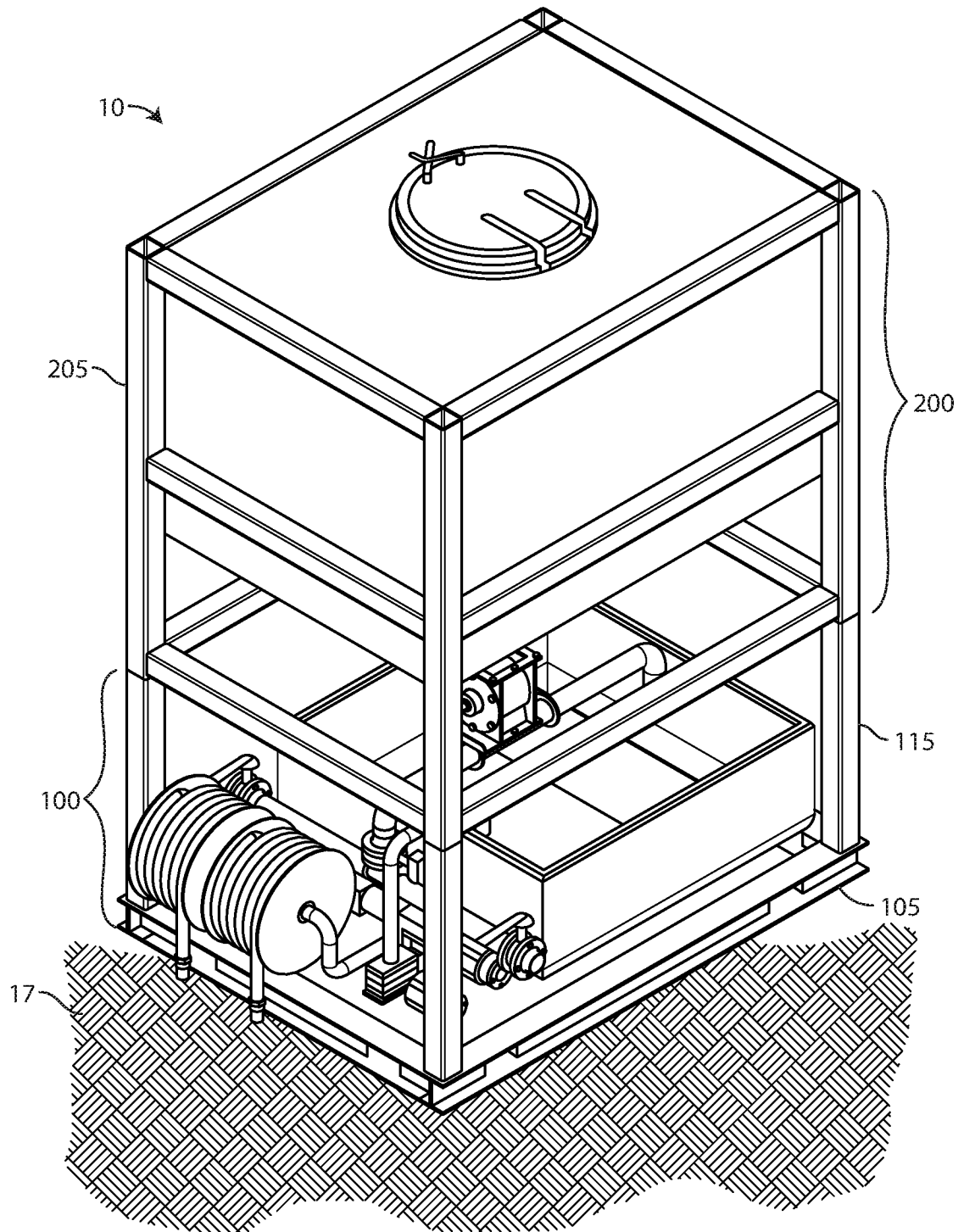


FIG. 1

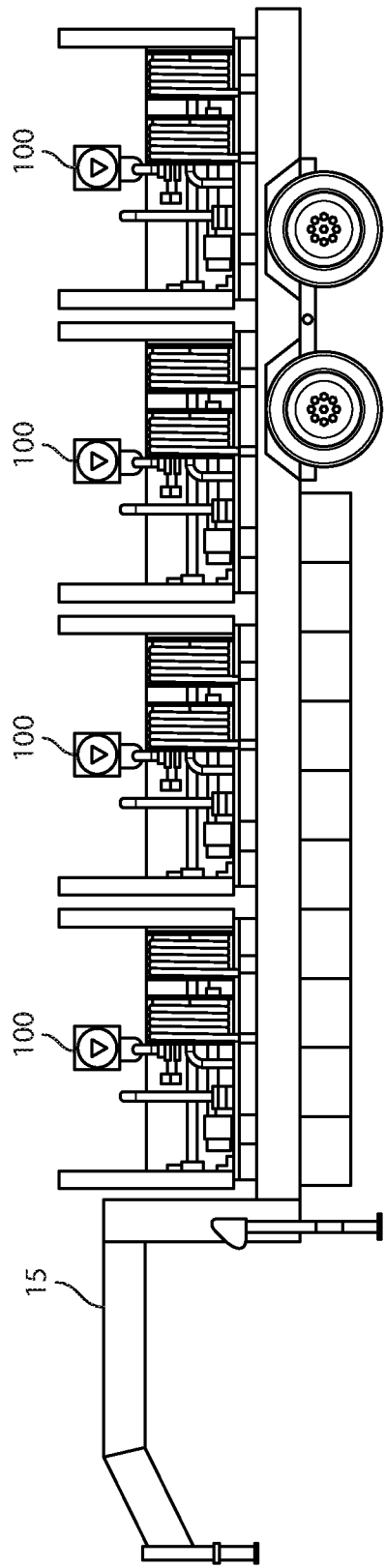


FIG. 2

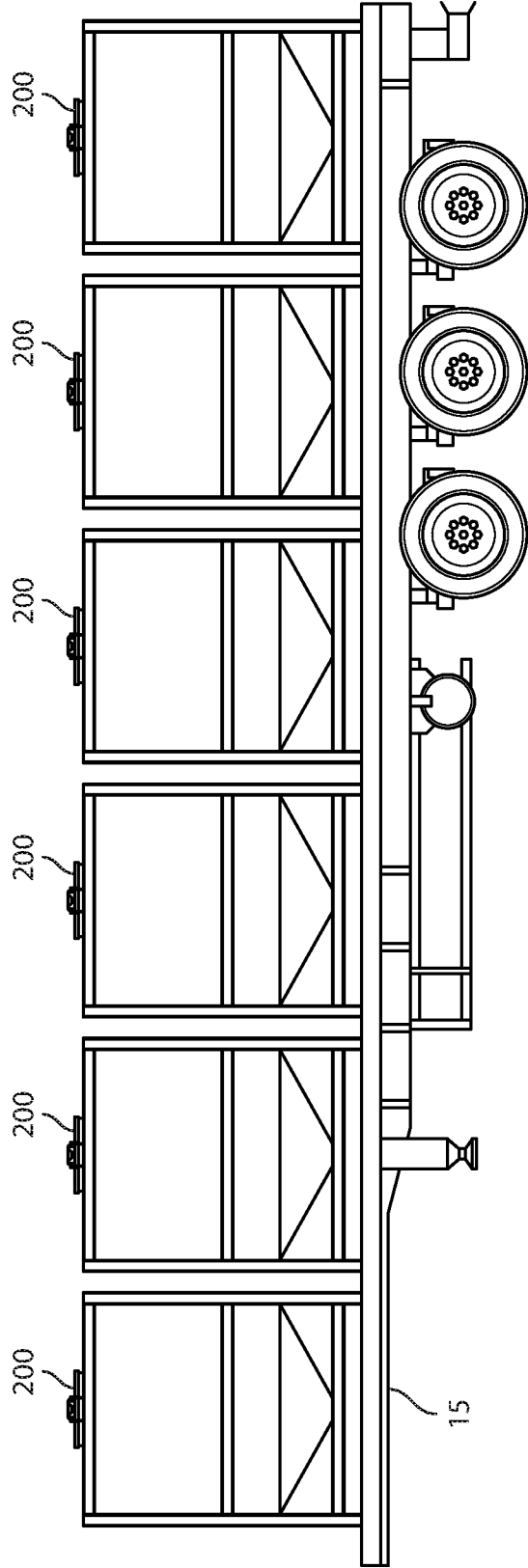


FIG. 3

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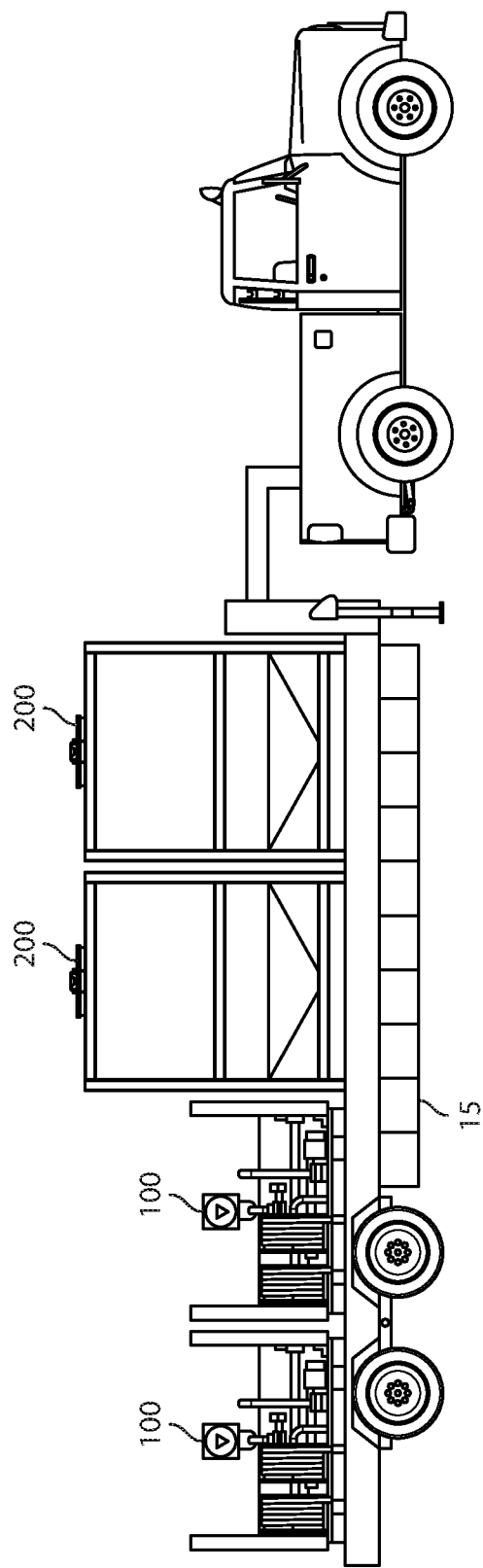


FIG. 4

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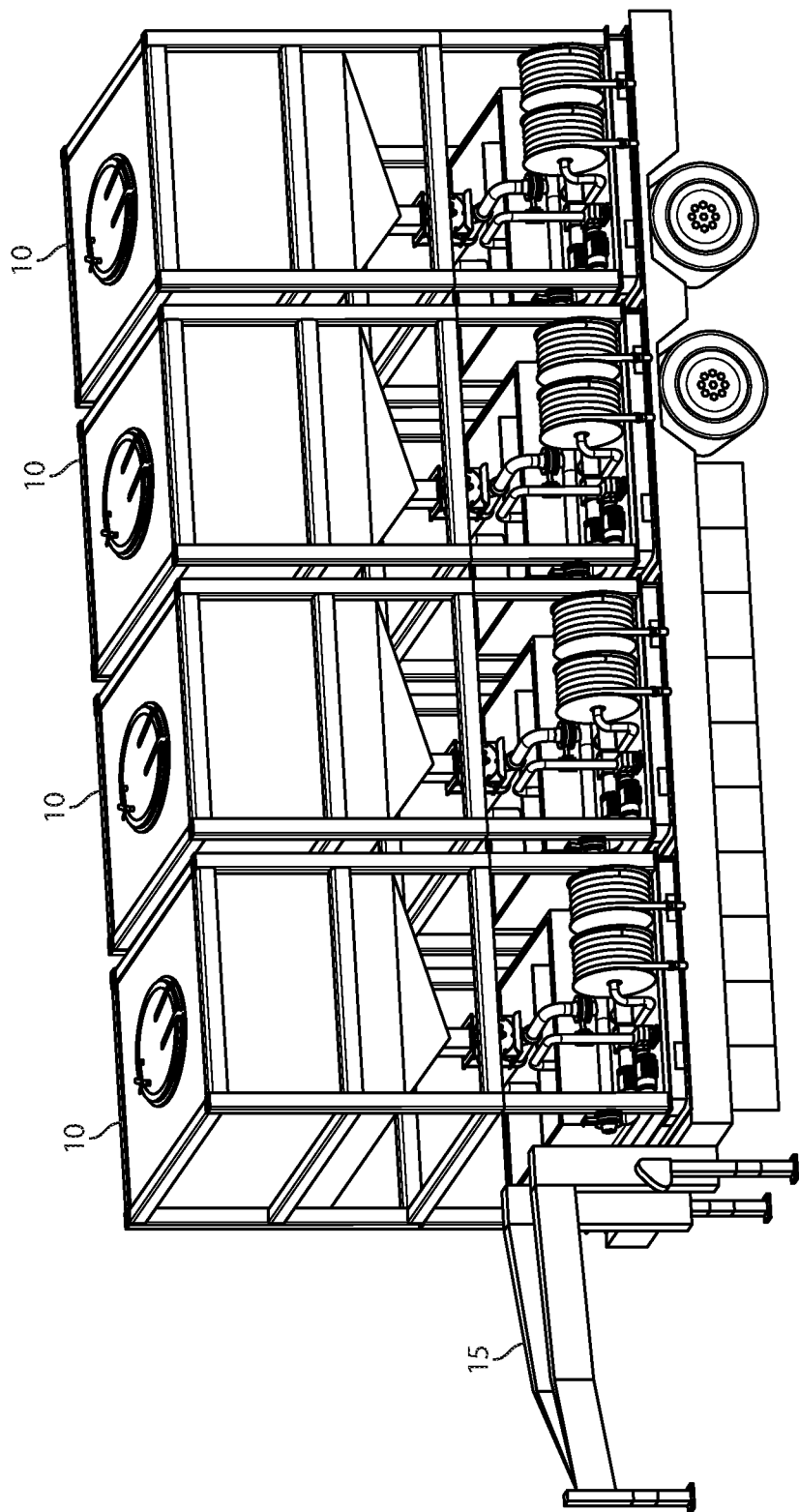


FIG. 5

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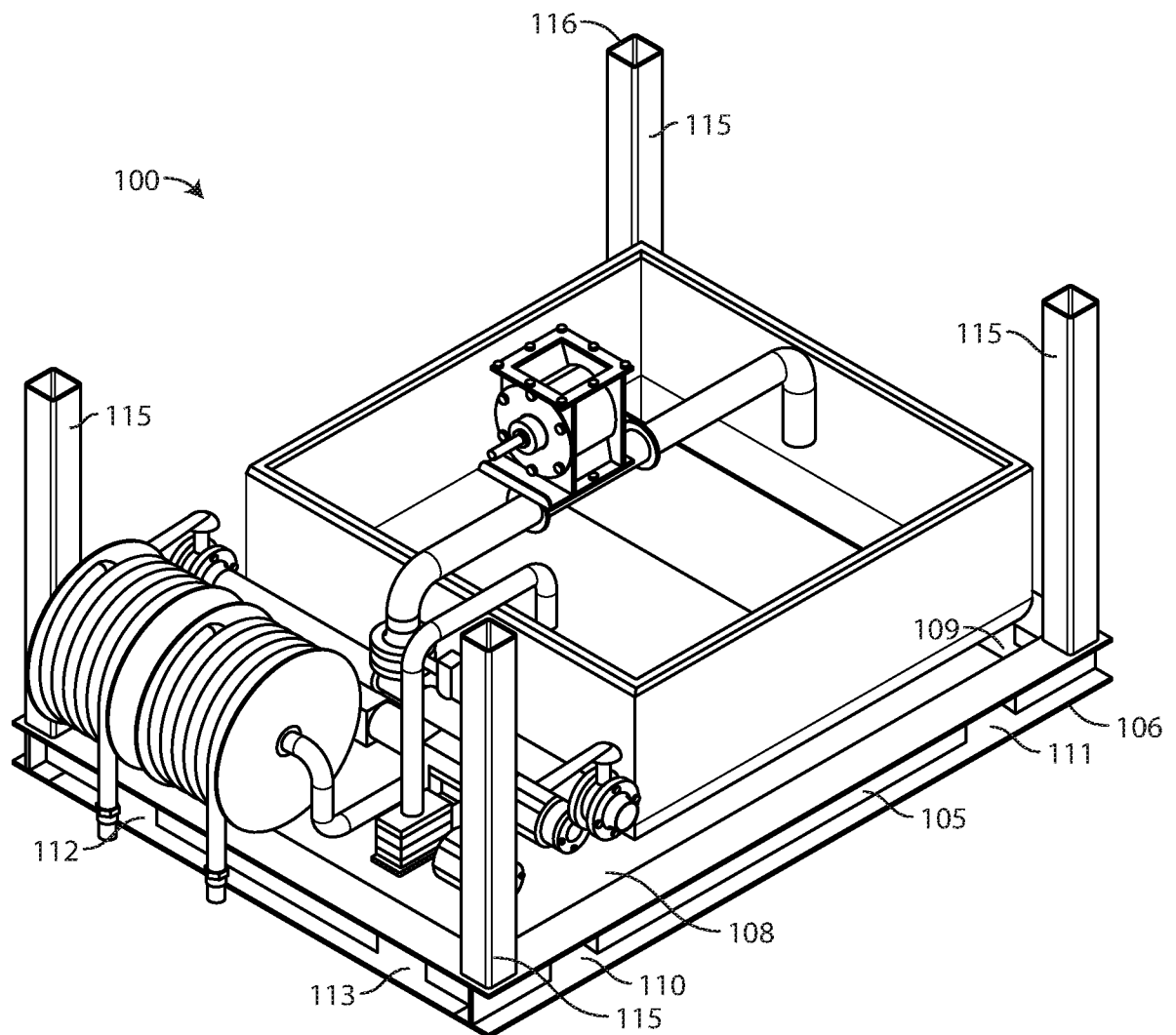


FIG. 6

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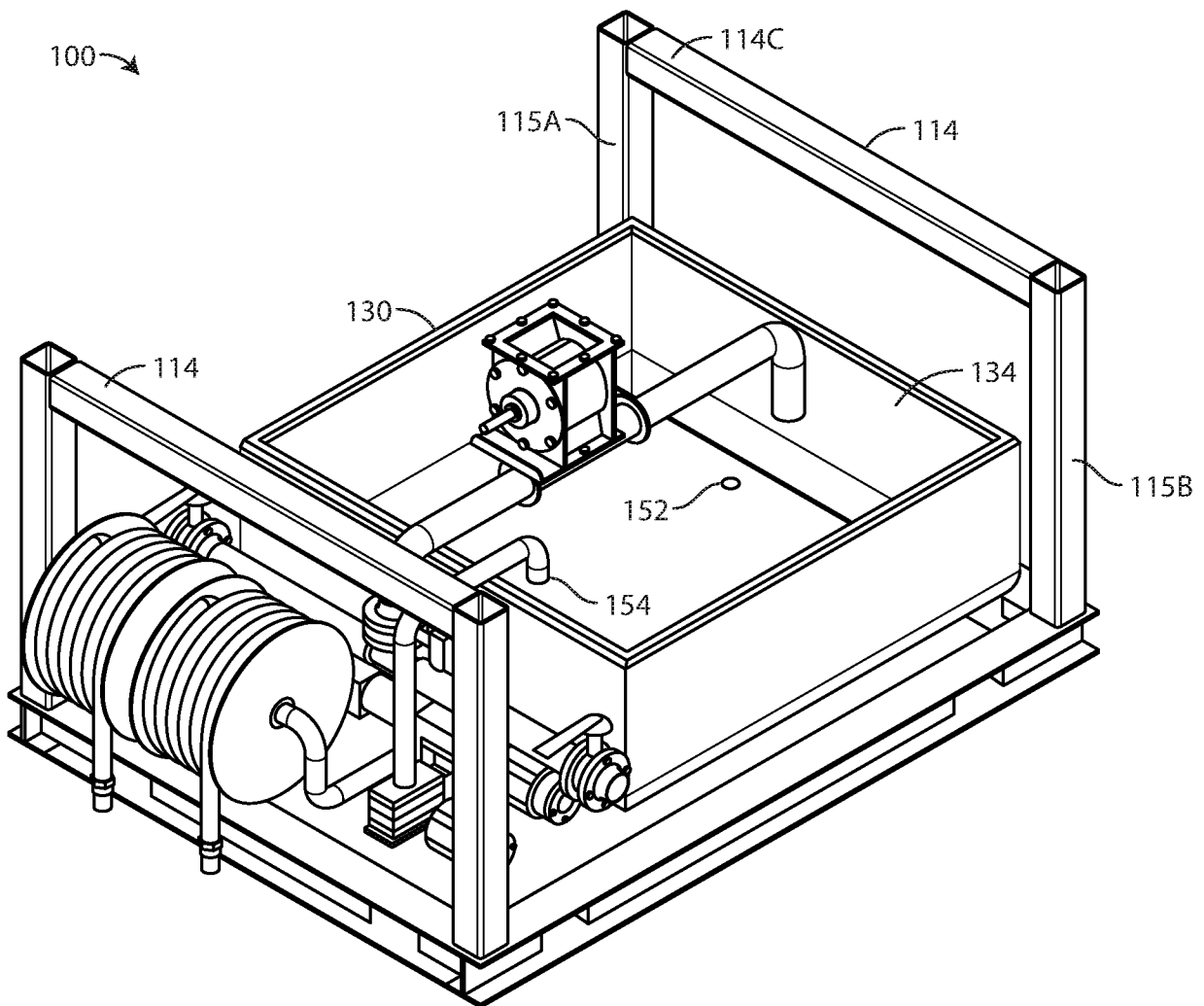


FIG. 7

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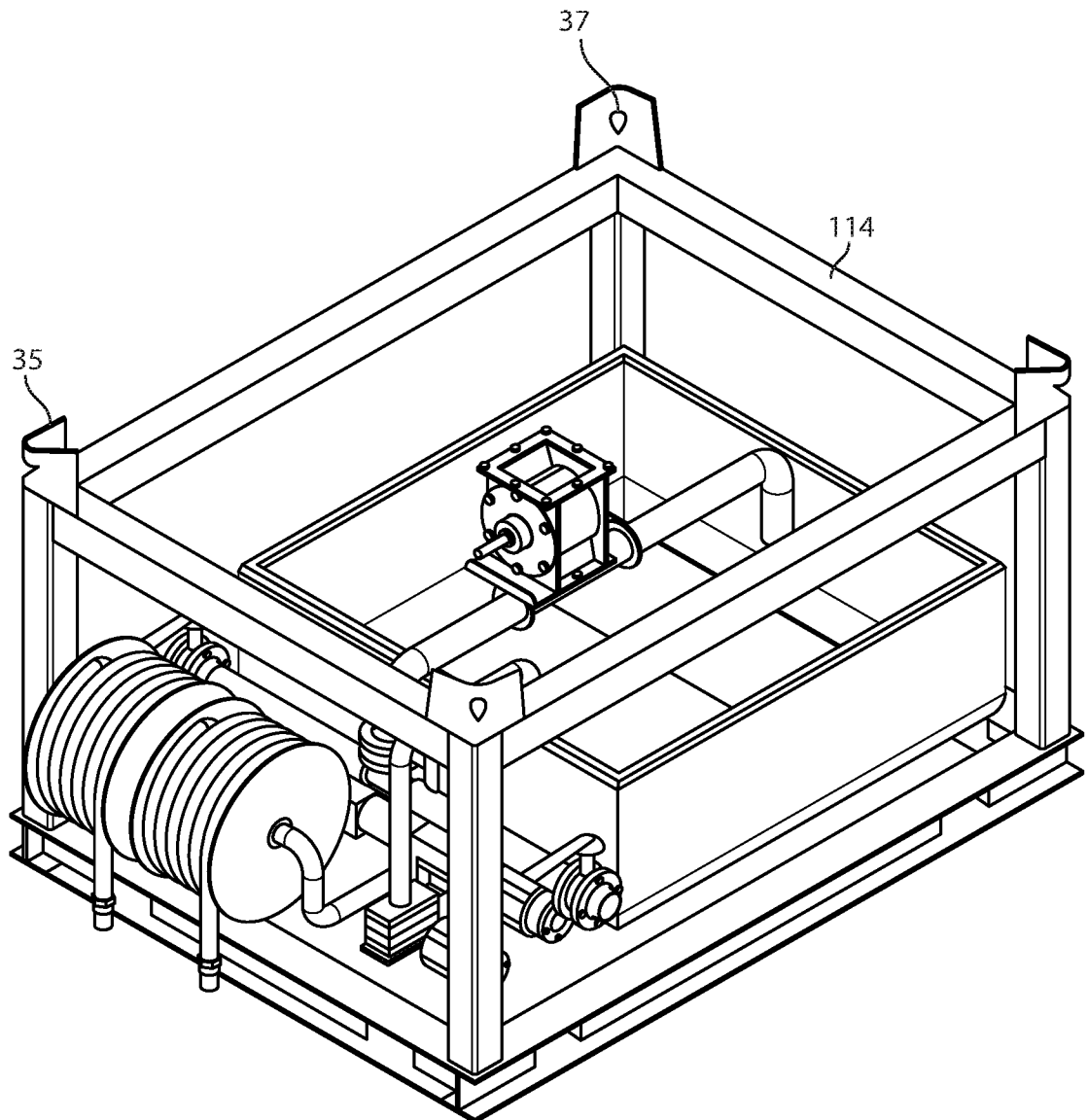


FIG. 8

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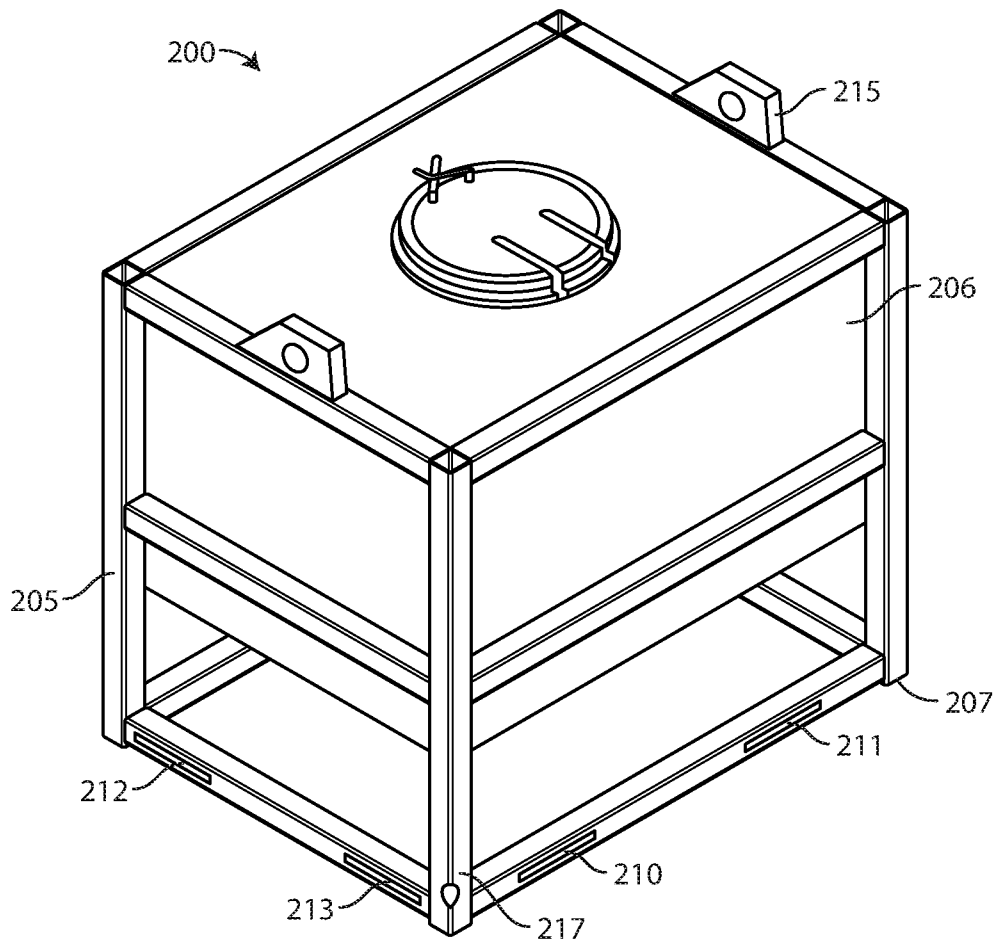


FIG. 9

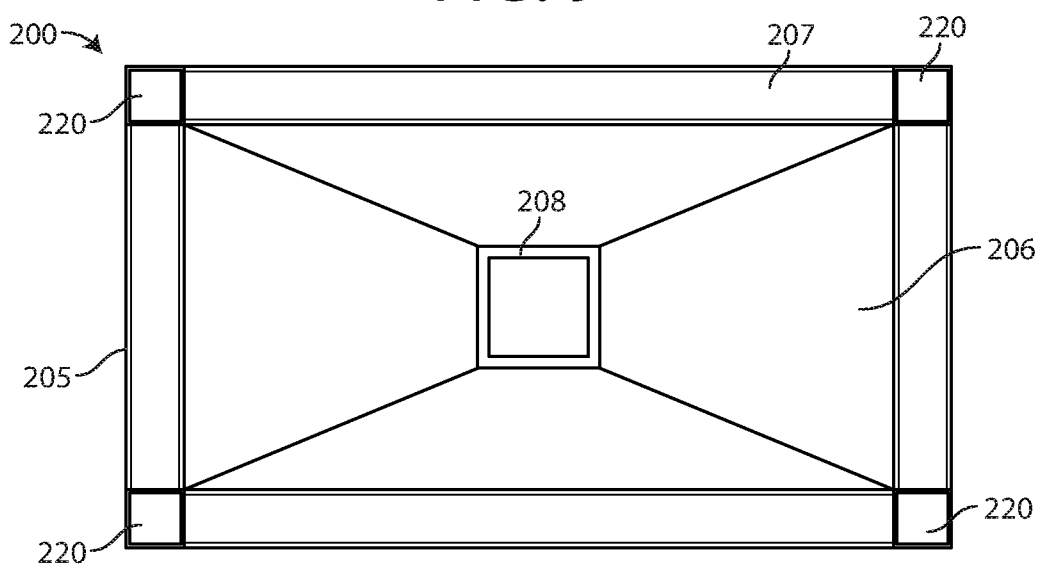


FIG. 10

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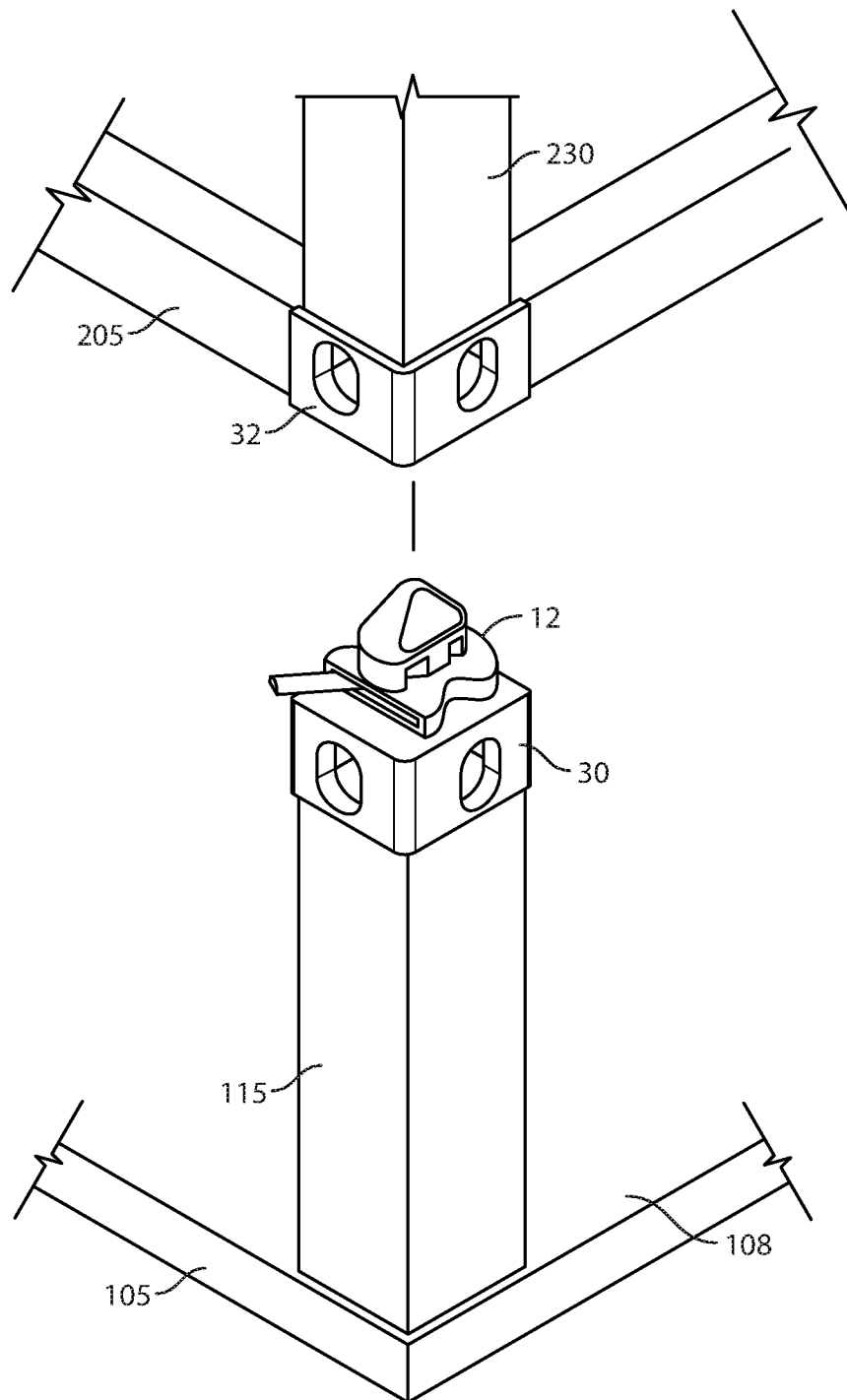


FIG. 11

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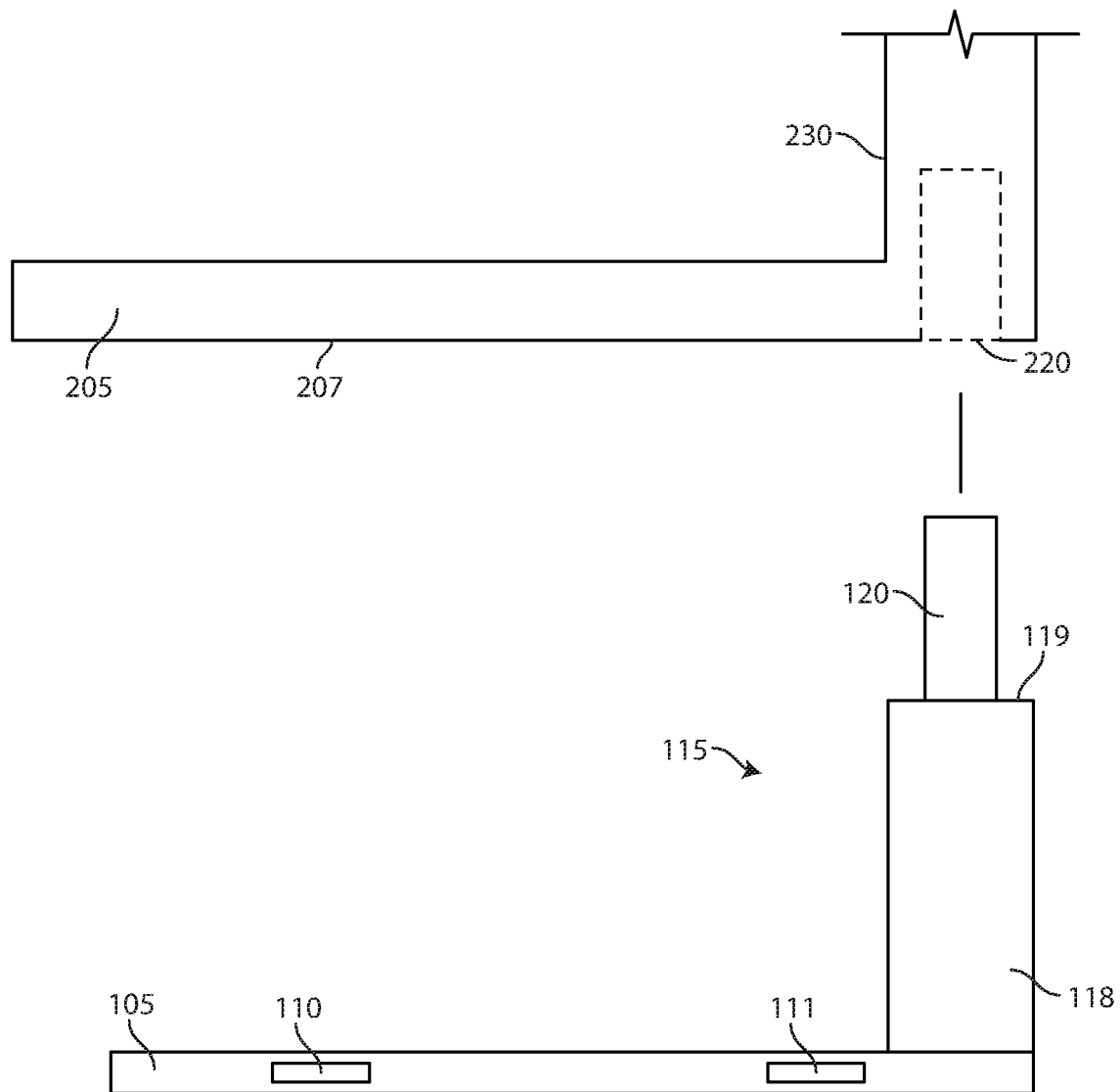


FIG. 12

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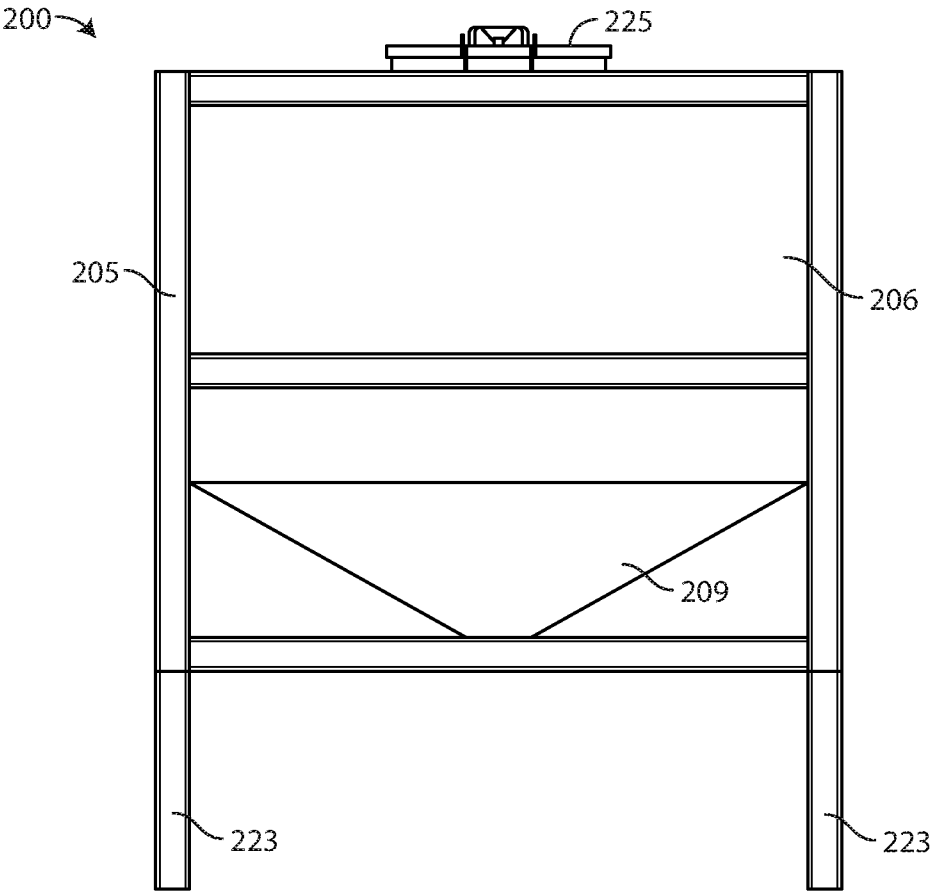


FIG. 13

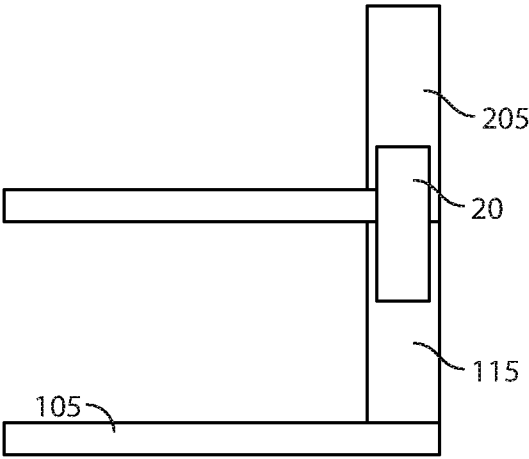


FIG. 14

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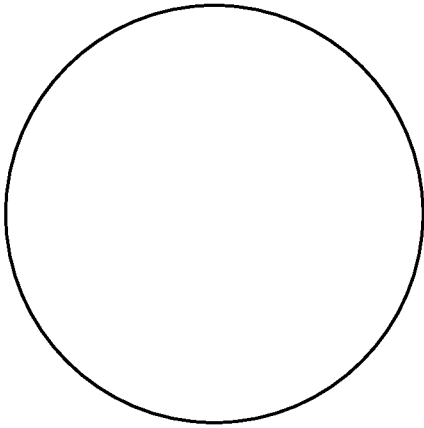


FIG. 15A

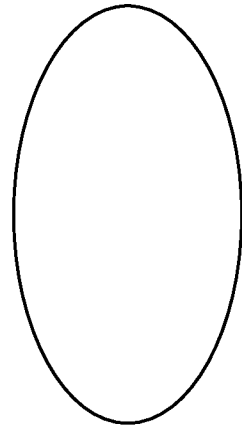


FIG. 15D

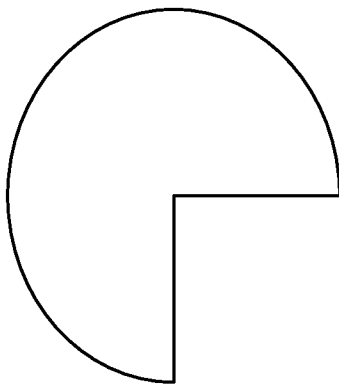


FIG. 15B

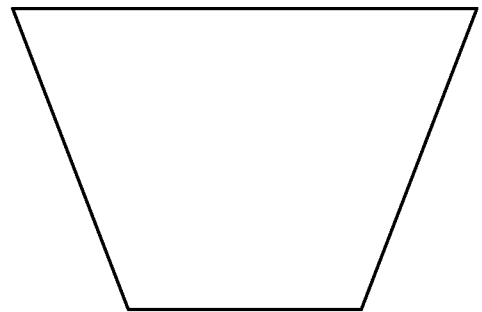


FIG. 15E

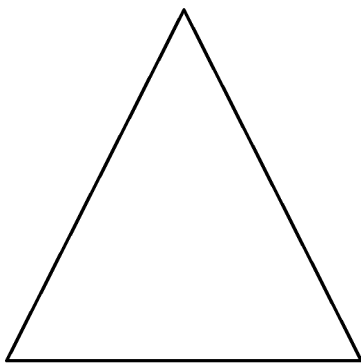


FIG. 15C

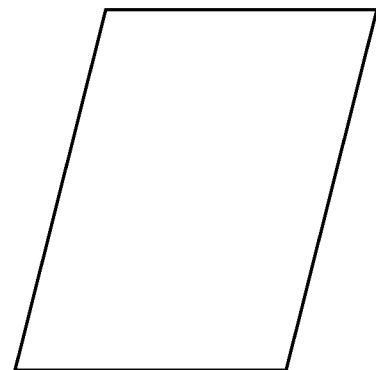


FIG. 15F

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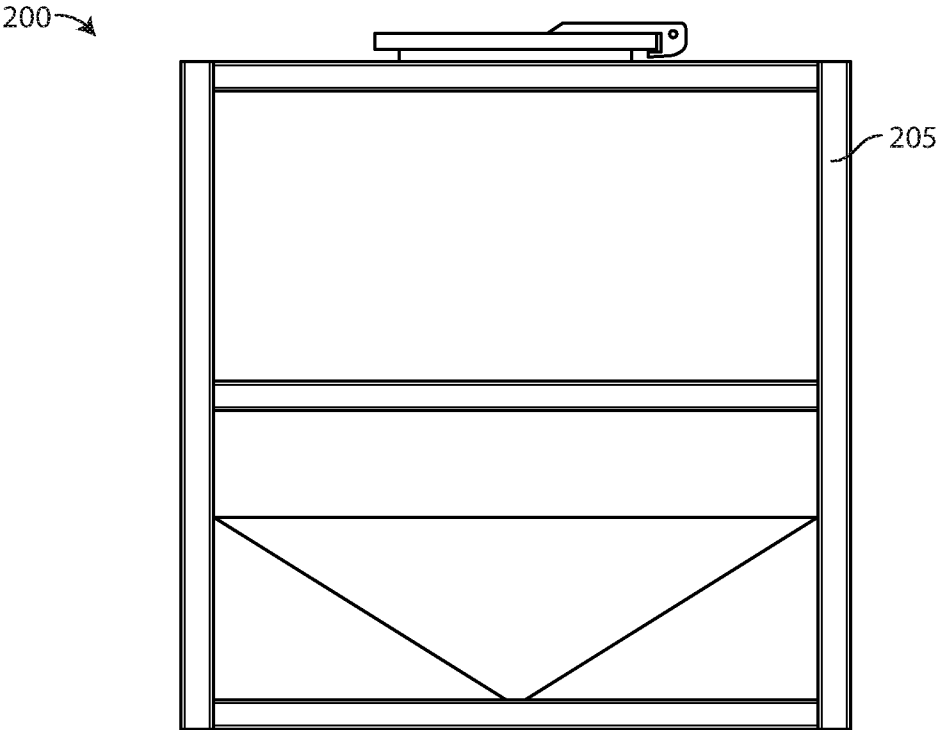


FIG. 16

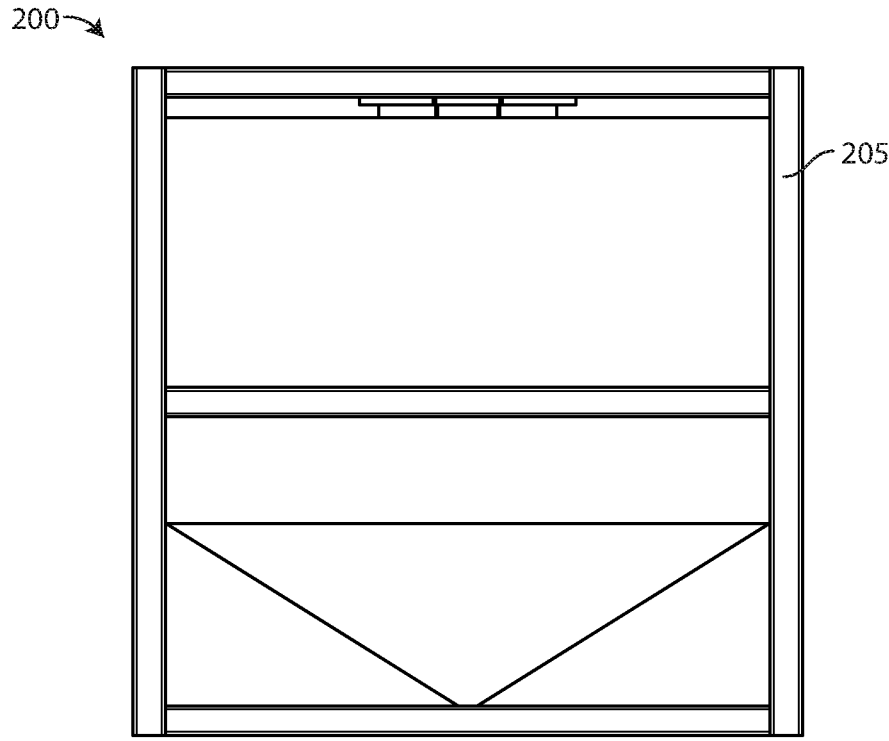


FIG. 17

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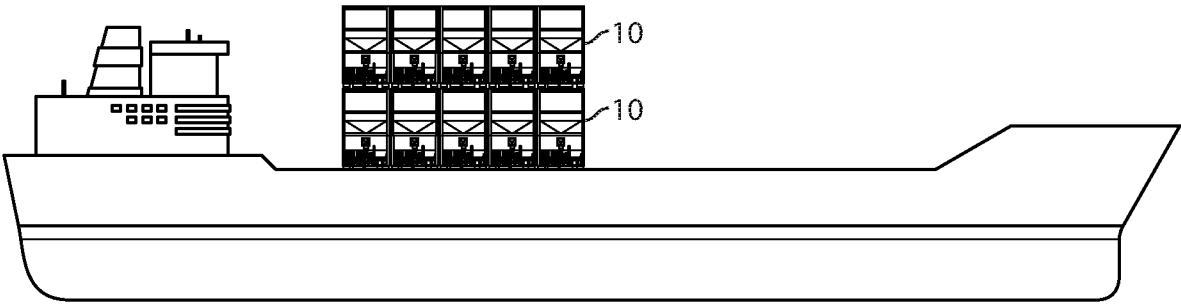


FIG. 18

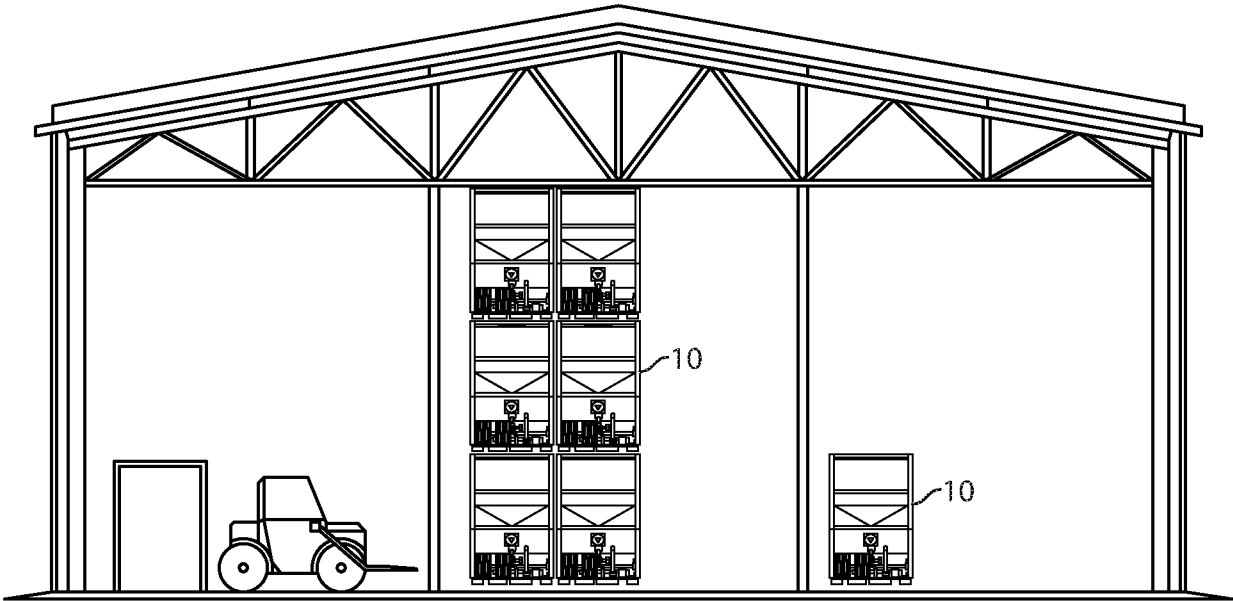


FIG. 19

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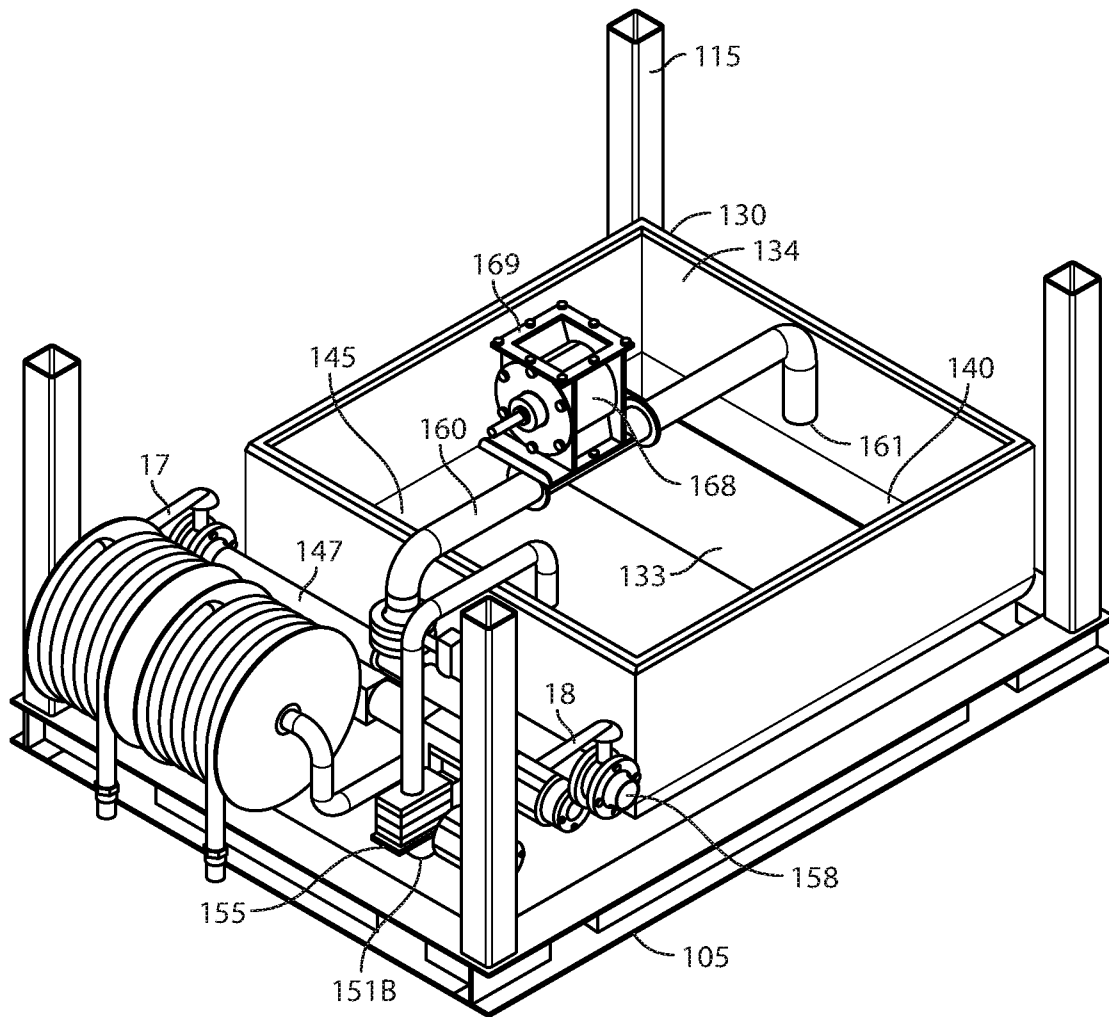


FIG. 20

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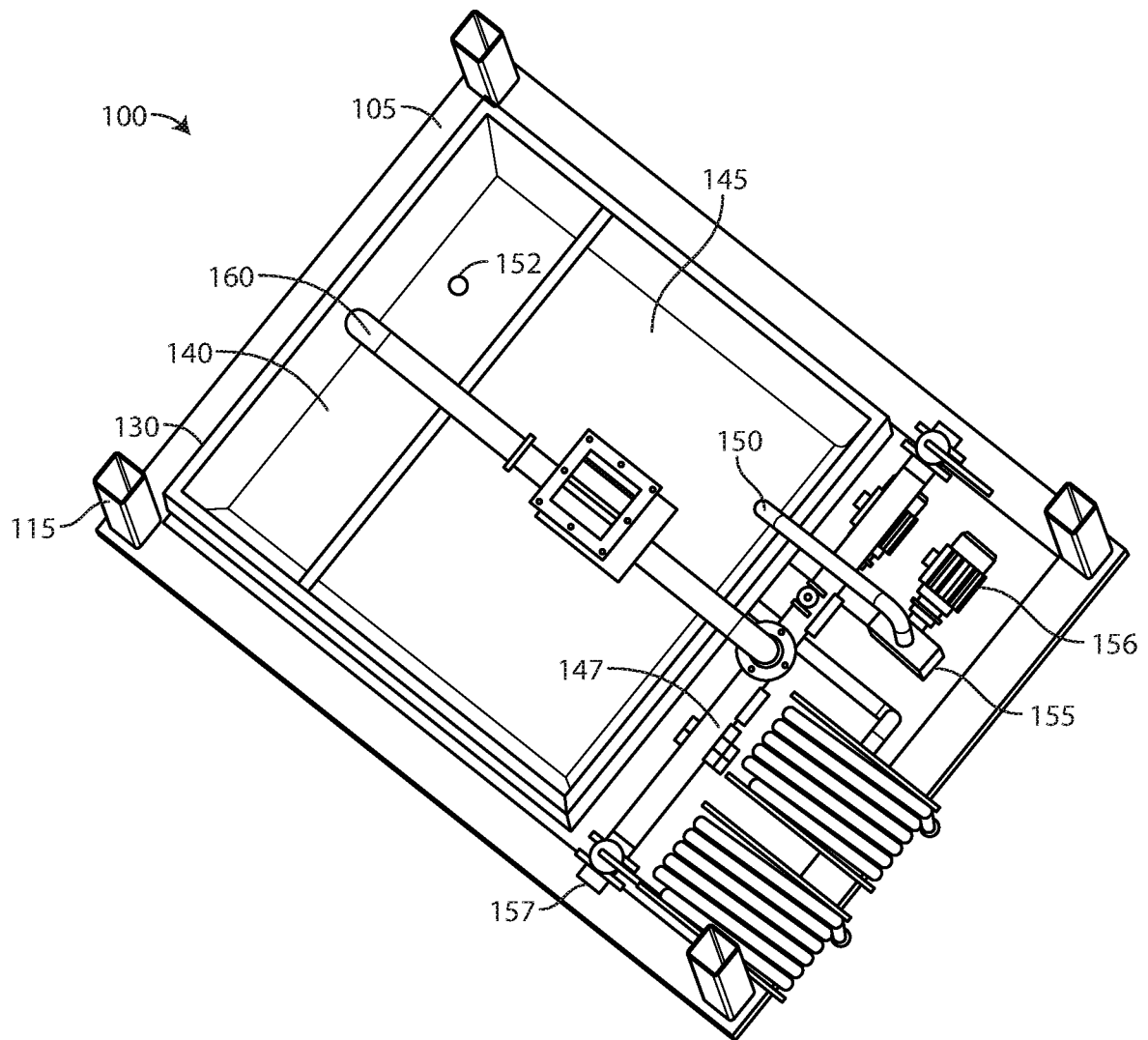


FIG. 21

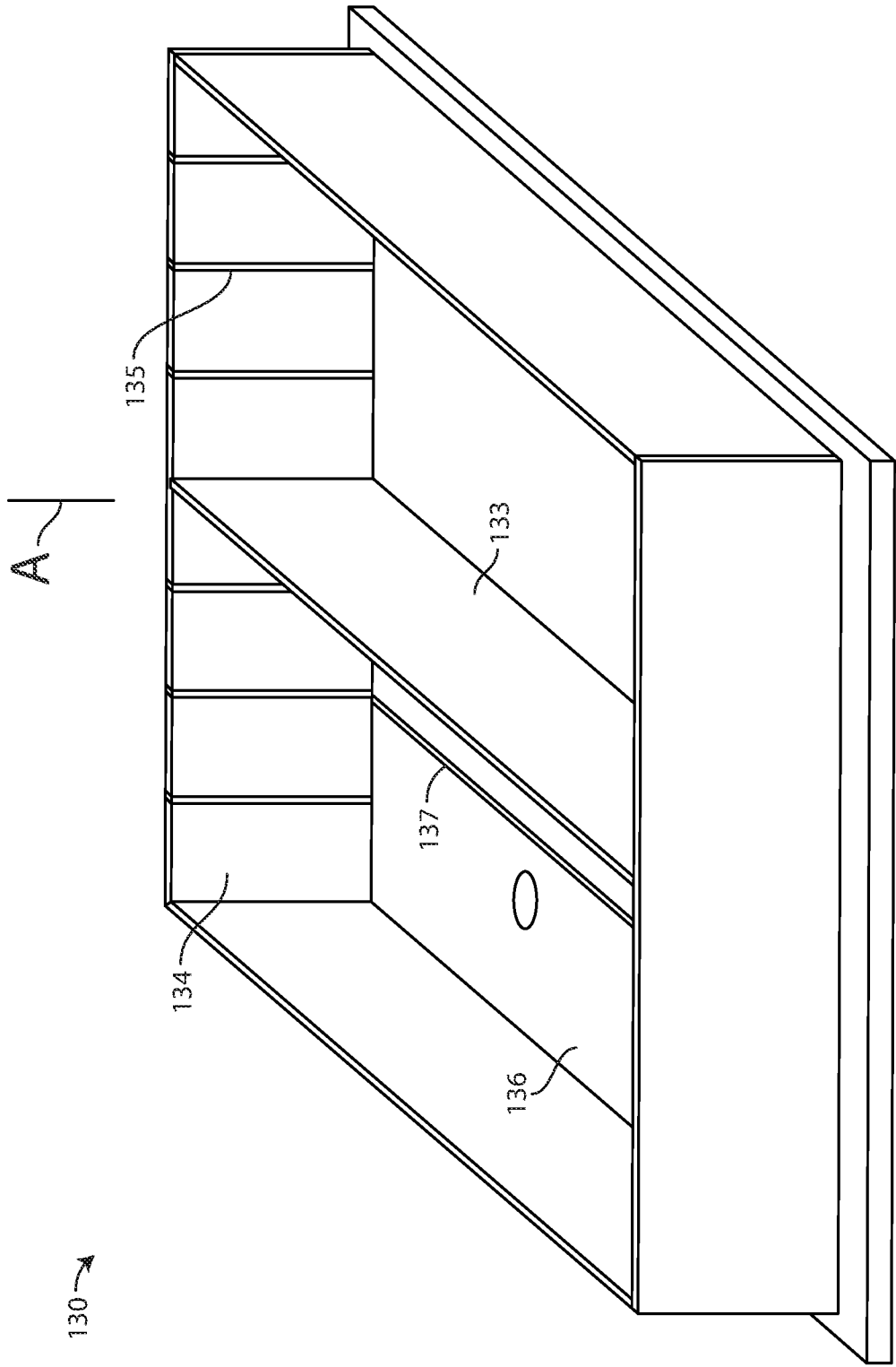


FIG. 22

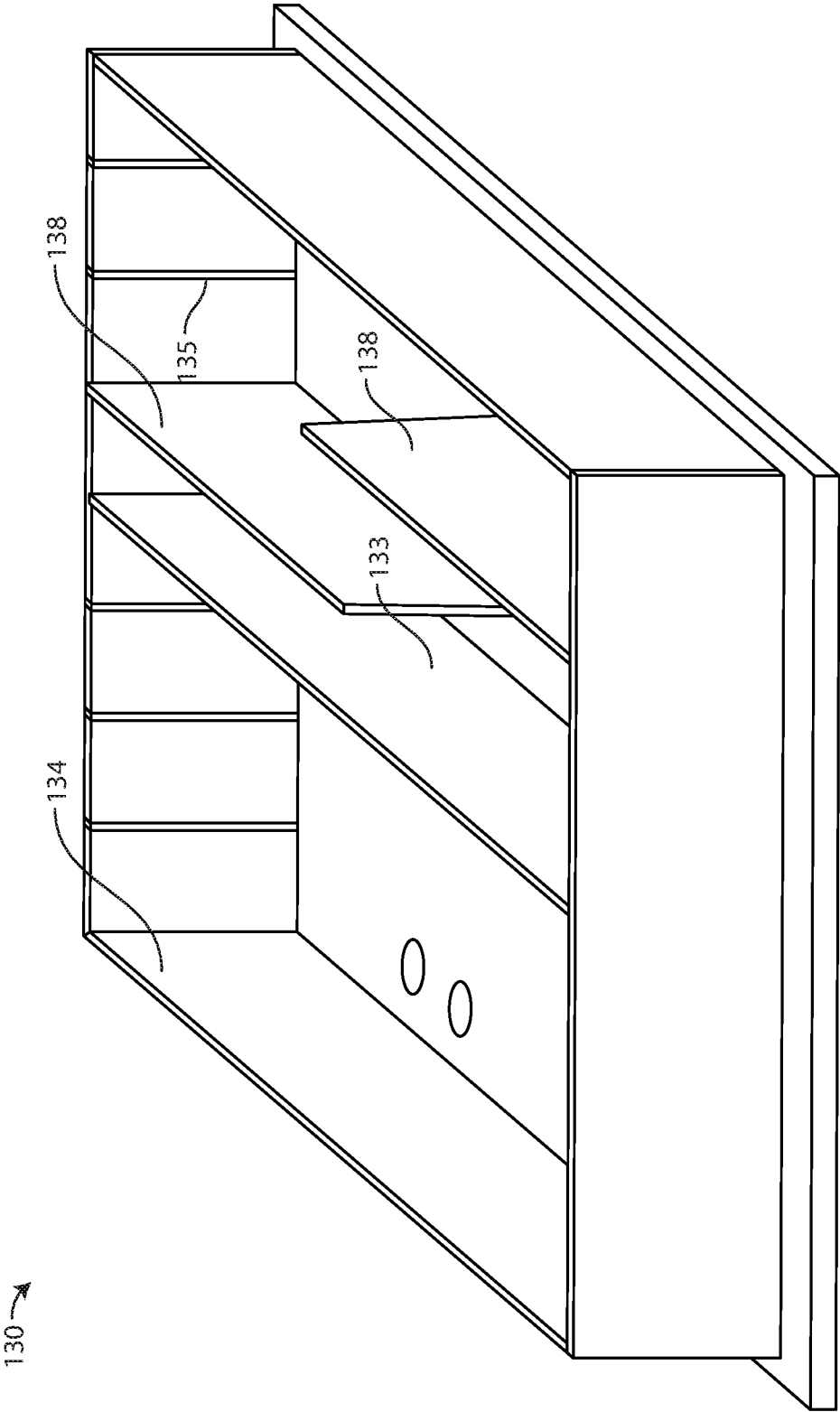


FIG. 23

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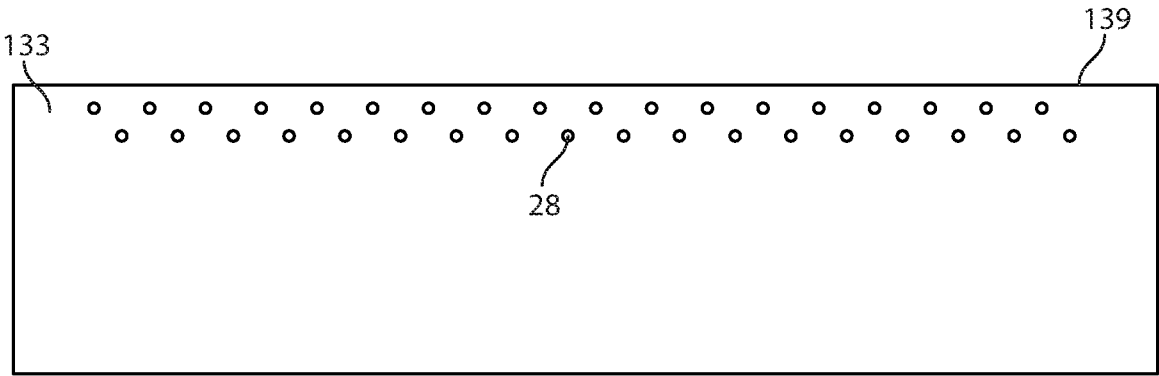


FIG. 24

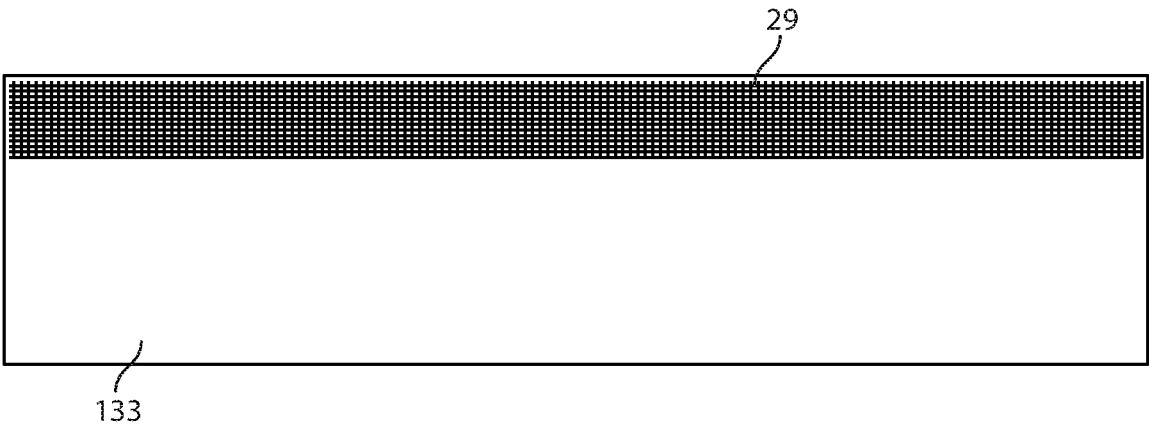


FIG. 25

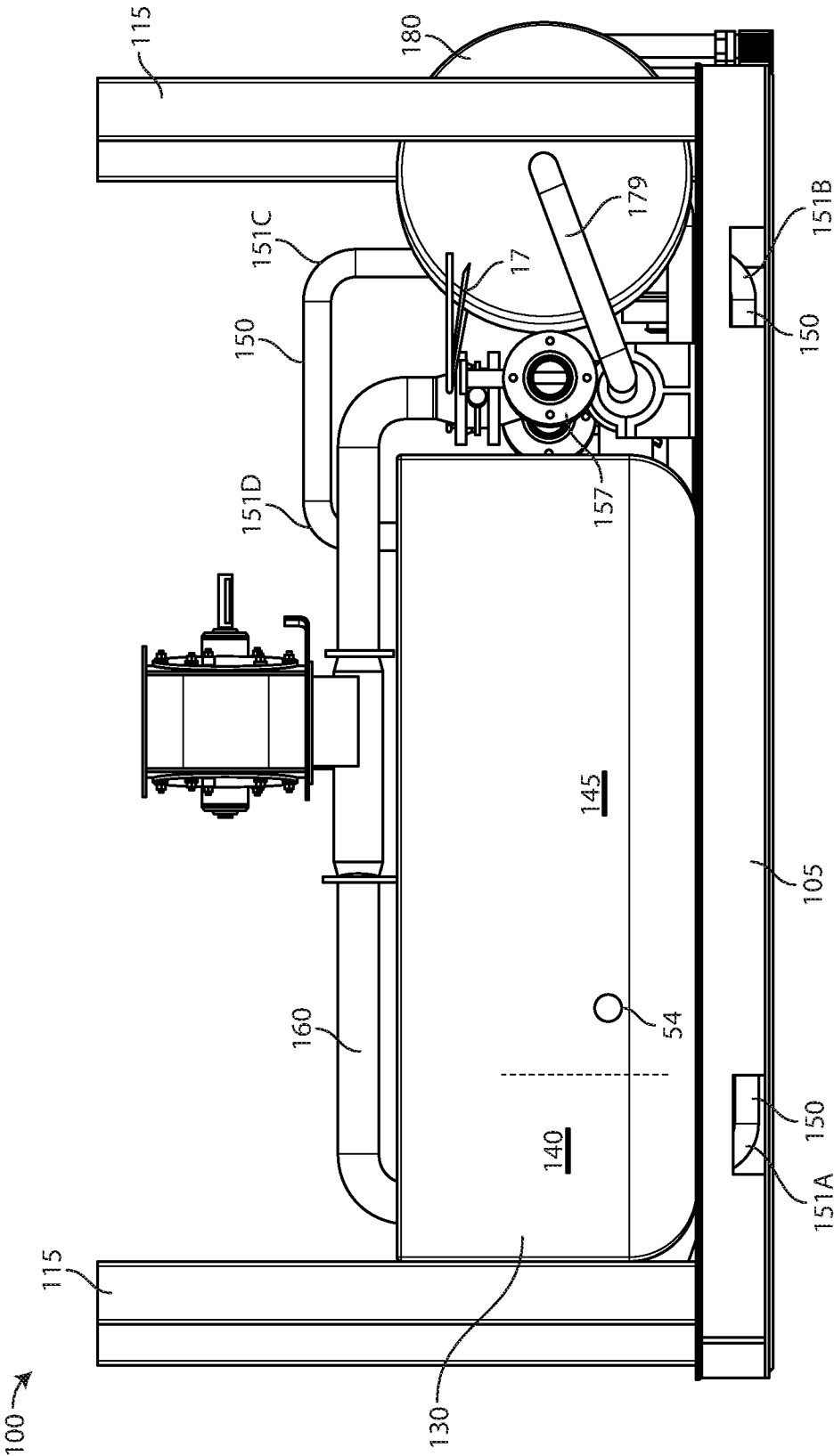


FIG. 26

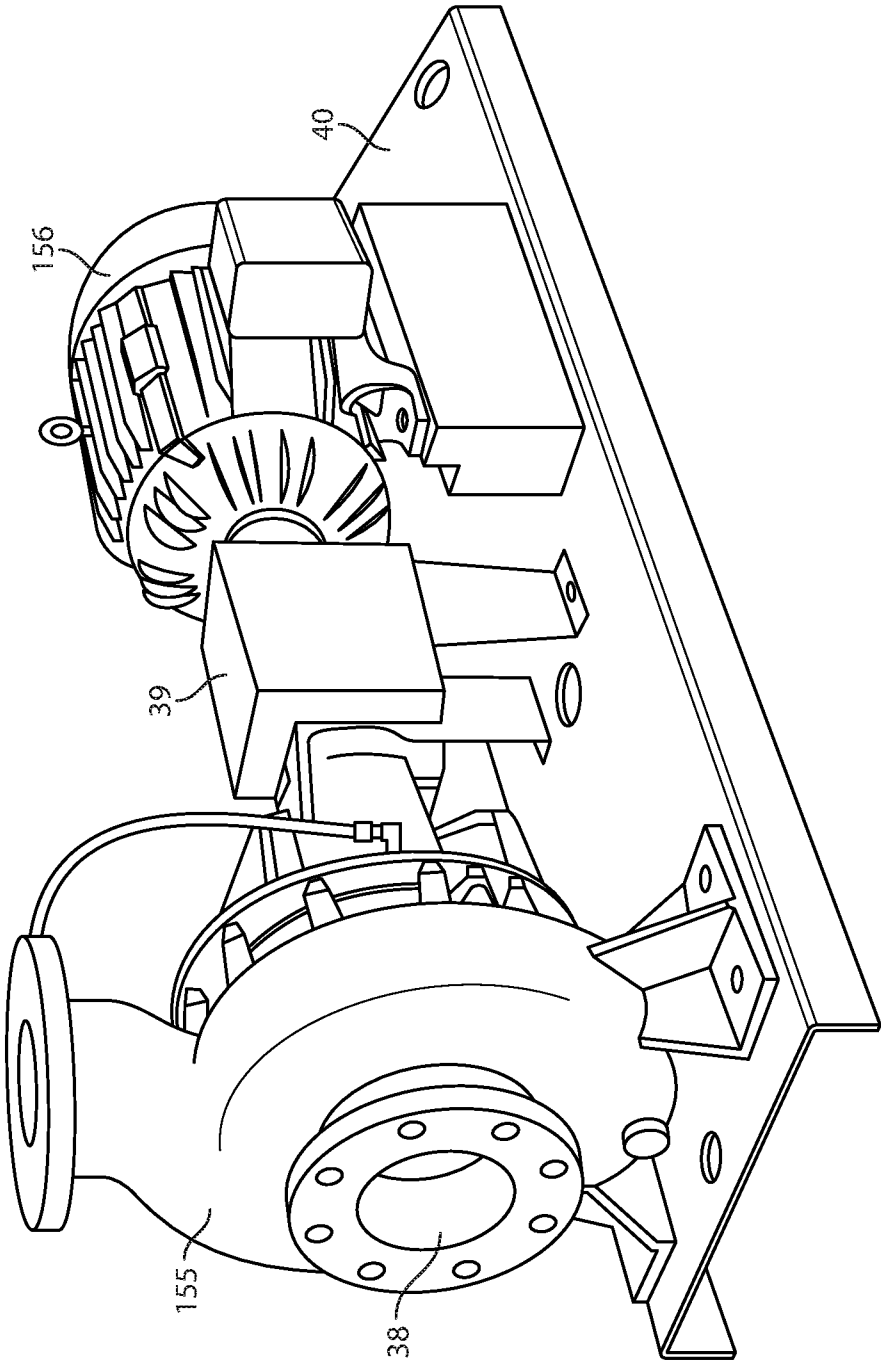


FIG. 27

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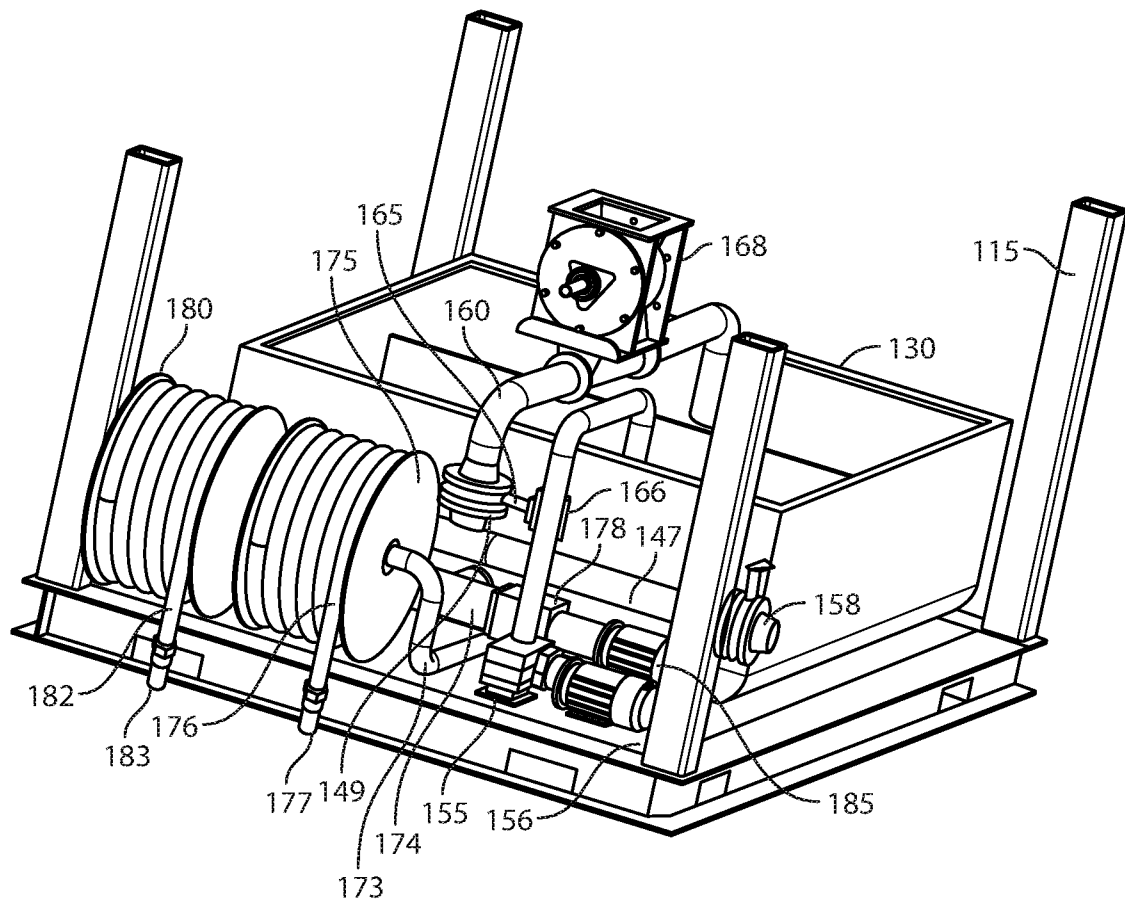


FIG. 28

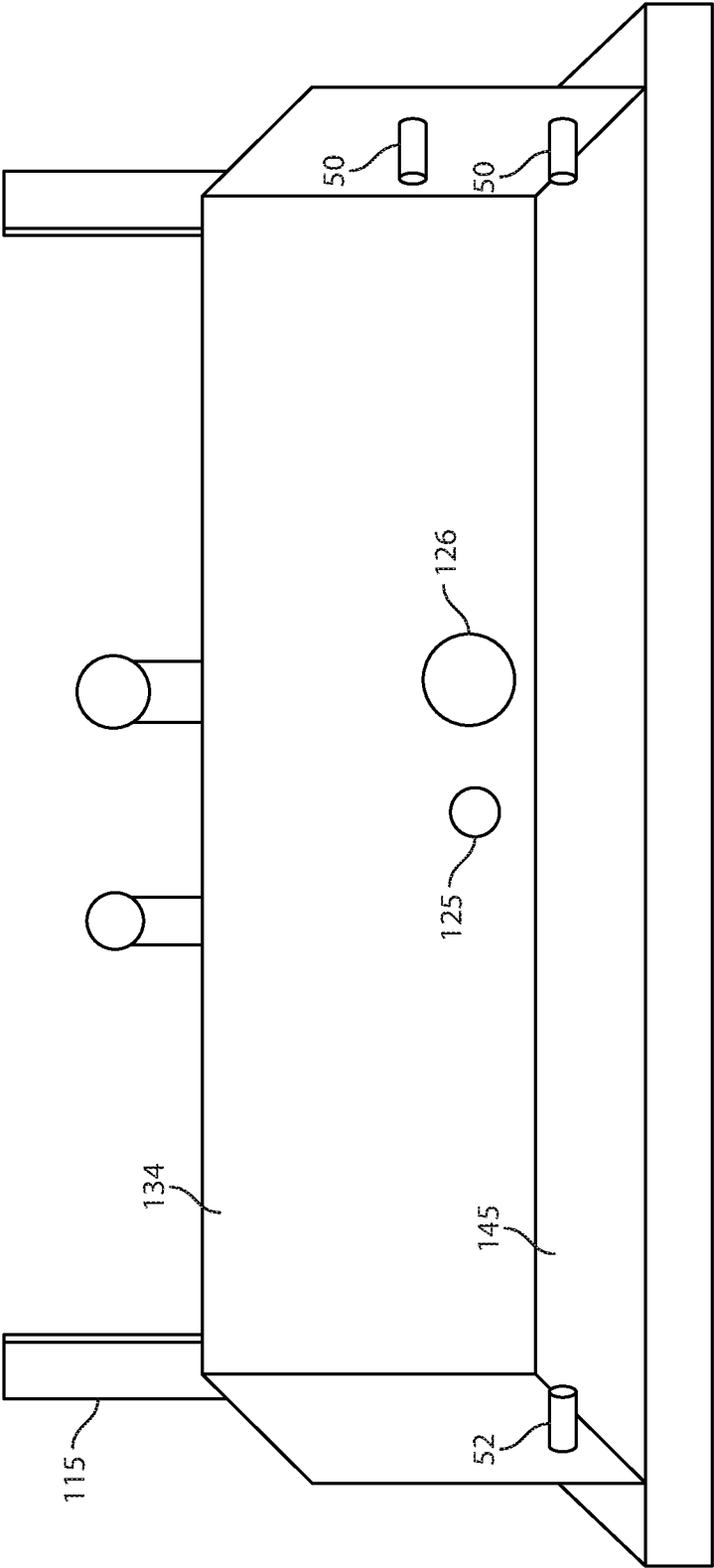


FIG. 29

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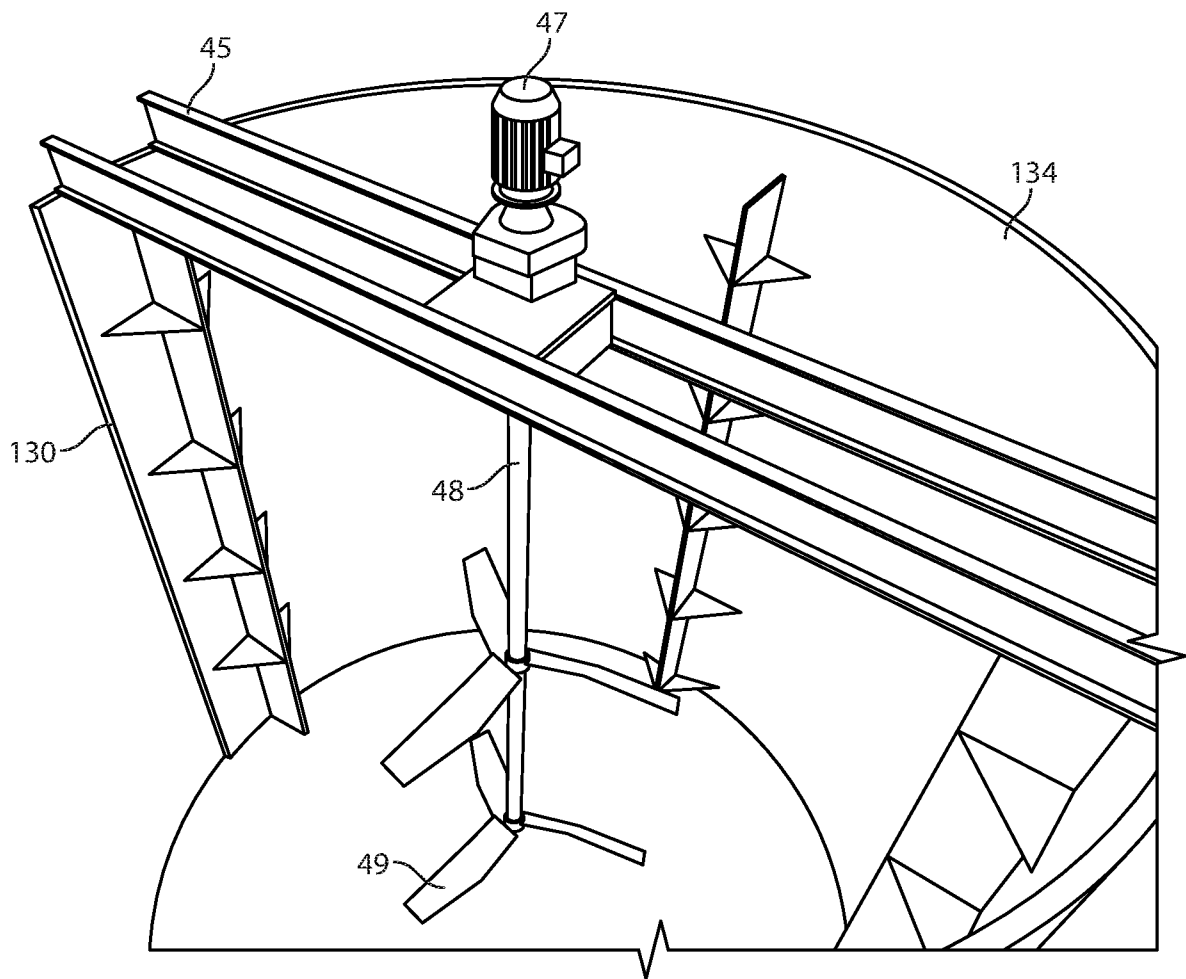


FIG. 30

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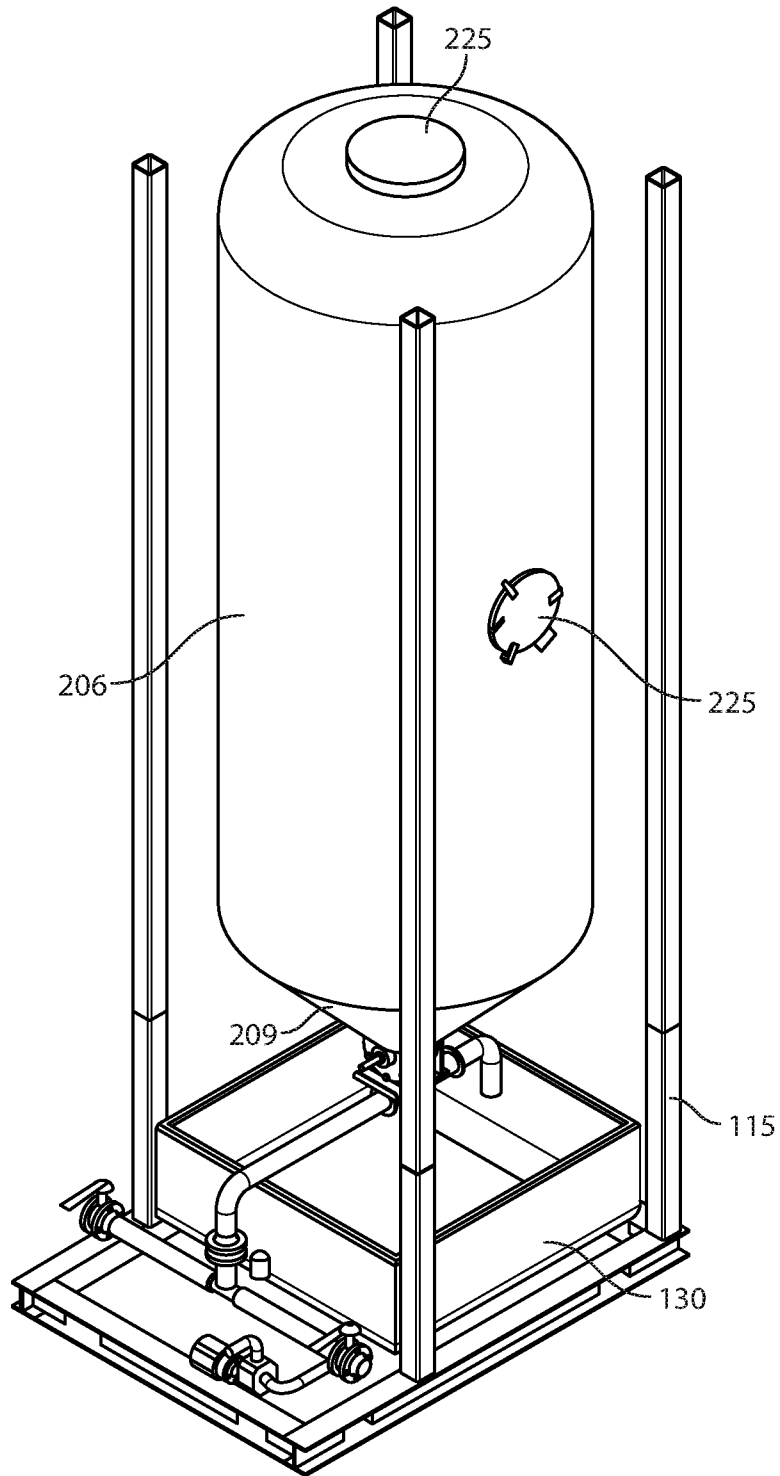


FIG. 31

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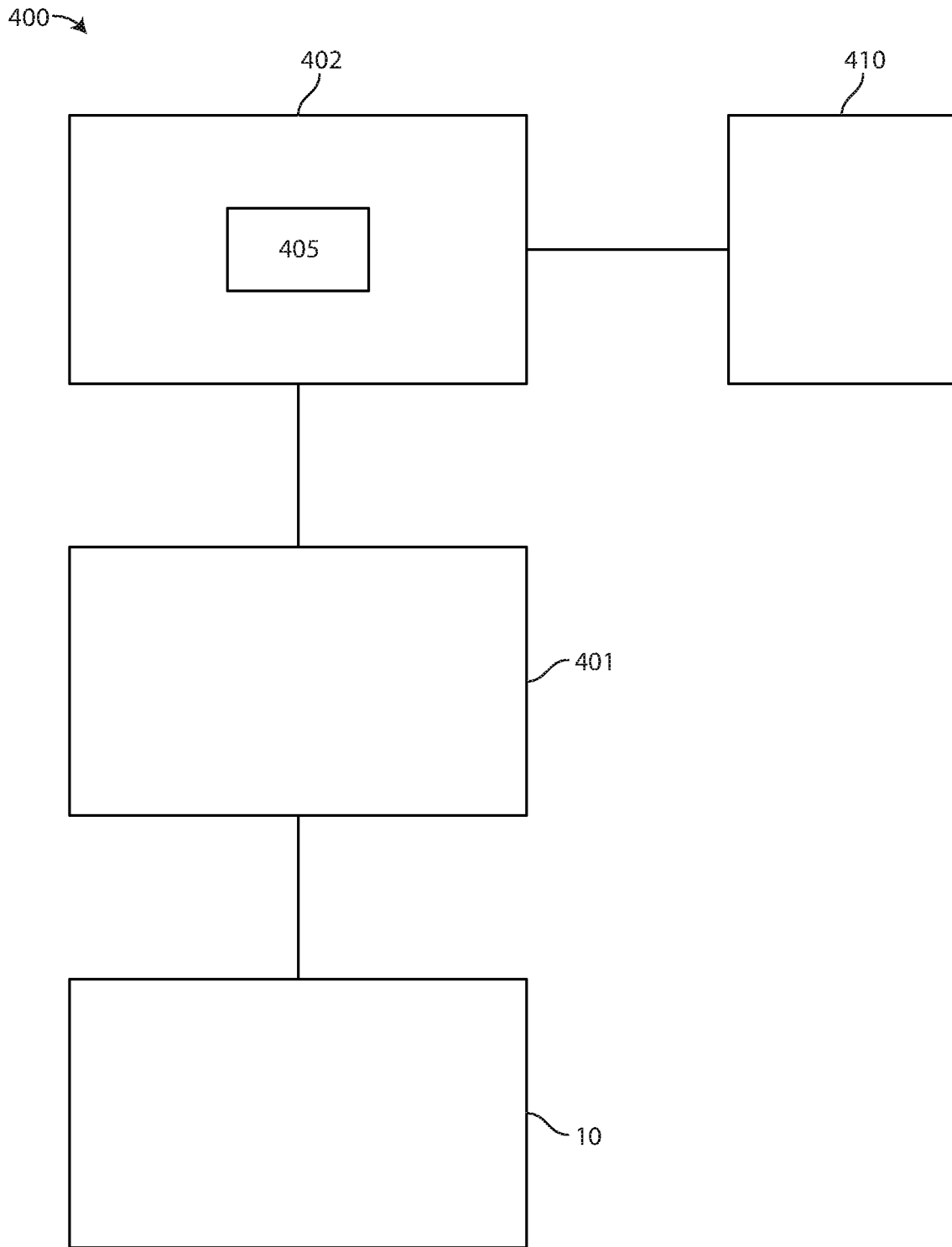


FIG. 32

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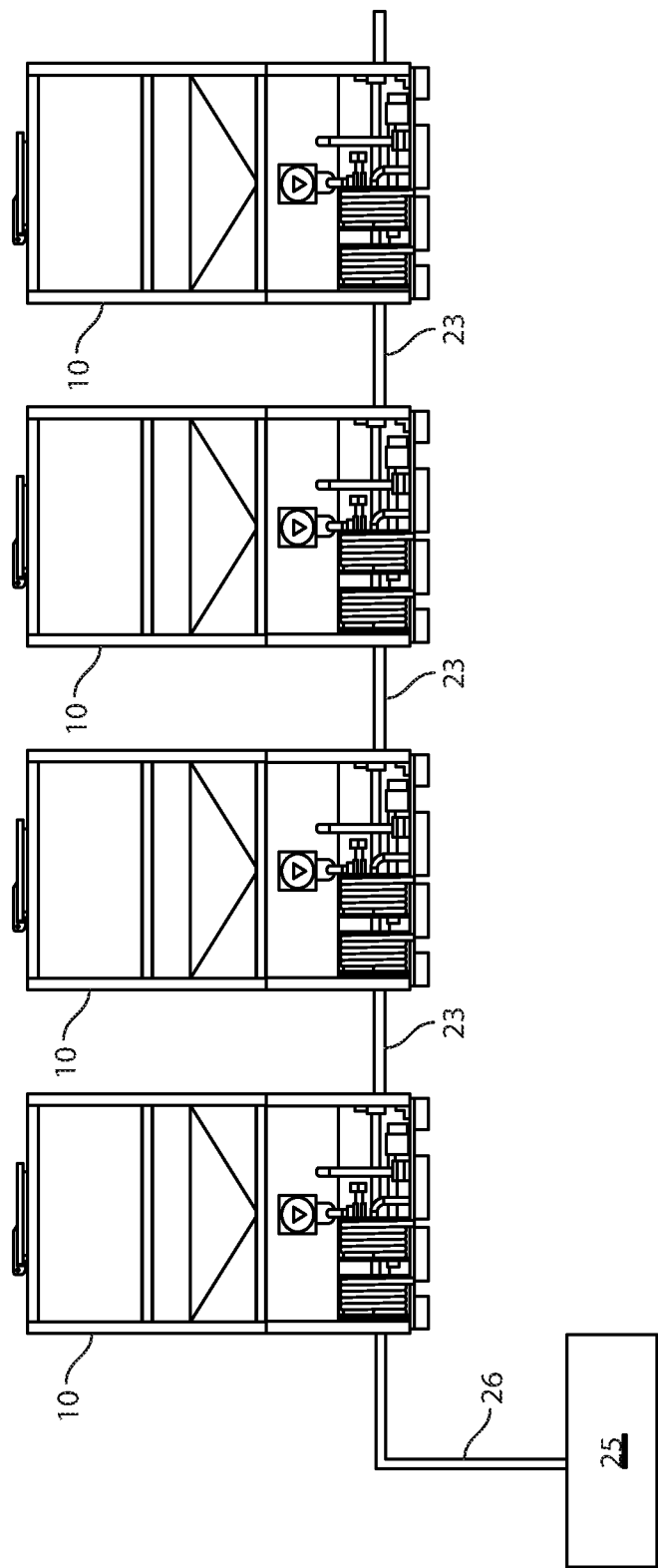


FIG. 33

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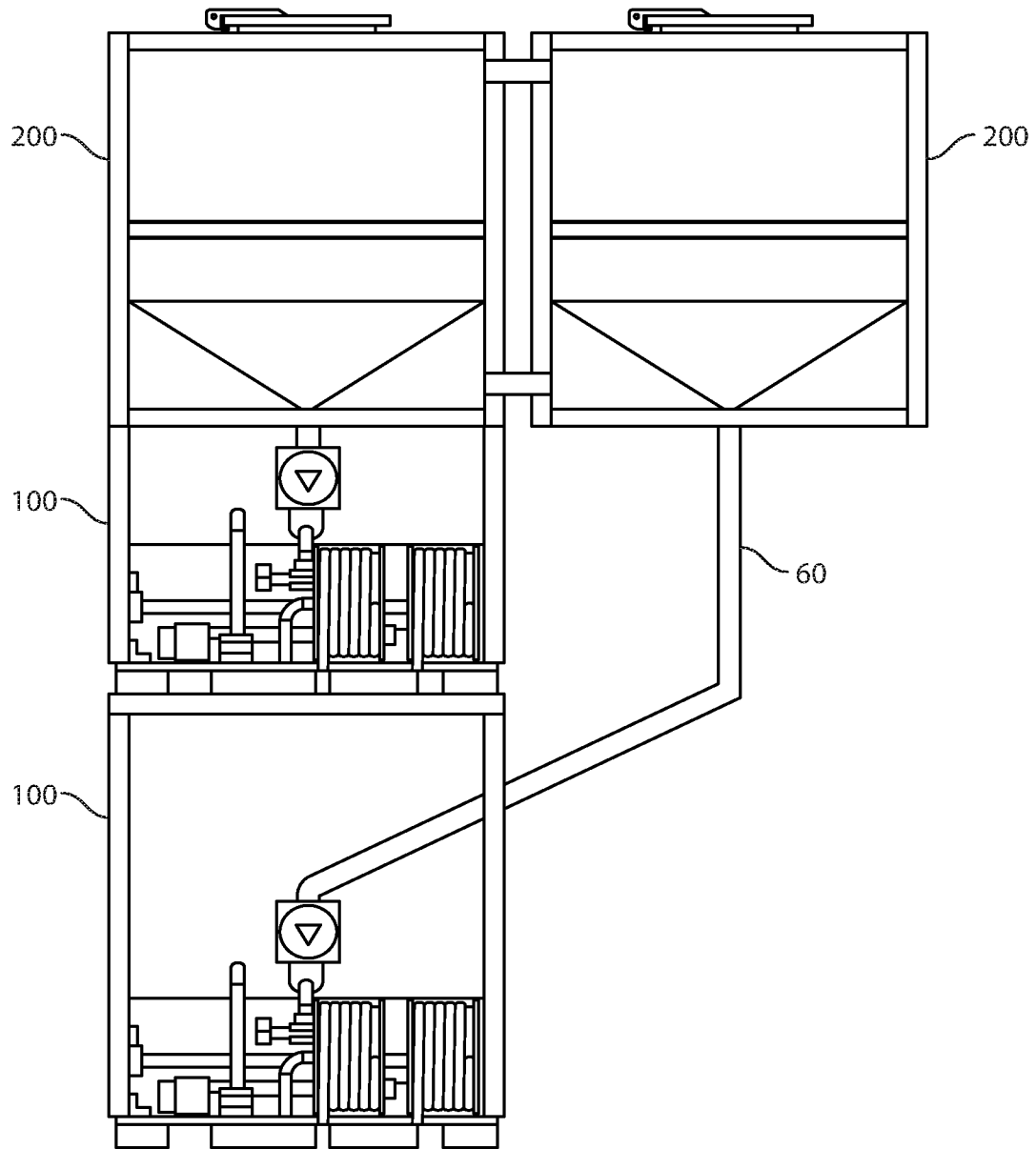


FIG. 34

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 19/13385

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B01F 13/00, B01F 13/10, B01F 3/12, C09K 8/68 (2019.01)

CPC - B01F 13/10, B01F 3/1271, B01F 5/0606, B01F 5/10, C09K 8/68, B01F 13/0035

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History Document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

See Search History Document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,114,239 A (ALLEN) 19 May 1992 (19.05.1992), Fig 1-3; col 6, ln 26-29; col 7, ln 20-22; col 7, ln 62-65; col 8, ln 8-col 9, ln 16	1-3, 6-9, 12, 13 ----- 4, 5, 10, 11
Y	US 2014/0364344 A1 (WEINSTEIN et al.) 11 December 2014 (11.12.2014), Fig 1, 2; para [0003], [0004], [0016], [0019]-[0025]	4, 5, 10, 11
A	US 2014/0041317 A1 (SCHLUMBERGER TECHNOLOGY CORPORATION) 13 February 2014 (13.02.2014), Fig 1-3; para [0003], [0004], [0036], [0037], [0056]	1-13
A	US 2017/0259223 A1 (ECOLAB USA INC.) 14 September 2017 (14.09.2017), entire document	1-13
A	US 2008/0264641 A1 (SLABAUGH et al.) 30 October 2008 (30.10.2008) entire document	1-13
A	US 4,715,721 A (WALKER et al.) 29 December 1987 (29.12.1987), entire document	1-13
A	US 9,022,120 B2 (ZAMORA et al.) 05 May 2015 (05.05.2015), entire document	1-13
A	US 4,159,180 A (COOPER et al.) 26 June 1979 (26.06.1979), entire document	1-13

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

* Special categories of cited documents:

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

25 March 2019

Date of mailing of the international search report

10 APR 2019

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