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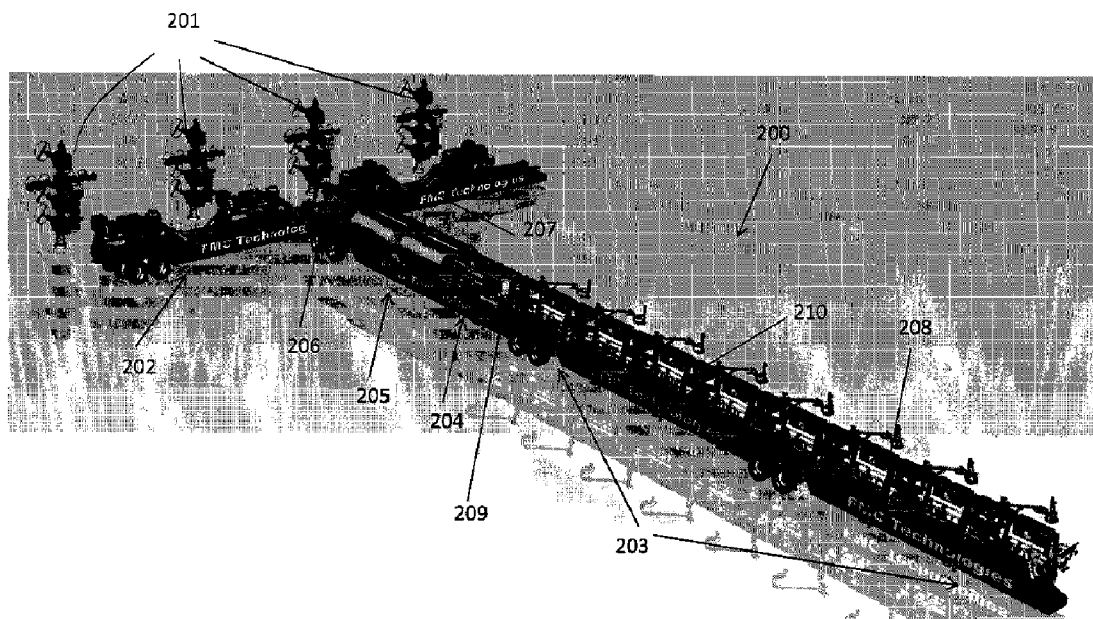
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(54) Titre : STRUCTURE DE COUSSIN DE FRACTURATION MODULAIRE

(54) Title: MODULAR FRACTURING PAD STRUCTURE



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(57) Abrégé/Abstract:

A modular pad system includes a plurality of connected-together modular skids, wherein each of the modular skids has a frame and a primary manifold connection with a primary inlet, a primary outlet and one or more primary flow paths extending therebetween, wherein the frame of each modular skid has a mounting footprint having substantially the same size, and wherein the primary manifold connection of each modular skid are connected together to fluidly connect the modular skids together.

ABSTRACT

A modular pad system includes a plurality of connected-together modular skids, wherein each of the modular skids has a frame and a primary manifold connection with a primary inlet, a primary outlet and one or more primary flow paths extending therebetween, wherein the frame of each modular skid has a mounting footprint having substantially the same size, and wherein the primary manifold connection of each modular skid are connected together to fluidly connect the modular skids together.

MODULAR FRACTURING PAD STRUCTURE

BACKGROUND

[0001] Hydraulic fracturing is a stimulation treatment routinely performed on oil and gas wells in low-permeability reservoirs. Specially engineered fluids are pumped at high pressure and rate into the reservoir interval to be treated, causing a vertical fracture to open. The wings of the fracture extend away from the wellbore in opposing directions according to the natural stresses within the formation. Proppant, such as grains of sand of a particular size, is mixed with the treatment fluid to keep the fracture open when the treatment is complete. Hydraulic fracturing creates high-conductivity communication with a large area of formation and bypasses any damage that may exist in the near-wellbore area. Furthermore, hydraulic fracturing is used to increase the rate at which fluids, such as petroleum, water, or natural gas can be recovered from subterranean natural reservoirs. Reservoirs are typically porous sandstones, limestones or dolomite rocks, but also include "unconventional reservoirs" such as shale rock or coal beds. Hydraulic fracturing enables the extraction of natural gas and oil from rock formations deep below the earth's surface (e.g., generally 2,000–6,000 m (5,000–20,000 ft)), which is greatly below typical groundwater reservoir levels. At such depth, there may be insufficient permeability or reservoir pressure to allow natural gas and oil to flow from the rock into the wellbore at high economic return. Thus, creating conductive fractures in the rock is instrumental in extraction from naturally impermeable shale reservoirs.

[0002] A wide variety of hydraulic fracturing equipment is used in oil and natural gas fields such as a slurry blender, one or more high-pressure, high-volume fracturing pumps and a monitoring unit. Additionally, associated equipment includes fracturing tanks, one or more units for storage and handling of proppant, high-pressure treating iron, a chemical additive unit (used to accurately monitor chemical addition), low-pressure flexible hoses, and many gauges and meters for flow rate, fluid density, and treating pressure. Fracturing equipment operates over a range of pressures and injection rates, and can reach up to 100 megapascals (15,000 psi) and 265 litres per second (9.4 cu ft/s) (100 barrels per minute).

[0003] As seen by the prior art in Figure 1, Figure 1 illustrates an example of an existing hydraulic fracturing pad system 100 (often referred to as a "frac pad" in the industry).

The fracturing pad system 100 includes at least one pump truck 102 connected to a missile manifold 104 via fluid connections 106. Additionally, a blending system 108 may be connected to the pump trucks 102 through one or more hoses 110 to supply proppant and other particulates to the pump trucks 102 to pump into the well (not shown) as part of the fracturing process. The missile trailer 104 may be connected to a valve structure 112 that, for instance, can include a safety valve that may open to relieve pressure in the system under certain conditions. The valve structure 112 may be connected to at least one manifold 114 through a pipe spool 116 that is a plurality of pipes flanged together, for instance. As can be seen from Figure 1, the fracturing pad system 100 includes many, non-uniform connections that must be made up and pressure tested, including the conduits to/from the pump trucks 102, missile trailer 104, and blending system 108. Furthermore, the connections between the missile manifold 104 and valve structure 112, and the pipe spool 116 between the valve structure 112 and the manifolds 114 are also non-uniform connections that must be made up and pressure tested. These connections take valuable time and resources on site. Additionally, the fracturing pad system 100 is generally not flexible regarding the number of pumps that can be used.

SUMMARY

[0004] This summary is provided to introduce a selection of concepts that are further described below in the detailed description. This summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in limiting the scope of the claimed subject matter.

[0005] In one aspect, the embodiments disclosed herein relate to a modular pad system that includes a plurality of connected-together modular skids, wherein each of the modular skids has a frame and a primary manifold connection with a primary inlet, a primary outlet and one or more primary flow paths extending therebetween, wherein the frame of each modular skid has a mounting footprint having substantially the same size, and wherein the primary manifold connection of each modular skid are connected together to fluidly connect the modular skids together.

[0006] In another aspect, the embodiments disclosed herein relate to a method of forming a modular pad system that includes connecting a first modular skid to a second modular skid, wherein each of the first and second modular skids a primary manifold

connection with a primary inlet, a primary outlet and one or more primary flow paths extending therebetween, and a frame, wherein the frames of the first and second modular skids have a substantially same mounting footprint, and connecting the primary manifold connection of the first and second modular skids together to fluidly connect the first and second modular skids together.

[0007] Other aspects and advantages will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

[0008] Figure 1 is a block diagram of an example of a conventional hydraulic fracturing pad system.

[0009] Figures 2A-2B are perspective views of a modular hydraulic fracturing pad system in accordance with one or more embodiments of the present disclosure.

[0010] Figures 3A-3C are perspective views of a trailer chassis in accordance with one or more embodiments of the present disclosure.

[0011] Figures 4A-4B are perspective views of an articulating fracturing arm (AFA) modular skid in accordance with one or more embodiments of the present disclosure.

[0012] Figures 5A-5B are perspective views of a power system modular skid in accordance with one or more embodiments of the present disclosure.

[0013] Figures 6A-6C are perspective views of a pop-off/bleed-off tank modular skid in accordance with one or more embodiments of the present disclosure.

[0014] Figure 7 is a perspective view of a well isolation modular skid in accordance with one or more embodiments of the present disclosure.

[0015] Figures 8A-8B are perspective views of a zipper manifold modular skid in accordance with one or more embodiments of the present disclosure.

[0016] Figures 9A-9C are perspective views of equipment modular skids in accordance with one or more embodiments of the present disclosure.

[0017] Figures 10A-10B are perspective views of equipment modular skids in accordance with one or more embodiments of the present disclosure.

DETAILED DESCRIPTION

[0018] In one aspect, embodiments disclosed herein relate to a modular fracturing pad system. The modular fracturing pad system may also be interchangeably referred to as a modular skid system in the present disclosure. As used herein, the term “coupled” or “coupled to” or “connected” or “connected to” may indicate establishing either a direct or indirect connection, and is not limited to either unless expressly referenced as such. Wherever possible, like or identical reference numerals are used in the figures to identify common or the same elements. The figures are not necessarily to scale and certain features and certain views of the figures may be shown exaggerated in scale for purposes of clarification.

[0019] A modular skid system, according to embodiments herein, is a system in which the elements of a hydraulic fracturing system are modularized and deployed on connectable modular skids that can be secured together to form an integrated fracturing structure capable of spanning from the outlet of a hydraulic fracturing pump to the wellhead. The hydraulic fracturing system elements are modularized in a way such that the primary manifolds/flow functionality is made up when the modular skids are connected. Further, the modularized hydraulic fracturing system elements may be held on units having standardized uniform connections, such that different types of hydraulic fracturing system element units may be connected together using the same connection type. The reduction of using non-uniform connections that must be made up and pressure tested may significantly reduce the complexity, design, time, and weight of the system. Additionally, a modular skid system may be used to direct fluid produced from or injected into a well. Furthermore, the modular skid system may be adapted for any operations in or around the well. For example, the modular skid system may be used for flow back operations, drill-out operations, well-logging operations, or any other post-drilling operations known in the art.

[0020] In some embodiments, multiple modular skids may be loaded onto and connected-together on a single chassis. In such embodiments, a chassis holding multiple rigged-up modular skids may be transported to a wellsite such that the equipment on the modular skids (e.g., junk catchers, desanders, choke manifolds, etc.) may all be pre-rigged and dropped on location in rigged-up condition. By using modular skid systems according to embodiments of the present disclosure to rig-up a wellbore

operations system, equipment may be pre-rigged and dropped on location in rigged-up condition, thereby reducing rig-up time in the field. As used herein, fluids may refer to proppant, liquids, gases, and/or mixtures thereof. Other instruments and devices, including without limitation, sensors and various valves may be incorporated within a modular hydraulic fracturing pad system.

[0021] Conventional hydraulic fracturing pad systems in the oil and gas industry typically consume a large amount of space and resources of a rig area. Conventional hydraulic fracturing pad systems may use elements that are individually designed and sized with pipes, flow lines, and other conduits being used to interconnect the conventional hydraulic fracturing pad systems. Furthermore, pipes, flow lines, and other conduits being used to interconnect the conventional hydraulic fracturing pad systems are not uniform and take valuable time to make up and pressure test. Additionally, the sheer number of pipes, hoses, and other fluid connections represent safety hazards for on-site workers. This additional need of more components needed to interconnect the conventional hydraulic fracturing pad systems adds to the weight, installation costs, and overall cost of the conventional hydraulic fracturing pad systems. However, using modular skid systems according to one or more embodiments of the present disclosure may overcome such challenges, as well as, provide additional advantages over conventional fracturing systems.

[0022] In one or more embodiments, a modular skid system may include purpose built, same-sized modular skids that are connected together to form a multi-functional super structure for use in fracturing operations. As used herein, purpose built modular skids may include modular skids having known and/or new equipment that serves a certain purpose or performs a certain job. For example, a modular skid according to embodiments of the present disclosure may have a known type of isolation valve mounted thereto or may have a new type of isolation valve mounted thereto, where at least one purpose of the purpose built modular skid is to selectively isolate flow or fluid through the modular skid. Other equipment types currently known and/or unknown in the art (e.g., as shown in some of the examples provided herein) may be utilized in modular skids according to embodiments of the present disclosure.

[0023] Modular skids according to embodiments of the present disclosure may have standardized uniform mounting footprints, whether same-type or different-type equipment is mounted to the modular skids. In other words, a modular skid system

according to embodiments of the present disclosure may include modular skids having same and/or different equipment configurations held on each modular skid, where each modular skid in the modular skid system may have the same mounting footprint. As used herein, a mounting footprint may refer to the size (width and length) of a base of a modular skid. Thus, in one or more embodiments, modular skids having different equipment units may have the same mounting footprint whether or not the different equipment units have different heights and/or elements of the different equipment units have different dimensions that swing or extend outward of the modular skid. For example, a modular skid system according to embodiments of the present disclosure may have a first modular skid with one or more elements of the equipment (e.g., a valve actuator or a valve connection flange) at a height above the first modular skid base and extending a distance outside of the first modular skid base width/length dimensions, and a second modular skid with an equipment unit configuration different from the first modular skid equipment, where both the first and second modular skids may have the same base width/length dimensions).

[0024] As described above, each modular skid in a modular skid system according to some embodiments of the present disclosure may have the same mounting footprint. However, in some embodiments, such as described in more detail below, a modular skid system may include one or more modular skids having a mounting footprint with one or more irregularities compared with the mounting footprints of the remaining modular skids, such that the modular skids in the modular skid system have substantially the same mounting footprints (i.e., have the same general widths and lengths not including the one or more irregularities). For example, in some embodiments, a modular skid system having modular skids with bases of the same general width and length and with connection points at axial ends of the base length may include a modular skid having base with an additional connection point extending past the width of the majority of the base, while the remaining modular skids in the modular skid system may have bases without such irregularities in the base width formed by an additional connection point.

[0025] The size of modular skids (including the size of modular skid mounting footprints, modular skid heights, equipment configurations arranged on the modular skids, etc.) may be selected based, for instance, on the size limitations of common transportation means, Department of Transportation (DOT) requirements (e.g., to meet

weight and size limits of loads being transported on roads by trailers), the type of function each modular skid is to perform, and/or to provide reduced cost and reduced time to manufacture. For instance, the size of the mounting footprint of modular skids may be selected so that three modular skids may fit end to end on a flatbed trailer. In some embodiments, the overall size of modular skids (including the mounting footprints and the size of the equipment held on the modular skids) may be selected such that one or more modular skids may be mounted to a flatbed trailer and also meet DOT regulations for transporting the loaded flatbed trailer.

[0026] For example, according to embodiments of the present disclosure, a modular skid may have a mounting footprint having a length ranging from, e.g., a lower limit selected from 7 ft, 10 ft or 14 ft to an upper limit selected from 14 ft or 28 ft, and a width ranging from, e.g., a lower limit selected from 4 ft, 6 ft or 8 ft to an upper limit selected from 6 ft, 8 ft, 10 ft, or 12 ft, where any lower limit may be used in combination with any upper limit. For example, in some embodiments, a modular skid may have a mounting footprint of about 8.5 ft wide and about 11.5 ft long. However, the dimensions of the mounting footprint of a modular skid may vary within the above-mentioned ranges or may be outside of the above-mentioned ranges, depending, for example, on the job the modular skid is designed to perform, DOT regulations, and/or other factors. For example, in some embodiments; the length of the mounting footprint for a modular skid may be designed to correspond with pump spacing when the modular skid is to be used in a pumping operation.

[0027] Further, in some embodiments, a modular skid may have a height ranging from, e.g., a lower limit selected from 2 ft, 4 ft or 6 ft to an upper limit selected from 10 ft, 14 ft, or 18 ft, where any lower limit may be used in combination with any upper limit. However, the height of a modular skid may be outside the above-mentioned ranges, depending, for example, on the job the modular skid is designed to perform, DOT regulations, and/or other factors. For example, in some embodiments, modular skids may be designed to have the same or different heights (depending on the types of equipment units being held on each modular skid), where the height of each of the modular skids may be about 10.6 ft or less. In instances where modular skids are being transported on a trailer (and DOT height regulations apply), the height of modular skids may be designed to be no greater than the regulation height minus the height of the trailer on which the modular skids are mounted to.

[0028] When modular skids according to embodiments of the present disclosure are connected together to form a modular skid system, different type equipment units held in different modular skids may also be connected together to form a manifold having a continuous flow path formed therethrough with limited connection. Thus, modular skids according to embodiments of the present disclosure may include substantially uniform mounting footprints in addition to equipment configured to align and/or connect with equipment in adjacently mounted modular skids.

[0029] Using modular skid systems according to embodiments of the present disclosure may reduce or eliminate the need for extensive non-uniform connections since the modular skid pad system is modularized and may be deployed on connectable skids to reduce the number of connections to other equipment. Further, modular skid systems according to embodiments of the present disclosure may be tailored to meet the specific job requirements needed (Rate, number of pumps, etc.), for example, by adding or subtracting a number of a certain purpose-type modular skid and/or by rearranging the connection pattern of modular skids. Overall, a modular skid system according to embodiments of the present disclosure may minimize product engineering, risk associated with non-uniform connections, reduction of assembly time, hardware cost reduction, and weight and envelope reduction.

[0030] Referring to Figures 2A-2B, Figures 2A-2B illustrates an example of a modular skid system 200 which connects to at least one wellhead 201. The modular skid system 200 couples with the at least one wellhead 201 by using at least one time and efficiency (TE) manifold modular skid or zipper manifold skid 202. A zipper manifold skid 202 refers to a modular skid that is purpose built for connection to a wellhead, which may include an outlet head (which may be referred to as a fracturing head or goat head in fracturing operations) for connection to the wellhead and one or more gate valves. The zipper manifold equipment may be arranged to fit on a modular skid frame having a selected mounting footprint, such that the base of the zipper manifold skid 202 may have a mounting footprint with a selected width and length.

[0031] Typically, spacing of the wellheads 201 is from 6 feet to 10 feet, and thus, the at least one zipper manifold skid 202 may be designed to align with known spacing of the wellheads 201. For example, the zipper manifold skids 202 may be designed to have a mounting footprint with a selected length that corresponds with an interval

between wellheads 201. Spacer skids 207 (modular skids that are purpose built to provide spacing between adjacent modular skids, which may include equipment to connect between the equipment in the adjacent modular skids) may be provided between the zipper manifold skids 202 to provide closer alignment of the spacing between the zipper manifold skids 202 with the spacing between the wellheads 201. If the wellheads 201 are spaced irregularly, one skilled in the art will appreciate how piping may be used to couple the wellheads 201 to the at least one zipper manifold skid 202. One skilled in the art will appreciate how the modular skid system 200 is not limited to a set number of wellheads 201. For example, additional zipper manifold skids 202 may be added to the modular skid system 200 to connect to additional wellheads 201.

[0032] In one or more embodiments, the modular skid system 200 may include at least one pump modular skid 203 such as, but not limited to, an articulating fracturing arm (AFA) modular skid. The pump modular skids 203 may be used in the oil and gas production industry to perform servicing operations on a well by connecting a system manifold to a pump. For example, in a well fracturing operation the pump modular skid 203 may be used to inject a slurry into the wellbore in order to fracture the hydrocarbon bearing formation, and thereby produce channels through which the oil or gas may flow, by providing a fluid connection between pump discharge and the modular skid system 200. In some embodiments, the pump modular skid 203 may use standard 3" connections with a plurality of piping (i.e., ground iron) running on the ground from a pump to the pump modular skid 203. In this operation, the pump skids 203 may connect a number of high pressure pumping units to the wellheads 201. The AFA manifold equipment may be arranged to fit on a modular skid having a selected mounting footprint, such that the base of the AFA skid 203 may have a mounting footprint with a selected width and length.

[0033] In one or more embodiments, the modular skid system 200 may include at least one auxiliary modular skid 204. The auxiliary skid 204 may provide a universal power and control unit, including a power unit and a primary controller of the modular skid system 200. Furthermore, the universal power and control unit within the auxiliary skid 204 may contain programmable logic controllers (PLC), sensors, and solar panel controllers. In one or more embodiments, a programmable logic controller monitors at least one sensor and makes decisions based upon a program to control the state of at

least one controllable element. Additionally, the auxiliary skid 204 may include one or more electronically controlled pressure relief valves (ePRV) which may be electrically powered and require no gas bottles or hoses. For example, an auxiliary modular skid may include a universal power and control unit and two ePRVs. The ePRV may pop open in the event power is lost, unless a battery backup is employed. The power manifold equipment may be arranged to fit on a modular skid frame having a selected mounting footprint, such that the base of the auxiliary skid 204 may have a mounting footprint with a selected width and length.

[0034] In one or more embodiments, the modular skid system 200 may include at least one pop-off/bleed-off tank modular skid 205. The pop-off/bleed-off tank modular skid 205 may be used in the oil and gas production industry to perform servicing operations on a well. For example, in a well fracturing operation the pop-off/bleed-off tank skid 205 may allow discharge pressure from bleed off/pop off operations to be immediately relieved and controlled. At the conclusion of high-pressure tests or treatments, the pressure within the associated systems must be bled off safely to enable subsequent phases of the operation to continue. The bleed off process must be conducted with a high degree of control to avoid the effect of sudden depressurization, which may create shock forces and fluid-disposal hazards. Thus, the pop-off/bleed-off tank skid 205 may equalize or relieve pressure from a vessel or system by collecting fluid bled-off from the system. The pop-off/bleed-off tank equipment may be arranged to fit on a modular skid frame having a selected mounting footprint, such that the base of the pop-off/bleed-off tank skid 205 may have a mounting footprint with a selected width and length.

[0035] In one or more embodiments, the modular skid system 200 may include at least one isolation modular skid 206. The isolation skid 206 may be used in the oil and gas production industry to perform servicing operations on a well. For example, in a well fracturing operation an isolation modular skid may be used to allow pump-side equipment and well-side equipment to be isolated from each other. Additionally, the isolation skid 206 may be capable of being simultaneously attached to multiple external holding vessels (e.g., pop-off/bleed-off tanks) and directing wellbore fluid bled-off from the well-side equipment or from the pump-side equipment to any of the external holding vessels. Furthermore, the isolation skid 206 may be connected to only one external holding vessel and may be capable of directing fluid from either the well-side equipment or from the pump-side equipment to the same external holding vessel. Thus,

the well isolation unit may provide more options for bleeding off well-side and pump-side equipment than traditional well isolation equipment. In the embodiment shown, the isolation skid 206 may include a bleed-off manifold fluidly connected to the pop-off/bleed-off tanks held in the pop-off/bleed-off tank skid 205, such that fluid bled off from the isolation equipment may be collected in the pop-off/bleed-off tanks.

[0036] Further, the isolation skid 206 may allow piping components with larger inner diameters than the piping components used in traditional wellbore operation systems to be used to perform wellbore operations. The well isolation unit disclosed herein may include automated valves. The isolation equipment may be arranged to fit on a modular skid frame having a selected mounting footprint, such that the base of the isolation skid 206 may have a mounting footprint with a selected width and length. The modular skids 202, 203, 204, 205, 206, 207 may align together to form a super structure. One skilled in the art will appreciate how the modular skid system 200 is not limited to a set number of modular skids but may have any number modular skids needed to perform a required job parameter.

[0037] In one or more embodiments, the modular skids 202, 203, 204, 205, 206, 207 may each include a primary manifold connection 210 with a single primary inlet and a single primary outlet and one or more primary flow paths extending therebetween mounted on same-sized A-frames 208 of the modular skids. Further, the primary manifold connections 210 extend a length of the modular skids 202, 203, 204, 205, 206, 207. The same-sized A-frames 208 have a base with frame beams extending upward from the base. Additionally, the frame beams are angled inward and are connected with a top beam to create an A shape. The top beam extends from one side of the same-sized A-frame 208 to another end of the same-sized A-frame 208. It is further envisioned the same-sized A-frame 208 may be any shape suitable to encompass the required equipment and is not limited to being the same-sized shape shown in Figures 2A and 2B. Furthermore, one skilled in the art will appreciate how the same-sized A-frames 208 may be formed from a base material such as metal, composite, plastic, or any material known in the art to be a suitable frame. Additionally, the A-frame 208 may be coated with any material known in the art to protect the base material. The primary manifold connections 210 and same-sized A-frame 208 allow for the number and order of the modular skids 202, 203, 204, 205, 206, 207 to be easily changed depending on hydraulic fracturing pad design considerations or well conditions. Additionally, the

primary manifold connections 210 may simplify the number of connections needed system wide, as the primary manifold connections 210 allows the modular skids 202, 203, 204, 205, 206, 207 to be in fluid communication via the primary manifold connections 210. Furthermore, Figure 2A shows the modular skids 202, 203, 204, 205, 206, 207 of the modular skid system 200 in a Tee configuration (i.e., forming a T-shape). In one or more embodiments, as shown in Figure 2B, the modular skids 202, 203, 204, 205, 206, 207 of the modular skid system 200 may be in a straight or linear configuration. One skilled in the art will appreciate how the modular skid system 200 is not limited to a set configuration and may be adapted to any configurations based on the job requirements.

[0038] According to embodiments of the present disclosure, a primary manifold connection may include piping or a body having one or more flow paths formed therethrough with a single inlet and a single outlet to the one or more flow paths. For example, when a primary manifold connection includes multiple flow paths (e.g., two or more flow paths run in parallel), secondary flow paths may branch off from a junction with a single inlet and/or may branch off from a junction with a primary flow path extending from the single inlet, and secondary flow paths may join at one or more junctions to a single outlet and/or primary flow path. In some embodiments, a primary manifold connection may include more than one primary inlet and/or more than one primary outlet with one or more primary flow paths extending therebetween.

[0039] As used herein, a flow path between a primary manifold connection may be referred to as a primary flow path. When multiple primary manifold connections (from multiple modular skids) are connected together to make up the primary flow functionality of a modular skid system, the connected-together primary manifold connections may form a primary flow path extending from one end of the modular skid system to another end of the modular skid system. For example, in the modular skid system shown in Figure 2A, the connected-together primary manifold connections 210 may provide a primary flow path extending from one or more pumps (at the pump skids 203) to the wellheads (at the zipper manifold modular skids 202).

[0040] As mentioned above, a primary flow path may include one or more secondary flow paths branching from and/or joining with the primary flow path extending between a single primary inlet and single primary outlet manifold connection. In some embodiments, one or more secondary flow paths may be used in different subsystems

of a modular skid system. For example, secondary flow paths may be formed through a bleed-off manifold in an isolation modular skid, and flow path(s) formed between a primary manifold connection of the isolation modular skid may form the primary flow path(s), where the primary flow path(s) may be used for transporting fluid from the pump side to the well side of the isolation modular skid, and where the secondary flow paths may carry fluid from the primary flow path(s) to be bled off (e.g., to a connected bleed-off tank or other external holding vessel). Accordingly, in some embodiments, secondary flow paths may have different outlets (referred to herein as secondary outlets) from the single primary outlet of a primary manifold connection. Further, in some embodiments, one or more secondary flow paths may have a different inlet (referred to herein as a secondary inlet) from the single primary inlet of the primary manifold connection. In some embodiments, such as described above, a secondary flow path may branch off and join a primary flow path within the distance between a single primary inlet and a single primary outlet of a primary manifold connection, such that the secondary flow path does not have a secondary inlet or secondary outlet.

[0041] According to embodiments of the present disclosure, one or more modular skids may have one or more secondary inlets and/or secondary outlets in addition to a primary manifold connection. In some embodiments, a secondary inlet of a modular skid may connect with a secondary outlet of an adjacent modular skid. In some embodiments, a secondary inlet and/or a secondary outlet of a modular skid may connect with an external vessel, which may or may not be modularized into a modular skid.

[0042] As described above, the term “primary” may be used for lines/manifold connections that are connected together to transport fluid from the pump to the well, while the term “secondary” can be used for lines/manifold that flow into or out of the primary lines/manifold connections, such as bleed offs, prime up lines, and / or chemical injections (Acid). In one or more embodiments of the present disclosure, when the primary manifold connections 210 of each modular skids are made up in the modular skid system 200, the connected-together primary manifold connections 210 provide a primary flow path extending from pump(s) (not shown) to wellheads 201, whereas the secondary lines/manifold do not. For example, the secondary lines/manifold may be used for priming. In priming, prime pumps may be used to circulate fluid through prime-up lines in a pump side system, but does not go all the way to the well. Additionally, secondary lines/manifold, such as chemical injection

lines, may be used to inject different chemicals into the primary lines/manifold. As such, the primary lines/manifold will typically be bigger than secondary lines/manifold.

[0043] According to embodiments of the present disclosure, the modular skid system 200 may be configured to a pressure rating of any job requirement. Specifically, a main pressure rating limitation of the modular skid system 200 may correspond with the wellheads 201, as known in the art. Furthermore, the modular skid system 200 may be rated up to 15,000 psi but is not limited to 15,000 psi (in some cases the pressure rating may go up to 20,000 psi or more). One skilled in the art will appreciate how the various equipment of the modular skid system 200 may have different pressure ratings. For example, a pump side (i.e., the isolation modular skid 206, pop-off/bleed-off tank modular skid 205, pump skid 203, and auxiliary modular skid 204) may have a pressure rating of 15,000 psi while the wellheads 201 and the zipper manifold skid 202 may have a pressure rating of 10,000 psi. In some embodiments, the pump side of the modular skid system 200 may be pressure rated higher than the wellheads 201 and the zipper manifold skid 202, which may have pressures ratings from 5,000 psi up to 15000 psi, for example, and can change from job to job.

[0044] According to embodiments of the present disclosure, a primary manifold connection may have an inner diameter ranging from, for example, 4 inches to 8 inches, such as about 7 inches. One skilled in the art will appreciate how the primary manifold connection is not limited to the range of 4 inches to 8 inches and may be any desired inner diameter based on the job requirements. As such, the primary manifold connection may be as small as $\frac{3}{4}$ inches (i.e., a 1" flow line) or as large as 30" (API 6A has regulations up to a 30" ID, 3000 PSI capacity). In some embodiments, the single primary inlet and the single primary outlet of a primary manifold connection may have inner bore diameters greater than the inner diameter of the one or more primary flow paths extending between the inlet and outlet. In such a case, the ends of the primary manifold connection may have an upset section to transition from a larger inner diameter at the ends to a smaller inner diameter. As stated above, the primary flow path will more than likely be larger than any of the secondary flow path lines. Typically, the primary flow path will be a 7-1/16" bore while the secondary lines may be 2" flow line iron (actual inner diameter 1.75").

[0045] Referring again to Figures 2A-2B, the modular skids 202, 203, 204, 205, 206, 207 of the modular skid system 200 may be mounted onto at least one trailer chassis

209 prior to deployment to the field. The modular skids 202, 203, 204, 205, 206, 207 may use ISO blocks and twist locks (not shown) to mount the modular skids to the at least one trailer chassis 209. In other embodiments, different connection types (such as mechanical fasteners) may be used to connect a modular skid to a chassis or other platform. Additionally, the modular skids may use an adhesive or be welded to the at least one trailer chassis 209. In some embodiments, the weight of the modular skid and connections to adjacent modular skids (e.g., manifold connections and/or frame connections) may be used to hold the modular skid on a trailer. Furthermore, the at least one trailer chassis 209 may be formed to have a surface with a plurality of grooves so that the same-sized A-frame 208 of the modular skids are designed to fit within the grooves.

[0046] Multiples trailer chassis 209 may be used depending on the number of modular skids being used. When using multiple trailer chassis 209, the trailer chassis 209 may be aligned and joined using similar technology to removable gooseneck trailers. In mounting the modular skids 202, 203, 204, 205, 206, 207 to the at least one trailer chassis 209, a field rig-up time may be significantly reduced. As stated above, the at least one trailer chassis 209 may allow for different configurations per job requirements. Additionally, in using the same-sized A-frame 208, the modular skids 202, 203, 204, 205, 206, 207 may have identical mounting footprints, regardless of function. However, it is further envisioned that the modular skids 202, 203, 204, 205, 206, 207 may be transported to the field and placed on a ground or other platform structure instead of using the at least one trailer chassis 209.

[0047] As seen by Figures 3A-3C, in one more embodiments, perspective views of a trailer chassis 300 is shown. The trailer chassis 300 has a top surface 301 adapted to be a carrier for the modular skids described in Figures 2A-2B. Furthermore, the top surface 301 may be configured to lock the modular skids in place with a plurality of ISO retractable twist locks 302 or any known locking device known in the art. Figure 3A illustrates the trailer chassis 300 utilizing a removable gooseneck 303 as known in the art. The removable gooseneck 303 may allow the trailer chassis 300 to be easily coupled to a motor vehicle (not shown) and removed if the trailer chassis 300 needs to be connected to a second trailer chassis 304 (shown in Figures 3B-3C).

[0048] Further, seen by Figures 3B-3C, a plurality of male connections 306 on the trailer chassis 300 may be inserted into a plurality of female connections 305 on the

second trailer chassis 304 to aid in proper alignment of the two trailers 300, 304. Furthermore, a plurality of trailer twist locks 307 on the trailer chassis 300 may engage and lock a plurality of ISO connection blocks 308 on the second trailer chassis 304, thereby, locking the two trailers 300, 304 together. It is further envisioned that the two trailers 300, 304 may be coupled together by a means of any mechanical fastener and not limited to the plurality of trailer twist locks 307 and the plurality of ISO connection blocks 308. Additionally, hydraulics may be used in conjunction or alone of the mechanical fastener. Furthermore, subsea connection technologies such as soft/hard landing may be used to couple the two trailers 300, 304. In some embodiments, the two trailers 300, 304 may be welded together or use adhesives.

[0049] According to embodiments of the present disclosure, a modular skid system may include a plurality of trailer chassis (e.g., as described Figures 3A-3C) adapted to be a carrier for modular skids according to embodiments of the present disclosure. Furthermore, the primary flow line of the modular skid system may be connected-together by physically attaching the plurality of trailer chassis together in the field. For example, a first modular skid may be mounted on a first trailer and a second modular skid may be mounted on a second trailer. The first modular skid may be connected to the second modular skid without removing the first modular skid from the first trailer or the second modular skid from the second trailer. Additionally, the connecting of the first modular skid to the second modular skid may include connecting the first trailer to the second trailer. It is further envisioned that the first modular skid on the first trailer may be connected to the second modular skid on the second trailer by using piping (i.e., ground iron) and with or without connecting the first trailer to second trailer.

[0050] As seen by Figures 4A-4B, in one more embodiments, a perspective view of pump skid or an articulating fracturing arm (AFA) modular skid 400 from two different sides is shown. While Figures 4A-4B illustrates articulating fracturing arm (AFA) modular skid 400, one skilled in the art would understand the AFA skid 400 may be configured to be a pump modular skid carrying other pump connecting equipment. For example, using a different pump modular skid, the plurality of AFA arms 403 may be replaced with a standard 3" connection. The AFA skid 400 may include a primary manifold connection 401 (e.g., primary manifold connection with a single primary inlet and a single primary outlet and one or more primary flow paths extending therebetween, such as described above) and a dual segment low pressure line 402 (which may have

secondary flow paths formed therethrough). The primary manifold connection 401 may be connected to a pump (not shown) on either side via the AFA arms 403 and may receive pressurized output from the pumps. Additionally, the dual segments low pressure line 402 may form two portions of a single low pressure manifold that receive particulates from a blending system (not shown) and provide particulates to fluid from the pumps through outlets. Furthermore, blenders (not shown) may operate anywhere from 0-150 psi, and a max of 120 BPM, and thus, the low pressure equipment may be rated higher than 150 psi for a safety factor. One skilled in the art would understand how the further away the pump is from the blender, the lower the pressure head can be at the pump. For example, if all the pumps are stroking, the first few pumps closest to the blender may have the greatest suction head and the ones further away may have less. Thus, the pumps may be run at different rates to compensate and prevent cavitation on the pumps with low suction head.

[0051] The dual segments low pressure line 402 has one end that is a low pressure hose 404 and an opposite end that is a low pressure header 405. One skilled in the art will appreciate how the low pressure hose 404 may allow flexibility in connecting the skids during rig-up operation. It is further envisioned that the dual segments low pressure line 402 may self-connect and not be limited having the low pressure hose 404 and the low pressure header 405. Furthermore, the low pressure header 405 may include vane (air) actuated butterfly valves 409. Further seen by Figures 4A-4B, the AFA skid 400 contains its own independent local hydraulic accumulator 406 for shock absorption. Additionally, a local power station 407 may be powered by a solar panel 408, which may provide power to work area flood lights (not shown). In some embodiments, the local power station 407 may include at least one programmable logic controllers (PLC), at least one sensor, and other electronics to aid in communicating directly with the automation of the AFA skid 400. Additionally, a hydraulically actuated 3" ULT Valve 410 may be connected to the AFA arms 403 and the primary manifold connection 401. Also seen by Figures 4A-4B are a plurality of ISO connection blocks 411 which may engage with the plurality of ISO retractable twist locks 301 (see Figure 3A) to lock the AFA skid 400 to the trailer chassis 300 (see Figure 3A).

[0052] According to embodiments of the present disclosure, Figure 4A illustrates a height 412, a width 413, and a length 414 of the AFA skid 400. For example, the width 413 may be 8 ½ feet and the length 414 may be 11 ½ feet. However, width 413 and the

length 414 is not limited to 8 ½ feet and 11 ½ feet respectively and may be any width or length to properly align the AFA skid 400 with the pumps or any other job requirements. Furthermore, the height 412 of the AFA skid 400 may be limited by a Department of Transportation (DOT) requirement. For example, in Texas the height limit is 14 feet of a total height of equipment mounted on a trailer chassis. As such, the height 412 of the AFA skid 400 may correspond with a height of a trailer that the AFA skid 400 sits on. For example, if the trailer sits 40 inches off the ground, the height 412 of the AFA skid 400 may not exceed 10.6 feet to comply with some DOT requirements (if the height 412 exceeds 10.6 feet, special permits are needed). Furthermore, the aforementioned dimensions of the AFA skid 400 may be used on any modular skids mentioned in the present application but are only shown in Figure 4A for simplicity purposes.

[0053] Now referring to Figures 5A-5B, in one or more embodiments, Figures 5A-5B illustrates an electronically controlled pressure relief valves (ePRV)/auxiliary modular skid 500 with a primary manifold connection 501 (e.g., a primary manifold connection with a single primary inlet and a single primary outlet and one or more primary flow paths extending therebetween, such as described above) that can be connected directly to another modular skid in any particular order. The auxiliary modular skid 500 may include a low pressure header 502 configured to couple to dual segment low pressure line 402 of the AFA skid 400 shown in Figures 4A-4B. The auxiliary skid 500 may have dual ePRVs 503 for redundancy. Furthermore, the auxiliary skid 500 may include an ePRV discharge iron 504 to discharge directly into a pop-off tank (not shown) or other external holding vessel. Additionally, hydraulically actuated isolation valves 505 may be used to connect the dual ePRVs 503 with the primary manifold connection 501. The auxiliary skid 500 may have a local power station 506, which may be powered by a solar panel 507. Further, hydraulic / air storage tanks 508 may be used on the auxiliary skid 500. Also seen by Figures 5A-5B are a plurality of ISO connection blocks 509 which may engage with ISO retractable twist locks (e.g., locks 301 in Figure 3A) to lock the power skid 500 to a trailer chassis (e.g., trailer chassis 300 in Figure 3A) or other mounting structure. One skilled in the art will appreciate how the power skid 500 may have an onboard power unit 510, such as an EnPac unit, to provide hydraulic/air/electricity for the entire modular hydraulic fracturing pad system. The local power station 506 may run off of battery/solar system primarily, but may use the

onboard power unit 510 if the battery/solar system supply isn't sufficient. In some embodiments, the local power station 506 may include at least one programmable logic controllers (PLC), at least one sensor, and other electronics to aid in communicating directly with the automation of the auxiliary modular skid 500.

[0054] Now referring to Figures 6A-6C, in one or more embodiments, Figures 6A-6C illustrates a pop-off/bleed-off tank modular skid 600 with a primary manifold connection 601 (e.g., a primary manifold connection with one or more primary inlets, one or more primary outlets and one or more primary flow paths extending therebetween) that can be connected directly to another modular skid in any particular order. The pop-off/bleed-off tank skid 600 may collect all discharge energy from bleed off/pop off operations (via a bleed off inlet 606 or a pop off inlet 604 in tank 603) to provide immediate relief and control. It is further envisioned a smart fluid level technology (not shown) may be used in a tank 603 to detect need for draining, leak detection from ePRV or bleed off systems, etc. Further, a drain valve may be disposed near a bottom of the tank 603. Additionally, the pop-off/bleed-off tank skid 600 may have a built-in baffle system 602 (See Figure 6C) to distribute pressure and force into the tank 603. The pop-off/bleed-off tank skid 600 has the ability to be daisy chained in the modular hydraulic fracturing pad system for increased capacity. Additionally, more than one pop-off/bleed-off tank skid 600 may be provided in a modular hydraulic fracturing pad system. One skilled in the art will appreciate how the pop-off/bleed-off tank skid 600 provides the capability to remove iron (piping connections) from the ground (where without the pop-off/bleed-off tank modular skid, iron must be ran to an open top/tank on location). Furthermore, the pop off inlet 604 may couple to the ePRV discharge iron 504 of the auxiliary modular skid 500 (not shown). Additionally, the bleed off inlet 606 may couple to an isolation modular skid (not shown). Also seen by Figures 6A-6C are a plurality of ISO connection blocks 607 which may engage with the plurality of ISO retractable twist locks to lock the pop-off/bleed-off tank skid 600 to a trailer chassis or other mounting platform.

[0055] Referring now to Figure 7, in one or more embodiments, Figure 7 illustrates an isolation modular skid 700 with a primary manifold connection 701 that can be connected directly to another modular skid. The isolation skid 700 may include an integrated automated bleed-off manifold having one or more valved bleed-off outlets 702 (e.g., two bleed-off outlets 702 shown in Figure 7) configured to couple to the bleed

off inlet of an external holding vessel (e.g., the bleed off inlet 606 of the pop-off/bleed-off tank skid 600 shown in Figures 6A-6C). Additionally, the integrated automated bleed-off manifold may have one or more connections 703 for connecting the bleed-off manifold to other bleed-off pathways in the modular skid system. Furthermore, the isolation skid 700 may have at least one hydraulically actuated 4" ULT valve 704 and at least one 4" check valve 705. Advantageously, the isolation skid 700 may remove all treating lines from the modular hydraulic fracturing pad system, integrates with the pop-off/bleed-off tank pod 600 (see Figures 6A-6C), bleeds well side or pump side independently to one or more bleed-off outlets, and optionally to a connected bleed-off tank (e.g., tank 603 in Figures 6A-6C). Also seen by Figure 7 is a plurality of ISO connection blocks 706 which may engage with a plurality of ISO retractable twist locks to lock the isolation skid 700 to a trailer chassis or other mounting platform.

[0056] Now referring to Figures 8A-8B, in one or more embodiments, Figures 8A-8B illustrates a time and efficiency (TE) manifold modular skid, also referred to as a zipper manifold modular skid 800 with a primary manifold connection 801 that can be connected directly to another modular skid. A gate valve 802 may be provided on the primary manifold connection 801 to divert flow into the TE manifold skid 800 (which may prevent "Sand-Offs" of unused mainline). Furthermore, the zipper manifold skid 800 may save space by using a dual valve block 803 (e.g., which may include one manual valve 804 and one hydraulic valve 805) to open/close flow to a specific well (not shown). Additionally, a goat head 806 (also referred to as a frac head in the industry) may hang off a side of the zipper manifold skid 800 for easy ground access for rigging up to the well. One skilled in the art will appreciate how the modular hydraulic fracturing pad system may have multiple zipper manifold skids 800, as needed per job requirements. Also seen by Figures 8A-8B are a plurality of ISO connection blocks 807 which may engage with a plurality of ISO retractable twist locks to lock the zipper manifold modular skid 800 to a trailer chassis or other mounting platform.

[0057] Now referring to Figures 9A-9C, in one or more embodiments, Figures 9A-9C illustrates different equipment modular skids with a primary manifold connection 901 that can be connected directly to another modular skid in any particular order. In Figure 9A, a spacer modular skid 900 is shown that is configured to allow proper equipment spacing when needed in the modular skid system. Further, Figures 9B and 9C illustrate

a Tee configuration modular skid 902 which includes a tie-in valve 903 connected to a Tee manifold connection 906 to allow the modular skid system to be reconfigured for different pad layouts/requirements. The manifold connection of the Tee configuration modular skid 902 may be referred to as a Tee manifold connection, as the primary flow path extending between an inlet and an outlet has a third access point (via the tie-in valve). The inlet, the outlet and/or the tie-in valve of the Tee manifold connection may be connected to an adjacent primary manifold connection to provide the primary flow functionality of a modular skid system. Additionally, Figure 9C shows a trailer tie-in 904 to allow the Tee configuration modular skid 902 to secure to a trailer chassis. Also seen by Figures 9A-9C are a plurality of ISO connection blocks 905 which may engage with a plurality of ISO retractable twist locks to lock the spacer modular skid 900 or the Tee configuration skid 902 to a trailer chassis or other mounting platform.

[0058] Further seen by Figures 10A-10B, in one or more embodiments, Figures 10A-10B illustrates an example of a post-drilling operation modular skid 1000 with a plurality of equipment 1001 mounted on a trailer 1002. The post-drilling operation skid 1000 may connect to the at least one wellhead, for example, using piping. One skilled in the art will appreciate how the plurality of equipment 1001 of the post-drilling operation skid 1000 may include equipment required for flow back operations, drill-out operations, well-logging operations, or any other post-drilling operations known in the art.

[0059] According to embodiments of the present disclosure, an axial end of a primary manifold connection on a modular skid may be connected to a tie-in valve of a Tee manifold connection on an adjacent Tee configuration modular skid to provide a perpendicular turn in the configuration of a modular skid system. In some embodiments, more than one Tee configuration modular skid may be used in a modular skid system to provide multiple perpendicular turns in the configuration of a modular skid system. In some embodiments, a Tee manifold connection may not be used, where a modular skid system may be made up of connected-together modular skids having a linear configuration.

[0060] In one or more embodiments, a modular skid system can be deployed in at least two ways. In a first way, modular skids may be loaded onto a truck and unloaded on site via a crane, for instance. Once unloaded, the modular skids can be placed in proximity to one another and secured together, such as by bolts and/or hydraulics, to

form a unitary structure. The end portions (the primary inlet(s) and the primary outlet(s)) of primary manifold connections on the modular skids may be connected together by any known mechanisms, including flanges, clamps, grayloc hubs, KL4 connectors. In some embodiments, modular skids may be mounted and deployed on flatbeds. Primary manifold connections between multiple modular skids on a truck can be made up before the trucks are driven to the site. In the case that enough modular skids are required such that multiple trucks are needed, the primary manifold connection between the end modules of the trucks may be made up in the field.

[0061] While the present disclosure has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments may be devised which do not depart from the scope of the disclosure as described herein. Accordingly, the scope of the disclosure should be limited only by the attached claims.

CLAIMS

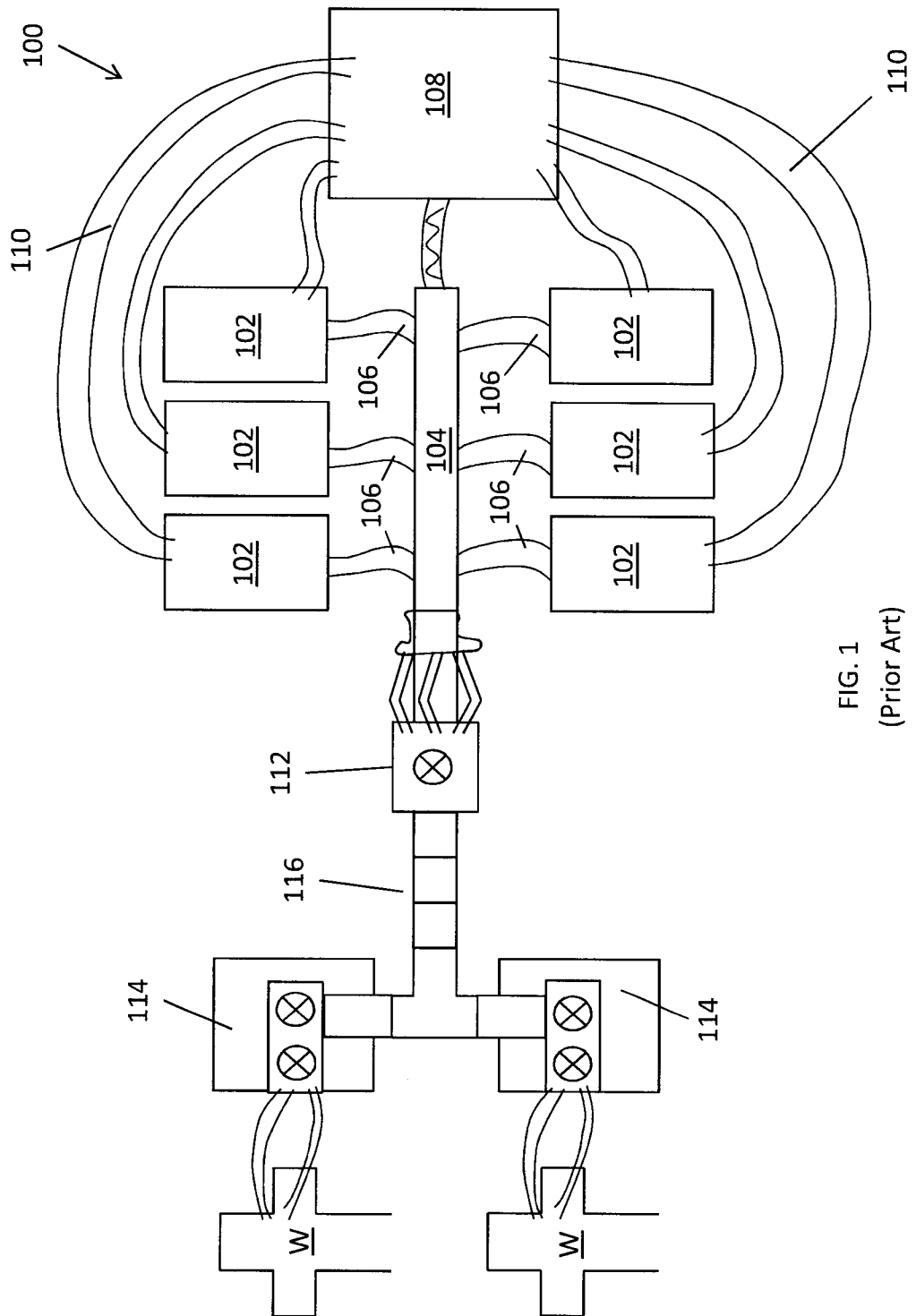
What is claimed:

1. A modular pad system, comprising:
a plurality of connected-together modular skids, wherein each of the modular skids comprises:
a frame; and
a primary manifold connection with a primary inlet, a primary outlet and one or more primary flow paths extending therebetween;
wherein the frame of each modular skid has a mounting footprint having substantially the same size; and
wherein the primary manifold connection of each modular skid are connected together to fluidly connect the modular skids together.
2. The system of claim 1, further comprising Tee configuration modular skid connected to the plurality of connected-together modular skids.
3. The system of claim 1, wherein the plurality of modular skids comprises any combination of at least one zipper manifold modular skid, at least one pump skid, at least one auxiliary modular skid, at least one pop-off/bleed-off tank modular skid, and / or at least one isolation modular skid, and at least one spacer skid.
4. The system of claim 3, wherein the least one auxiliary modular skid comprises a universal power and control unit to power the modular hydraulic fracturing pad system.
5. The system of claim 3, wherein the least one zipper manifold modular skid is coupled to at least one wellhead.
6. The system of claim 3, wherein the at least one pump skid is an articulating fracturing arm modular skid.
7. The system of claim 1, wherein the mounting footprint of a base of each modular skid comprises a selected length to correspond with wellhead spacing.

8. The system of claim 1, wherein the frame comprises a base with a plurality of frame beams extending upward from the base, wherein the plurality of frame beams are angled inward and are connected with a top beam to form an A-frame.
9. The system of claim 1, wherein the frame of each modular skid is directly in contact with an adjacent modular skid.
10. The system of claim 1, wherein a material of the frame is a metal, composite, or plastic material.
11. The system of claim 1, wherein the modular skids are aligned and connected together in an end-to-end manner to have a straight line configuration.
12. The system of claim 1, wherein the modular skids are aligned and connected together to have configuration with at least one perpendicular turn.
13. The system of claim 1, further comprising at least one trailer, wherein the modular skids are mounted to the at least one trailer.
14. The system of claim 13, wherein the modular skids are mounted to the at least one trailer via a plurality of ISO connection blocks provided on the modular skids connected to twist locks provided on the at least one trailer.
15. A method for forming a modular pad system, comprising:
 - connecting a first modular skid to a second modular skid, wherein each of the first and second modular skids comprises:
 - a primary manifold connection with a primary inlet, a primary outlet and one or more primary flow paths extending therebetween; and
 - a frame,
 - wherein the frames of the first and second modular skids have a substantially same mounting footprint; and
 - connecting the primary manifold connection of the first and second modular skids together to fluidly connect the first and second modular skids together.
16. The method of claim 15, further comprising connecting the frame of the first modular skid to the frame of the second modular skid to directly connect the first and second modular skids together.

17. The method of claim 15, further comprising connecting a third modular skid to the second modular skid, wherein the third modular skid comprises a third primary manifold connection and a third frame with the substantially same mounting footprint.
18. The method of claim 15, wherein the first and second modular skids further comprises at least one equipment unit mounted to the frame, the at least one equipment unit selected from any combination of a zipper manifold, an articulating fracturing arm, a universal power and control unit, a pop-off/bleed-off tank, and / or an isolation unit.
19. The method of claim 15, wherein the first and second modular skids are selected from any combination of a zipper manifold modular skid, an articulating fracturing arm manifold modular skid, an auxiliary modular skid, a pop-off/bleed-off tank modular skid, an isolation modular skid, a spacer modular skid, and / or a Tee configuration modular skid.
20. The method of claim 15, further comprising powering the modular pad system with a universal power and control unit provided by an auxiliary modular skid.
21. The method of claim 15, further comprising fluidly connecting the primary manifold connection of the first and second modular skids together to a well of a wellhead.
22. The method of claim 15, wherein the first and second modular skids are aligned in an end-to-end manner and connected together in a linear configuration.
23. The method of claim 15, further comprising:
connecting an axial end of the primary manifold connection in the first modular skid to a tie-in valve disposed along the primary manifold connection in the second modular skid to connect the first and second modular skids in a perpendicular configuration.
24. The method of claim 15, further comprising mounting the first and second modular skids on a trailer and transporting the connected-together first and second modular skids on the trailer.
25. The method of claim 15, further comprising mounting the first modular skid on a first trailer and mounting the second modular skid on a second trailer.

26. The method of claim 25, further comprising connecting the first modular skid to the second modular skid without removing the first modular skid from the first trailer or the second modular skid from the second trailer.
27. The method of claim 26, wherein connecting the first modular skid to the second modular skid comprises connecting the first trailer to the second trailer.



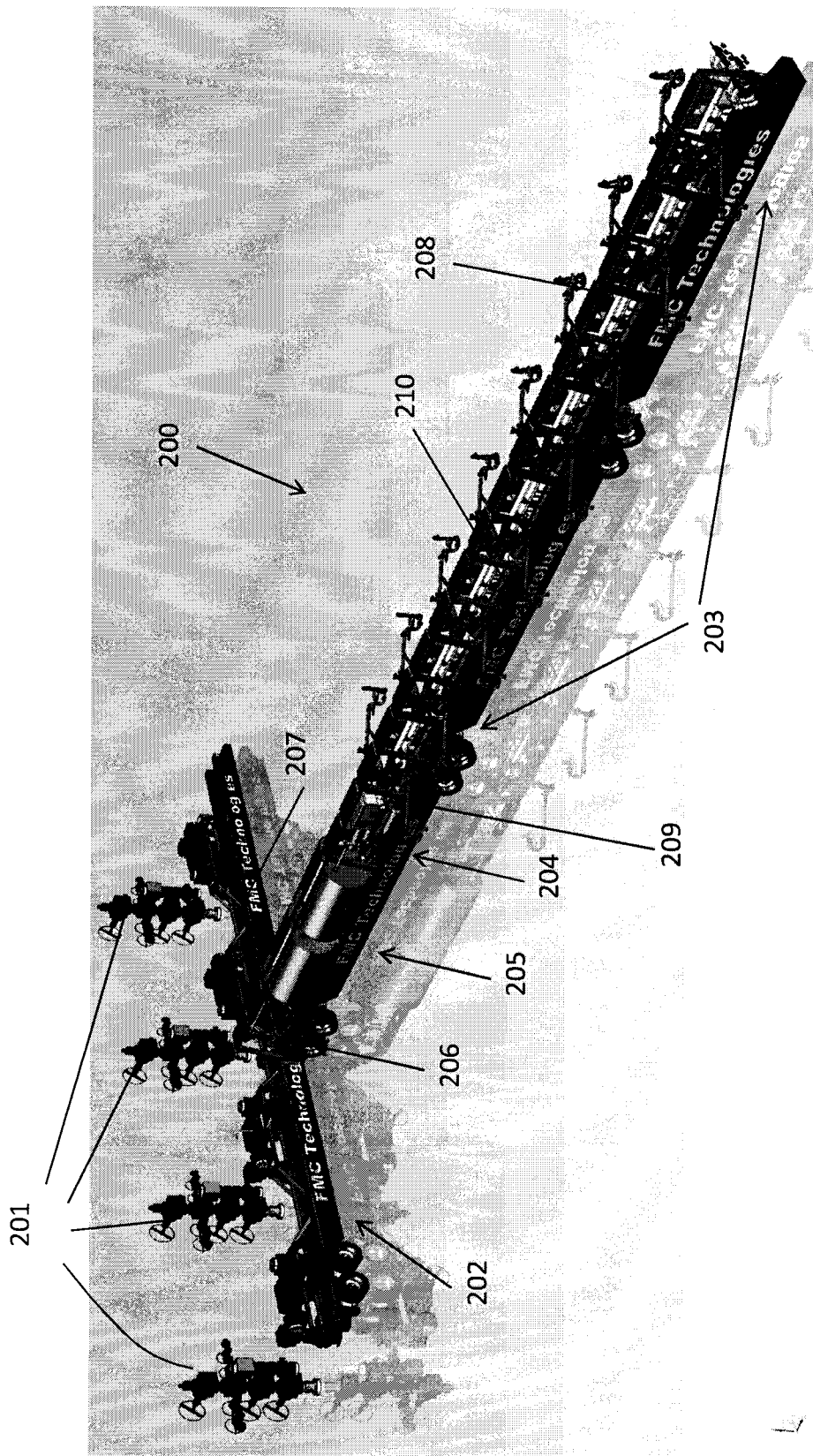


Figure 2A

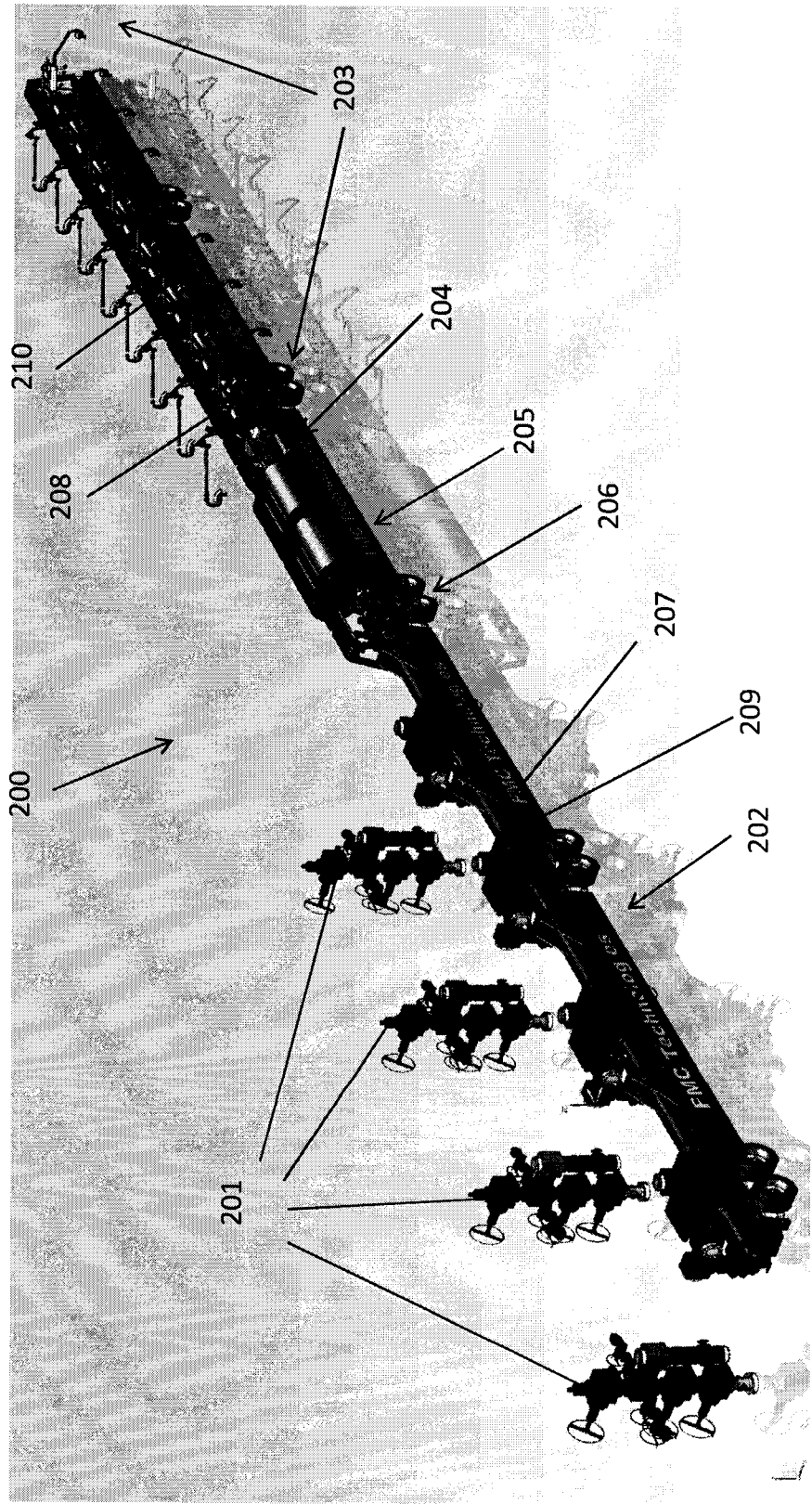


Figure 2B

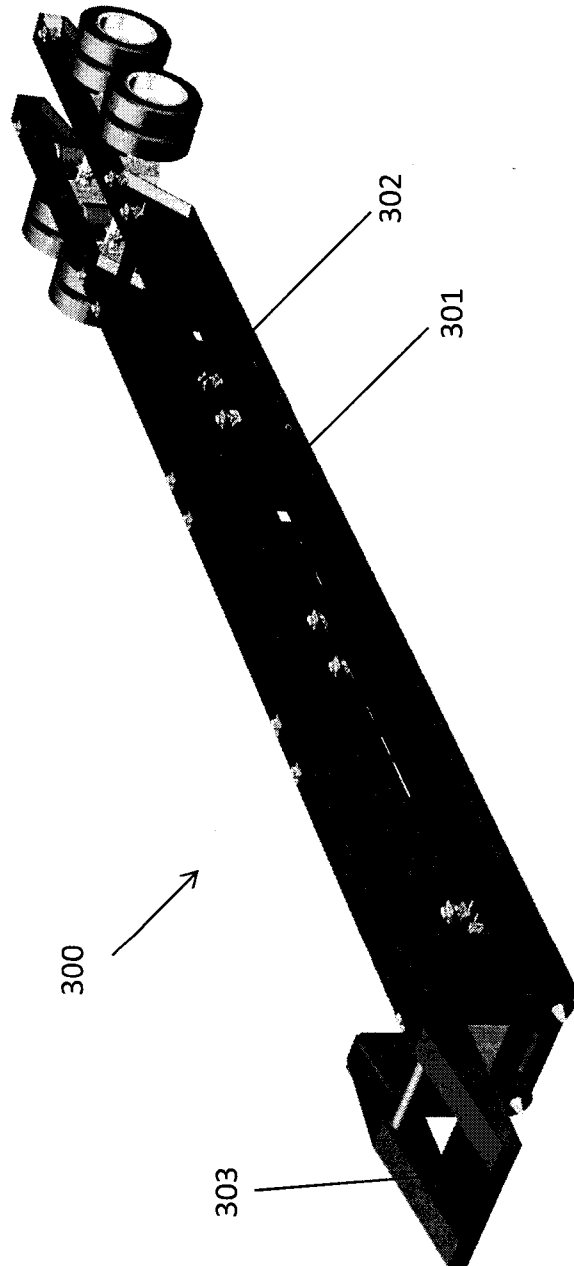
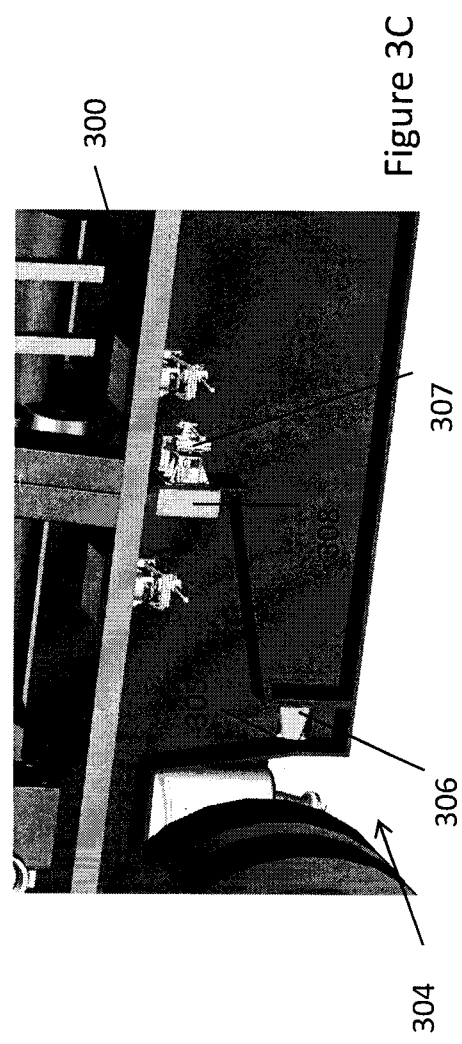
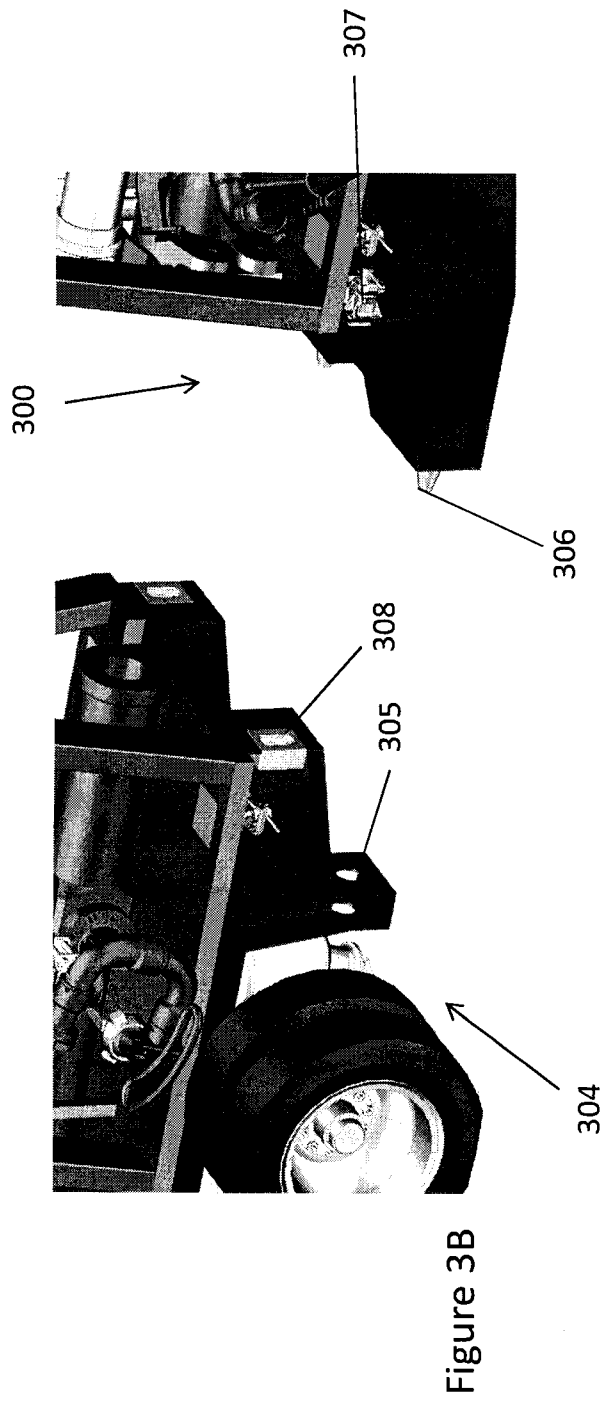


Figure 3A



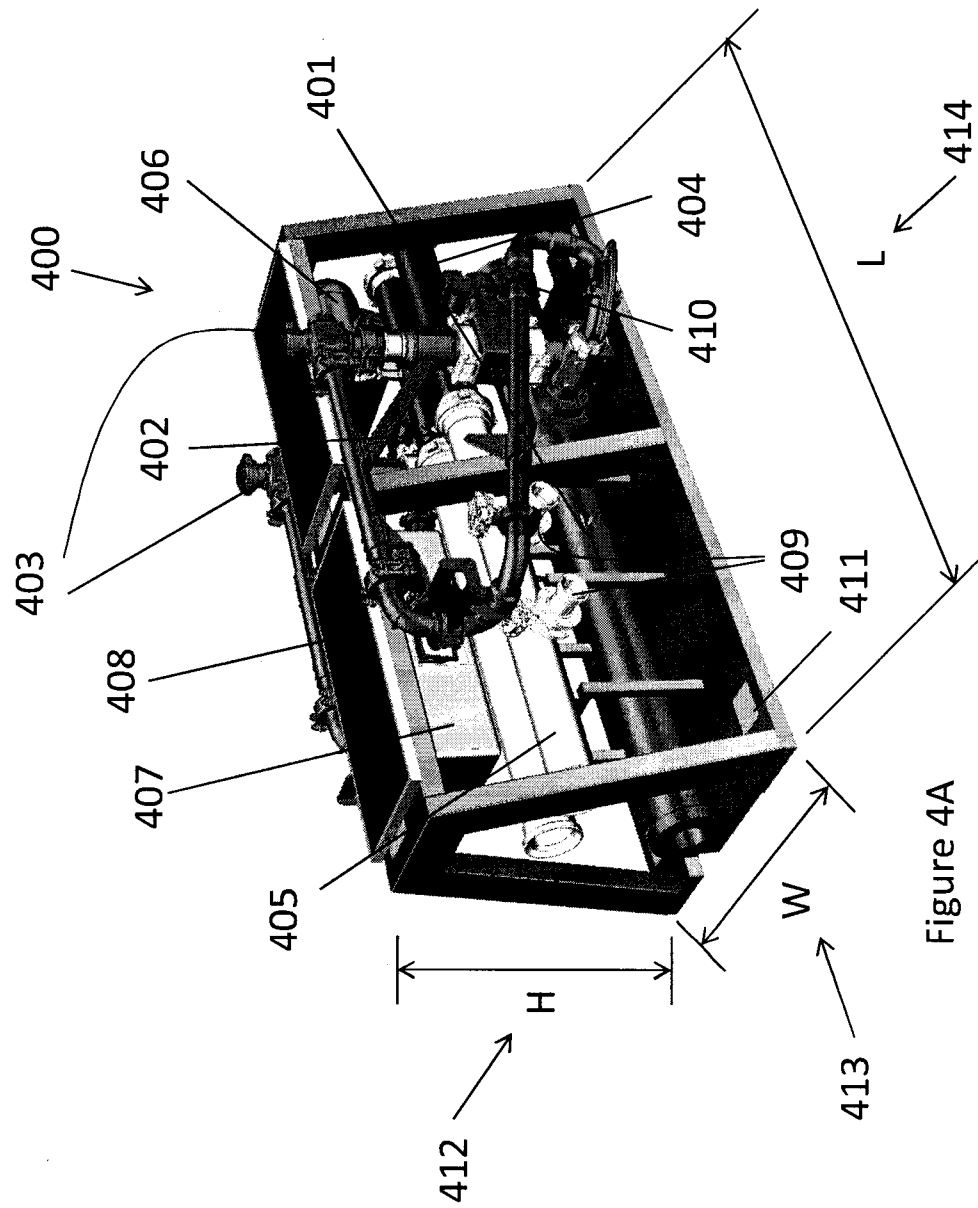


Figure 4A

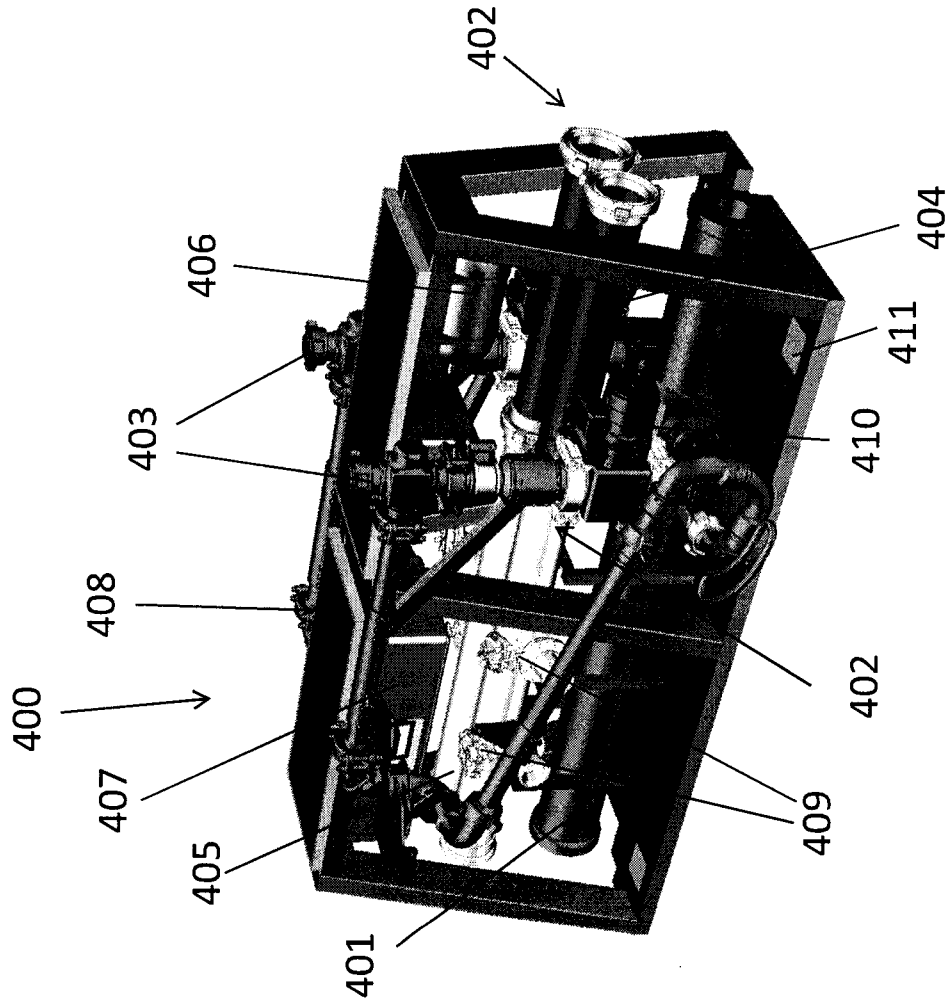


Figure 4B

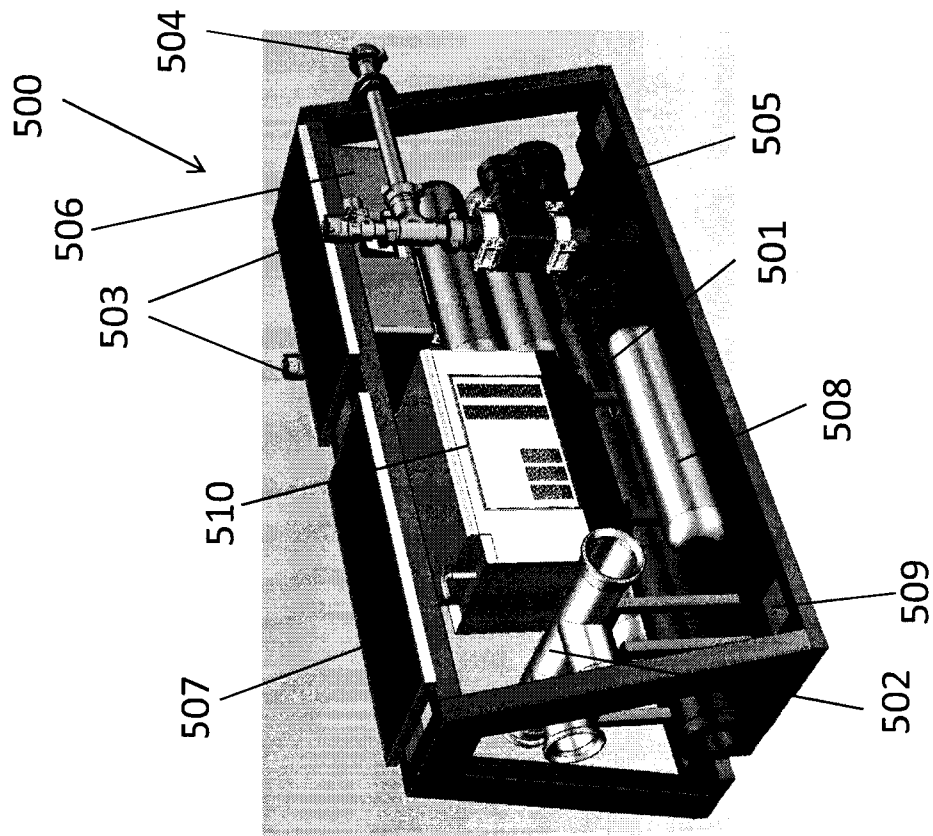


Figure 5A

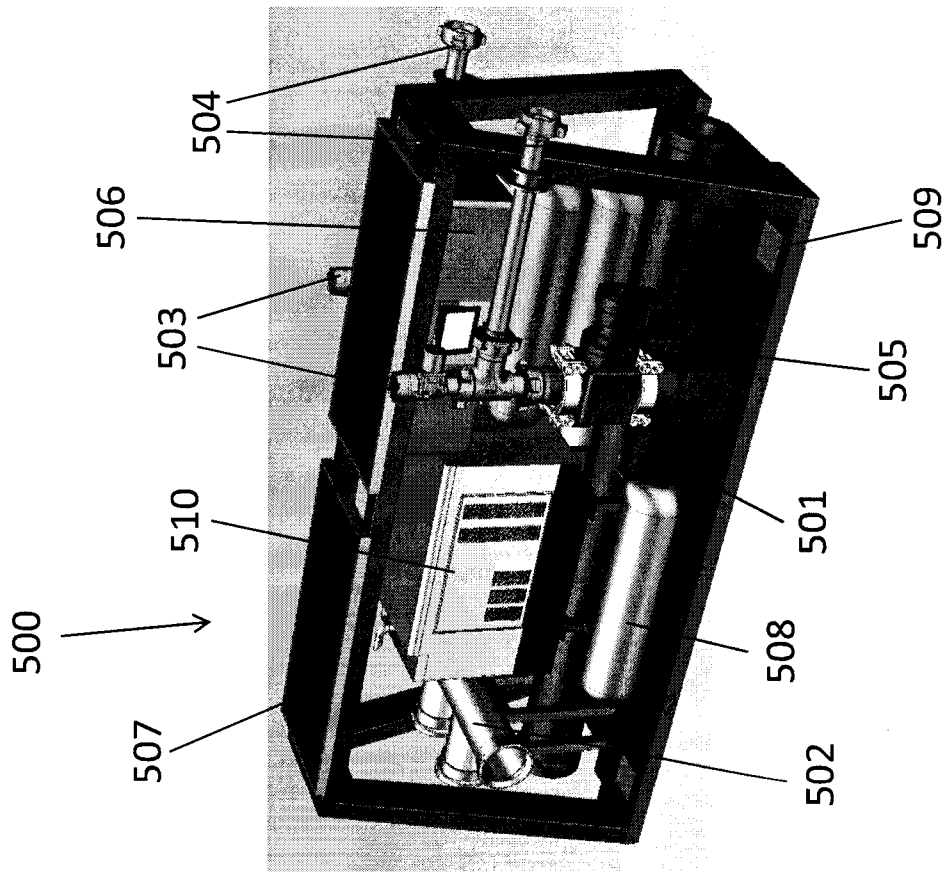
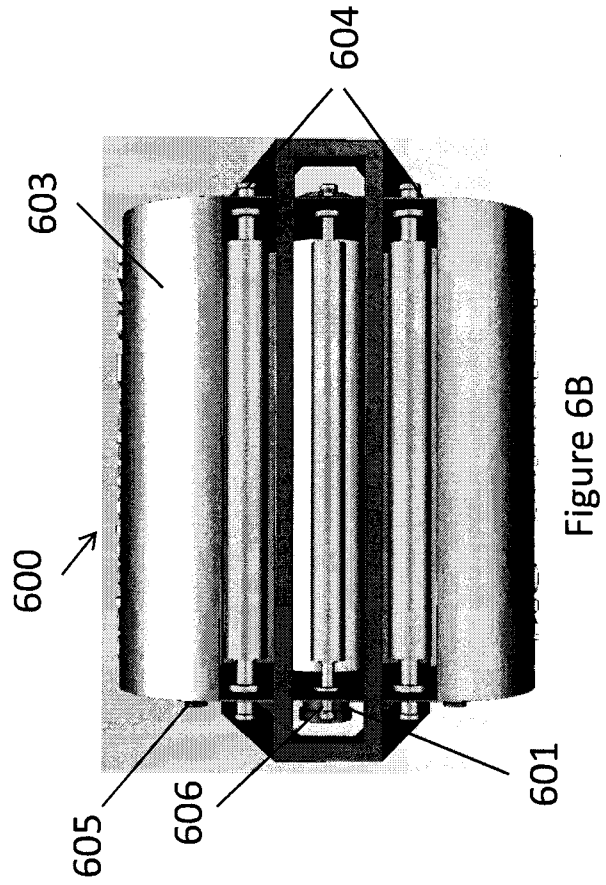
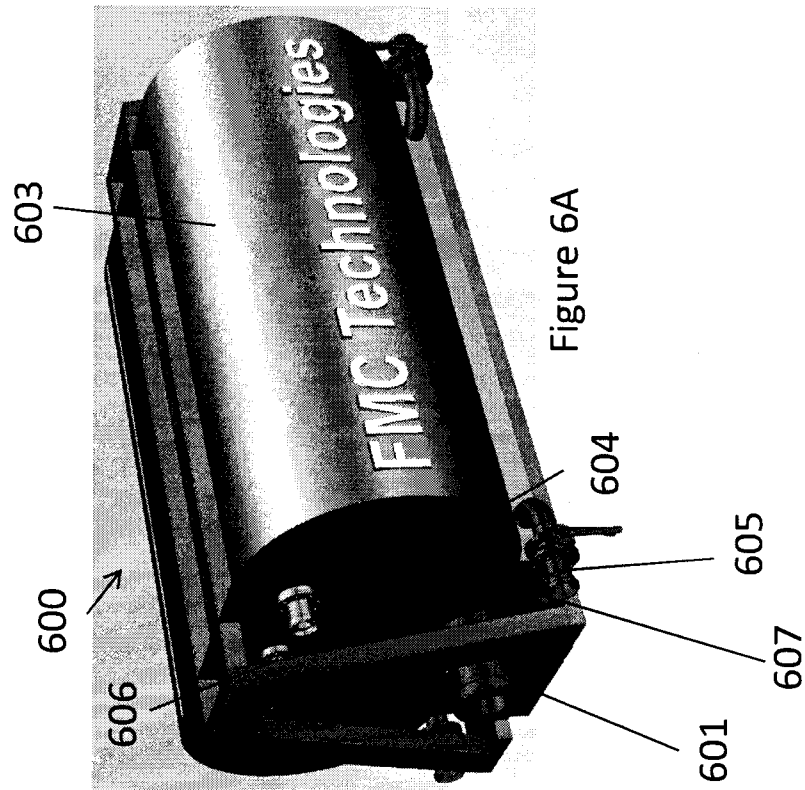
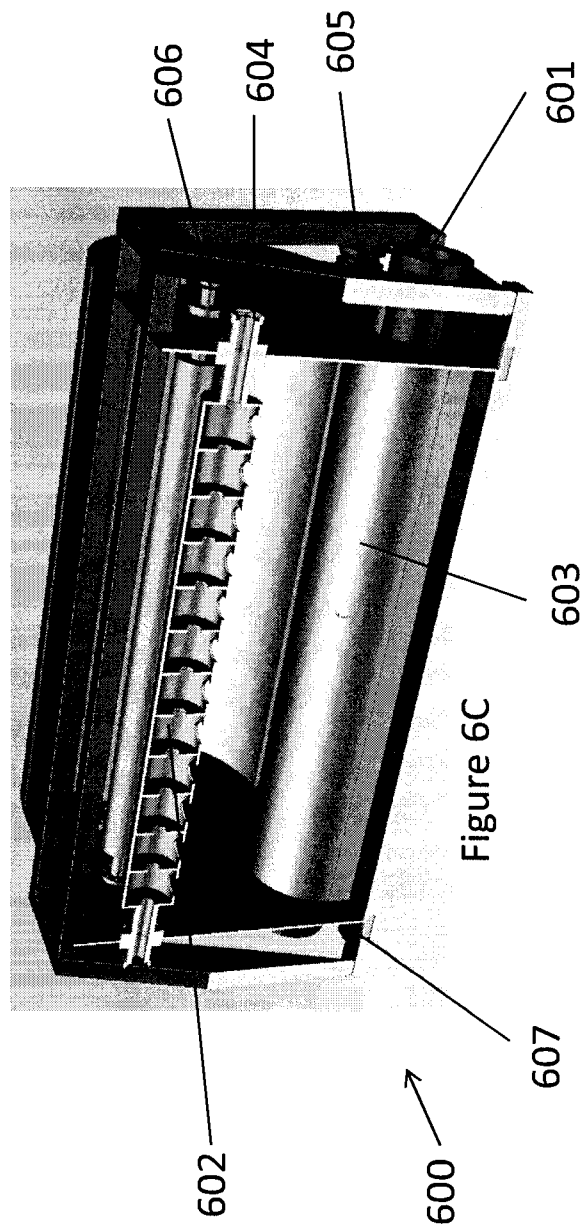
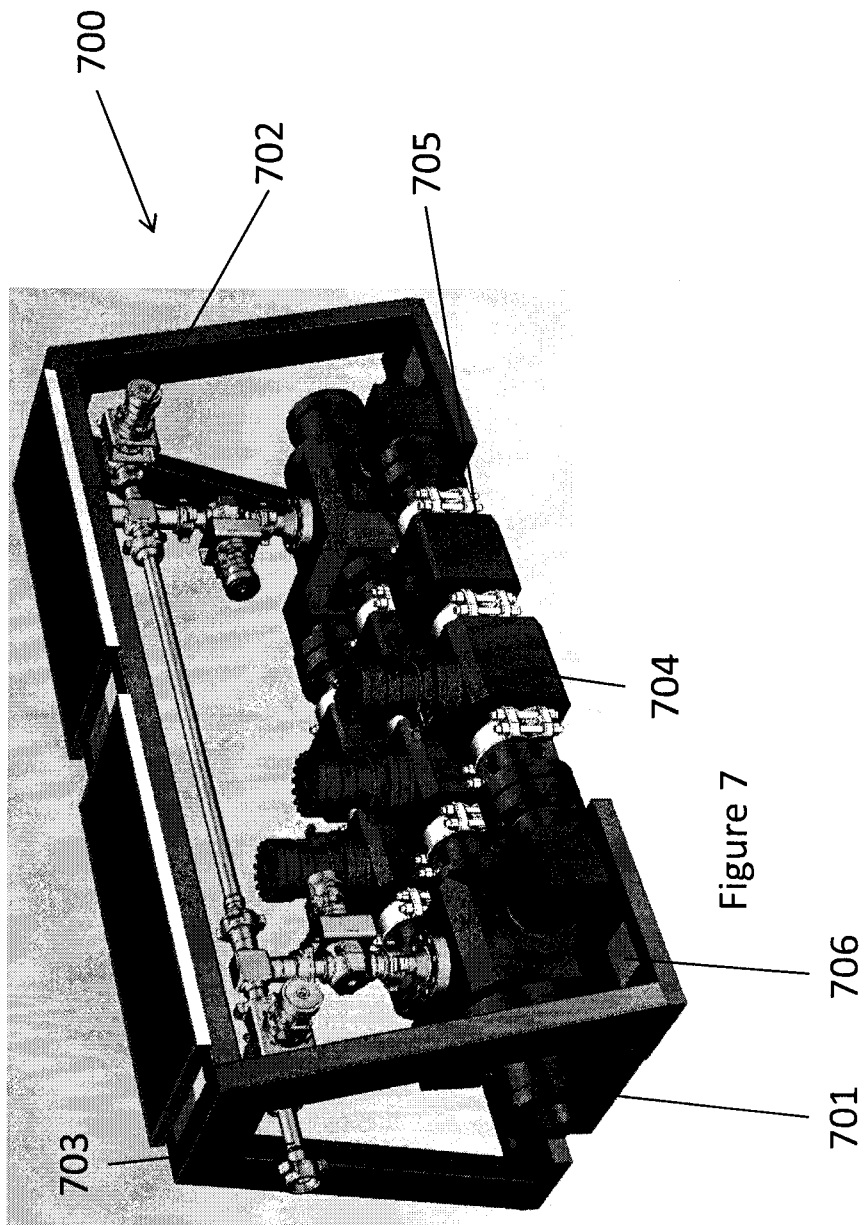
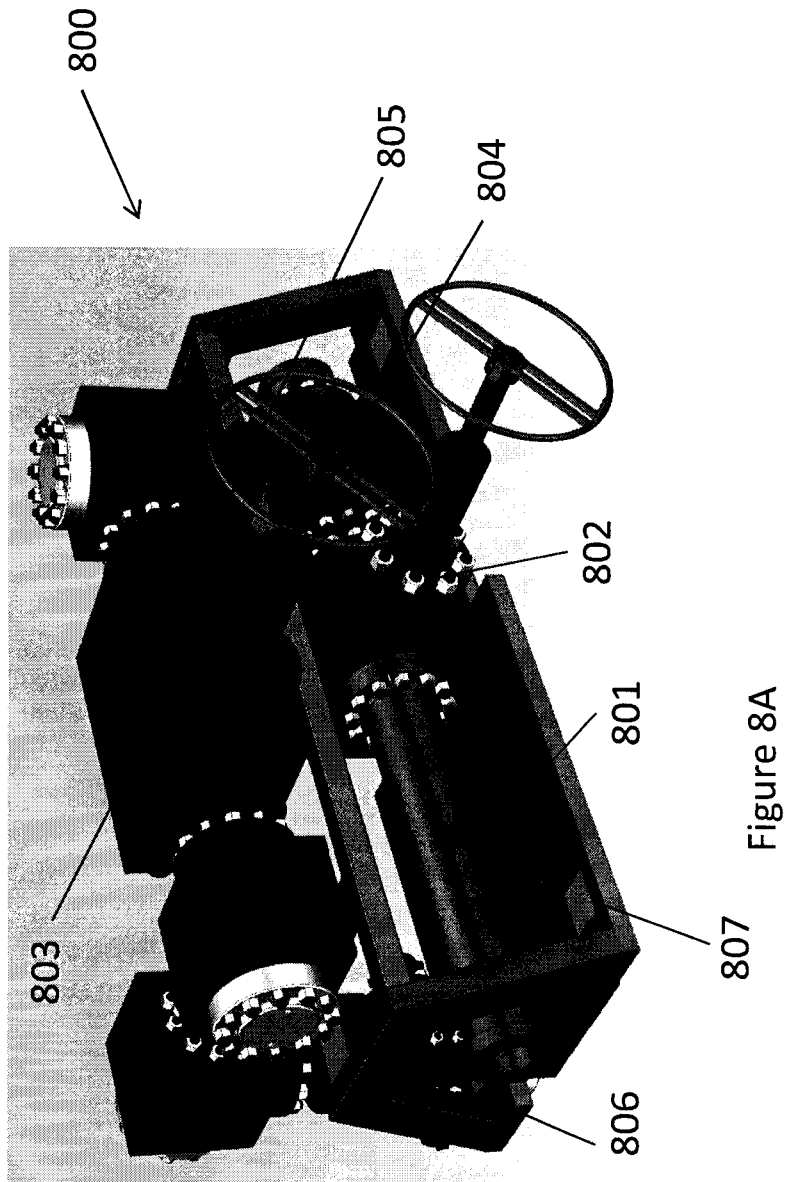


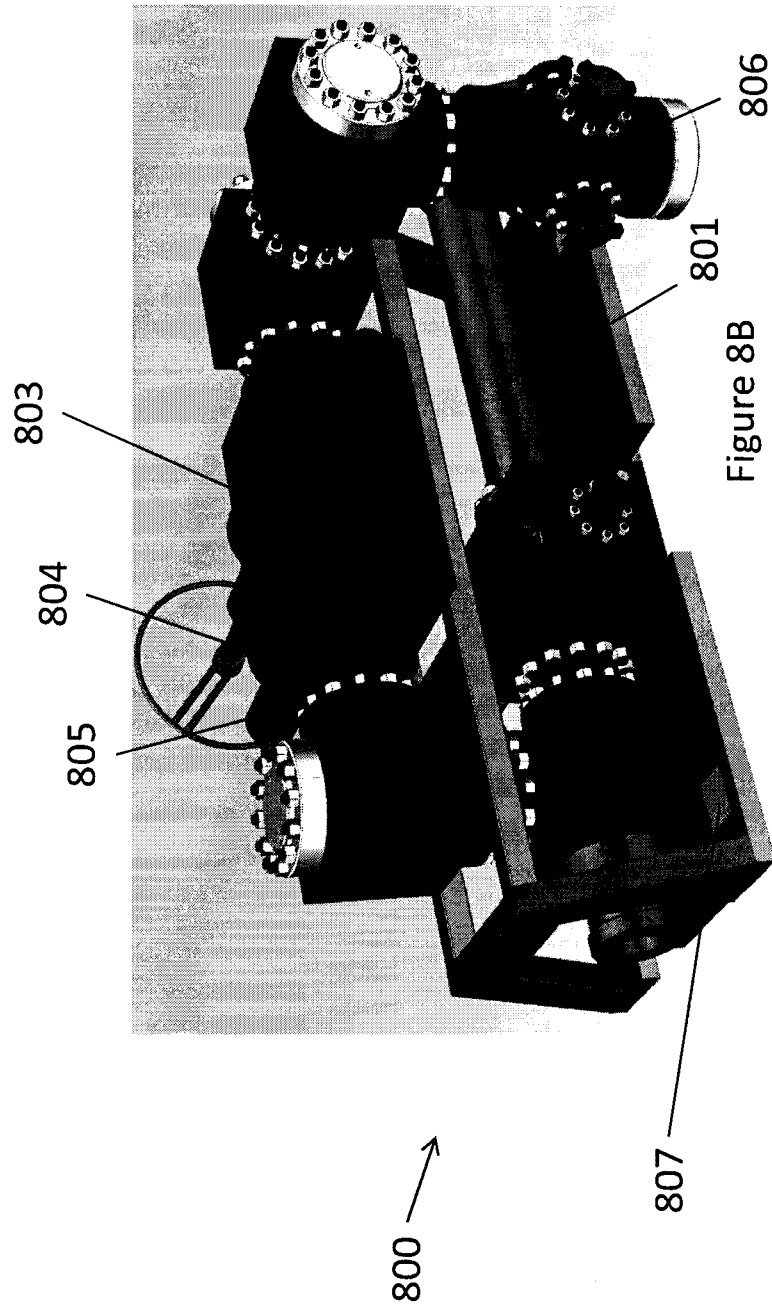
Figure 5B











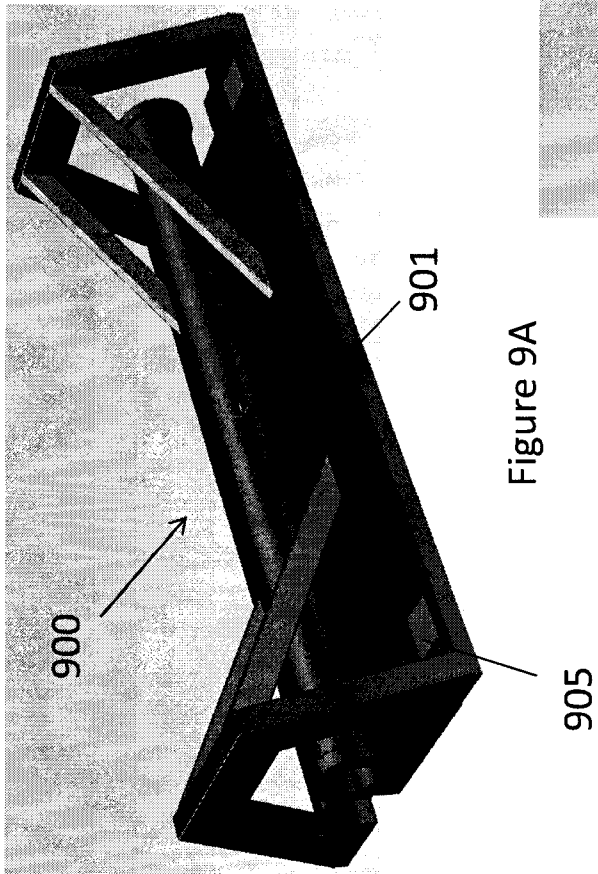


Figure 9A

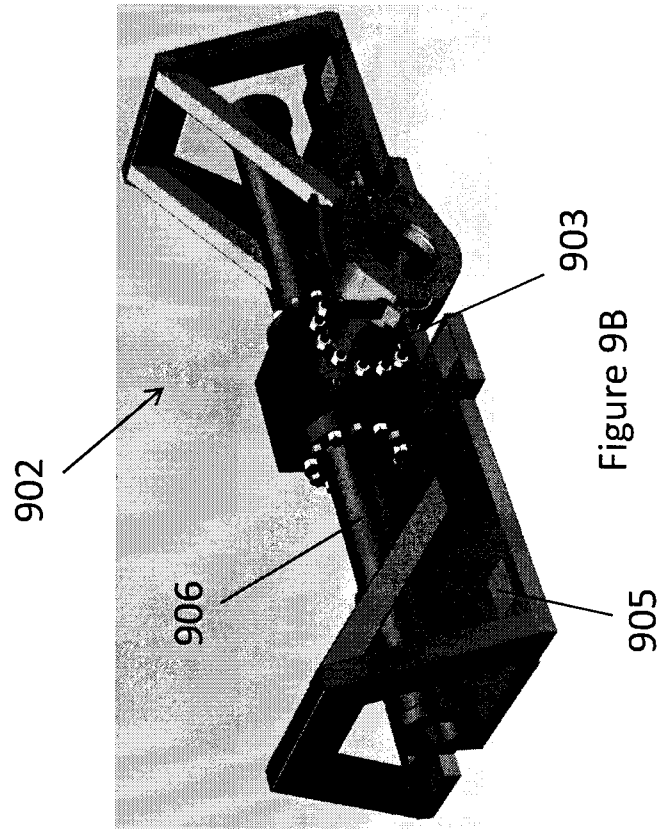


Figure 9B

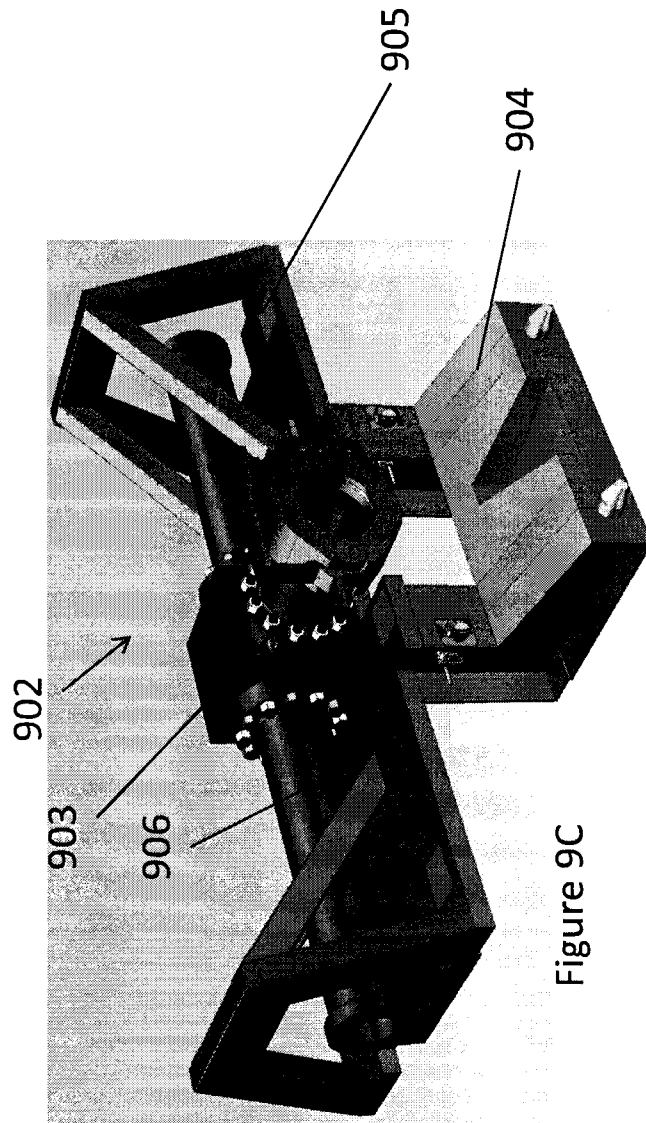
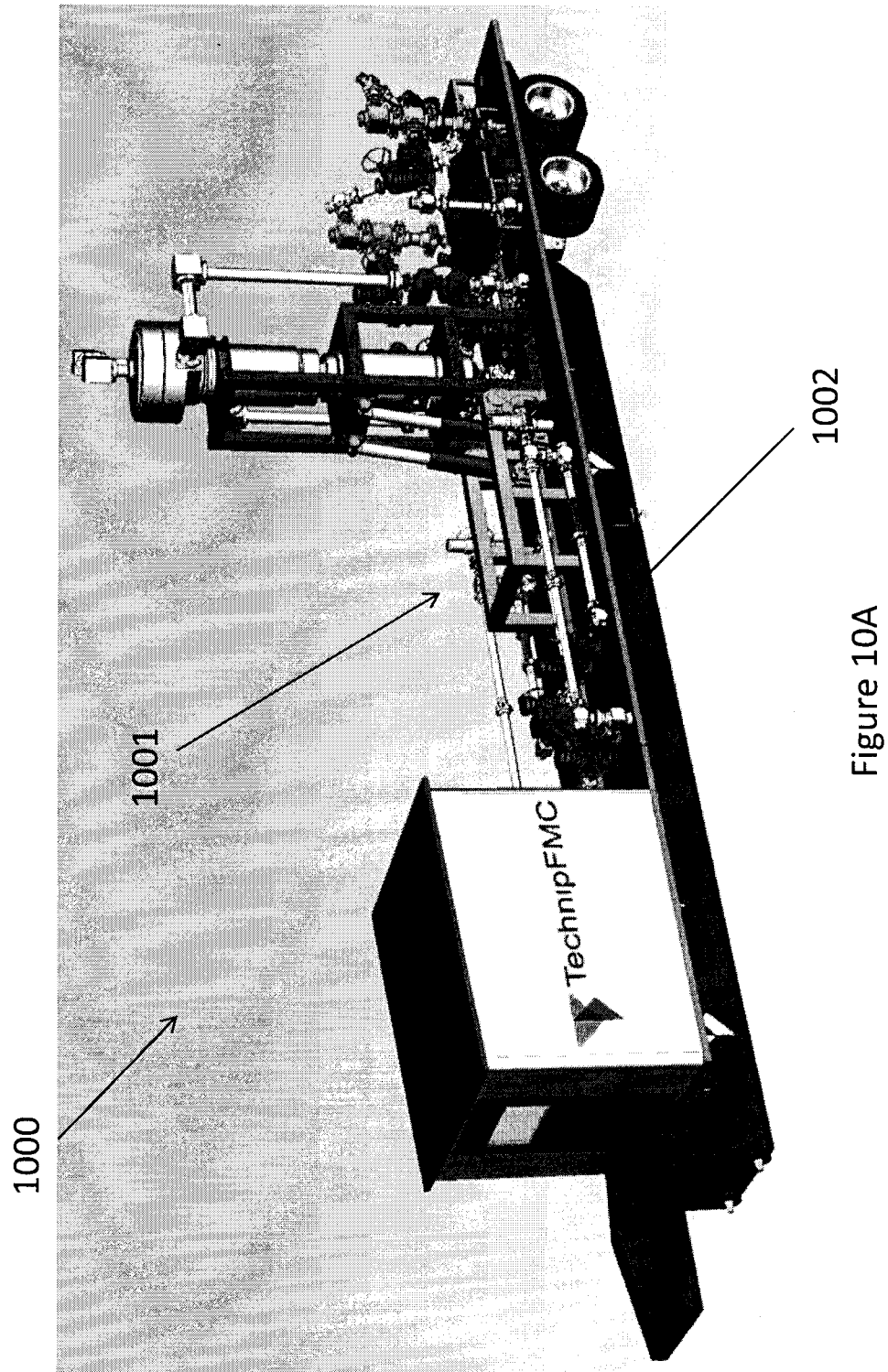


Figure 9C



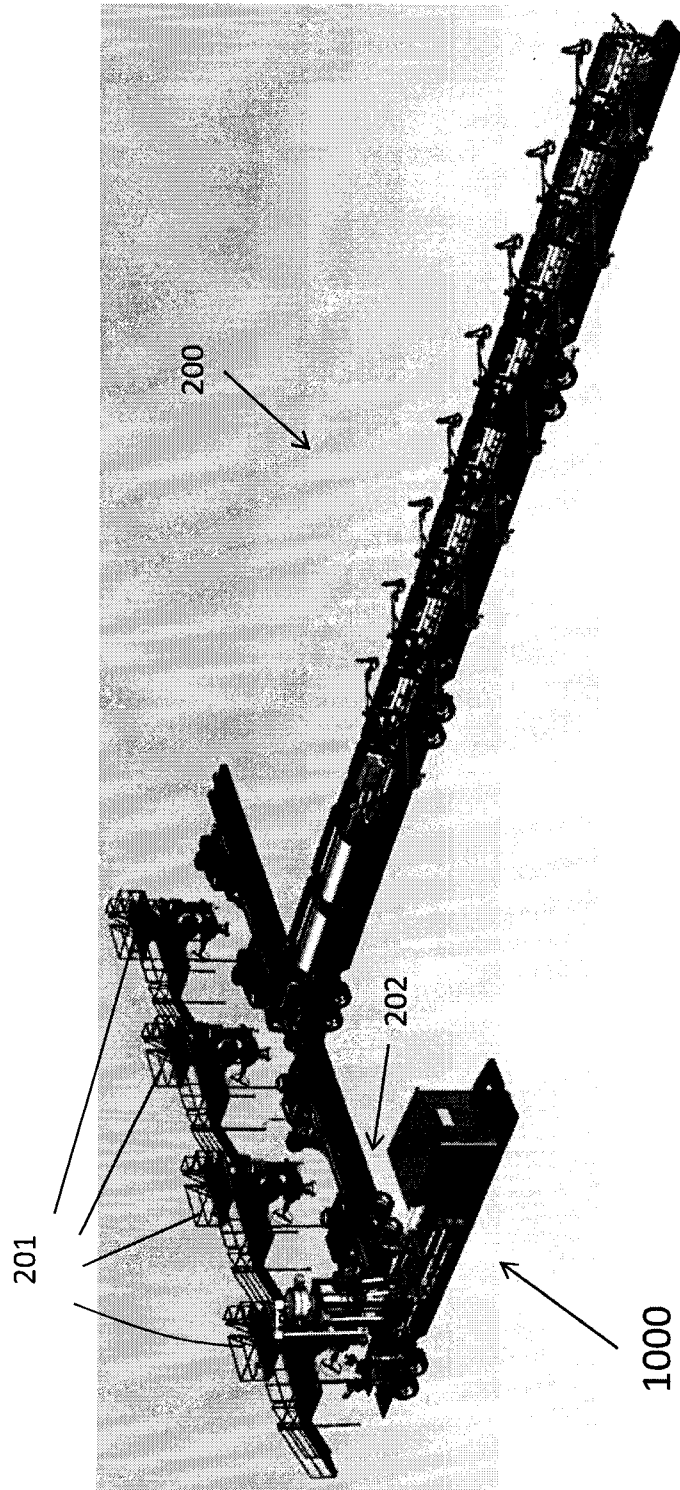
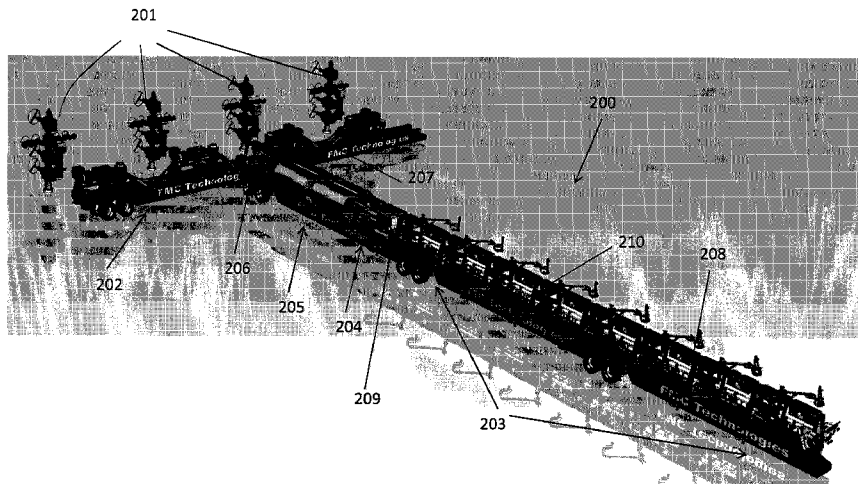


Figure 10B



A