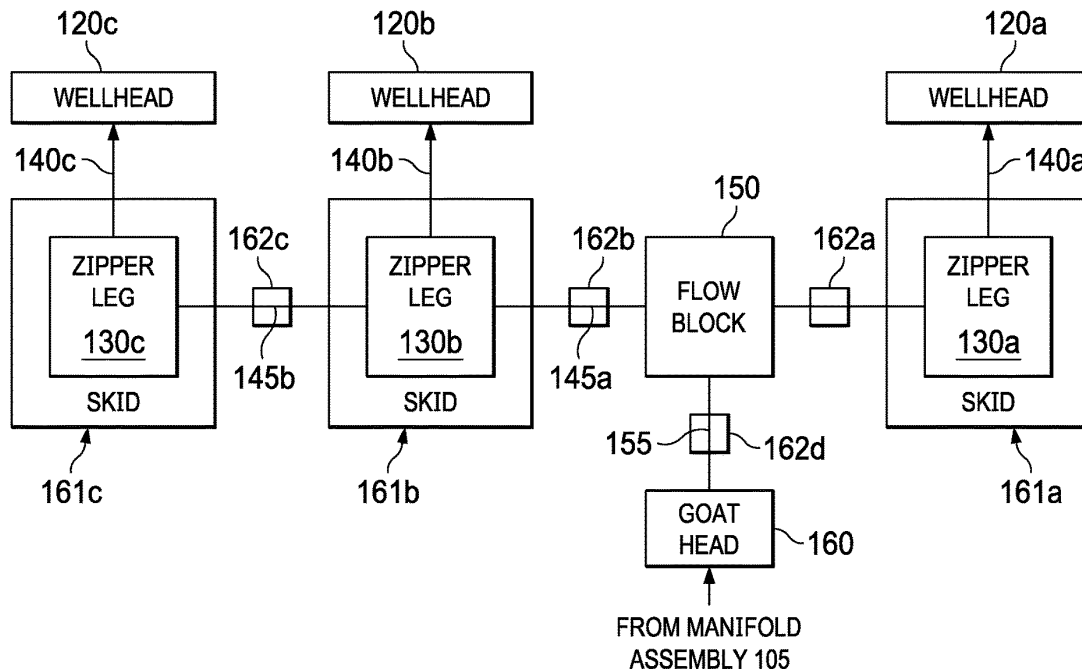




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**FLOYD**(10) **Pub. No.: US 2021/0054727 A1**(43) **Pub. Date: Feb. 25, 2021**(54) **OIL AND GAS ZIPPER MANIFOLD**(71) Applicant: **PetroStar Services, LLC**, San Antonio,  
TX (US)(72) Inventor: **Stacey V. FLOYD**, Jena, LA (US)(21) Appl. No.: **16/998,804**(22) Filed: **Aug. 20, 2020****Related U.S. Application Data**(60) Provisional application No. 62/889,632, filed on Aug.  
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(2013.01); **E21B 17/20** (2013.01); **E21B**  
**34/025** (2020.05)(57) **ABSTRACT**

A fluid conduit communicates fluid between a zipper leg and an oil and gas wellhead. The fluid conduit may be completely flexible, completely rigid, or partially flexible and partially rigid. The fluid conduit is coupled to the wellhead via a first flow block. The first flow block may include a first downwardly angled surface through which a first downwardly angled flow passage extends and to which a first end portion of the fluid conduit is connected. Similarly, the fluid conduit is coupled to the zipper leg via a second flow block. The second flow block may include a second downwardly angled surface through which a second downwardly angled flow passage extends and to which the fluid conduit is connected.



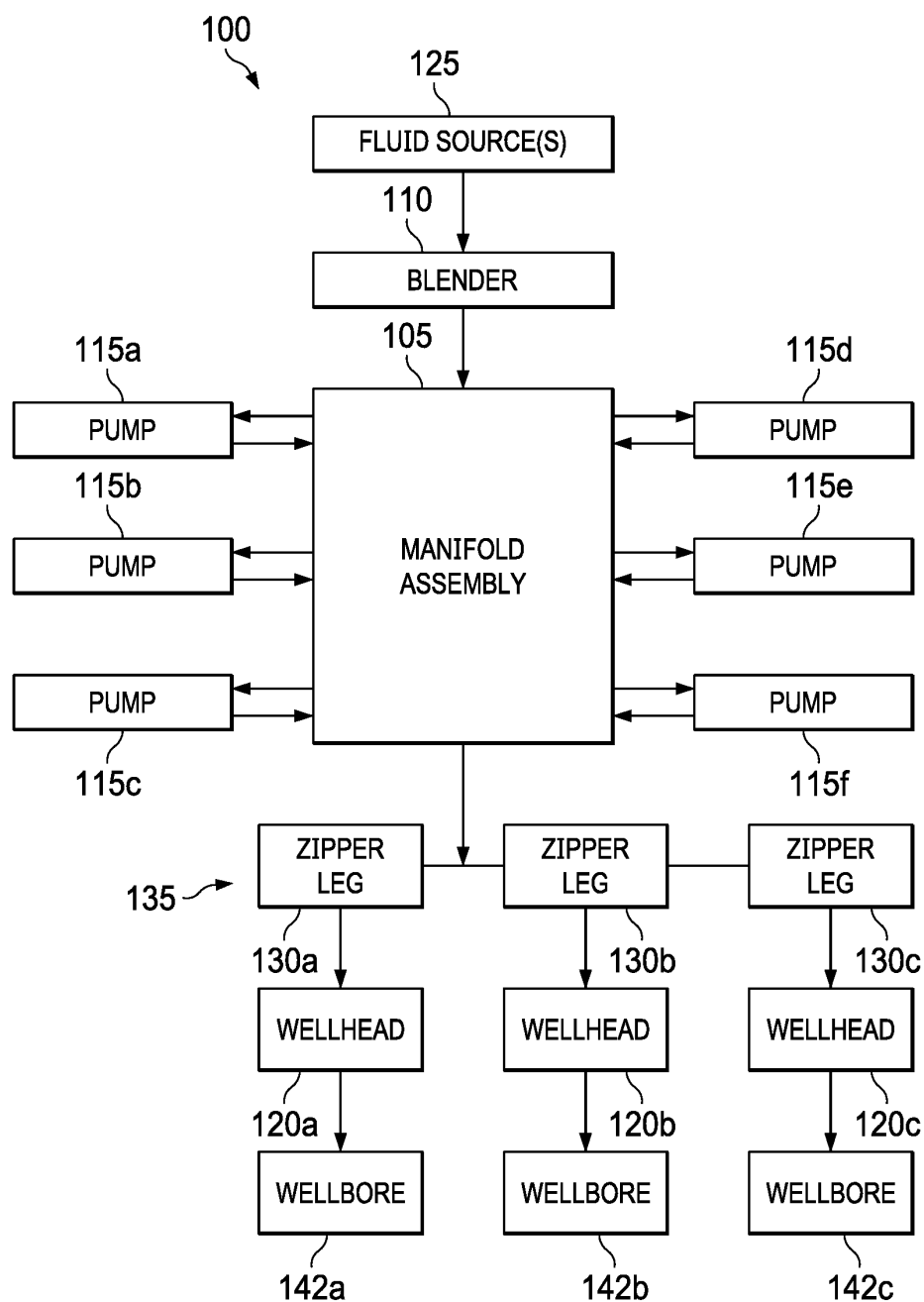


FIG. 1

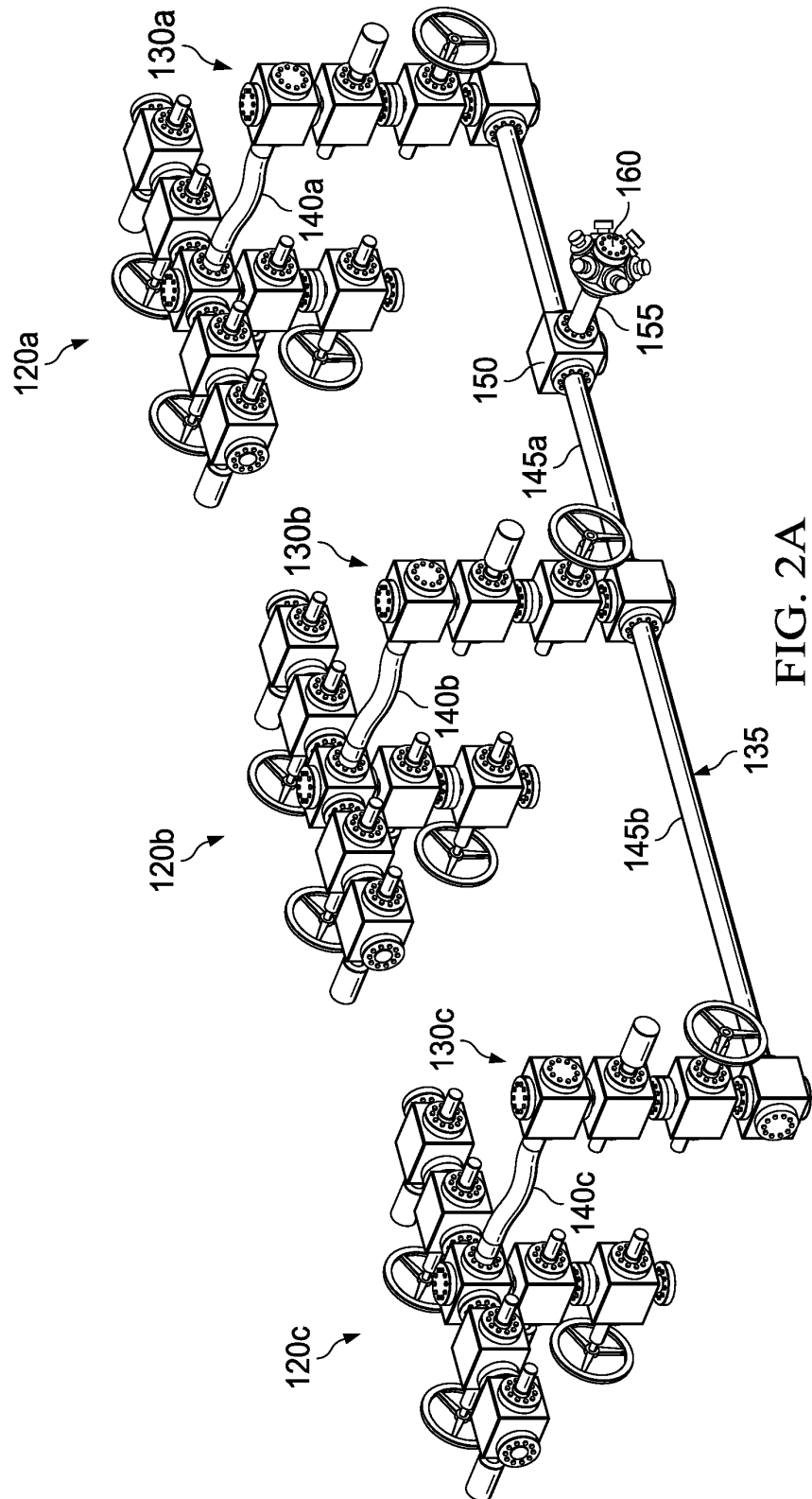


FIG. 2A

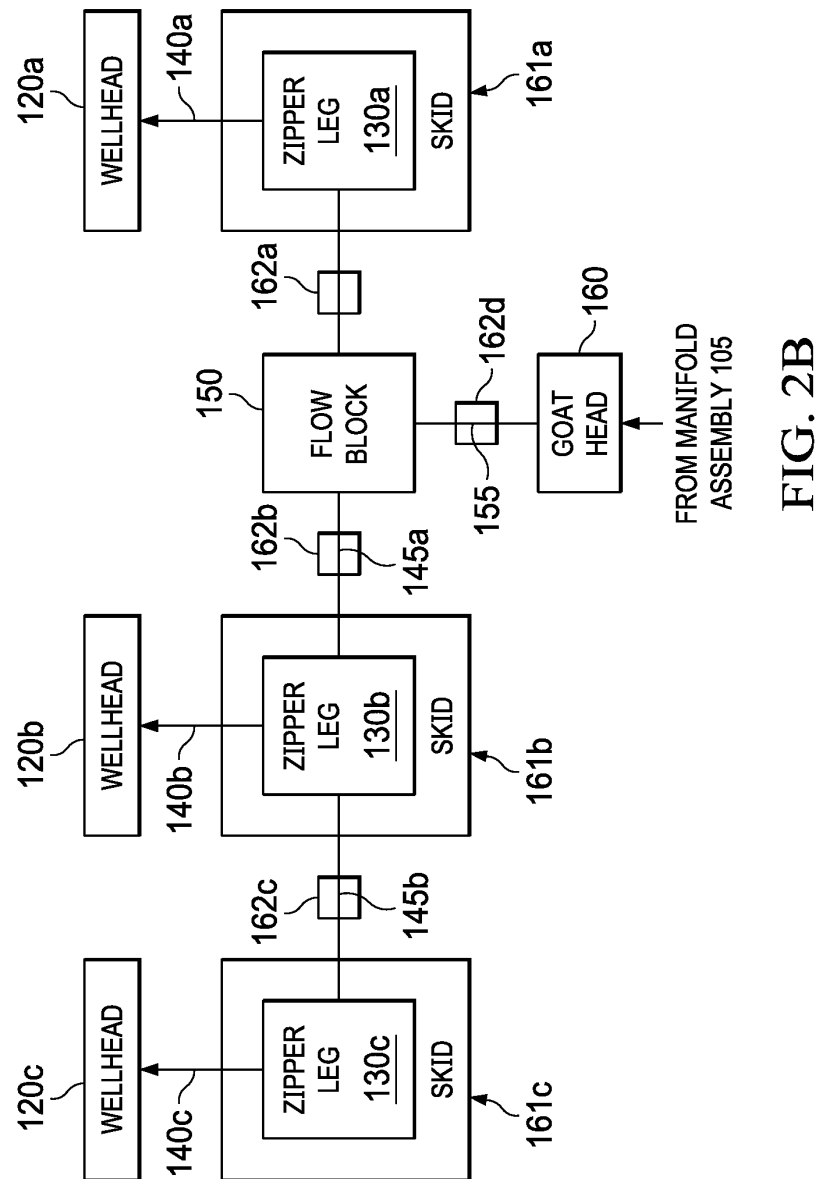


FIG. 2B

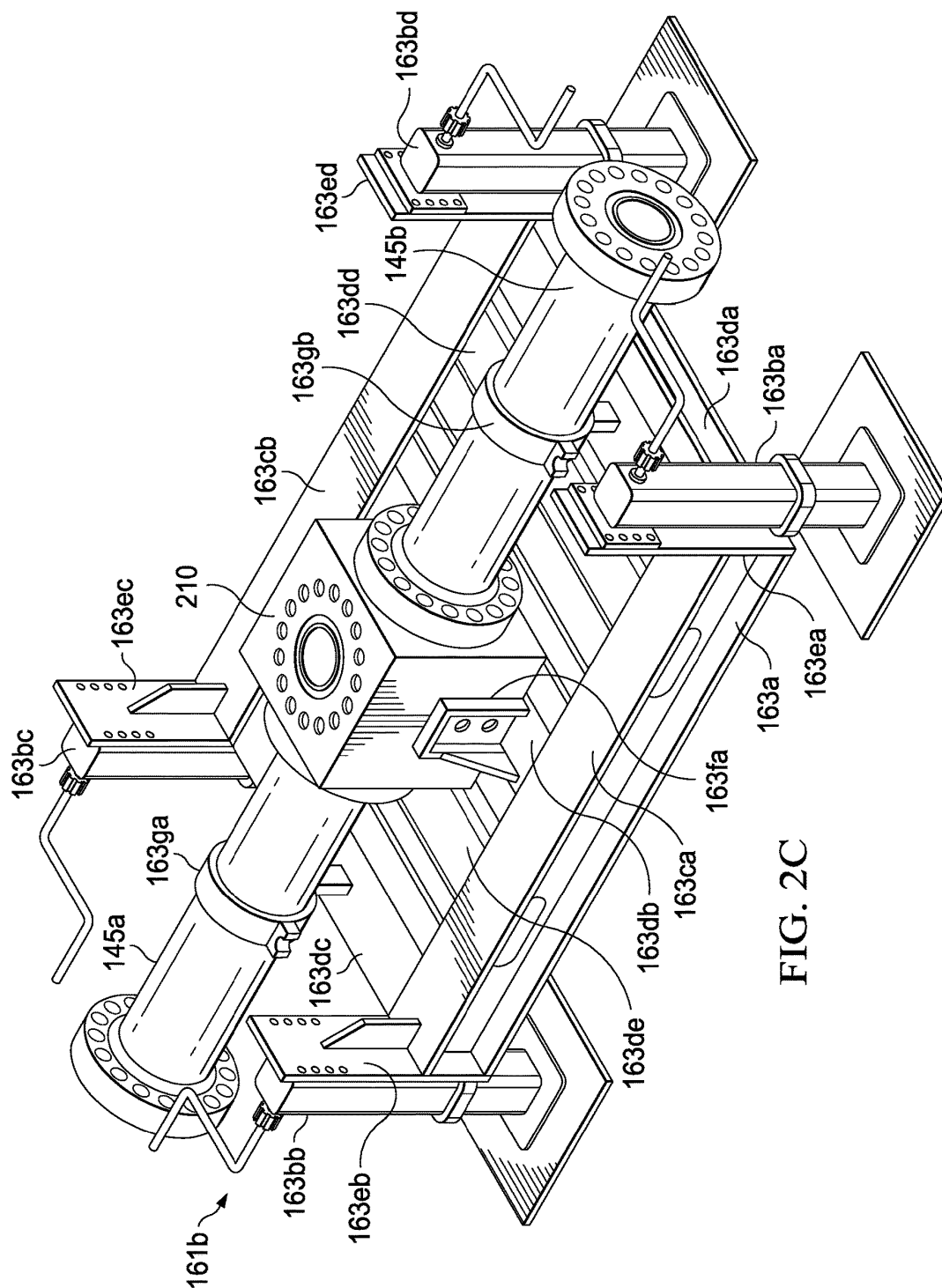
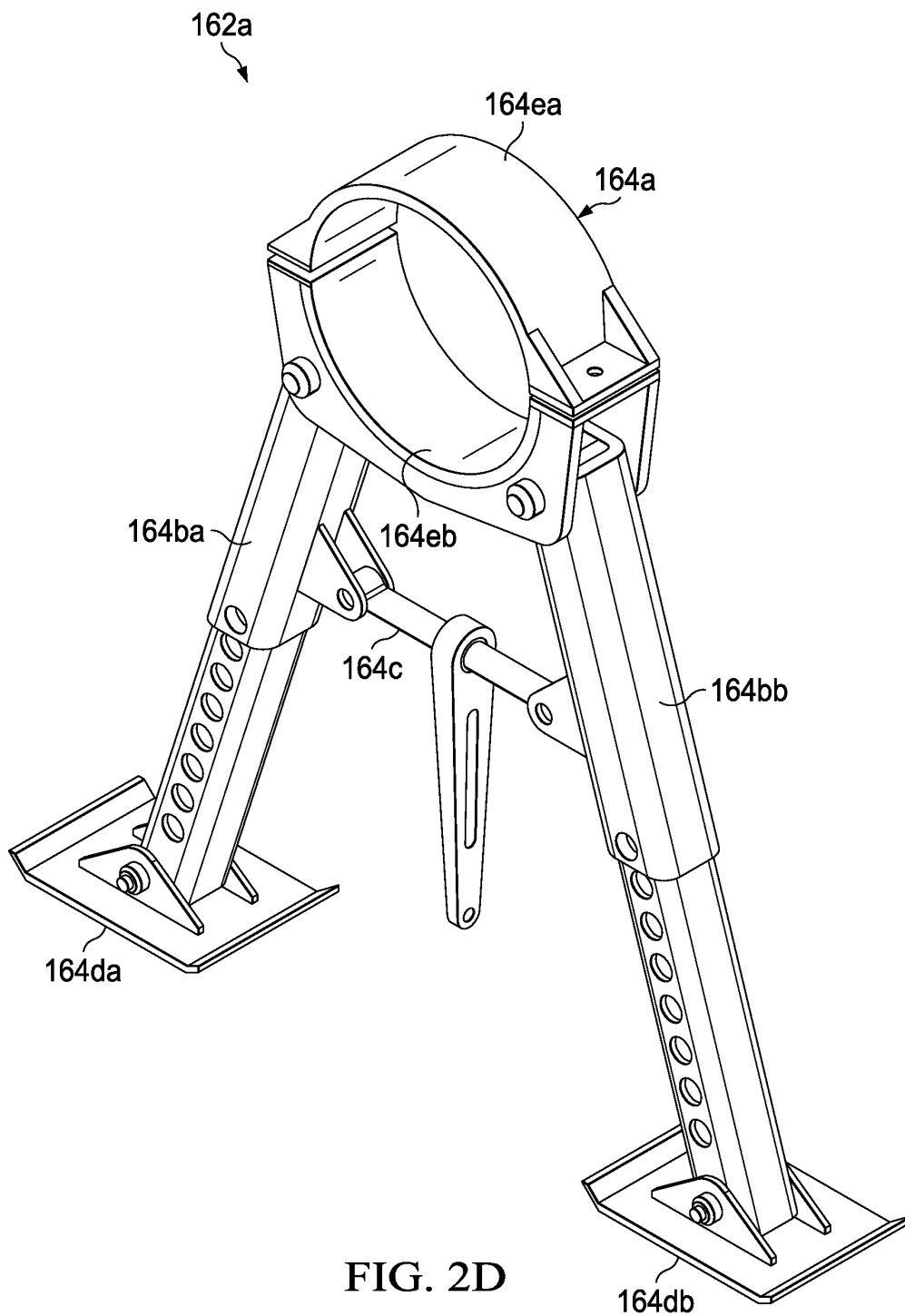


FIG. 2C



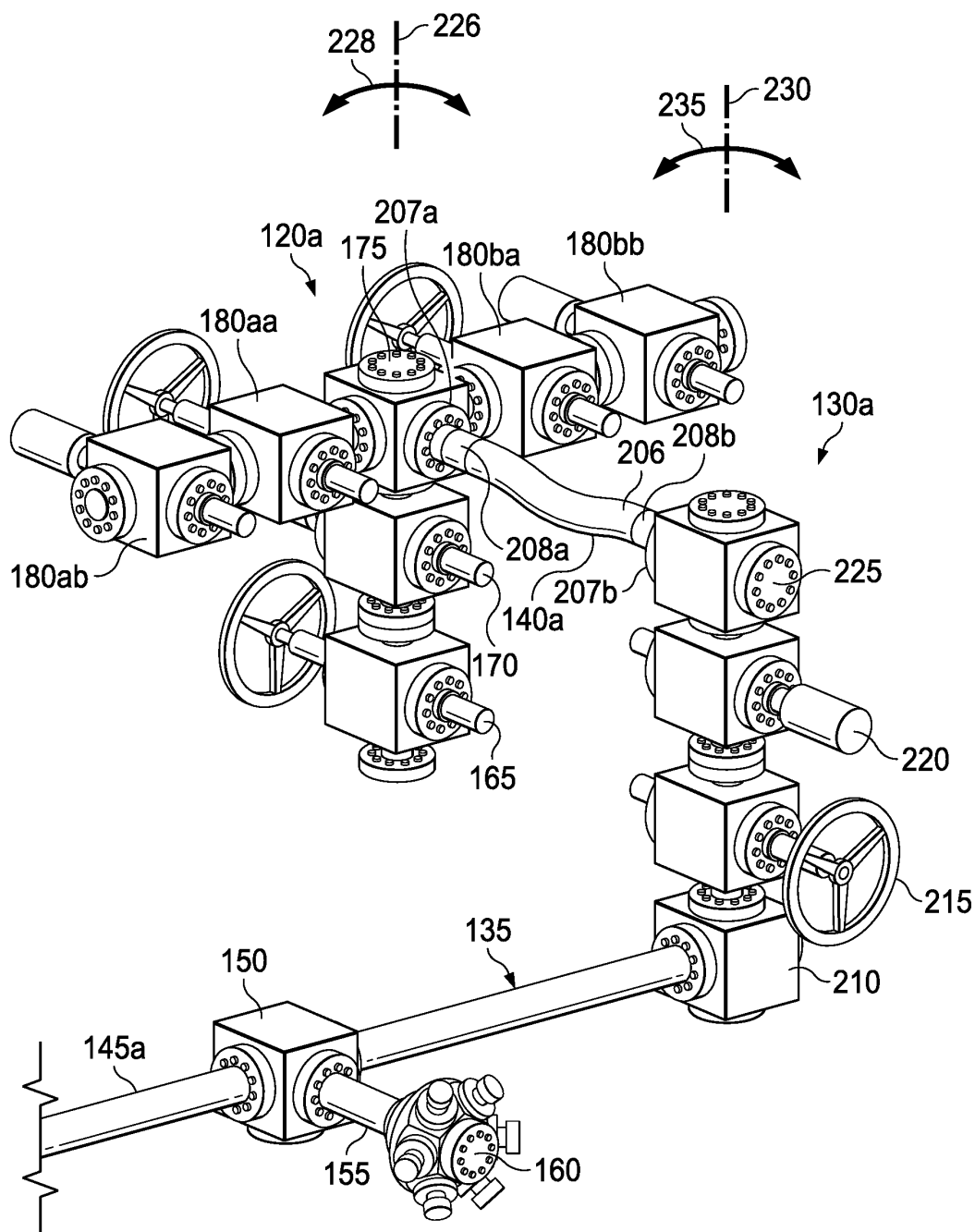


FIG. 3A

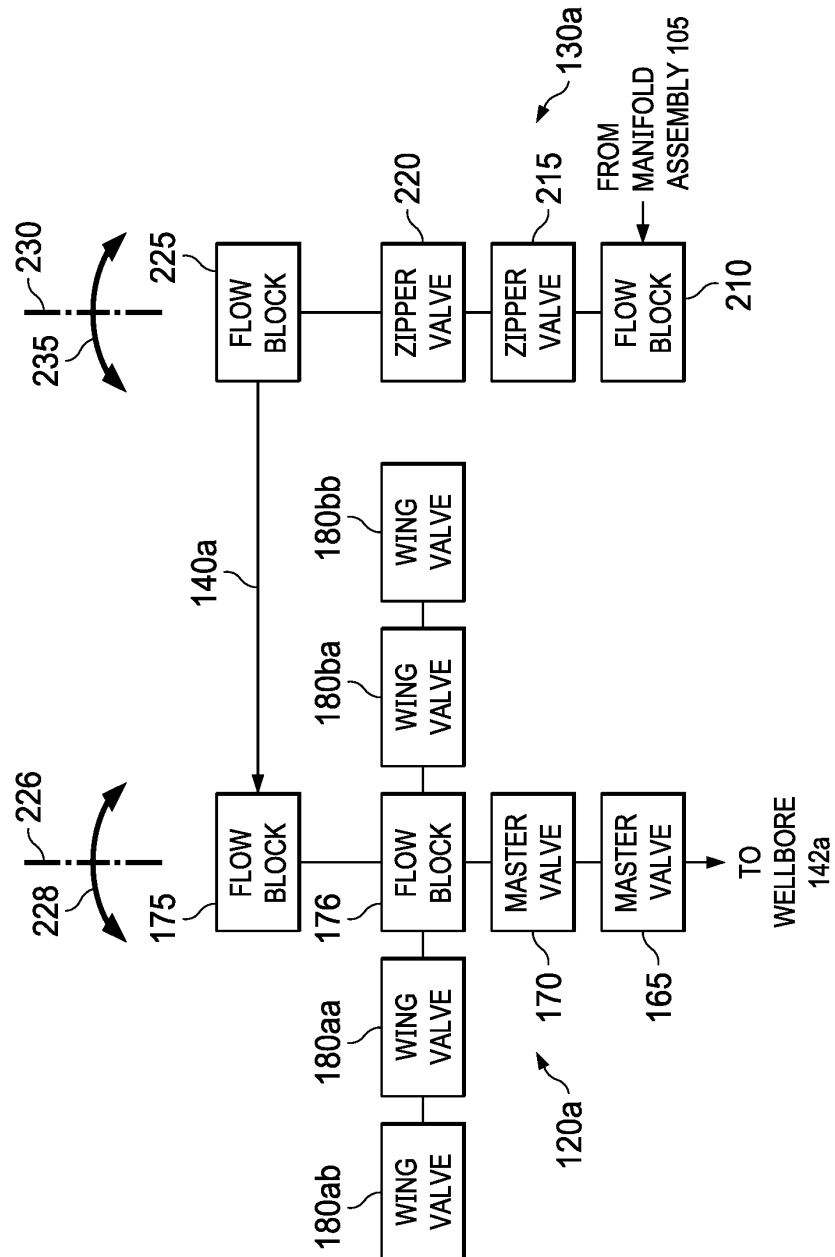


FIG. 3B

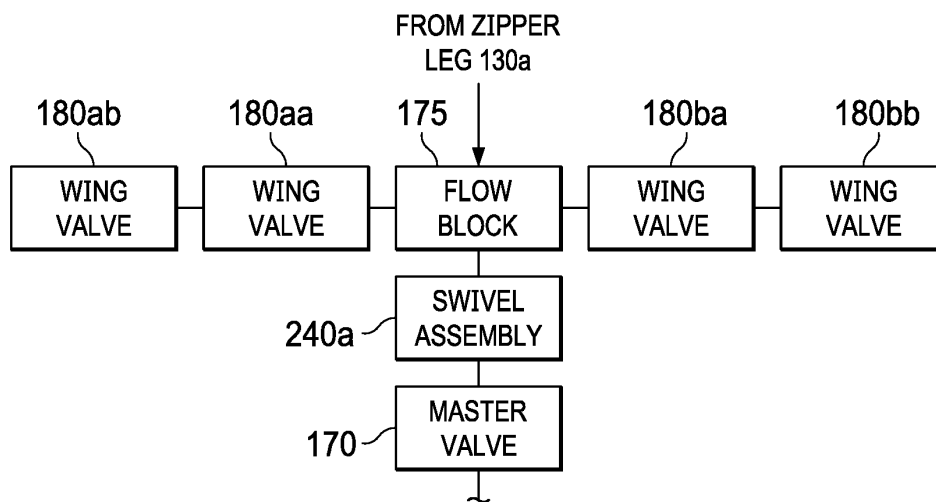


FIG. 3C-1

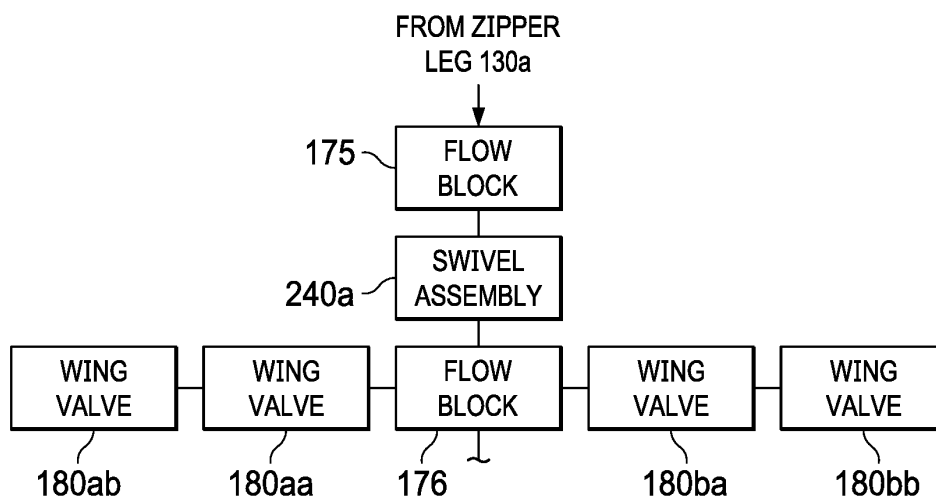


FIG. 3C-2

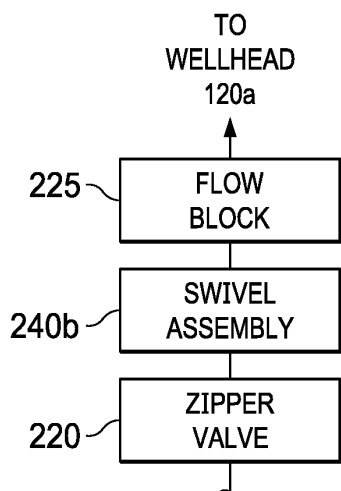


FIG. 3C-3

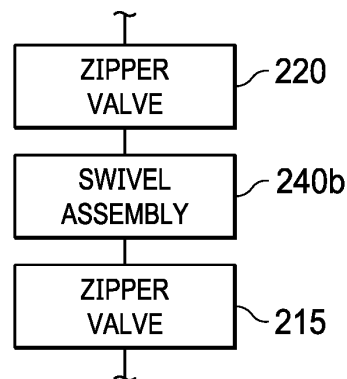


FIG. 3C-4

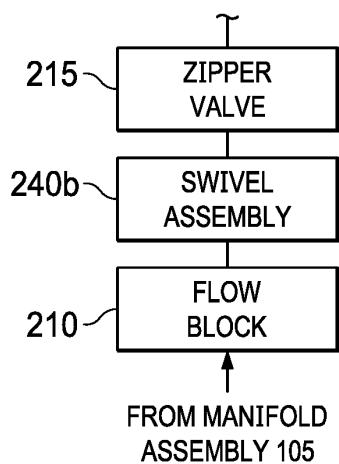
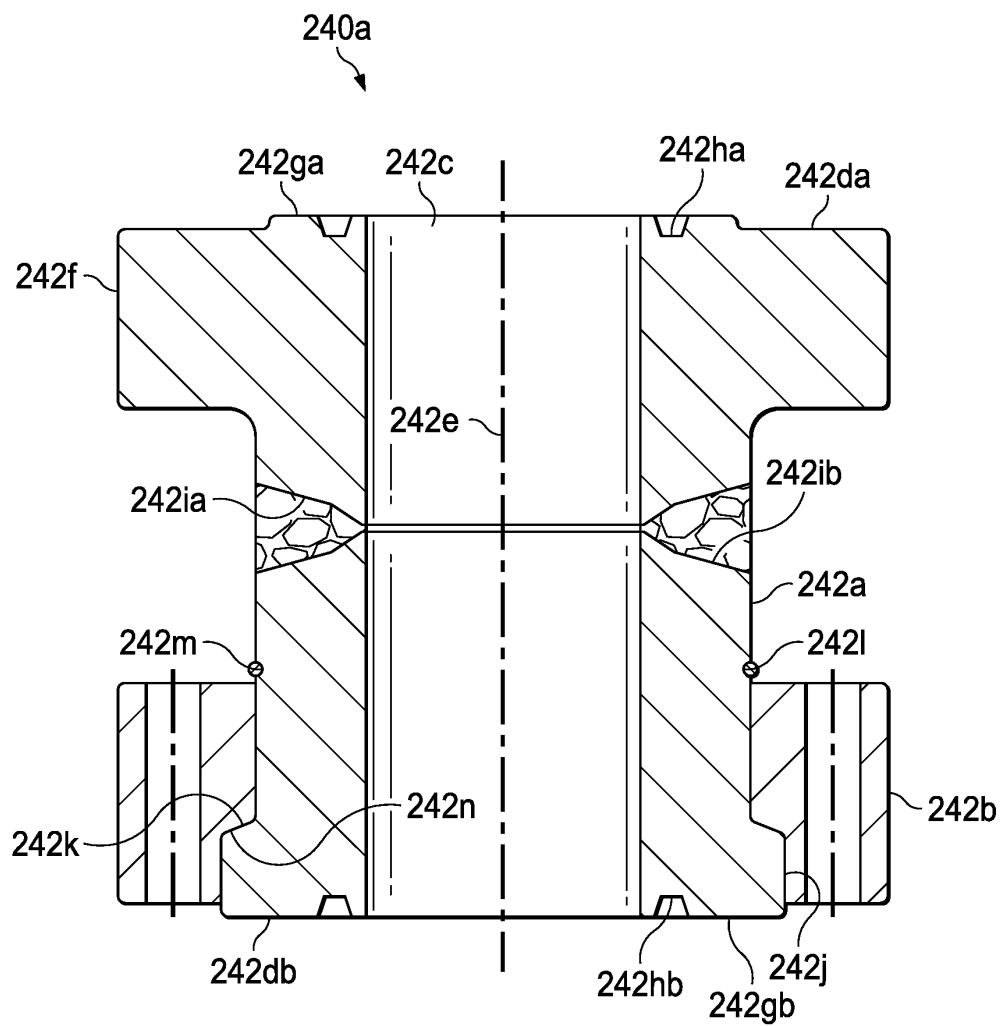


FIG. 3C-5



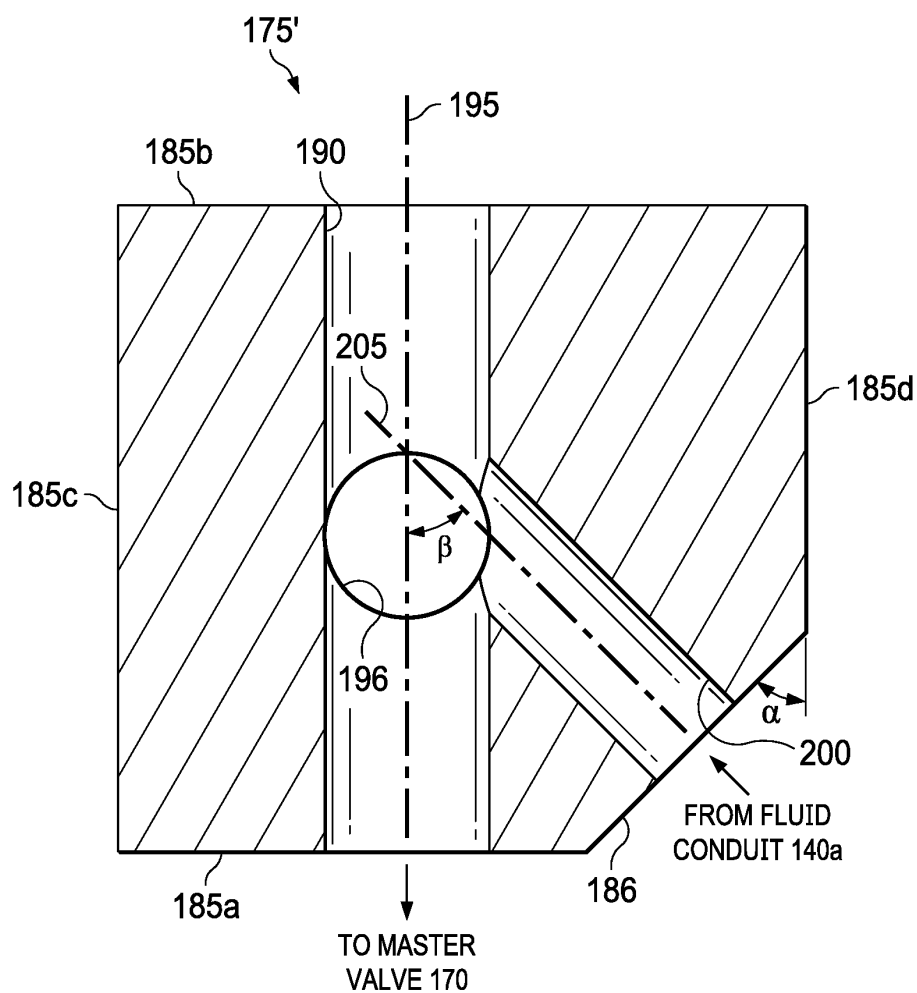


FIG. 4

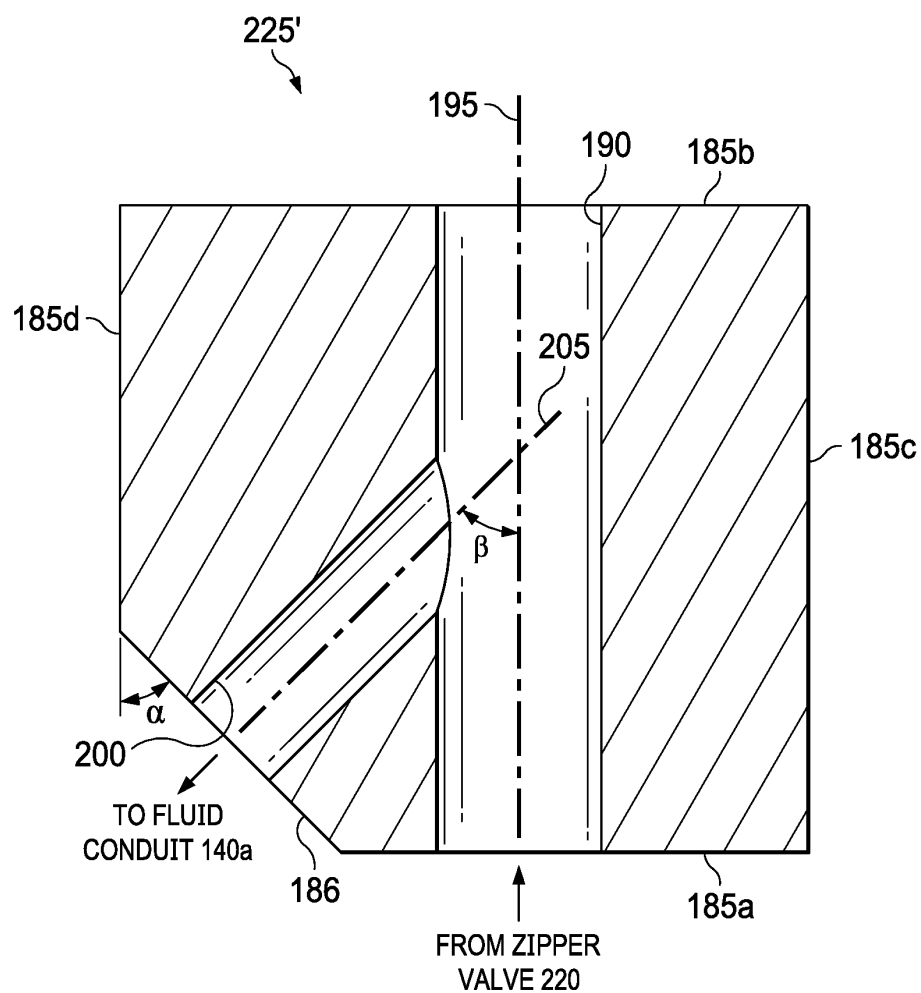
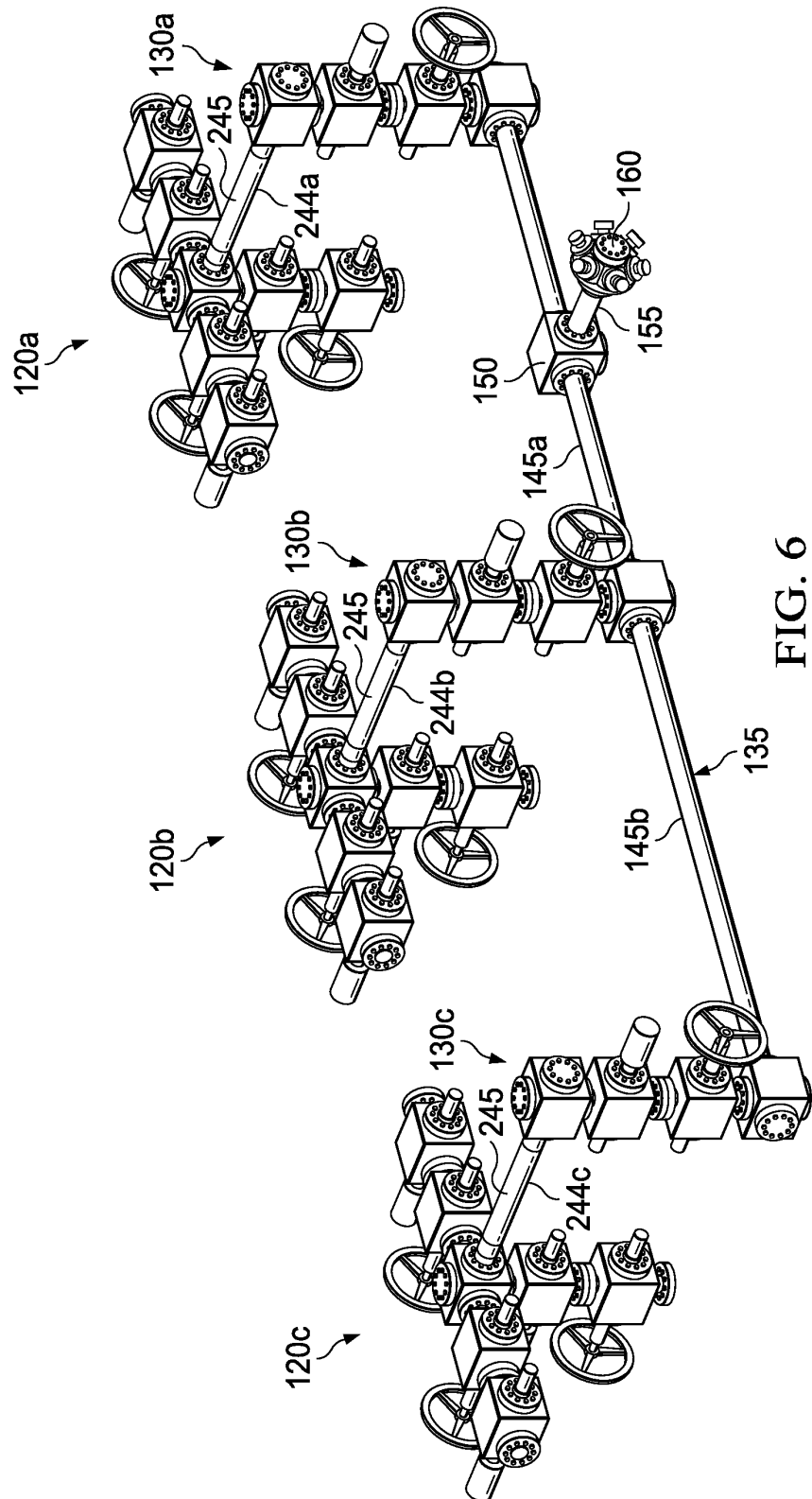


FIG. 5



**OIL AND GAS ZIPPER MANIFOLD****CROSS-REFERENCE TO RELATED APPLICATION**

[0001] This application claims the benefit of the filing date of, and priority to, U.S. Application No. 62/889,632, filed Aug. 21, 2019, the entire disclosure of which is hereby incorporated herein by reference.

**TECHNICAL FIELD**

[0002] The present application relates generally to oil and gas manifold systems, and, more particularly, to oil and gas zipper manifolds.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0003] FIG. 1 is a schematic illustration of a system (e.g., a hydraulic fracturing system) including, inter alia, zipper legs and wellheads, according to one or more embodiments.

[0004] FIG. 2A is a perspective view of the zipper legs and the wellheads of FIG. 1, the zipper legs each being connected to a corresponding one of the wellheads via a flexible fluid conduit, according to one or more embodiments.

[0005] FIG. 2B is a diagrammatic illustration of the zipper legs and the wellheads of FIGS. 1 and 2A in which skids support each of the zipper legs and stands support fluid conduits interconnecting the zipper legs, according to one or more embodiments.

[0006] FIG. 2C is a perspective view of one of the skids of FIG. 2B, according to one or more embodiments.

[0007] FIG. 2D is a perspective view of one of the stands of FIG. 2B, according to one or more embodiments.

[0008] FIG. 3A is an enlarged perspective view of one of the zipper legs, one of the wellheads, and one of the flexible fluid conduits of FIG. 2A, said one of the wellheads including a first flow block, and said one of the zipper legs including a second flow block, according to one or more embodiments.

[0009] FIG. 3B is a diagrammatic illustration of the one of the zipper legs, the one of the wellheads, and the one of the flexible fluid conduits of FIG. 3A according to another embodiment in which said one of the wellheads further includes a third flow block.

[0010] FIG. 3C-1 is a diagrammatic illustration of the one of the wellheads of FIG. 3A according to one or more embodiments in which said one of the wellheads includes a first swivel assembly between the first flow block and a master valve.

[0011] FIG. 3C-2 is a diagrammatic illustration of the one of the wellheads of FIG. 3B according to one or more embodiments in which said one of the wellheads includes the first swivel assembly between the first flow block and the third flow block.

[0012] FIG. 3C-3 is a diagrammatic illustration of the one of the zipper legs of FIGS. 3A and 3B according to one or more embodiments in which said one of the zipper legs includes a second swivel assembly between the second flow block and a first zipper valve.

[0013] FIG. 3C-4 is a diagrammatic illustration of the one of the zipper legs of FIGS. 3A and 3B according to one or more embodiments in which said one of the zipper legs includes a second swivel assembly between the first zipper valve and a second zipper valve.

[0014] FIG. 3C-5 is a diagrammatic illustration of the one of the zipper legs of FIGS. 3A and 3B according to one or more embodiments in which said one of the zipper legs includes a second swivel assembly between the second zipper valve and a fourth flow block.

[0015] FIG. 3D is a cross-sectional view of the first swivel assembly of FIGS. 3C-1 through 3C-2, according to one or more embodiments.

[0016] FIG. 4 is a cross-sectional view of another flow block that may replace the first flow block of the one of the wellheads of FIG. 3A, or that may replace the first flow block of the one of the wellheads of FIG. 3B, according to one or more embodiments.

[0017] FIG. 5 is a cross-sectional view of yet another flow block that may replace the second flow block of the one of the zipper legs of FIGS. 3A and 3B, according to one or more embodiments.

[0018] FIG. 6 is a perspective view of the zipper legs and the wellheads of FIG. 1, the zipper legs each being connected to a corresponding one of the wellheads via a rigid fluid conduit, according to one or more embodiments.

**DETAILED DESCRIPTION**

[0019] Referring to FIG. 1, in an embodiment, a system is schematically illustrated and generally referred to by the reference numeral 100. The system 100 includes a manifold assembly 105 in fluid communication with a blender 110, pumps 115a-f, and wellheads 120a-c. The system 100 includes one or more fluid sources 125 that are in fluid communication with the blender 110. The wellheads 120a-c are in fluid communication with the manifold assembly 105 via, for example, zipper legs 130a-c. The zipper legs 130a-c are operably coupled to the wellheads 120a-c, respectively, and are interconnected with each other to form a zipper manifold 135 to which the manifold assembly 105 is operably coupled. In an embodiment, the system 100 is part of a hydraulic fracturing (or "frac") system, which may be used to facilitate oil and gas exploration and production operations. The embodiments provided herein are not, however, limited to a hydraulic fracturing system, as the embodiments may be used with, or adapted to, a mud pump system, a well treatment system, other pumping systems, one or more systems at the wellheads 120a-c, one or more systems upstream of the wellheads 120a-c, one or more systems downstream of the wellheads 120a-c, or one or more other systems associated with the wellheads 120a-c.

[0020] Referring to FIG. 2A, with continuing reference to FIG. 1, in an embodiment, the zipper legs 130a-c are operably coupled to fluid conduits 140a-c, respectively, and the fluid conduits 140a-c are operably coupled to the wellheads 120a-c, respectively (each of the fluid conduits 140a-c may include multiple fluid conduits connected end-to-end). The respective zipper legs 130a-c are thus operably coupled to, and in fluid communication with, the wellheads 120a-c via the respective fluid conduits 140a-c. The wellheads 120a-c are located at the respective tops or heads of the oil and gas wellbores 142a-c (shown in FIG. 1) that penetrate one or more subterranean formations (not shown) and are used in oil and gas exploration and production operations. To form the zipper manifold 135, the zipper legs 130a and 130b are interconnected with each other via a fluid conduit 145a (which may include multiple fluid conduits connected end-to-end) and the zipper legs 130b and 130c are interconnected with each other via a fluid conduit 145b (which may

include multiple fluid conduits connected end-to-end). The fluid conduit **145a** includes a flow block **150** to which a pipe **155** (which may include pipes or other fluid conduits connected end-to-end) is operably coupled to thereby operably couple the zipper manifold **135** to the manifold assembly **105** (shown in FIG. 1). In an alternative embodiment, rather than the fluid conduit **145a** including the flow block **150**, the fluid conduit **145b** includes the flow block **150** to thereby operably couple the zipper manifold **135** to the manifold assembly **105** via the pipe **155**. In another alternative embodiment, the flow block **150** is omitted and the pipe **155** is instead operably coupled directly to one of the zipper legs **130a-c**.

[0021] In some embodiments, as in FIG. 2A, a goat head **160** is operably coupled to the pipe **155** opposite the zipper manifold **135** to facilitate operable coupling of the zipper manifold **135** to the manifold assembly **105**. More particularly, in such embodiments, the goat head **160** includes connection points allowing for a plurality of pipes, hoses, and/or other fluid conduits to be operably coupled from the manifold assembly **105** to the pipe **155** to facilitate fluid communication between the manifold assembly **105** and the zipper manifold **135**.

[0022] Referring to FIG. 2B, with continuing reference to FIG. 2A, in an embodiment, the zipper legs **130a-c** are supported by skids **161a-c**, respectively, the fluid conduit **145a** is supported by supports **162a-b**, the fluid conduit **145b** is supported by a support **162c**, and the pipe **155** is supported by a support **162d**. In some embodiments, one or more of the skids **161a-c** is/are omitted. In some embodiments, one or more of the supports **162a-d** is/are omitted. In addition, or instead, the supports **162a-d** and/or additional supports substantially similar or identical to the supports **162a-d** may be placed at different locations than those shown in FIG. 2B in order to support the fluid conduits **142a-b**, the pipe **155**, or other fluid conduits, in a manner suitable to the particular layout of the zipper legs **130a-c**.

[0023] Referring now to FIG. 2C, with continuing reference to FIG. 2B, in some embodiments, the skids **161a-c** are substantially identical to one another and, therefore, in connection with FIG. 2C, only the skid **161b** will be shown and described in detail; however, the description of the skid **161b** applies equally to the skids **161a-c**. In an embodiment, the skid **161b** includes a deck **163a** and legs **163ba-bd**. The deck **163a** includes longitudinally-extending members **163ca** and **163cb**, laterally-extending members **163da-de**, and alignment plates **163ea-ed**. The laterally-extending members **163da-de** are connected to, and extend between, the longitudinally-extending members **163ca** and **163cb**. In some embodiments, as in FIG. 2C, the longitudinally-extending members **163ca** and **163cb** are I-beams spaced in a parallel relation with each other; the laterally-extending members **163da-de** are I-beams spaced in a parallel relation with each other and in a perpendicular relation with the longitudinally-extending members **163ca** and **163cb**; and the laterally-extending members **163dd** and **163de** are tubular beams spaced in a parallel relation with each other and in a perpendicular relation with the longitudinally-extending members **163ca** and **163cb**; and the laterally-extending members **163dd** and **163de** are interposed between the laterally-extending members **163da-de**. The alignment plates **163ea** and **163eb** are connected to the deck **163a** at opposing ends of the longitudinally-extending member **163ca**. Likewise, the alignment plates **163ec** and **163ed** are

connected to the deck **163a** at opposing ends of the longitudinally-extending member **163cb**.

[0024] The legs **163ba-bd** are connected to the respective alignment plates **163ea-ed** to support the deck **163a**. In some embodiments, one or more of the alignment plates **163ea-ed** is/are omitted and the corresponding one(s) of the legs **163ba-bd** are connected to the deck **163a** in another suitable manner. In addition, or instead, the alignment plates **163ea-ed** and/or additional alignment plates substantially similar or identical to the alignment plates **163ea-ed** may be connected to the deck **163a** at different locations than those shown in FIG. 2C, and the legs **163ba-bd** and/or additional legs substantially similar or identical to the legs **163ba-bd** may be connected to the respective alignment plates **163ea-ed** and/or the additional alignment plates to support the deck **163a**. In some embodiments, as in FIG. 2C, the legs **163ba-bd** are adjustable jacks capable of leveling the deck **163a**, and thus the zipper leg **130b** supported by the skid **161b**. A pair of mounting brackets **163fa** and **163fb** operably couples a flow block **210** (also shown in FIG. 3A) of the zipper leg **130b** to the deck **163a**, that is, to the laterally-extending member **163db** (the mounting bracket **163fb** is hidden from view behind the flow block **210** in FIG. 2C). Additionally, a pair of support brackets **163ga** and **163gb** are also coupled to the deck **163a**, that is, to the laterally-extending members **163da** and **163dc**, respectively, on opposing sides of the flow block **210**. The support brackets **163ga** and **163gb** support the fluid conduits **145a** and **145b**, respectively.

[0025] Referring now to FIG. 2D, with continuing reference to FIG. 2B, in some embodiments, the supports **162a-d** are substantially identical to one another and, therefore, in connection with FIG. 2D, only the support **162a** will be shown and described in detail; however, the description of the support **162a** applies equally to the supports **162a-d**. In an embodiment, the support **162a** includes a support ring **164a**, legs **164ba** and **164bb**, a spreader **164c**, and feet **164da** and **164db**. The support ring **164a** includes a top portion **164ea** that is attachable to, and detachable from, a bottom portion **164eb** to accommodate the fluid conduit **145a**. The legs **164ba** and **164bb** are pivotably connected to the bottom portion **164eb**. The legs **164ba** and **164bb** each have an adjustable length; for example, the legs **164ba** and **164bb** may be telescoping. The spreader **164c** is connected to, and extends between, the legs **164ba** and **164bb**. The spreader **164c** has an adjustable length; for example, the spreader **164c** may be or include a ratcheting mechanism, such as an LB ratchet binder model R-10. The feet **164da** and **164db** are pivotably connected to the legs **164ba** and **164bb**, respectively, opposite the bottom portion **164eb** of the support ring **164a**. The feet **164da** and **164db** are adapted to distribute the load supported by the support **162a**, and are further adapted to slide along the ground (or another support surface) when the spreader **164c** is lengthened or shortened. For example, the spreader **164c** may be lengthened to increase a distance between the feet **164da** and **164db**, and to increase an angle between the legs **164ba** and **164bb**, thereby lowering the fluid conduit **145a** accommodated by the support ring **164a**. For another example, the spreader **164c** may be shortened to decrease the distance between the feet **164da** and **164db**, and to decrease the angle between the legs **164ba** and **164bb**, thereby raising the fluid conduit **145a** accommodated by the support ring **164a**.

[0026] Referring to FIG. 3A, with continuing reference to FIG. 2A, in an embodiment, the wellhead **120a** includes a

pair of master valves **165** and **170**, such as, for example, upper and lower gate valves, and a flow block **175**. The wellhead **120a** may be operably coupled to a casing string and/or a tubing string extending within the associated wellbore **142a**. For example, an adapter may operably couple the wellhead **120a** to a casing head of the casing string and/or a tubing head of the tubing string. The master valves **165** and **170** are connected in series at the base of the wellhead **120a**. In some embodiments, the master valve **165** is a manual gate valve, and the master valve **170** is an automatic gate valve. In other embodiments, the master valve **165** and/or the master valve **170** is/are omitted in favor of plug valve(s) (not shown). The flow block **175** is connected to the master valve **170**, opposite the master valve **165**. In some embodiments, the flow block **175** is a 7" 15k standard tee positioned directly above the master valve **170**. For example, the flow block **175** may include a flange-by-studded adapter ("FSA") 7" 15K×5" 15K via which the fluid conduit **140a** is connected to the wellhead **120a**.

[0027] Wing valves **180aa** and **180ab** such as, for example, gate valves, are connected to the flow block **175**. In some embodiments, the wing valves **180aa** and **180ab** are production valves. In some embodiments, the wing valve **180aa** is a manual gate valve, and the wing valve **180ab** is an automatic gate valve. In other embodiments, the wing valve **180aa** and/or the wing valve **180ab** is/are omitted in favor of plug valve(s) (not shown). Wing valves **180ba** and **180bb** such as, for example, gate valves, are also connected to the flow block **175**, opposite the wing valves **180aa** and **180ab**. In some embodiments, the wing valves **180ba** and **180bb** are kill valves. In some embodiments, the wing valve **180ba** is a manual gate valve, and the wing valve **180bb** is an automatic gate valve. In other embodiments, the wing valve **180ba** and/or the wing valve **180bb** is/are omitted in favor of plug valve(s) (not shown). The fluid conduit **140a** is operably coupled to the flow block **175**. As a result, in addition to being operably coupled between, and in fluid communication with, the wing valves **180aa** and **180ba**, the flow block **175** is operably coupled between, and in fluid communication with, the master valve **170** and the fluid conduit **140a**. In some embodiments, the flow block **175** is capped by, for example, a blind flange. In other embodiments, the blind flange is omitted and replaced with one or more additional components of the wellhead **120a** such as, for example, a swab valve, an adapter, a cap, another component, the like, or any combination thereof.

[0028] Referring to FIG. 3B, with continuing reference to FIG. 3A, in an embodiment, the flow block **175** is replaced with a flow block **176**, which flow block **176** is operably coupled between, and in fluid communication with, the wing valves **180aa** and **180bb**, and the flow block **175**, to which the fluid conduit **140a** is operably coupled, is connected to the flow block **176**, opposite the master valve **170**; in such embodiments, the flow block **175** is operably coupled between, and in fluid communication with, the flow block **176** and the fluid conduit **140a**.

[0029] In some embodiments, the flow block **175** is configured to rotate or swivel about a vertical axis **226** and relative to the master valve **165**, as indicated by curvilinear arrow **228** in FIGS. 3A and 3B. The rotation or swiveling of the flow block **175** about the vertical axis **226** and relative to the master valve **165** is facilitated by a swivel assembly **240a**. Turning to FIG. 3C-1, for example, the swivel assembly **240a** may be positioned between the flow block **175** and

the master valve **170** in the embodiment of FIG. 3A. Turning to FIG. 3C-2, for another example, the swivel assembly **240a** may be positioned between the flow block **175** and the flow block **176** in the embodiment of FIG. 3B. In either case, the resulting adjustability in the circumferential orientation of the flow block **175** relative to the master valve **165** effects a circumferential offset therebetween, which circumferential offset facilitates connection of the fluid conduit **140a** between the zipper leg **130a** and the wellhead **120a**, as will be described in further detail below. In an alternative embodiment, in order to effect the circumferential offset of the flow block **175** relative to the master valve **165**: the master valve **170** may be de-coupled from the master valve **165**, and, subsequently, re-coupled to the master valve **165** with a different circumferential orientation relative thereto; the flow block **175** may be de-coupled from the master valve **170** (in the embodiment of FIG. 3A), and, subsequently, re-coupled to the master valve **170** with a different circumferential orientation relative thereto; and/or the flow block **175** may be de-coupled from the flow block **176** (in the embodiment of FIG. 3B), and, subsequently, re-coupled to the flow block **176** with a different circumferential orientation relative thereto.

[0030] Referring to FIG. 3D, with continuing reference to FIGS. 3C-1 and 3C-2, in an embodiment, the swivel assembly **240a** includes a swivel spool **242a** and a swivel flange **242b**. The swivel spool **242a** defines an internal passage **242c** and opposing end portions **242da** and **242db**. The internal passage **242c** extends along a longitudinal axis **242e**. The end portion **242da** of the swivel spool **242a** includes a flange **242f**. An end face **242ga** of the swivel spool **242a** is axially offset from the flange **242f** in a direction opposite the end portion **242db** of the swivel spool **242a**. An annular groove **242ha** is formed into the end face **242ga**. The annular groove **242ha** is adapted to accommodate a sealing element (not shown) to facilitate sealing engagement between the swivel spool **242a** and a first adjacent component (e.g., the flow block **175**). The axial offset between the end face **242ga** and the flange **242f** of the swivel spool **242a** facilitates the sealing engagement of the sealing element accommodated within the annular groove **242ha** and the first adjacent component when the flange **242f** of the swivel spool **242a** is connected to the first adjacent component. The end portion **242da** of the swivel spool **242a** also includes a tapered annular surface **242ia**, opposite the end face **242ga**.

[0031] The end portion **242db** of the spool includes an external hub **242j**. The external hub **242j** defines an external shoulder **242k** in the swivel spool **242a**. In some embodiments, as in FIG. 3D, the external shoulder **242k** is tapered. An end face **242gb** of the swivel spool **242a** adjoins the external hub **242j**. An annular groove **242hb** is formed into the end face **242gb**. The annular groove **242hb** is adapted to accommodate a sealing element (not shown) to facilitate sealing engagement between the swivel spool **242a** and a second adjacent component (e.g., the master valve **170** in the embodiment of FIGS. 3A and 3C-1, or the flow block **176** in the embodiment of FIGS. 3B and 3C-2). The end face **242gb** of the swivel spool **242a** is axially offset from the swivel flange **242b**, in a direction opposite the end portion **242da** of the swivel spool **242a**. The axial offset between the end face **242gb** of the swivel spool **242a** and the swivel flange **242b** facilitates the sealing engagement of the sealing element accommodated within the annular groove **242hb** and the

second adjacent component. The end portion **242db** of the swivel spool **242a** also includes a tapered annular surface **242ib**, opposite the end face **242gb**. The tapered annular surfaces **242ia** and **242ib** of the swivel spool **242a** together form a weld channel in which a weld is formed to connect the end portions **242da** and **242db** of the swivel spool **242a**. An external annular groove **242i** is formed in the end portion **242db** of the swivel spool **242a** between the external shoulder **242k** and the tapered annular surface **242ib**. The external annular groove **242i** accommodates a retaining member **242m** (e.g., a retaining ring) to retain the swivel flange **242b** on the swivel spool **242a**. The swivel flange **242b** is a ring-shaped member defining an internal shoulder **242n**. The internal shoulder **242n** of the swivel flange **242b** engages the external shoulder **242k** of the swivel spool **242a** to facilitate attachment of the swivel assembly **240a** to the second adjacent component.

**[0032]** To assemble the swivel assembly **240a**, prior to welding the end portions **242da** and **242db** of the swivel spool **242a** together, the swivel flange **242b** is placed around the end portion **242db** of the swivel spool **242a** with the internal shoulder **242n** of the swivel flange **242b** facing the external shoulder **242k** of the swivel spool **242a**. The retaining member **242m** is placed in the external annular groove **242i** to retain the swivel flange **242b** on the end portion **242db** of the swivel spool **242a**. The end portions **242da** and **242db** of the swivel spool **242a** are positioned so that the tapered annular surfaces **242ia** and **242ib** of the swivel spool **242a** together form the weld channel and the weld is formed in the weld channel to connect the end portions **242da** and **242db** of the swivel spool **242a** to each other. The flange **242f** of the swivel spool **242a** may then be connected to the first adjacent component using first fasteners (not shown), and the swivel flange **242b** may be connected to the second adjacent component using second fasteners (not shown). The rotation or swiveling of the first adjacent component relative to the second adjacent component is facilitated by sliding engagement between the internal shoulder **242n** of the swivel spool **242a** and the external shoulder **242k** of the swivel spool **242a**. In some embodiments, such sliding engagement is facilitated by loosening (or not completely tightening) the second fasteners connecting the swivel flange **242b** to the second adjacent component. In this manner, the rotation or swiveling of the flow block **175** about the vertical axis **226** (shown in FIGS. **3A** and **3B**) and relative to the master valve **165** is facilitated by the swivel assembly **240a**.

**[0033]** Referring to FIG. **4**, with continuing reference to FIG. **3A**, in an embodiment, the flow block **175** is omitted and replaced with a flow block **175'**. The flow block **175'** includes side surfaces **185a-d**. In some embodiments, the side surfaces **185a** and **185b** are parallel. The side surface **185a** of the flow block **175'** may include a  $7\frac{1}{16}$ " 15K connection. Likewise, the side surface **185b** of the flow block **175'** may include a  $7\frac{1}{16}$ " 15K connection. In some embodiments, as in FIG. **4**, the flow block **175'** is oriented so that the side surface **185a** faces downwardly and the side surface **185b** faces upwardly. In such embodiments, the  $7\frac{1}{16}$ " 15K connection at the side surface **185a** of the flow block **175'** is connected to the master valve **170** (or the flow block **176**, in some embodiments) and the  $7\frac{1}{16}$ " 15K connection at the side surface **185b** of the flow block **175'** is connected to the blind flange (shown in FIGS. **2A** and **3A**) or the one or more additional components of the wellhead

**120a** (e.g., the swab valve, the adapter, the cap, the another component, the like, or any combination thereof). Alternatively, in some embodiments, the flow block **175'** is oriented so that the side surface **185a** faces upwardly and the side surface **185b** faces downwardly. In such embodiments, the  $7\frac{1}{16}$ " 15K connection at the side surface **185b** of the flow block **175'** is connected to the master valve **170** (or the flow block **176**, in some embodiments) and the  $7\frac{1}{16}$ " 15K connection at the side surface **185a** of the flow block **175'** is connected to the blind flange (shown in FIGS. **2A** and **3A**) or the one or more additional components of the wellhead **120a** (e.g., the swab valve, the adapter, the cap, the another component, the like, or any combination thereof).

**[0034]** The side surfaces **185c** and **185d** extend between the side surface **185a** and the side surface **185b**. In some embodiments, the side surfaces **185c** and **185d** are parallel. In some embodiments, the side surfaces **185c** and **185d** are perpendicular to the side surfaces **185a** and **185b**. The flow block **175'** also includes additional side surfaces (not visible in FIG. **4**). The wing valve **180aa** is connected to the flow block **175'** at one of the additional side surfaces. Similarly, the wing valve **180ba** is connected to the flow block **175'** at the other of the additional side surfaces. The additional side surfaces extend between the side surface **185a** and the side surface **185b**. The additional side surfaces also extend between the side surface **185c** and the side surface **185d**. In some embodiments, the additional side surfaces are parallel. In addition, or instead, the additional side surfaces may be perpendicular to the side surfaces **185a** and **185b**. In addition, or instead, the additional side surfaces may be perpendicular to the side surfaces **185c** and **185d**.

**[0035]** The flow block **175'** also includes an angled surface **186**. The angled surface **186** extends between the additional side surfaces. The angled surface **186** also extends between the side surface **185a** and the side surface **185d**. More particularly, the angled surface **186** extends at an angle  $\alpha$  with respect to the side surface **185d**. For example, the angle  $\alpha$  may be between 70 degrees and 60 degrees, greater than 60 degrees, 60 degrees, less than 60 degrees, between 60 degrees and 45 degrees, greater than 45 degrees, 45 degrees, less than 45 degrees, between 45 degrees and 30 degrees, greater than 30 degrees, 30 degrees, less than 30 degrees, or between 30 degrees and 20 degrees. In some embodiments, the angled surface **186** of the flow block **175'** includes a  $5\frac{1}{8}$ " 15K connection via which the fluid conduit **140a** is connected to the flow block **175'**, as will be described in further detail below.

**[0036]** The flow block **175'** defines a flow passage **190** via which the flow block **175'** is in fluid communication with the master valve **170**. In some embodiments, the flow passage **190** is a 7" bore. The flow passage **190** extends through the flow block **175'**, including the side surfaces **185a** and **185b**, along an axis **195**. In some embodiments, the axis **195** of the flow passage **190** of the flow block **175'** is substantially coaxial with a vertical center axis that extends through the center of a vertical flow passage of the wellhead **120a**. The flow block **175'** also defines a flow passage **196** via which the flow block **175'** is in fluid communication with the wing valve **180ba**. The flow passage **196** extends through the flow block **175'**, including the other of the additional side surfaces to which the wing valve **180ba** is connected, and into the flow passage **190**. The flow block **175'** also defines an additional flow passage (not visible in FIG. **4**) via which the flow block **175'** is in fluid communication with the wing

valve 180aa. The additional flow passage extends through the flow block 175', including the one of the additional side surfaces to which the wing valve 180aa is connected, and into the flow passage 190.

[0037] The flow block 175' also defines a flow passage 200 via which the flow block 175' is in fluid communication with the fluid conduit 140a. In some embodiments, the flow passage 200 is a 5" bore. The flow passage 200 extends downward-and-to-the-right (as viewed in FIG. 4) from the flow passage 190, through the flow block 175', including the angled surface 186, and along an axis 205 that is oriented at an angle  $\beta$  with respect to the axis 195 of the flow passage 190. In some embodiments, the axis 205 is oriented at an angle of 90 degrees with respect to the angled surface 186. In some embodiments, the angle  $\beta$  at which the axis 205 of the flow passage 190 is oriented with respect to the axis 195 of the flow passage 190 reduces wear and excessive turbulence in the flow block 175' by, for example, easing the change in the direction of fluid flow. For example, the angle  $\beta$  may be between 20 degrees and 30 degrees, less than 30 degrees, 30 degrees, greater than 30 degrees, between 30 degrees and 45 degrees, less than 45 degrees, 45 degrees, greater than 45 degrees, between 45 degrees and 60 degrees, less than 60 degrees, 60 degrees, greater than 60 degrees, or between 60 degrees and 70 degrees.

[0038] Turning back to FIG. 3A, in an embodiment, the fluid conduit 140a includes a pipe segment 206, end connectors 207a and 207b, and adapters 208a and 208b. The end connector 207a is coupled to an end portion of the pipe segment 206 via the adapter 208a. In some embodiments, the adapter 208a is part of the end connector 207a. However, the end connector 207a does not form part of the pipe segment 206, that is, the end connector 207a and the pipe segment 206 are separately formed. Similarly, the end connector 207b is coupled to an end portion of the pipe segment 206 opposite the end connector 207a via the adapter 208b. In some embodiments, the adapter 208b is part of the end connector 207b. However, the end connector 207b does not form part of the pipe segment 206, that is, the end connector 207b and the pipe segment 206 are separately formed. The end connectors 207a and 207b may be identical. In some embodiments, the end connectors 207a and 207b are or include flanged connections. The adapters 208a and 208b may be identical. The pipe segment 206 extends between the end connectors 207a and 207b.

[0039] In some embodiments, as in FIG. 3A, the pipe segment 206 includes a single flexible portion and does not include a rigid portion. For example, the pipe segment 206 may be or include Halliburton's Coflexip® Flexible Pipe. For another example, the pipe segment 206 may be or include Technip's Coflexip® Flexible Line. In other embodiments, the pipe segment 206 includes one or more flexible portions and one or more rigid portions (not shown). Although the fluid conduit 140a has been described herein as including the pipe segment 206, the end connectors 207a and 207b, and the adapters 208a and 208b, in addition, or instead, the fluid conduit 140a may include any combination of other pipe segments, end connectors, adapters, or other components defining a fluid flow path between the wellhead 120a and the zipper leg 130a.

[0040] Referring still to FIG. 3A, in an embodiment, the zipper leg 130a includes the flow block 210 (also shown in FIG. 2C), a pair of zipper valves 215 and 220, such as, for example, gate valves, and a flow block 225. The flow block

210 is positioned at the base of the zipper leg 130a. The zipper valves 215 and 220 are connected to each other in series, with the zipper valve 215 being connected to the flow block 210. In some embodiments, the zipper valve 215 is a manual gate valve, and the zipper valve 220 is an automatic gate valve. In other embodiments, the zipper valve 215 and/or the zipper valve 220 is/are omitted in favor of plug valve(s) (not shown). The flow block 225 is connected to the zipper valve 220, opposite the zipper valve 215. In some embodiments, the flow block 225 is a 7" 15k standard tee positioned directly above the zipper valve 220. For example, the flow block 175 may include an FSA 7" 15Kx5" 15K via which the fluid conduit 140a is connected to the zipper leg 130a. The fluid conduit 140a is operably coupled to the flow block 225. As a result, the flow block 225 is operably coupled between, and in fluid communication with, the zipper valve 220 and the fluid conduit 140a. In some embodiments, the flow block 225 is capped by, for example, a blind flange. In other embodiments, the blind flange is omitted and replaced with one or more additional components of the zipper leg 130a such as, for example, a valve, an adapter, a cap, another component, the like, or any combination thereof.

[0041] In some embodiments, the flow block 225 is configured to rotate or swivel about a vertical axis 230 and relative to the flow block 210, as indicated by curvilinear arrow 235 in FIGS. 3A and 3B. The rotation or swiveling of the flow block 225 about the vertical axis 230 and relative to the flow block 210 is facilitated by a swivel assembly 240b. Turning to FIG. 3C-3, for example, the swivel assembly 240b may be positioned between the flow block 225 and the zipper valve 220. Turning to FIG. 3C-4, in addition, or instead, the swivel assembly 240b (or another swivel assembly) may be positioned between the zipper valve 215 and the zipper valve 220. Turning to FIG. 3C-5, in addition, or instead, the swivel assembly 240b (or another swivel assembly) may be positioned between the flow block 210 and the zipper valve 215. The resulting adjustability in the circumferential orientation of the flow block 225 relative to the flow block 210 effects a circumferential offset therebetween, which circumferential offset facilitates connection of the fluid conduit 140a between the zipper leg 130a and the wellhead 120a, as will be described in further detail below. In an alternative embodiment, in order to effect the circumferential offset of the flow block 225 relative to the flow block 210: the zipper valve 215 may be de-coupled from the flow block 210, and, subsequently, re-coupled to the flow block 210 with a different circumferential orientation relative thereto; the zipper valve 220 may be de-coupled from the zipper valve 215, and, subsequently, re-coupled to the zipper valve 215 with a different circumferential orientation relative thereto; and/or the flow block 225 may be de-coupled from the zipper valve 220, and, subsequently, re-coupled to the zipper valve 220 with a different circumferential orientation relative thereto.

[0042] The swivel assembly 240b is substantially identical to the swivel assembly 240a and, therefore, the structure of the swivel assembly 240b will not be described in further detail. Furthermore, the manner in which the swivel assembly 240b facilitates the rotation or swiveling about the vertical axis 230 (shown in FIGS. 3A and 3B) and relative to the flow block 210 is substantially similar to that described above with respect to the swivel assembly 240a

and, therefore, the operation of the swivel assembly 240b will not be described in further detail.

[0043] Referring to FIG. 5, with continuing reference to FIG. 3A, in an embodiment, the flow block 225 is omitted and replaced with a flow block 225'. The flow block 225' includes several features that are substantially identical to corresponding features of the flow block 175', which substantially identical features are given the same reference numerals. However, the flow block 225' does not include: the flow passage 196 extending through the flow block 225' and into the flow passage 190; or the additional flow passage extending through the flow block 225' and into the flow passage 190.

[0044] In some embodiments, as in FIG. 5, the flow block 225' is oriented so that the side surface 185a faces downwardly and the side surface 185b faces upwardly. In such embodiments, the 7/16" 15K connection at the side surface 185a of the flow block 225' is connected to the zipper valve 220 and the 7/16" 15K connection at the side surface 185b of the flow block 175' is connected to the blind flange (shown in FIGS. 2A and 3A) or the one or more additional components of the zipper leg 130a (e.g., the valve, the adapter, the cap, the another component, the like, or any combination thereof).

[0045] Alternatively, in some embodiments, the flow block 225' is oriented so that the side surface 185a faces upwardly and the side surface 185b faces downwardly. In such embodiments, the 7/16" 15K connection at the side surface 185b of the flow block 225' is connected to the zipper valve 220 and the 7/16" 15K connection at the side surface 185a of the flow block 175' is connected to the blind flange (shown in FIGS. 2A and 3A) or the one or more additional components of the zipper leg 130a (e.g., the valve, the adapter, the cap, the another component, the like, or any combination thereof). In some embodiments, the angled surface 186 of the flow block 225' includes the 5/8" 15K connection via which the fluid conduit 140a is connected to the flow block 225', as will be described in further detail below.

[0046] The flow block 225' is in fluid communication with the zipper valve 220 via the flow passage 190. In some embodiments, the axis 195 of the flow passage 190 of the flow block 225' is substantially coaxial with a vertical center axis that extends through the center of a vertical flow passage of the zipper leg 130a. The flow block 225' is in fluid communication with the fluid conduit 140a via the flow passage 200, which flow passage 200 extends downward-and-to-the-left (as viewed in FIG. 5) from the flow passage 190.

[0047] Referring again to FIGS. 1, 2A, and 3A, in an embodiment, to facilitate proper assembly of the zipper manifold 135, the respective heights of the flow blocks 175 (or the flow blocks 175') of the wellheads 120a-c are measured, the respective spacings between the wellheads 120a-c are measured, and any respective offsets between the wellheads 120a-c are measured. One or more of the zipper legs 130a-c may be placed on the adjustable skids 161a-c (as shown in FIG. 2B), each having the legs 163ba-bd (e.g., the jacks) to facilitate height adjustment so that the flow blocks 225 (or the flow blocks 225') may be sufficiently vertically aligned with the flow blocks 175 (or the flow blocks 175'). The fluid conduits 145a and 145b between the respective zipper legs 130a may be fabricated to length to account for the respective spacings between the wellheads 120a-c and to

allow the flow blocks 225 (or the flow blocks 225') to be sufficiently horizontally aligned with the flow blocks 175 (or the flow blocks 175'). Moreover, the fluid conduits 140a-c may be fabricated to length to account for any respective offsets (i.e., perpendicular to the respective spacings between the wellheads 120a-c) between the wellheads 120a-c. The swivel assemblies 240a enable circumferential offsetting between the respective flow blocks 175 (or the respective flow blocks 175') and the respective master valves 165 of the wellheads 120a-c. Likewise, the swivel assemblies 240b enable circumferential offsetting between the respective flow blocks 225 (or the respective flow blocks 225') and the respective flow blocks 210 of the zipper legs 130a-c. Such circumferential offsetting allows for sufficient angular alignment to be established between the flow blocks 225 (or the flow blocks 225') of the respective zipper legs 130a-c and the flow blocks 175 (or the flow blocks 175') of the respective wellheads 120a-c. Finally, the flexible portion (s) of the pipe segments 206 of the fluid conduits 140a-c allow for at least some vertical, horizontal, and/or angular misalignment between the flow blocks 225 (or the flow blocks 225') of the respective zipper legs 130a-c and the flow blocks 175 (or the flow blocks 175') of the respective wellheads 120a-c while still enabling connection of the fluid conduits 140a-c therebetween.

[0048] In operation, the pumps 115a-f pump fluid (e.g., hydraulic fracturing fluid) to the zipper manifold 135 via the manifold assembly 105, which fluid then flows through the flow block 210, the zipper valves 215 and 220, and the flow block 225 (or the flow block 225') of the zipper leg 130a, through the fluid conduit 140a, through the flow block 175 (or the flow block 175') and the master valves 170 and 165 of the wellhead 120a, and into the wellbore 142a. In some embodiments, the wellheads 120b and 120c are substantially identical to the wellhead 120a, the fluid conduits 140b and 140c are substantially identical to the fluid conduit 140a, and the zipper legs 130b and 130c are substantially identical to the zipper leg 130a; therefore, the structure and operation of the wellheads 120b and 120c, the fluid conduits 140b and 140c, and the zipper legs 130b and 130c will not be described in further detail.

[0049] Referring again to FIGS. 3A, 3B, 4, and 5, in an embodiment, the wellhead 120a includes the flow block 175' shown in FIG. 4 (instead of the flow block 175) and the zipper leg 130a includes the flow block 225' shown in FIG. 5 (instead of the flow block 225). For example, the flow block 175' may be connected to the master valve 170 of the wellhead 120a (in the embodiment of FIG. 3A), or to the flow block 176 (in the embodiment of FIG. 3B), at the side surface 185a (e.g., via the 7/16" 15K connection) so that the angled surface 186 and the flow passage 200 of the flow block 175' are angled downwardly. The end connector 207a of the fluid conduit 140a is connected to the flow block 175' of the wellhead 120a at the angled surface 186 so that fluid is communicable between the fluid conduit 140a and the flow passage 190 of the flow block 175' via the flow passage 200 of the flow block 175'. For example, the end connector 207a may be connected to the flow block 175' via the 5/8" 15K connection (facing downward-and-to-the-right as viewed in FIG. 4) of the flow block 175'. In addition, the flow block 225' is connected to the zipper valve 220 of the zipper leg 130a at the side surface 185a (e.g., via the 7/16" 15K connection) so that the angled surface 186 and the flow passage 200 of the flow block 225' are angled downwardly.

The end connector 207b of the fluid conduit 140a is connected to the flow block 225' of the zipper leg 130a at the angled surface 186 so that fluid is communicable between the flow passage 190 of the flow block 225' and the fluid conduit 140a via the flow passage 200 of the flow block 225'. For example, the end connector 207b may be connected to the flow block 225' via the 5/8" 15K connection (facing-downward-and-to-the-left as viewed in FIG. 5) of the flow block 225'.

[0050] The downward angles of the angled surfaces 186 of the flow blocks 175' and 225', in combination, allow the pipe segment 206 of the fluid conduit 140a to flex relatively more evenly along its length. Among other advantages, such substantially even flexing of the pipe segment 206 eases the transition of fluid flow through the pipe segment 206, decreases turbulent flow in the pipe segment 206, and/or decreases wear on the pipe segment 206. Moreover, the downward angles of the angled surfaces 186 of the flow blocks 175' and 225', in combination, ease connection of the fluid conduit 140 between the wellhead 120a and the zipper leg 130a.

[0051] Alternatively, in some embodiments, the flow block 175' is connected to the master valve 170 of the wellhead 120a (in the embodiment of FIG. 3A), or to the flow block 176 (in the embodiment of FIG. 3B), at the side surface 185b so that the angled surface 186 and the flow passage 200 of the flow block 175' are angled upwardly. The end connector 207a of the fluid conduit 140a is connected to the flow block 175' of the wellhead 120a at the angled surface 186 so that fluid is communicable between the fluid conduit 140a and the flow passage 190 of the flow block 175' via the flow passage 200 of the flow block 175'. For example, the end connector 207a may be connected to the flow block 175' via the 5/8" 15K connection (facing downward-and-to-the-right as viewed in FIG. 4) of the flow block 175'. In addition, the flow block 225' is connected to the zipper valve 220 of the zipper leg 130a at the side surface 185b so that the angled surface 186 and the flow passage 200 of the flow block 225' are angled upwardly. The end connector 207b of the fluid conduit 140a is connected to the flow block 225' of the zipper leg 130a at the angled surface 186 so that fluid is communicable between the flow passage 190 of the flow block 225' and the fluid conduit 140a via the flow passage 200 of the flow block 225'. For example, the end connector 207b may be connected to the flow block 225' via the 5/8" 15K connection (facing-downward-and-to-the-left as viewed in FIG. 5) of the flow block 225'.

[0052] The upward angles of the angled surfaces 186 of the flow blocks 175' and 225', in combination, allow the pipe segment 206 of the fluid conduit 140a to flex relatively more evenly along its length. Among other advantages, such substantially even flexing of the pipe segment 206 eases the transition of fluid flow through the pipe segment 206, decreases turbulent flow in the pipe segment 206, and/or decreases wear on the pipe segment 206. Moreover, the upward angles of the angled surfaces 186 of the flow blocks 175' and 225', in combination, ease connection of the fluid conduit 140 between the wellhead 120a and the zipper leg 130a.

[0053] In some embodiments, rather than being oriented vertically, the zipper manifold 135 shown in FIG. 2A may be tipped horizontally toward the wellheads 120a-c so that the zipper legs 130a-c are each oriented horizontally. Further, rather than being gate valves, the zipper valves 215 and 220

of the zipper legs 130a-c may be plug valves. Further still, rather than being connected to the flow blocks 225 of the zipper legs 130a-c as illustrated in FIG. 2A, the fluid conduits 140a-c may be connected to the zipper legs 130a-c, respectively, via different connections of the flow blocks 225 such as, for example, the end connections covered by the (top) blind flanges (as viewed in FIG. 2A). Finally, in at least one such embodiment, the flow blocks 175 of the respective zipper legs 130a-c may be omitted and replaced with the flow blocks 175' so that the fluid conduits 140a-c are connected to the wellheads 120a-c, respectively, via the 5/8" 15K connections at the respective angled surfaces 186 of the flow blocks 175'.

[0054] Referring to FIG. 6, with continuing reference to FIGS. 2A and 3A, in an embodiment, the fluid conduits 140a-c are omitted from the system 100 and replaced with fluid conduits 244a-c. As discussed above, the zipper legs 130a and 130b are interconnected with each other to form the zipper manifold 135. Moreover, the zipper legs 130a-c are operably coupled to fluid conduits 244a-c, respectively, and the fluid conduits 244a-c are operably coupled to the wellheads 120a-c, respectively. The respective zipper legs 130a-c are thus operably coupled to, and in fluid communication with, the wellheads 120a-c via the respective fluid conduits 244a-c. The fluid conduit 244a includes several features that are substantially identical to corresponding features of the fluid conduit 140a. However, the pipe segment 206 is omitted from the fluid conduit and replaced with a pipe segment 245. In some embodiments, as in FIG. 6, the pipe segment 245 includes a single rigid portion and does not include a flexible portion. Although the fluid conduit 244a has been described herein as including the pipe segment 245, in addition, or instead, the fluid conduit 244a may include any combination of other pipe segments or other components defining a fluid flow path between the wellhead 120a and the zipper leg 130a. In some embodiments, the fluid conduits 244b and 244c are substantially identical to the fluid conduit 244a, and, therefore, will not be described in further detail. Moreover, the operation of the system 100 including the fluid conduits 244a-c is substantially identical to the operation of the system 100 including the fluid conduits 140a-c, and, therefore, will not be described in further detail.

[0055] A system has been disclosed. The system generally includes: one or more zipper legs, each including a first flow block; one or more wellheads, each including a second flow block; and one or more first fluid conduits, each connecting the first flow block on of one the zipper leg(s) to the second flow block of one of the wellhead(s); wherein: (i) at least one of the zipper leg(s) includes a first swivel assembly; and at least a portion of the first fluid conduit connected to the first flow block of the at least one of the zipper leg(s) is flexible; (ii) at least one of the wellhead(s) includes a second swivel assembly; and at least a portion of the first fluid conduit connected to the second flow block of the at least one of the wellhead(s) is flexible; or (iii) both (i) and (ii). In some embodiments, (iii). In some embodiments, (ii). In some embodiments, (i). In some embodiments, the at least one of the zipper leg(s) is supported by a skid including legs each having an adjustable length. In some embodiments, the one or more zipper legs include first and second zipper legs; a second fluid conduit is connected between the first and second zipper legs; and the second fluid conduit is supported by a stand including legs having an adjustable length and/or

an adjustable angle. In some embodiments, the first flow block of at least one of the zipper leg(s) includes: a side surface; a first flow passage via which the first flow block is in fluid communication with the at least one of the zipper leg(s), the first flow passage extending through the side surface; an angled surface that is angled relative to the side surface; and a second flow passage via which the first fluid conduit connected to the first flow block of the at least one of the zipper leg(s) is in fluid communication with the at least one of the zipper leg(s), the second flow passage extending through the angled surface. In some embodiments, the second flow block of at least one of the wellhead(s) includes: a side surface; a first flow passage via which the second flow block is in fluid communication with the at least one of the wellhead(s), the first flow passage extending through the side surface; an angled surface that is angled relative to the side surface; and a second flow passage via which the first fluid conduit connected to the second flow block of the at least one of the wellhead(s) is in fluid communication with the at least one of the wellhead(s), the second flow passage extending through the angled surface.

**[0056]** Another system has also been disclosed. The another system generally includes: one or more zipper legs, each including a first flow block; one or more wellheads, each including a second flow block; and one or more first fluid conduits, each connecting the first flow block of one of the zipper leg(s) to the second flow block of one of the wellhead(s); wherein: (i) the first flow block of at least one of the zipper leg(s) includes: a first side surface; a first flow passage via which the first flow block is in fluid communication with the at least one of the zipper leg(s), the first flow passage extending through the first side surface; a first angled surface that is angled relative to the first side surface; and a second flow passage via which the first fluid conduit connected to the first flow block of the at least one of the zipper leg(s) is in fluid communication with the at least one of the zipper leg(s), the second flow passage extending through the first angled surface; (ii) the second flow block of at least one of the wellhead(s) includes: a second side surface; a first flow passage via which the second flow block is in fluid communication with the at least one of the wellhead(s), the first flow passage extending through the second side surface; a second angled surface that is angled relative to the second side surface; and a second flow passage via which the first fluid conduit connected to the second flow block of the at least one of the wellhead(s) is in fluid communication with the at least one of the wellhead(s), the second flow passage extending through the second angled surface; or (iii) both (i) and (ii). In some embodiments, (iii). In some embodiments, (i); and at least a portion of the first fluid conduit connected to the first flow block of the at least one of the zipper leg(s) is flexible. In some embodiments, the at least one of the zipper leg(s) is supported by a skid including legs each having an adjustable length. In some embodiments, the at least one of the zipper leg(s) includes a swivel assembly. In some embodiments, the second flow passage angles downwardly from the first flow passage. In some embodiments, (ii); and at least a portion of the first fluid conduit connected to the second flow block of the at least one of the wellhead(s) is flexible. In some embodiments, the at least one of the wellhead(s) includes a swivel assembly. In some embodiments, the fourth flow passage angles downwardly from the third flow passage. In some embodiments, the one or more zipper legs include first

and second zipper legs; a second fluid conduit is connected between the first and second zipper legs; and the second fluid conduit is supported by a stand, the stand including legs, the legs having an adjustable length and/or an adjustable angle.

**[0057]** A zipper leg has also been disclosed, which zipper leg is adapted to be connected to a wellhead via a fluid conduit. The zipper leg generally includes: a flow block, the flow block including: a side surface; a first flow passage via which the flow block is adapted to be in fluid communication with the zipper leg, the first flow passage extending through the side surface; an angled surface to which the fluid conduit is adapted to be connected, the angled surface being angled relative to the side surface; and a second flow passage via which the zipper leg is adapted to be in fluid communication with the fluid conduit, the second flow passage extending through the angled surface. In some embodiments, the zipper leg is supported by a skid including legs each having an adjustable length. In some embodiments, the zipper leg further includes a swivel assembly. In some embodiments, the second flow passage of the flow block angles downwardly from the first flow passage.

**[0058]** A fluid conduit has also been disclosed according to one or more embodiments of the present disclosure. The fluid conduit communicates fluid between a zipper leg and an oil and gas wellhead has been disclosed according to one or more embodiments of the present disclosure. The fluid conduit may be completely flexible, completely rigid, or partially flexible and partially rigid. The fluid conduit is coupled to the wellhead via a first flow block. The first flow block may include a first downwardly angled surface through which a first downwardly angled flow passage extends and to which a first end portion of the fluid conduit is connected. Similarly, the fluid conduit is coupled to the zipper leg via a second flow block. The second flow block may include a second downwardly angled surface through which a second downwardly angled flow passage extends and to which the fluid conduit is connected.

**[0059]** An apparatus for communicating fluid between a zipper leg and a wellhead has also been disclosed according to one or more embodiments of the present disclosure, said apparatus comprising a fluid conduit and a flow block. In some embodiments, the flow block is part of the wellhead. In some embodiments, the flow block is part of the zipper leg.

**[0060]** It is understood that variations may be made in the foregoing without departing from the scope of the present disclosure.

**[0061]** In one or more embodiments, the elements and teachings of the various embodiments may be combined in whole or in part in some or all of the embodiments. In addition, one or more of the elements and teachings of the various embodiments may be omitted, at least in part, and/or combined, at least in part, with one or more of the other elements and teachings of the various embodiments.

**[0062]** Any spatial references, such as, for example, “upper,” “lower,” “above,” “below,” “between,” “bottom,” “vertical,” “horizontal,” “angular,” “upwards,” “downwards,” “side-to-side,” “left-to-right,” “right-to-left,” “top-to-bottom,” “bottom-to-top,” “top,” “bottom,” “bottom-up,” “top-down,” etc., are for the purpose of illustration only and do not limit the specific orientation or location of the structure described above.

**[0063]** In one or more embodiments, while different steps, processes, and procedures are described as appearing as

distinct acts, one or more of the steps, one or more of the processes, and/or one or more of the procedures may also be performed in different orders, simultaneously and/or sequentially. In one or more embodiments, the steps, processes, and/or procedures may be merged into one or more steps, processes and/or procedures.

**[0064]** In one or more embodiments, one or more of the operational steps in each embodiment may be omitted. Moreover, in some instances, some features of the present disclosure may be employed without a corresponding use of the other features. Moreover, one or more of the above-described embodiments and/or variations may be combined in whole or in part with any one or more of the other above-described embodiments and/or variations.

**[0065]** Although several embodiments have been described in detail above, the embodiments described are illustrative only and are not limiting, and those skilled in the art will readily appreciate that many other modifications, changes and/or substitutions are possible in the embodiments without materially departing from the novel teachings and advantages of the present disclosure. Accordingly, all such modifications, changes, and/or substitutions are intended to be included within the scope of this disclosure as defined in the following claims. In the claims, any means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents, but also equivalent structures. Moreover, it is the express intention of the applicant not to invoke 35 U.S.C. § 112(f) for any limitations of any of the claims herein, except for those in which the claim expressly uses the word “means” together with an associated function.

What is claimed is:

1. A system, comprising:

one or more zipper legs, each including a first flow block; one or more wellheads, each including a second flow block; and

one or more first fluid conduits, each connecting the first flow block of one the zipper leg(s) to the second flow block of one of the wellhead(s);

wherein:

(i) at least one of the zipper leg(s) includes a first swivel assembly; and

at least a portion of the first fluid conduit connected to the first flow block of the at least one of the zipper leg(s) is flexible;

(ii) at least one of the wellhead(s) includes a second swivel assembly; and

at least a portion of the first fluid conduit connected to the second flow block of the at least one of the wellhead(s) is flexible;

or

(iii) both (i) and (ii).

2. The system of claim 1, wherein (iii).

3. The system of claim 1, wherein (ii).

4. The system of claim 1, wherein (i).

5. The system of claim 4, wherein the at least one of the zipper leg(s) is supported by a skid including legs each having an adjustable length.

6. The system of claim 1, wherein the one or more zipper legs comprise first and second zipper legs;

wherein a second fluid conduit is connected between the first and second zipper legs; and

wherein the second fluid conduit is supported by a stand including legs each having an adjustable length and/or having an adjustable angle therebetween.

7. The system of claim 1, wherein the first flow block of at least one of the zipper leg(s) comprises:

a side surface;

a first flow passage via which the first flow block is in fluid communication with the at least one of the zipper leg(s), the first flow passage extending through the side surface;

an angled surface that is angled relative to the side surface; and

a second flow passage via which the first fluid conduit connected to the first flow block of the at least one of the zipper leg(s) is in fluid communication with the at least one of the zipper leg(s), the second flow passage extending through the angled surface.

8. The system of claim 1, wherein the second flow block of at least one of the wellhead(s) comprises:

a side surface;

a first flow passage via which the second flow block is in fluid communication with the at least one of the wellhead(s), the first flow passage extending through the side surface;

an angled surface that is angled relative to the side surface; and

a second flow passage via which the first fluid conduit connected to the second flow block of the at least one of the wellhead(s) is in fluid communication with the at least one of the wellhead(s), the second flow passage extending through the angled surface.

9. A system, comprising:

one or more zipper legs, each including a first flow block; one or more wellheads, each including a second flow block; and

one or more first fluid conduits, each connecting the first flow block of one the zipper leg(s) to the second flow block of one of the wellhead(s);

wherein:

(i) the first flow block of at least one of the zipper leg(s) comprises:

a first side surface;

a first flow passage via which the first flow block is in fluid communication with the at least one of the zipper leg(s), the first flow passage extending through the first side surface;

a first angled surface that is angled relative to the first side surface; and

a second flow passage via which the first fluid conduit connected to the first flow block of the at least one of the zipper leg(s) is in fluid communication with the at least one of the zipper leg(s), the second flow passage extending through the first angled surface;

(ii) the second flow block of at least one of the wellhead(s) comprises:

a second side surface;

a first flow passage via which the second flow block is in fluid communication with the at least one of the wellhead(s), the first flow passage extending through the second side surface;

a second angled surface that is angled relative to the second side surface; and

a second flow passage via which the first fluid conduit connected to the second flow block of the at least one

of the wellhead(s) is in fluid communication with the at least one of the wellhead(s), the second flow passage extending through the second angled surface;

or

(iii) both (i) and (ii).

10. The system of claim 9, wherein (iii).

11. The system of claim 9, wherein (i); and

wherein at least a portion of the first fluid conduit connected to the first flow block of the at least one of the zipper leg(s) is flexible.

12. The system of claim 11, wherein the at least one of the zipper leg(s) is supported by a skid including legs each having an adjustable length.

13. The system of claim 11, wherein the at least one of the zipper leg(s) includes a swivel assembly.

14. The system of claim 11, wherein the second flow passage angles downwardly from the first flow passage.

15. The system of claim 9, wherein (ii); and

wherein at least a portion of the first fluid conduit connected to the second flow block of the at least one of the wellhead(s) is flexible.

16. The system of claim 15, wherein the at least one of the wellhead(s) includes a swivel assembly.

17. The system of claim 15, wherein the fourth flow passage angles downwardly from the third flow passage.

18. The system of claim 9, wherein the one or more zipper legs comprise first and second zipper legs;

wherein a second fluid conduit is connected between the first and second zipper legs; and

wherein the second fluid conduit is supported by a stand including legs each having an adjustable length and/or having an adjustable angle therebetween.

19. A zipper leg adapted to be connected to a wellhead via a fluid conduit, the zipper leg comprising:

a flow block, the flow block comprising:

a side surface;

a first flow passage via which the flow block is adapted to be in fluid communication with the zipper leg, the first flow passage extending through the side surface; an angled surface to which the fluid conduit is adapted to be connected, the angled surface being angled relative to the side surface; and

a second flow passage via which the zipper leg is adapted to be in fluid communication with the fluid conduit, the second flow passage extending through the angled surface.

20. The zipper leg of claim 19, wherein the zipper leg is supported by a skid including legs each having an adjustable length.

21. The zipper leg of claim 19, further comprising a swivel assembly.

22. The zipper leg of claim 19, wherein the second flow passage of the flow block angles downwardly from the first flow passage.

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