US Patent & Trademark Office
Patent Public Search | Text View

United States Patent Application Publication 20250257727
Kind Code A1
Publication Date August 14, 2025
Inventor(s) PHAM; Hau Nguyen-Phuc

FLUID END ASSEMBLY

Abstract

The present disclosure relates to fluid end assemblies having discharge ports and/or valves aligned with plunger chambers. The fluid end assemblies can include inlet ports and/or valves aligned with access ports. Some configurations have a plunger chamber longitudinal axis aligned with a discharge port longitudinal axis. Some configurations have an inlet port longitudinal axis aligned with an access port longitudinal axis.

Inventors: **PHAM; Hau Nguyen-Phuc (The Woodlands, TX)**

Applicant: **BJ Energy Solutions, LLC** (The Woodlands, TX)

Family ID: **96660630**

Assignee: **BJ Energy Solutions, LLC (The Woodlands, TX)**

Appl. No.: **19/046809**

Filed: **February 06, 2025**

Related U.S. Application Data

us-provisional-application US 63551122 20240208

Publication Classification

Int. Cl.: **F04B53/16** (20060101); **F04B1/0452** (20200101)

U.S. Cl.:

CPC **F04B53/16** (20130101); **F04B1/0452** (20130101);

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application claims priority to and benefit of 63/551,122, entitled “FLUID END ASSEMBLY,” filed Feb. 8, 2024, the contents of which are incorporated in their entirety for all purposes.

FIELD OF DISCLOSURE

[0002] The present invention relates generally to fluid end assemblies for reciprocating pumps; and more particularly, but not by way of limitation, to a fluid end assembly having a discharge port and/or valve aligned with a plunger chamber.

BACKGROUND

[0003] Reciprocating pumps, also known as positive displacement pumps, are used in many applications and industries to convert mechanical energy into hydraulic energy. Reciprocating pumps generally include two sections: a power end and a fluid end. The power end is configured to move one or more plungers toward, and away from, the fluid end. The fluid end is where the pumping takes place—fluid is drawn in and forcibly pushed out at a high pressure by the plungers.

SUMMARY

[0004] The present disclosure relates to fluid end assemblies having a discharge port and/or valve aligned with a plunger chamber. The fluid end assemblies may have a crossbore configuration and be part of reciprocating pumps having any configuration, including reciprocating pumps with inverted-V, upright-V, inverted-Y, upright-Y, and/or X cross sections. In some embodiments, a fluid end assembly has a crossbore configuration that comprises an intersecting bore internal geometry as shown in some of the figures accompanying this disclosure. Reciprocating pumps in some configurations, such as those listed above, may experience a higher accumulation of particles (e.g., sand) within the fluid end assemblies due to, for example, a downward slant of the fluid end. Aligning discharge ports and/or valves with respective plunger chambers may reduce the accumulation of particles, improve performance, and minimize maintenance requirements. Some configurations have an inlet port and/or valve aligned with an access port. Some configurations have a plunger chamber longitudinal axis aligned with a discharge port longitudinal axis. Some configurations have an inlet port longitudinal axis aligned with an access port longitudinal axis.

[0005] In a first aspect, a fluid end assembly includes one or more bodies in a crossbore configuration, each body including: a plunger chamber having a first plunger chamber end, a second plunger chamber end opposite the first plunger chamber end, and a plunger chamber longitudinal axis extending between the first and second plunger chamber ends; an inlet port comprising an inlet valve; and a discharge port having a first discharge port end, a second discharge port end opposite the first discharge port end, and a discharge port longitudinal axis extending between the first and second discharge port ends, the discharge port comprising a discharge valve, wherein the plunger chamber longitudinal axis and the discharge port longitudinal axis are aligned with each other.

[0006] In a second aspect, in combination with the first aspect, the plunger chamber longitudinal axis and the discharge port longitudinal axis are in line with each other.

[0007] In a third aspect, in combination with one or more of the first through the second aspects, the inlet port has a first inlet port end, a second inlet port end opposite the first inlet port end, and an inlet port longitudinal axis extending between the first and second inlet port ends, and the inlet port longitudinal axis is perpendicular to both the plunger chamber longitudinal axis and the discharge port longitudinal axis.

[0008] In a fourth aspect, in combination with one or more of the first through the third aspect, the body further comprises an access port, the access port having a first access port end, a second access port end opposite the first access port end, and an access port longitudinal axis extending between the first and second access port ends, and wherein the inlet port longitudinal axis and the access port longitudinal axis are aligned with each other.

[0009] In a fifth aspect, in combination with one or more of the first through the fourth aspect, the

inlet port longitudinal axis and the access port longitudinal axis are in line with each other.
[0010] In a sixth aspect, in combination with one or more of the first through the fifth aspect, a first length from the first inlet port end to the second inlet port end is longer than a second length from the first access port end to the second access port end.
[0011] In a seventh aspect, in combination with one or more of the first through the sixth aspect, the one or more bodies comprise a first body, a second body, a third body, and a fourth body, and wherein the first, second, third, and fourth bodies form a unitary structure.
[0012] In an eighth aspect, in combination with one or more of the first through the seventh aspect, the plunger chamber axes of the first, second, third, and fourth bodies are parallel to each other, wherein the access ports of the first, second, third, and fourth bodies are aligned with each other, wherein the inlet ports of the first, second, third, and fourth bodies are aligned with each other, wherein the assembly has a first assembly end near the access ports of the first, second, third, and fourth bodies, wherein the assembly has a second assembly end near the inlet ports of the first, second, third, and fourth bodies, and wherein a length from the first assembly end to a plane crossing the plunger chamber longitudinal axes is shorter than a length from the second assembly end to the plane.
[0013] In a ninth aspect, in combination with one or more of the first through the eighth aspect, the discharge port further comprises a valve cover and the discharge valve comprises a stem coupled to the valve cover.
[0014] In a tenth aspect, in combination with one or more of the first through the ninth aspect, the valve cover comprises an extension coupled to the stem and having one or more drain holes.
[0015] In an eleventh aspect, in combination with one or more of the first through the tenth aspect, a reciprocating pump includes a power end frame having a crankshaft aperture; a crankshaft extending through the crankshaft aperture; a plurality of plungers connected to the crankshaft; and a fluid end assembly comprising a plurality of bodies in a crossbore configuration.
[0016] As used herein, various terminology is for the purpose of describing particular implementations only and is not intended to be limiting of implementations. For example, as used herein, an ordinal term (e.g., “first,” “second,” “third,” etc.) used to modify an element, such as a structure, a component, an operation, etc., does not by itself indicate any priority or order of the element with respect to another element, but rather merely distinguishes the element from another element having a same name (but for use of the ordinal term). The term “coupled” is defined as connected, although not necessarily directly, and not necessarily mechanically; two items that are “coupled” may be unitary with each other. The terms “a” and “an” are defined as one or more unless this disclosure explicitly requires otherwise. The term “substantially” is defined as largely but not necessarily wholly what is specified—and includes what is specified; e.g., substantially 90 degrees includes 90 degrees and substantially parallel includes parallel—as understood by a person of ordinary skill in the art. In any disclosed embodiment, the term “substantially” may be substituted with “within [a percentage] of” what is specified, where the percentage includes 0.1, 1, 5, and 10 percent; and the term “approximately” may be substituted with “within 10 percent of” what is specified. The phrase “and/or” means “and” or “or.” To illustrate, A, B, and/or C includes: A alone, B alone, C alone, a combination of A and B, a combination of A and C, a combination of B and C, or a combination of A, B, and C. In other words, “and/or” operates as an inclusive or. The phrase “A, B, C, or a combination thereof” includes A alone, B alone, C alone, a combination of A and B, a combination of A and C, a combination of B and C, or a combination of A, B, and C. In other words, “or” is used inclusively unless otherwise is expressly specified.
[0017] The terms “comprise” and any form thereof such as “comprises” and “comprising,” “have” and any form thereof such as “has” and “having,” and “include” and any form thereof such as “includes” and “including” are open-ended linking verbs. As a result, an apparatus that “comprises,” “has,” or “includes” one or more elements possesses those one or more elements, but is not limited to possessing only those elements. Likewise, a method that “comprises,” “has,” or

“includes” one or more steps possesses those one or more steps, but is not limited to possessing only those one or more steps.
[0018] Any implementation of any of the apparatuses, systems, and methods can consist of or consist essentially of—rather than comprise/include/have—any of the described steps, elements, and/or features. Thus, in any of the claims, the term “consisting of” or “consisting essentially of” can be substituted for any of the open-ended linking verbs recited above, in order to change the scope of a given claim from what it would otherwise be using the open-ended linking verb. Additionally, it will be understood that the term “wherein” may be used interchangeably with “where.”
[0019] Further, a device or system that is configured in a certain way is configured in at least that way, but it can also be configured in other ways than those specifically described. Aspects of one example may be applied to other examples, even though not described or illustrated, unless expressly prohibited by this disclosure or the nature of a particular example. Some details associated with the aspects described above and others are described below.
[0020] Some details associated with the aspects are described above, and others are described below. Other implementations, advantages, and features of the present disclosure will become apparent after review of the entire application, including the following sections: Brief Description of the Drawings, Detailed Description, and the Claims.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0021] These drawings illustrate by way of example and not limitation. For the sake of brevity and clarity, every feature of a given structure is not always labeled in every figure in which that structure appears. Identical reference numbers do not necessarily indicate the same structure. Rather, the same reference number may be used to indicate a similar feature or a feature with similar functionality, as may non-identical reference numbers.
[0022] FIG. **1** is a cross-section view of a reciprocating pump according to some aspects of this disclosure.
[0023] FIG. **2**A is a cross-section view of a reciprocating pump according to some aspects of this disclosure.
[0024] FIG. **2**B is a cross-section view of a fluid end assembly according to some aspects of this disclosure.
[0025] FIG. **3** is a cross-section view of a reciprocating pump according to some aspects of this disclosure.
[0026] FIG. **4** is a plan view of a fluid end assembly according to some aspects of this disclosure.
[0027] FIG. **5** is a method of operating a fluid end according to some aspects of this disclosure.
DETAILED DESCRIPTION OF ILLUSTRATIVE ASPECTS
[0028] Referring to FIG. **1**, a reciprocating pump **100** is shown. Reciprocating pump **100** has two sections: a power end **110** and a fluid end **150**. Power end **110** is configured to move one or more plungers toward, and away from, fluid end **150**. Fluid end **150** is where the pumping takes place—fluid is drawn in and forcibly pushed out at a high pressure by the plungers.
[0029] Power end **110** includes a plurality of plunger assemblies **120**, a plurality of crankshaft assemblies **130**, and a power end frame assembly having a plurality of bearing plates **140**. Because FIG. **1** is a cross-section view of reciprocating pump **100**, only one plunger assembly **120**, crankshaft assembly **130**, and bearing plate **140** is shown. Each plunger assembly **120** includes a plunger **122**, a crosshead **124**, and a connecting rod **126**. Plunger **122** is coupled to crosshead **124** via a ponyrod **128**. Connecting rod **126** couples crosshead **124** to crankshaft assembly **130** via rod cap **129**. Each crankshaft assembly **130** has at least a portion partially positioned within an opening

142 on bearing plate **140** and includes a crankshaft **132** and a crankshaft bearing **134** around crankshaft **132**. Crankshaft bearing **134** is supported by opening **142** and couples crankshaft **132** to bearing plate **140** while allowing crankshaft **132** to rotate within opening **142**. Adjacent bearing plates **140** of the power end frame assembly form receptacles **146** that accommodate crosshead **124** and configure crosshead **124** to displace linearly as crankshaft **132** rotates.

[0030] Fluid end **150** includes a fluid end assembly **151** having a plurality of bodies **152**, each body **152** having a chamber **160**, an inlet port **170**, a discharge port **180**, and an access port **190**. Because FIG. **1** is a cross-section view of reciprocating pump **100**, only one body **152** is shown. Chamber **160** is configured to receive a plunger portion of plunger **122** and allow the plunger portion to reciprocate within chamber **160**. Inlet port **170** includes an inlet valve **174** and is configured to receive a fluid and direct the fluid to enter chamber **160**. Discharge port **180** includes a discharge valve **184** and is configured to receive the fluid from chamber **160** and direct the fluid to exit body **152**. Access port **190** includes an access cover **194** and is configured to selectively allow access to components of body **152** and/or fluid end assembly **151**. As shown in FIG. **1**, inlet port **170** and discharge port **180** are aligned with each other (e.g., located across from each other along an imaginary line extending through body **152**)—and chamber **160** and access port **190** are aligned with each other (e.g., located across from each other along an imaginary line extending through body **152** that is approximately perpendicular to the line between inlet port **170** and discharge port **180**). Reciprocating pump **100** increases pressure of the fluid in chamber **160** by reciprocating plunger **122** longitudinally within chamber **160**. As a result, low-pressure fluid enters chamber **160** via inlet port **170** and high-pressure fluid exits chamber **160** and is discharged via discharge port **180**.

[0031] Referring to FIG. **2**A, a reciprocating pump **200** is shown. Reciprocating pump **200** is similar to reciprocating pump **100**, may include some or all of the components of reciprocating pump **100**, and has a power end (**210**) and a fluid end (**250**). Like power end **110**, power end **210** includes a power end frame assembly having a plurality of bearing plates **240**, each bearing plate **240** having an opening **242** to receive a crankshaft **232** of a crankshaft assembly **230**. And like fluid end **150**, fluid end **250** includes a fluid end assembly (**251**) having a plurality of bodies (**252**) with a chamber (**260**), an inlet port (**270**), a discharge port (**280**), and an access port (**290**). But as shown in FIGS. **2**A and **2**B, in bodies **252**, discharge ports **280** and chambers **260** are aligned with each other—and inlet ports **270** and access ports **290** are aligned with each other. Because FIGS. **2**A and **2**B are cross-section views of reciprocating pump **200** and fluid end assembly **251**, only one plunger assembly **220**, crankshaft assembly **230**, bearing plate **240**, and body **252** are shown. Fluid end assembly **251** has a first end **254** near discharge ports **280**, a second end **255** near chambers **260** and opposite first end **254**, a third end **256** near access ports **290**, and a fourth end **257** near inlet ports **270** and opposite third end **256**.

[0032] Referring to FIG. **2**B, fluid end assembly **251** is shown. Chamber **260** is, in the shown configuration, a cylinder having a first chamber end **261**, a second chamber end **262** opposite first chamber end **261**, and a first chamber longitudinal axis **263** extending between first chamber end **261** and second chamber end **262**. Chamber **260** may be configured to receive a portion of a plunger and allow the plunger portion to reciprocate within chamber **260**. The plunger portion may, for example, reciprocate between first chamber end **261** and second chamber end **262**. Discharge port **280** is, in the shown configuration, a bore having a first discharge port end **281** adjacent to second chamber end **262**, a second discharge port end **282** opposite first discharge port end **281**, and a discharge port longitudinal axis **283** extending between first discharge port end **281** and second discharge port end **282**. Discharge port **280** is configured to receive fluid from the chamber and direct fluid to exit body **252**. Discharge port **280** includes a discharge valve **284** (e.g., a stem and wing valve) connected to a valve cover **286**. Discharge valve **284** may have a stem **285** positioned within a stem bore **287**A of valve cover **286**, which may accommodate a bushing for stem **285**. Valve cover **286** may have drain holes **287**B to prevent sand accumulation within stem

bore **287**A, which could hinder performance and travel of discharge valve **284**. Discharge port **280** also includes discharge compartment **288** between first discharge port end **281** and second discharge port end **282**. Discharge compartment **288** has a discharge opening **289** configured to direct fluid to exit body **252**. As shown in FIG. **2**B, chamber **260** is aligned with both discharge port **280** and discharge valve **284**. In the shown configuration, for example, chamber longitudinal axis **263** and discharge port longitudinal axis **283** are in line with each other. In other embodiments, chamber **260** may be aligned with discharge port **280** and/or valve **284** in other ways (e.g., parallel).

[0033] Inlet port **270** is, in the shown configuration, a bore having a first inlet port end **271**, a second inlet port end **272** opposite first inlet port end **271**, and an inlet port longitudinal axis **273** extending between first inlet port end **271** and second inlet port end **272**. Inlet port **270** includes an inlet valve **274** (e.g., a wing valve) and is configured to receive a fluid and direct the fluid to enter chamber **260**. Inlet port **270** also includes inlet compartment **278** between first inlet port end **271** and second inlet port end **272**. Access port **290** is, in the shown configuration, a bore having a first access port end **291**, a second access port end **292** opposite first access port end **291**, and an access port longitudinal axis **293** extending between first access port end **291** and second access port end **292**. Access port **290** includes an access cover **294** and is configured to selectively allow access to components of body **252** and/or fluid end assembly **251**. Access port **290** also includes access compartment **298** between first access port end **291** and second access port end **292**. In the FIG. **2**B configuration, inlet port **270** and inlet valve **274** are aligned with both access port **290** and access cover **294**. In the shown configuration, for example, inlet port longitudinal axis **273** and access port longitudinal axis **293** are in line with each other. But inlet port **270** and/or inlet valve **274** may be aligned with access port **290** and/or access cover **294** in other ways (e.g., parallel). And in other configurations, inlet port **270** and/or inlet valve **274** may not be aligned with access port **290** and/or access cover **294**. In the FIG. **2**B configuration, inlet port longitudinal axis **273** and access port longitudinal axis **293** are perpendicular to both chamber longitudinal axis **263** and discharge port longitudinal axis **283**.

[0034] Referring to FIG. **3**, reciprocating pump **300** is shown. Reciprocating pump **300** is similar to reciprocating pumps **100** and **200** and may include some or all of the components of reciprocating pumps **100** and/or **200** described above. In the shown configuration, reciprocating pump **300** has an inverted-V cross section. Yet reciprocating pump **300** can have any other cross-section shape, including (but not limited to) upright V, inverted Y, upright Y, and/or X cross-sectional shapes. For example, reciprocating pump **300** can have an inverted-Y cross-section (e.g., when viewed in a direction substantially parallel to a longitudinal axis of the crankshaft), where another fluid end (with corresponding power-end components) is disposed above the crankshaft and extends in a vertical direction. As another example, reciprocating pump **300** can have third and fourth fluid ends (in addition to the first and second fluid ends shown in FIG. **3**) and an X cross-section (e.g., when viewed in a direction substantially parallel to a longitudinal axis of the crankshaft), where the third fluid end (with corresponding power-end components) is disposed above the first fluid end and extends in a direction opposite to the second fluid end and a fourth fluid end (with corresponding power-end components) is disposed above the second fluid end and extends in a direction opposite to the first fluid end. Reciprocating pumps in some configurations, such as those listed above, may experience a higher accumulation of particles (e.g., sand) within the fluid end assemblies due to, for example, the downward slant of the fluid end. In the FIG. **3** configuration, discharge ports and valves are aligned with respective plunger chambers, which may reduce the accumulation of particles, improve performance, and minimize maintenance requirements. In some embodiments, reciprocating pump **300** may have multiple sections and the sections may have different cross-section shapes. For example, one section may have an inverted-V cross section and another section may have an X cross section.

[0035] Reciprocating pump **300** has a power end frame assembly **238** with a crankshaft aperture

242, a crankshaft **232** extending through crankshaft aperture **242**, a plurality of first plungers **222**A connected to crankshaft **232**, a first fluid end assembly with a plurality of first fluid end bodies **252**A corresponding to respective first plungers **222**A, a plurality of second plungers **222**B connected to crankshaft **232**, and a second fluid end assembly with a plurality of second fluid end bodies **252**B corresponding to respective second plungers **222**B. Because FIG. **3** is a cross-section view of reciprocating pump **300**, only one first plunger **222**A, first fluid end body **252**A, second plunger **222**B, and second fluid end body **252**B are shown. As shown in FIG. **3**, first fluid end body **252**A and second fluid end body **252**B are like fluid end body **252** and may include some or all of the components of fluid end body **252** described above. In the FIG. **3** configuration, first plunger **222**A is configured to reciprocate in a first plane, second plunger **222**B is configured to reciprocate in a second plane, a discharge port longitudinal axis **280**A of first fluid end body **252**A is aligned with the first plane, and a discharge port longitudinal axis **280**B of second fluid end body **252**B is aligned with the second plane. And as shown in FIG. **3**, discharge port longitudinal axis **280**A and discharge port longitudinal axis **280**B define a non-zero offset angle.

[0036] Referring to FIG. **4**, fluid end assembly **251** is shown. Fluid end assembly **251** includes bodies **252***a*, **252***b*, **252***c*, **252***d*, and **252***e*. In the FIG. **4** configuration, bodies **252***a-e* form a unitary structure. Fluid end assembly **251** has first ends **254***a-e* near respective discharge ports (not shown) and second ends **255***a-e* near respective chambers (not shown) and opposite respective first ends **254***a-c*. Fluid end assembly **251** also has third ends **256***a-e* near respective access ports (not shown) and fourth ends **257***a-e* near respective inlet ports (not shown) and opposite respective third ends **256***a-c*.

[0037] Referring to FIG. **5** shown is an example of a method of operating a fluid end. The method **500** may be performed at, by, or with (A) reciprocating pumps **100**, **200**, and/or **300**; (B) fluid ends **150** and/or **250**; (C) fluid end assemblies **151** and/or **251**; and/or (D) power ends **110** and/or **210**. The method **500** includes a block **502**: move a plunger within a chamber of a fluid end assembly from a first position to a second position, wherein a first end of the plunger is near a first end of the chamber when the plunger is in the first position, the first end of the plunger is near a second end of the chamber when the plunger is in the second position, and the first end of the chamber is opposite the second end of the chamber. The method **500** further includes a block **504**: direct a fluid to the chamber via an inlet port. The method **500** further includes a block **506**: direct the fluid from the chamber to a discharge port by moving the plunger from the second position to the first position, wherein the chamber and the discharge port are aligned with each other. In some configurations, the method **500** can include a block: discharge the fluid via the discharge port. In some configurations, the method **500** can include a block: discharge the fluid via an opening on the discharge port. In some configurations, the method **500** can include a block: access one or more components of the fluid end assembly via an access port aligned with the inlet port.

[0038] Those of skill in the art that one or more blocks (or operations) described with reference to FIGS. **1-5** may be combined with one or more blocks (or operations) described with reference to another of the figures. For example, one or more blocks (or operations) of FIGS. **1-4** may be combined with one or more blocks (or operations) of FIG. **5**.

[0039] The above specification and examples describe the structure and use of illustrative implementations. Although certain examples have been described above with some particularity, or with reference to one or more individual examples, those skilled in the art could make numerous alterations to the disclosed implementations without departing from the scope of this invention. So the various illustrative implementations of the methods and systems are not intended to be limited to the particular forms disclosed. Rather, they include all modifications and alternatives falling within the scope of the claims, and examples other than the one shown may include some or all of the features of the depicted example. For example, elements may be omitted or combined as a unitary structure, and/or connections may be substituted. Further, where appropriate, aspects of any of the examples described above may be combined with aspects of any of the other examples

described to form more examples having comparable or different properties and/or functions and addressing the same or different problems. Similarly, it will be understood that the benefits and advantages described above may relate to one embodiment or may relate to several implementations.

[0040] The claims are not intended to include, and should not be interpreted to include, means-plus- or step-plus-function limitations, unless such a limitation is explicitly recited in each claim using the phrase(s) “means for” or “step for,” respectively.

Claims

1. A fluid end assembly comprising: one or more bodies in a crossbore configuration, each body comprising: a plunger chamber having a first plunger chamber end, a second plunger chamber end opposite the first plunger chamber end, and a plunger chamber longitudinal axis extending between the first and second plunger chamber ends; an inlet port comprising an inlet valve; and a discharge port having a first discharge port end, a second discharge port end opposite the first discharge port end, and a discharge port longitudinal axis extending between the first and second discharge port ends, the discharge port comprising a discharge valve, wherein the plunger chamber longitudinal axis and the discharge port longitudinal axis are aligned with each other.

2. The assembly of claim 1, wherein the plunger chamber longitudinal axis and the discharge port longitudinal axis are in line with each other.

3. The assembly of claim 2, wherein the inlet port has a first inlet port end, a second inlet port end opposite the first inlet port end, and an inlet port longitudinal axis extending between the first and second inlet port ends, and the inlet port longitudinal axis is perpendicular to both the plunger chamber longitudinal axis and the discharge port longitudinal axis.

4. The assembly of claim 3, wherein the body further comprises an access port, the access port having a first access port end, a second access port end opposite the first access port end, and an access port longitudinal axis extending between the first and second access port ends, and wherein the inlet port longitudinal axis and the access port longitudinal axis are aligned with each other.

5. The assembly of claim 4, wherein the inlet port longitudinal axis and the access port longitudinal axis are in line with each other.

6. The assembly of claim 5, wherein a first length from the first inlet port end to the second inlet port end is longer than a second length from the first access port end to the second access port end.

7. The assembly of claim 5, wherein the one or more bodies comprise a first body, a second body, a third body, and a fourth body, and wherein the first, second, third, and fourth bodies form a unitary structure.

8. The assembly of claim 7, wherein the plunger chamber axes of the first, second, third, and fourth bodies are parallel to each other, wherein the access ports of the first, second, third, and fourth bodies are aligned with each other, wherein the inlet ports of the first, second, third, and fourth bodies are aligned with each other, wherein the assembly has a first assembly end near the access ports of the first, second, third, and fourth bodies, wherein the assembly has a second assembly end near the inlet ports of the first, second, third, and fourth bodies, and wherein a length from the first assembly end to a plane crossing the plunger chamber longitudinal axes is shorter than a length from the second assembly end to the plane.

9. The frame assembly of claim 1, wherein the discharge port further comprises a valve cover and the discharge valve comprises a stem coupled to the valve cover.

10. The frame assembly of claim 9, wherein the valve cover comprises an extension coupled to the stem and having one or more drain holes.

11. A reciprocating pump comprising: a power end frame having a crankshaft aperture; a crankshaft extending through the crankshaft aperture; a plurality of plungers connected to the crankshaft; and a fluid end assembly comprising a plurality of bodies in a crossbore configuration, each body

corresponding to a respective plunger of the plurality of plungers, each body comprising: a chamber having a first chamber end, a second chamber end opposite the first chamber end, and a chamber longitudinal axis extending between the first and second chamber ends, the chamber configured to receive a plunger portion of the respective plunger and allow the plunger portion to reciprocate between the first and second chamber ends; an inlet port comprising an inlet valve and configured to receive a fluid and direct the fluid to enter the chamber; and a discharge port having a first discharge port end, a second discharge port end opposite the first discharge port end, and a discharge port longitudinal axis extending between the first and second discharge port ends, the discharge port comprising a discharge valve and configured to receive the fluid from the chamber and direct the fluid to exit the body; wherein the chamber longitudinal axis and the discharge port longitudinal axis are aligned with each other.

12. The pump of claim 11, wherein the chamber longitudinal axis and the discharge port longitudinal axis are in line with each other.

13. The pump of claim 12, wherein the inlet port has a first inlet port end, a second inlet port end opposite the first inlet port end, and an inlet port longitudinal axis extending between the first and second inlet port ends, and the inlet port longitudinal axis is perpendicular to both the chamber longitudinal axis and the discharge port longitudinal axis.

14. The pump of claim 13, wherein each body further comprises an access port, the access port having a first access port end, a second access port end opposite the first access port end, and an access port longitudinal axis extending between the first and second access port ends, and wherein the inlet port longitudinal axis and the access port longitudinal axis are aligned with each other.

15. The pump of claim 14, wherein the inlet port longitudinal axis and the access port longitudinal axis are in line with each other.

16. The pump of claim 15, wherein a first length from the first inlet port end to the second inlet port end is longer than a second length from the first access port end to the second access port end.

17. The pump of claim 15, wherein the plurality of bodies form a unitary structure, the chambers of the plurality of bodies are aligned with each other, the access ports of the plurality of bodies are aligned with each other, and the inlet ports of the plurality of bodies are aligned with each other.

18. The pump of claim 17, wherein the fluid end assembly has a first assembly end near the access ports of the plurality of bodies, wherein the fluid end assembly has a second assembly end near the inlet ports of the plurality of bodies, and wherein a first length from the first assembly end to a plane crossing the chamber longitudinal axes of the plurality of bodies is shorter than a second length from the second assembly end to the plane.

19. The pump of claim 11, wherein the plurality of plungers is a first plurality of plungers and the fluid end assembly is a first fluid end assembly, and wherein the pump further comprises: a second plurality of plungers connected to the crankshaft; and a second fluid end assembly comprising a plurality of bodies, each body corresponding to a respective plunger of the second plurality of plungers, each body comprising: a chamber having a first chamber end, a second chamber end opposite the first chamber end, and a chamber longitudinal axis extending between the first and second chamber ends, the chamber configured to receive a plunger portion of the respective plunger and allow the plunger portion to reciprocate between the first and second chamber ends; an inlet port comprising an inlet valve and configured to receive a fluid and direct the fluid to enter the chamber; and a discharge port having a first discharge port end, a second discharge port end opposite the first discharge port end, and a discharge port longitudinal axis extending between the first and second discharge port ends, the discharge port comprising a discharge valve and configured to receive the fluid from the chamber and direct the fluid to exit the body; wherein the chamber longitudinal axis and the discharge port longitudinal axis are aligned with each other; wherein each plunger of the first plurality of plungers is configured to reciprocate in a first plane, each plunger of the second plurality of plungers is configured to reciprocate in a second plane, the discharge port longitudinal axes of the first fluid end are aligned with the first plane, and the

discharge port longitudinal axes of the second fluid end are aligned with the second plane.

20. The frame assembly of claim 19, wherein the discharge port longitudinal axes of the first fluid end and the discharge port longitudinal axes of the second fluid end define a non-zero offset angle.