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[54] **HIGH PRESSURE PUMP FLUID END**

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[51] **Int. Cl.** **F04b 21/00,** F04b 39/00

[58] **Field of Search** 417/454, 63, 571, 569, 417/539; 137/454.4

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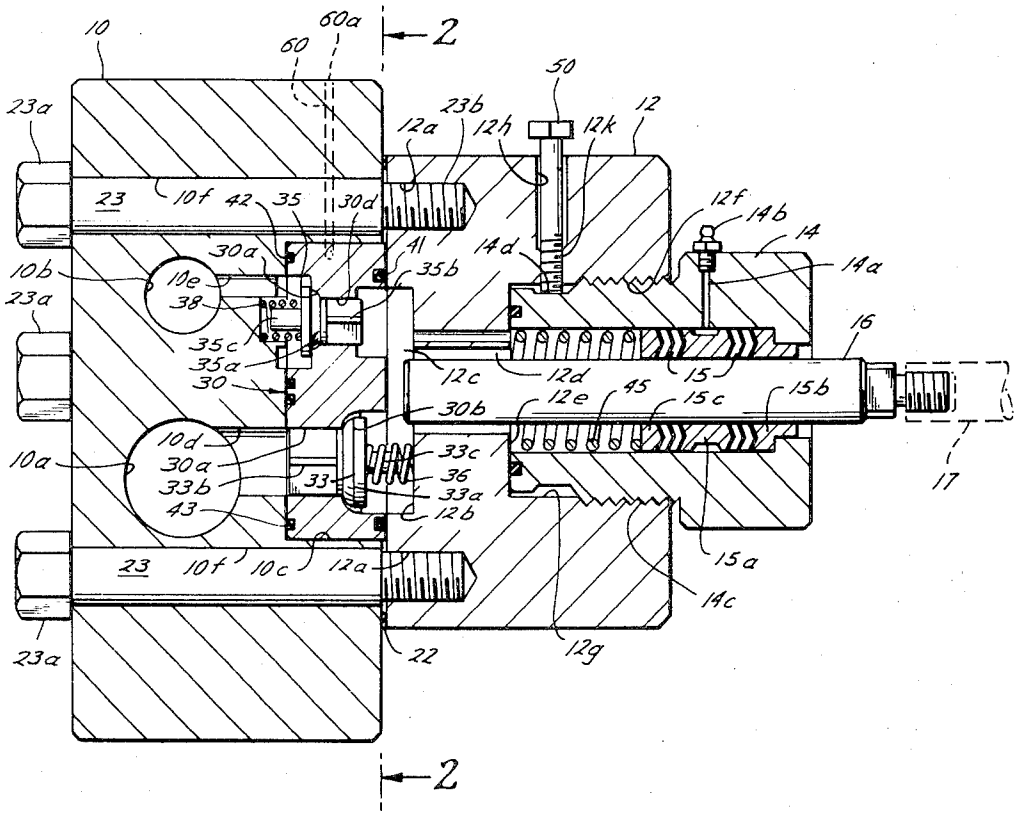
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[57] **ABSTRACT**

A new and improved fluid end for a high pressure pump, wherein the valves are assembled with a valve seat unit to form a readily removable and replaceable valve cartridge, and wherein the packing around the pump plunger is also readily accessible for replacement or repacking without requiring special tools. Peak pressures developed by the pump plunger, particularly during cavitation, are transmitted to the valve seat unit and the pump plunger packing rather than the much more expensive pump manifold so that if failure occurs due to such high pressures, the failure is in the readily replaceable and less expensive valve seat and pump packing.

4 Claims, 2 Drawing Figures



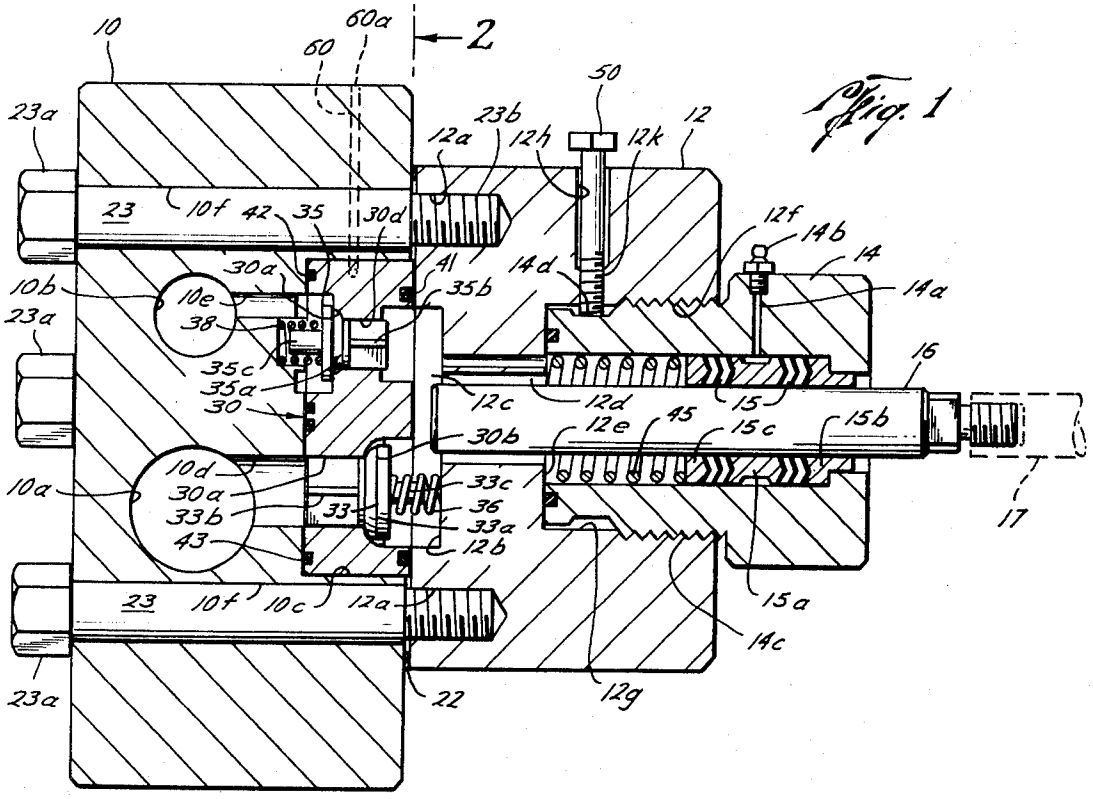

10
60a
60
2
50
23a
23b
12a
12h
12k
12
23
10f
42
35
30d
12f
14b
14
14a
10b
10e
38
30a
41
35b
14d
23a
35c
35a
30
12c
12d
15
16
45
12e
15c
15b
30b
10d
10a
30a
33b
43
33c
33
36
33a
12b
17
23
10f
10c
12a
15a
14c
23a
22
12g

Fig. 1

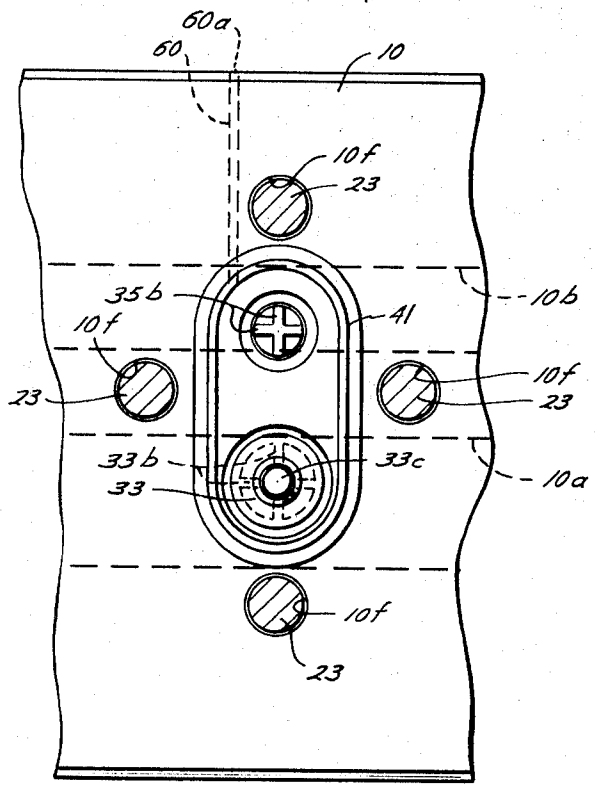

60a
60
10
10f
23
35b
41
10b
10f
10f
23
23
33b
33c
10a
33
10f
23

Fig. 2

HIGH PRESSURE PUMP FLUID END

BACKGROUND OF THE INVENTION

The field of this invention is high pressure pumps, fluid end.

In high pressure pumps heretofore known and in common use today, they have been so constructed that disassembly, repair and replacement have been difficult and expensive. Repairs in the field have been a particular problem because of the need for special tools and the difficulties of disassembly and reassembly.

SUMMARY OF THE INVENTION

The present invention relates to a new and improved fluid end for a high pressure pump, wherein a valve cartridge having the valve seats and valves is subjected to peak pressures developed by the plunger, especially during cavitation, rather than the pump manifold, whereby the less expensive and easily replaceable parts of the pump are the ones subject to failure at such peak pressures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view of the fluid end of a high pressure pump, showing the improvements of this invention; and

FIG. **2** is a partial view taken on line **2—2** of FIG. **1**, illustrating further details of the pump fluid end of FIG. **1**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the numeral **10** refers generally to the pump manifold block which is disposed adjacent to a pump cylinder **12.** The cylinder **12** has a stuffing box **14** therewith through which a conventional pump plunger or piston **16** moves in response to a power supplied through a typical cross head **17,** a portion of which is illustrated, and which is connected to a conventional power source in the known manner for reciprocating the plunger **16.** As will be explained more in detail, the present invention includes a valve cartridge **30** which is disposed with the manifold **10,** but which is removable thereform as a unit so that all of the valve components and valve seats may be removed readily from the rest of the parts to effect repairs and/or replacements. Also, the stuffing box **14** is readily removable for access to the packing **15** therewith so that such packing can be replaced or repaired.

Considering the invention more in detail, the manifold block **10** is mounted in a fixed position and has a section inlet opening or manifold **10***a* therethrough for the supply of fluid being pumped. Also, the manifold block **10** has an outlet discharge manifold or opening **10***b* for the discharge of fluid being pumped with the plunger **16,** as will be more evident hereinafter. The inlet opening **10***a* connects with a valve cartridge recess or cavity **10***c* by means of one or more openings **10***d*. Similarly, the outlet manifold **10***b* connects with such cavity **10***c* by an opening **10***e*.

The manifold block **10** is positioned adjacent the pump cylinder **12,** with a gasket **22** of any suitable gasket material therebetween to prevent fluid from escaping. The manifold block **10** has a plurality of bolt holes **10***f*, each of which is adapted to receive a bolt **23** having a conventional bolt head **23***a* with wrench flats

thereon so that the bolts **23** may be rotated with a conventional wrench. Each bolt **23** has a threaded inner end **23***b* which is adapted to be releasably threaded into internally threaded openings **12***a* in the cylinder **12,** which correspond in number and in location to the openings **10***f* in the block **10.** Thus, by unthreading the bolts **23** so as to disengage the threads **23***b* from the threaded openings **12***a*, the cylinder **12** is released from its secured position with the block **10** and may be pulled away from the block **10,** as will be more evident hereinafter.

A valve cartridge **30** is disposed within the valve cartridge recess **10***c* of the manifold block **10** and it includes at least two valves **33** and **35.** The valve **33** is mounted in a valve passage **30***a* for movement therein and it seats upon an annular valve seat **30***b* which preferably has a spherical shape in cross-section to conform with a corresponding surface on the valve **33** for effective closing of fluid flow through the passage **30***a* when the valve **33** is in the seated position.

The valve **33** may be made in numerous ways, but as illustrated in the drawings, it includes a valve body **33***a*, with a plurality of valve guide ribs **33***b* disposed therewith and extending into the opening **30***a*. Such ribs **33***b* are preferably arranged in the form of a cross and they permit fluid flow therebetween so that when the valve body **33** is unseated from the seat **30***b*, fluid may flow past the valve **33.**

The valve **33** has a valve stem **33***c* which receives a spring **36** disposed between the body **33***a* and a surface **12***b* of a cylinder recess **12***c*. The spring **36** is a relatively light spring and acts to keep the valve **33** seated when the fluid pressures are essentially balanced across the valve **33** and it prevents the opening of the valve **33** until a predetermined pressure is developed to unseat the valve **33.**

The valve **35** is constructed in almost an identical manner to the valve **33,** although it is slightly smaller in diameter and it includes a valve body **35***a* which is adapted to seat on an annular valve seat **30***c* in a valve opening **30***d* of the valve cartridge **30.** The valve **35** has longitudinally extending guide ribs **35***b* (FIGS. **1** and **2**), which, like the ribs **33***b* are preferably arranged in the form of a cross and which keep the valve **35** aligned during its reciprocating movement to and from its open and closed positions.

The valve **35** also has a spring guide stem **35***c* around which is positioned a spring **38** which serves to seat the valve **35** until a predetermined pressure urging it to an unseated position is acting on the valve **35.**

It is to be noted that the valve **33** permits fluid flow from the suction inlet manifold **10***a* to the cylinder recess **12**c and the plunger opening **12***d* within the cylinder **12** in which the plunger **16** reciprocates. During such flow, the valve **35** is retained in the seated or closed position. When the reverse occurs, and the plunger **16** moves towards the block **10,** fluid is permitted to flow from the plunger opening **12***d* and the recess **12***c* to the outlet manifold **10***b* by opening the valve **35** and the valve **33** remains closed to prevent fluid from flowing out through the inlet opening **10***a*. Thus, each of the valves **33** and **35** is a oneway valve controlling the flow in the opposite direction.

A fluid seal is maintained between the valve cartridge **30** and the cylinder **12** by a seal **41,** which may be brass, a rubber O-ring, or any suitable sealing material. Fluid seals **42** and **43** which also may be brass, rubber

O-rings or suitable sealing members are provided for sealing engagement between the valve cartridge **30** and the wall of the valve cartridge recess **10c** in the manifold block **10.** Such seals **41–43** may be readily replaced as will be more evident hereinafter when the valve cartridge **30** is exposed and is removed for replacement and/or repair. Such seals **41–43** may all be formed of brass or any other suitable sealing material.

The packing **15** in the stuffing box **14** is preferably of the conventional chevron type and it has a lantern ring **15***a* between the sections of the chevron packing in the known manner. Such lantern ring **15***a* may be formed of brass or other suitable material. Also adapter rings **15***b* and **15***c* at each end of the chevron packings **15** are preferably utilized for confining the packing **15** and such rings **15***b* and **15***c* are likewise formed of brass or other suitable material. The packing **15** is thus confined in sealing engagement with the external polished surface of the plunger rod **16** and such sealing engagement is further enhanced by a spring or other resilient means **45** which is confined in engagement with the ring **15***c* and a shoulder **12***e* in the cylinder **12.**

Grease is injected into the lantern ring area by means of a grease opening **14***a* and any conventional grease fitting **14***b*, as will be well understood. The stuffing box **14** has external threads **14***c* which are in threaded engagement with internal threads **12***f* in a counterbore **12***g* of the pump cylinder **12.** The entire stuffing box **14** may thus be readily removed from the cylinder **11** by unthreading the threads **14***c* from the threads **12***f*. To lock the stuffing box **14** in the cylinder **12** during operation, a locking bolt **50** is preferably utilized and it extends through an opening **12***h* in the cylinder **12** and threads into a threaded section **12***k* and enters a shallow recess **14***d* in the stuffing box, whereby the stuffing box **14** is prevented from rotating or being rotated until the locking bolt **50** is unthreaded enough to come out of the recess **14***d*.

For the purpose of indicating to an operator when the seals around the valve cartridge **30** are leaking fluid, it is desirable to have a tell-tale hole **60** in the manifold block **10** extending to a point between the seals **40** and **42** so that in the event fluid is leaking therebetween, it will appear externally of the manifold block at the exit opening **60***a* of the tell-tale hole **60.** At that point, the operator has an indication that the seals should be replaced before the leakage becomes serious.

In the operation or use of the pump fluid end of this invention, a plunger **16** is connected to a conventional cross head **17** as indicated in FIG. **1** and such cross head **17** is connected to a conventional prime mover or power source for reciprocating the plunger **16** within the cylinder **12** in the known manner.

The suction manifold **10***a* is connected to a source of fluid to be pumped in the known manner, and the outlet opening or manifold is preferably connected to a pipe or receptacle which is receiving the fluid being pumped.

When the pump plunger **16** moves away from the manifold **10,** the suction stroke occurs and the fluid is drawn in to the plunger recess **12***d* by flowing through the open valve **33** from the suction or inlet manifold **10***a* to the recess **12***c* and the plunger opening **12***d*. At that time, the valve **35** is closed by the spring pressure of the spring **38** and by the reduced pressure internally of the recess **12***c* which is less than the fluid pressure on the other side of the valve **35.**

The plunger **16** is moved towards the manifold block **10** on the pumping stroke so as to force the fluid through the valve **35** and out of the discharge manifold **10***b*. At that time, the valve **33** is closed. Thus, it will be seen that the fluid end pump illustrated in FIGS. **1** and **2** operates in a conventional manner by drawing in fluid on the suction stroke and discharging the fluid on the pump or pressure stroke. In the event it becomes desirable or necessary to replace or repair any part of the valve cartridge **30,** or the seals therewith, the entire valve cartridge **30** may be readily exposed by unthreading the bolts **23** so as to disconnect the cylinder **12** from the manifold **10.** Then by operating the pump plunger **16** so that it moves away from the manifold **10,** it will carry with it the cylinder **12** and expose the valve cartridge **30.** The valve cartridge **30** with its seals may be removed as a unit and replaced in its entirety in the field with a spare valve cartridge **30** and the seals. On the other hand, if such spare is not readily available, the worn parts can be repaired or replaced in part with conventional equipment and then the repaired or replacement valve cartridge **30** may be reinserted into the recess **10***c* and the cylinder **12** may be returned to its position adjacent the manifold block. When the bolts **23** are then reconnected as shown in FIG. **1,** the pump is again ready for use. The disassembly and reassembly can thus be accomplished by the use of a wrench of an ordinary size and type capable of unthreading the bolts **23** so that no special tools are required for such operation.

The packing **15** may also be easily replaced and any of the parts therewith may be replaced or repaired at the same time. The entire stuffing box **14** may be disconnected from the cylinder **12** by releasing the locking action of the bolt **50** and then unthreading the stuffing box **14** from the cylinder **12** which exposes the entire bore of the stuffing box **14** so that the packing **15,** the annular rings **15**b and **15**c and the lantern ring **15***a* can all be removed and replaced with new parts or repaired as necessary. The reassembly is carried out in the reverse by simply threading the stuffing box **14** back to the position shown in FIG. **1** and then inserting the locking bolt **50** to the locking position shown in FIG. **1.** Again, no special tools are required for such operations.

Should cavitation occur when pumping, the presence of the air with the liquid results in a greater plunger velocity before impacting with the liquid, and as a result, higher peak pressures in the neighborhood of 20,000 p.s.i. and above are developed which have heretofore been exerted directly on the pump manifold, but in the present invention, the peak pressures are exerted on the valve cartridge **20** and the pump packing **15,** so that if such peak pressures are high enough to cause failure, the failure occurs in the relatively inexpensive parts, namely, the cartridge **30** and/or the packing **15,** rather than the very expensive manifold **10.**

It should also be noted that the cylinder **12** and stuffing box **14** can be made in one-piece, in which case the packing **15** is replaced by releasing the bolts **23** from the threads **12***a* to expose the packing. A removable snap ring (not shown) would be used instead of the shoulder **12***e* to enable the spring **45** and the packing **15** to be removed for replacement.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape, and materials as well

as in the details of the illustrated construction may be made without departing from the spirit of the invention.

We claim:

1. A high pressure pump fluid end, comprising,

a manifold block having both an inlet suction manifold and an outlet discharge manifold located therein,

a pump cylinder mounted adjacent and perpendicular to said manifold block and having a plunger opening therein,

connector means releasably connecting said pump cylinder to said manifold block,

a pump plunger operably mounted in said pump cylinder for reciprocation in said opening,

said manifold block including a recessed valve cartridge cavity having communication with said inlet manifold, said outlet manifold and said plunger opening, said cavity being located at the interface between the block and the plunger opening, and being larger than the plunger opening and encompassing said plunger opening,

an integral replaceable generally oval valve cartridge disposed in said valve cartridge cavity and having a first valve means therein for permitting fluid flow from said inlet manifold into said plunger opening upon movement of said pump plunger in a direction away from said manifold block, and a second valve means therein for permitting fluid flow from said plunger opening to said outlet discharge manifold upon movement of said pump plunger in a direction towards said manifold block,

said first and second valve means comprising wing guided valves situated wholly within the cartridge, mounted side by side and parallel to the axis of the pump plunger,

said cartridge positioned between the plunger opening and said manifold block, and extending outwardly beyond the depth of the cavity, and

an oval seal mounted in a groove in the cartridge and encircling said plunger opening for sealing between said pump cylinder and said valve cartridge whereby fluid pumped by said pump plunger is caused to exert peak fluid pressure directly on said cartridge and peak fluid pressure is isolated from said manifold block.

2. The apparatus of claim **1** wherein said first and second valve means include spherically shaped valve seats and elements.

3. The apparatus of claim **1** including,

a second circular seal means between the cartridge and said block sealing about the inlet suction manifold, and

third seal circular means between the cartridge and the block sealing about the outlet discharge manifold.

4. The apparatus of claim **3** including a tell-tale leak detector hole extending through said manifold block to said cartridge between the manifold block and pump cylinder for allowing fluid to leak externally of said manifold block from said hole when one of said seal members is allowing fluid to leak.

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