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Mulvey et al.

[11] **3,849,032**

[45] **Nov. 19, 1974**

[54] **HIGH PRESSURE RECIPROCATING PUMP**

[75] Inventors: **Philip A. Mulvey**, Elmhurst; **Kenneth G. Porter**, Mt. Prospect, both of Ill.

[73] Assignee: **Perfect Pump Co.**, Melrose Park, Ill.

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[52] **U.S. Cl.**..... **417/454**, 92/156, 92/168, 137/454.4, 137/454.6, 137/543.19, 417/503, 417/569

[51] **Int. Cl.** .. **F04b 39/14**, F01b 31/10, F16k 25/00

[58] **Field of Search**..... 137/540, 543.17, 543.19, 137/454.2, 454.4, 454.6; 417/454, 567, 540, 542, 533–535, 560, 572, 569; 29/156.7 R

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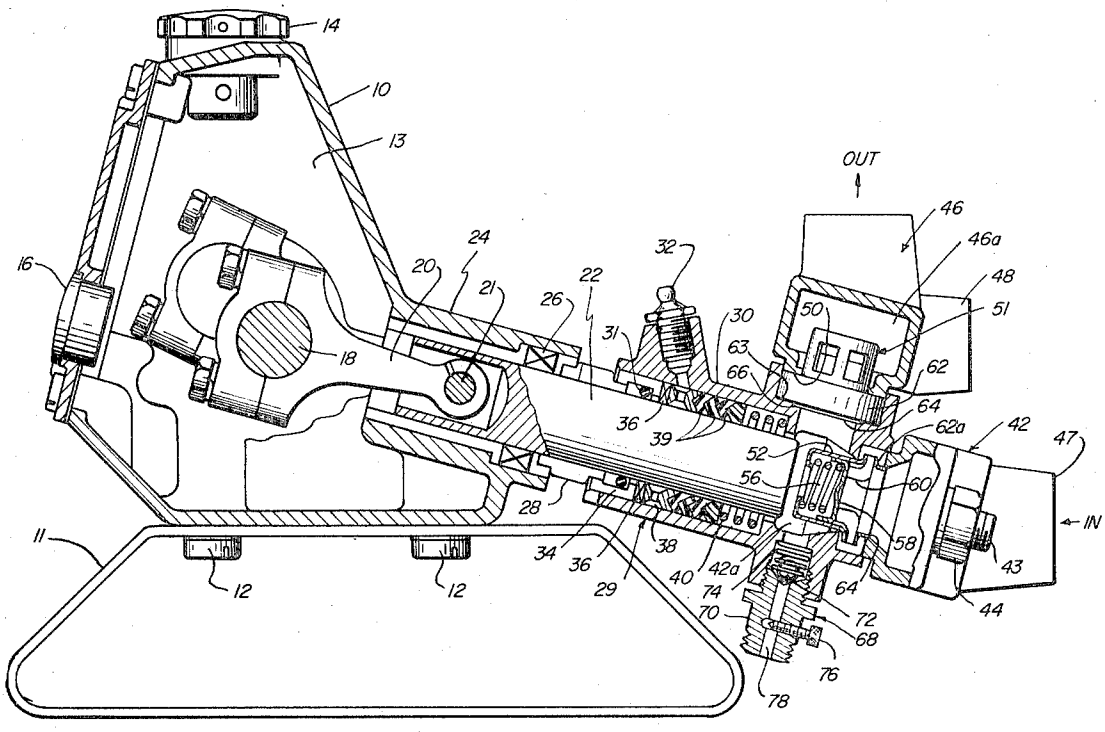
Primary Examiner—William L. Freeh
Assistant Examiner—Gregory P. LaPointe

[57] **ABSTRACT**

A high pressure pump having reciprocating plungers executing suction and discharge strokes, improved by valve assemblies in which valve components extend from a side of an elastomeric seal and an anchoring ring extends from the opposite side of the seal to reduce wear and assure proper alignment of the valve assembly. Similar interchangeable valve assemblies are mounted in communication with the suction and discharge chambers of the pump, but in reverse directions. An improved sealing means is provided by a plurality of V-rings compressed against a lubricating ring by a spring bottomed in a cylindrical chamber wherein the plunger operates in executing the suction and discharge strokes. An additive fluid adaptor with metering means is mounted to a passageway communicating with the suction chamber, and a one-way check valve controls entry of the additive fluid only upon execution of the suction stroke of the plunger.

11 Claims, 4 Drawing Figures



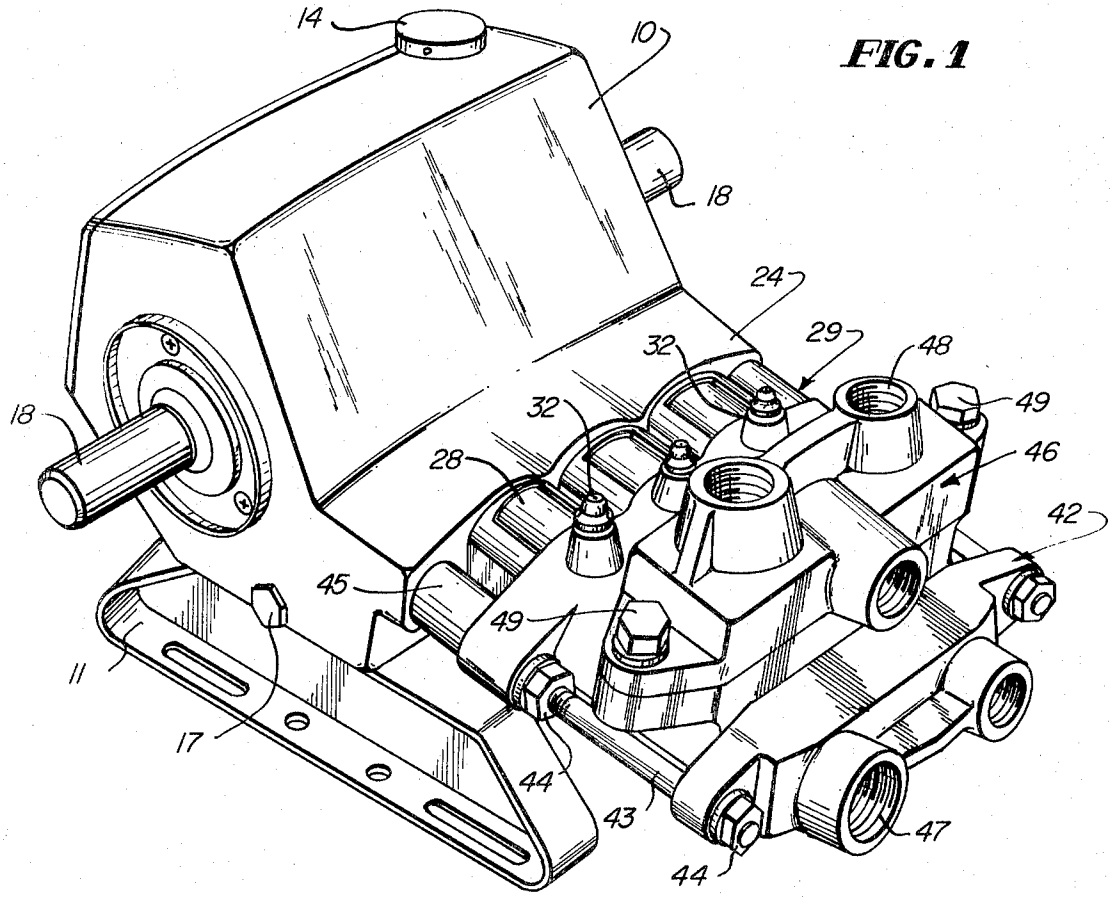


FIG. 1

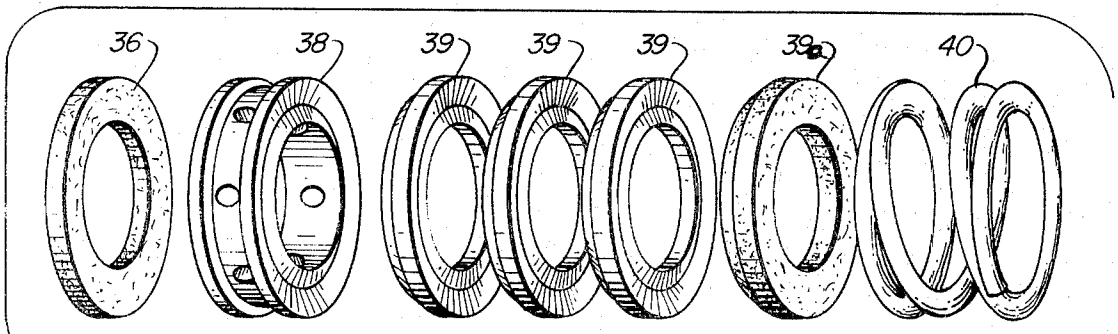


FIG. 3

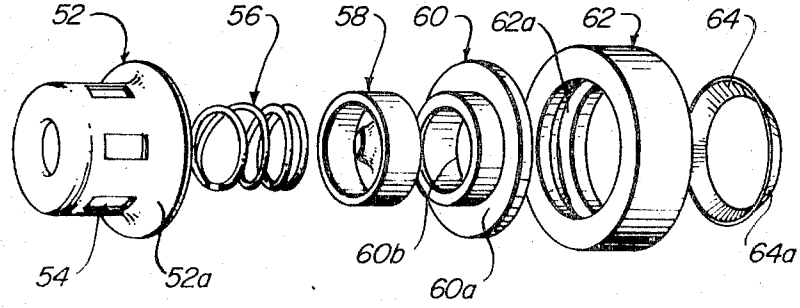
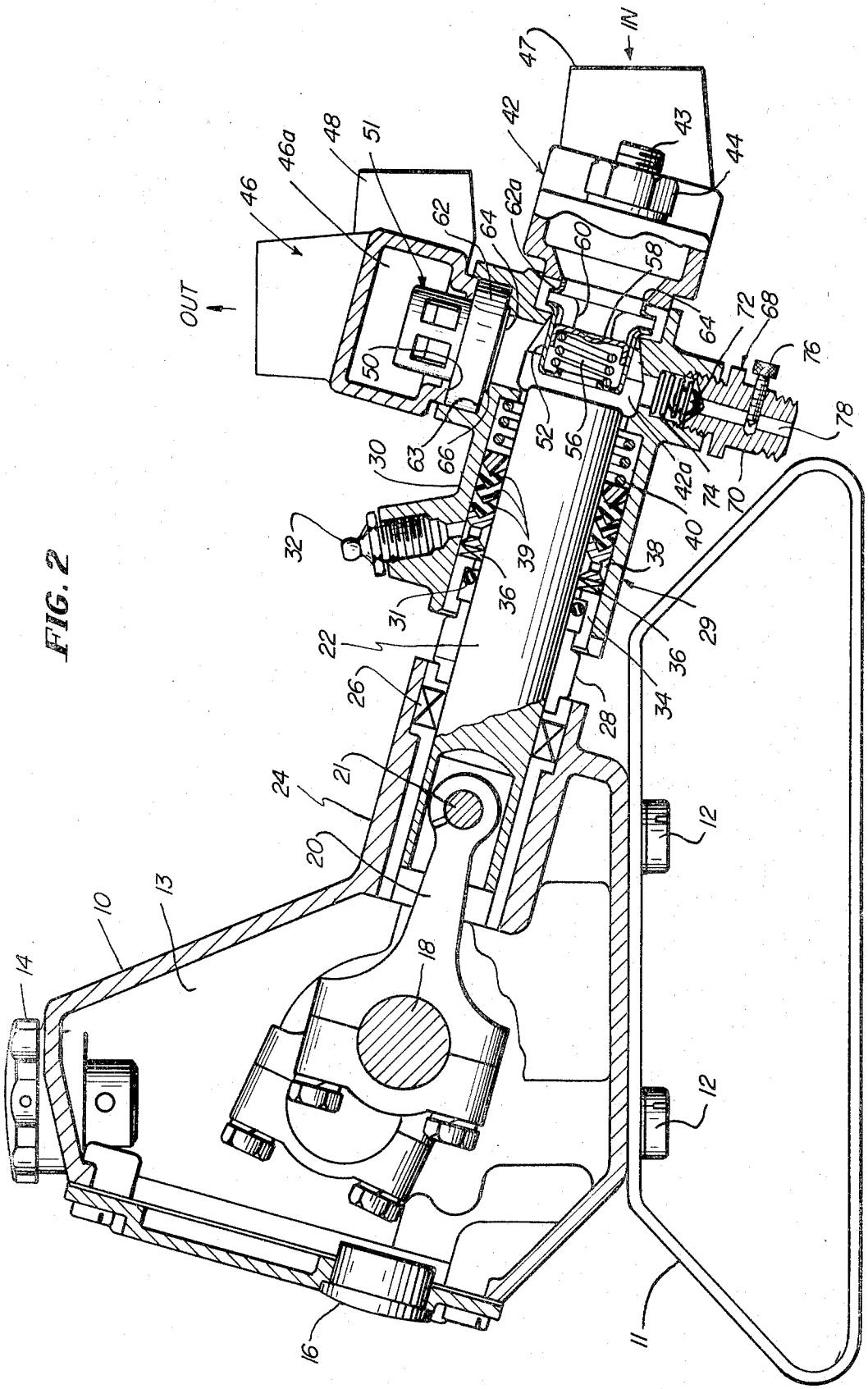


FIG. 4


IN
OUT
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46a
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FIG. 2

HIGH PRESSURE RECIPROCATING PUMP

This invention relates to an improved high pressure pump having one or more plungers which execute suction and discharge strokes to move fluid through suction and discharge chambers, the invention particularly relating to improved valve assemblies, sealing means and additive fluid fittings for the pump. The general type of reciprocating plunger pumps disclosed herein are known in the art as shown, for example, in U.S. Pat. No. 3,666,382 and U.S. Pat. No. 3,558,244, the latter teaching being a pump of the piston type, and the former teaching showing a pump of the plunger type. Both these representative teachings include a pump wherein the piston or plunger is operated by a crankshaft rotated by an auxiliary prime mover such as an electric or internal combustion engine motor.

It is highly important for such high pressure pumps to provide good and reliable sealing in operating. The principal seal or packing is provided around plunger rods, which is essential to the operation of the pump. Good sealing is also required in the valve assemblies which move the fluid, such as water, from outside the pump into a suction chamber, and then through a discharge chamber to outside the pump. The seals in the valve assembly are known to fail at undesirably early periods, and replacement of such seals is often a problem in that the seal assembly must be carefully removed, repaired and then properly refitted and aligned.

It is one important object of the present invention to provide an improved high pressure pump of the reciprocating plunger type which has valve assemblies to control fluid entry and discharge in long-life operation with continued good sealing. It is an aspect of this object that the improved valve assemblies are compactly packaged and assembled so that they can be quickly and easily removed and inserted in proper alignment without requiring extraordinary attention or manipulation.

Still yet another important object of the present invention is to provide an improved high pressure pump of the reciprocating plunger type characterized by a spring loaded packing system around the plunger rods to assure the essential sealing action for high performance pump operation.

Yet still another important object of the present invention is to provide an improved high pressure pump of the reciprocating type wherein an impulse injector type of fitting is provided so that additive fluids, such as detergents, can be delivered into the suction chamber for admixture with the fluids and discharged out of the pump. It is an aspect of this object that such an impulse injector can be provided with means to meter the amount of additive fluid into the suction chamber through one-way movement.

The foregoing objects are attained, together with still other objects which will occur to practitioners from time to time, by the invention of the following disclosure, which includes drawings, wherein:

FIG. 1 is a perspective view of a high pressure pump of the reciprocating plunger type;

FIG. 2 is a sectional side elevational view, on an enlarged scale, of the pump shown in FIG. 1;

FIG. 3 is an exploded view, on an enlarged scale, of the spring loaded packing system to be mounted around the plunger rods; and

FIG. 4 is an exploded view, on an enlarged scale, of the improved valve assembly used interchangeably at the suction and discharge sides of the pump.

Referring now to the drawings, particularly FIGS. 1 and 2, there is seen a high pressure pump of the reciprocating plunger type. The pump has a crank housing 10 which is supported by a mounting rail 11 held by fasteners 12. The housing includes a crank chamber 13 in which lubricating oil is delivered through oil entry assembly 14. The crank housing is also shown with a window gauge 16 for checking oil levels, as well as a drain closure 17 for the purposes of changing the oil.

The crank housing 10 houses a crankshaft 18 to which is joined a plurality of connecting rods 20, each joined by a pivot pin 21 to a plunger rod 22. The plunger rod is located within housing extension 24, and seal 26 is positioned to sealingly engage the rearward portion of the plunger rod 22.

A spacer element 28 separates housing extension 24 from pump housing 29. The pump housing includes a cyclinder wall 30. The plunger rod 22 is provided with an O-ring 31 to sealingly engage the plunger rod 22. The pump housing includes zerk fitting assemblies 32 which are of the conventional design to operate as grease fittings.

The cylinder wall 30 defines a cylindrical chamber 34 in which the plunger rod 22 reciprocates under urgings of rotating crankshaft 18. An improved sealing means or packing system is provided around the plunger rod. Such packing system includes a polyethylene washer 36 which butts against the forward end of spacer. A grease ring 38 adjoins the washer and such ring has a plurality of openings in its periphery as better seen in the view of FIG 3. The ring underlies the zerk fitting assembly 32 so that grease can be circumferentially distributed around the plunger rod 22. A plurality of flexible annular elements, shown as V-packing rings 39 are grouped together. The apices of the respective V-rings are disposed in a uniform direction as shown. A spring 40 has one final turn which is bottomed in the cylinder and an opposite final turn which bears against a base V-ring 39*a*, preferably hardened by being formed from material such as phenol resin. The spring 40 compresses the packing rings to allow the plunger rods 22 to ride rather freely while maintaining the packing rings in good sealing position. The first packing ring in the group fits against grease ring 38 in sealing relationship.

The forward part of the pump includes a suction housing 42 which is clamped tightly to housing 10 by housing bolts 43 and nuts 44. Tightening the nuts and housing bolts compresses spring 40, places the grease ring under the zerk fitting, and desirably loads the packing system around the plunger rods. A spacer nut 45 is shown around bolt 43, said spacer being located between housing extension 24 of crankcase housing 10 and pump housing 29.

A discharge housing 46 is shown on top of the pump housing 29. Both the suction and the discharge housing are provided with parts such as inlet or suction part 47 on suction housing 42, and discharge part 48 on discharge housing 46. The discharge housing is held to the pump housing 29 by fasteners 49 The bottoms of the suction and discharge housing are further provided with flats 50 which engage the valve assemblies in a manner which will be described.

The valve assemblies are shown generally as 51, and are located in the suction chamber and in the discharge

chamber but in reverse position relative to each other. The valve assemblies are, however, interchangable so that valve assembly in discharge chamber **46***a* can be reversed and mounted in pump chamber **42***a*. Each valve assembly has a group of valve components. There is present a valve housing **52** which is somewhat in the form of a bell having a bottom continuous flange **52***a*. A plurality of discharge ports **54** are circumferentially distributed in the wall. of the housing. A spring **56** is positionable inside the valve housing **52** and a valve cap **58** engages one final turn of spring **56**. The valve cap **56** moves to off and on positions on valve seat **60** which has a bottom continuous flange **60***a*. The valve seat has a central passage **60***b* which is opened and closed by the moving valve cap **58**.

An annular elastomeric seal **62** serves as a seat for the foregoing valve components which extend beyond one side of seal **62**. The interior of the annular seal has a continuous grooved seat **62***a* in which is captured the adjoining bottom flanges **60***a* of seat **60** and bottom flange **52***a* of valve housing **52**. The seals **62** are positioned in bores **63** in the pump housing and adjacent to the suction and discharge chambers. The flats **50** at the bottom of the respective housings engage the top of the seals **63**. It is seen that the valve housing positioned in the suction chamber is the portion of the valve assembly which is closest to the end of the plunger. The valve housing positioned in the discharge chamber is the portion of the valve assembly which is farthest from the end of the plunger.

A support or anchoring ring **64** extends beyond the side of the seal **62** which is opposite to the side from which the valve components extend. Such ring is shown to have a bottom flange **64***a* which adjoins the bottom flanges of the valve seat and the valve housing when captured interiorly in groove **62***a* of seal **62**. The extending portion of support ring **64** is positioned in a machined seat **66** in the pump housing. This seat is a circular groove which is immediately below larger bore **63** in which seal **62** is seated. The seated extending support ring assures correct alignment of the valve assembly in the respective suction and discharge chambers. Anchoring the support ring in the machine seat further improves the life of the seal **62** in that the ring funnels fluid into and from their respective chambers thus reducing the effect of the fluid pressure directly on the seals. The seals are tightly compressed between their respective bores and the flats **50** of the housing portion when the fasteners are tightened, such as **49** and **44**.

Additive fluids are introduced into the suction chamber during the suction stroke of the plunger through an impulse injector assembly **68**. The assembly includes a fitting **70** which is positioned to communicate with a passage and pump housing **29**. A one-way check valve is provided in the form of a ball **72** and spring **74** to provide that additive fluid moves only in one direction into the suction chamber upon execution of the suction stroke. The additive fluid is preferably metered by means such as a needle valve **76** which selectively diminishes the opening of passage **78** in the fitting.

In operation, the suction chamber valve assembly is open during suction stroke to allow fluids such as water to move into entries **47**. The reduced pressure in the suction chamber makes it easier for the water pressure to move the cap **58** against spring **56**. At the same time, the discharge chamber valve assembly has its cap **58** closed under urgings of spring **56**. At the same time, additive fluids may be moved through the impulse injector into the suction chamber where they mix with the fluid present therein. During pressure stroke, the valve assembly in the suction chamber is closed by fluid pressure holding cap **58** against seat **60** while such fluid is discharged through the valve assembly in the discharge chamber by unseating cap **58** from seat **60**. During such suction and pressure strokes of the plunger, spring **40** urges the plurality of packing rings in compressed relationship against lubricating ring **38** which is fixed by stop or washer **36** in the cylinder.

The claims of the invention are now presented, and the terms of such claims may be better understood by reference to the language of the preceding specification and the views of the drawings.

What is claimed is:

1. In a high pressure pump having a plunger movable in a cylinder by a rotatable crankshaft to urge fluid through an entry into a suction chamber of the pump, and then urge the fluid under pressure through a discharge chamber and out of said pump, the improvement which comprises

an interchangeable valve assembly mounted in said suction and discharge chambers, said valve assemblies being reversed relative to each other so that such suction chamber valve assembly is opened and said discharge chamber valve assembly is closed during a suction stroke of the plunger, and said opening and closing of the valve assemblies is reversed during the pressure stroke of the plunger,

each valve assembly including a continuous flange mounted interiorly in an annular groove in an elastomeric seal ring and extending beyond one side of said elastomeric ring,

a rigid anchoring ring having a continuous flange mounted interiorly in said annular groove in said elastomeric seal ring and extending beyond the opposite side of said elastomeric seal ring, and

a matching continuous grooved seat in each of said chambers wherein said anchoring ring is positioned.

2. In a high pressure pump which includes the features of claim **1** above, wherein the valve assembly extending out of one side of the elastomeric seal includes a bottom flanged valve housing, a valve cap urged to closed position against a bottom flanged valve seat, the bottom flanges of said housing and valve seat being held in adjoining relationship within said elastomeric seal, and said valve housing having discharge ports to move the fluids under pressure therethrough when the valve cap is opened by being unseated from said valve seat under pressure fluid levels.

3. A pressure pump which includes the features of claim **2** above, wherein the valve housing positioned in the suction chamber is the portion of the valve assembly which is closest to the end of the plunger, and the valve housing positioned in the discharge chamber is the portion of the valve assembly which is farthest from the end of said plunger.

4. A pressure pump which includes the features of claim **3** above, wherein a plurality of plungers operate in communication with said suction chamber, and a plurality of entries, each aligned with a valve assembly, are in communication with said suction chamber.

5. A pressure pump which includes the features of claim 4 above, wherein said discharge chamber has a plurality of communicating discharge outlets.

6. A pressure pump which includes the features of claim 2 above, wherein said anchoring ring has a large flanged opening mounted within the elastomeric seal and a small opening extending out of said seal for positioning in a seat formed in the pump body.

7. A pressure pump which includes the features of claim 1 above, wherein said plunger is reciprocably positioned in a cyclinder housing, annular sealing means between the plunger and the cylindrical housing, and means at one end of the cyclindrical housing urging said annular sealing means in sealing engagement towards the opposite end of the cylindrical housing.

8. A pressure pump which includes the features of claim 7 above, wherein said annular sealing means are a plurality of flexible V-rings and a hardened base V-ring, the apices whereof are disposed in a uniform direction, and said biasing means is a spring having one final turn bottomed in the cylindrical housing and the opposite final turn bottomed against the hardened base.

9. A high pressure pump which includes the features of claim 8 above, wherein the V-ring most remote from the bottom of the cylindrical housing adjoins a lubricating ring which position is fixed by an annular stop within the cylindrical housing, said lubricating ring having a plurality of passages communicating with the cylinder chamber, and said ring being aligned with a lubricating inlet in said cylindrical housing.

10. A pressure pump which includes the features of claim 1 above, and which further includes a passageway communicating with said suction chamber, an impulse injector fitting mounted to said passageway, said fitting including a one-way check valve operable to allow introduction of additive fluid only upon the suction stroke of said plunger.

11. A pressure pump which includes the features of claim 9 above, and which further includes metering means on said impulse injector fitting to control the amount of additive fluid which is introduced into the suction chamber.

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