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3,279,391

ULTRA-HIGH PRESSURE PISTON PUMP

Filed June 18, 1964

2 Sheets-Sheet 1

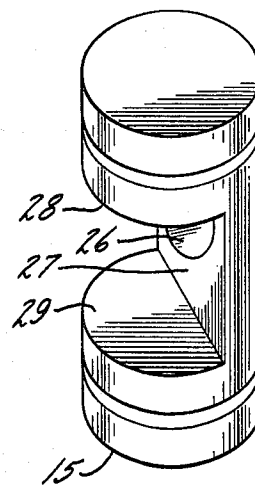
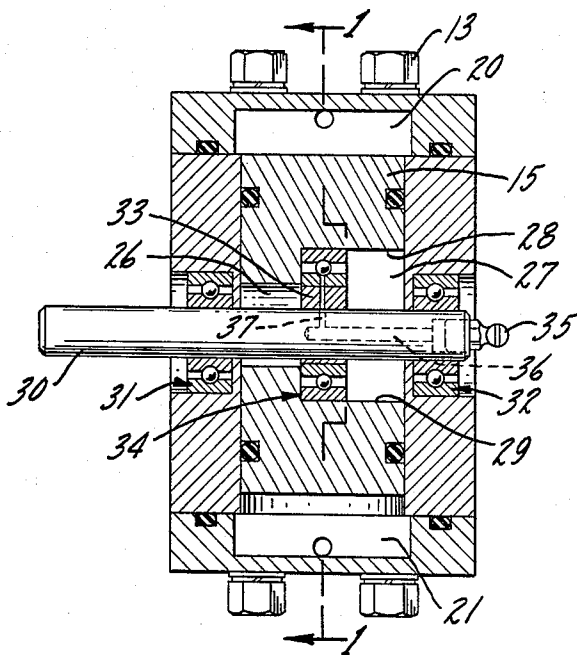
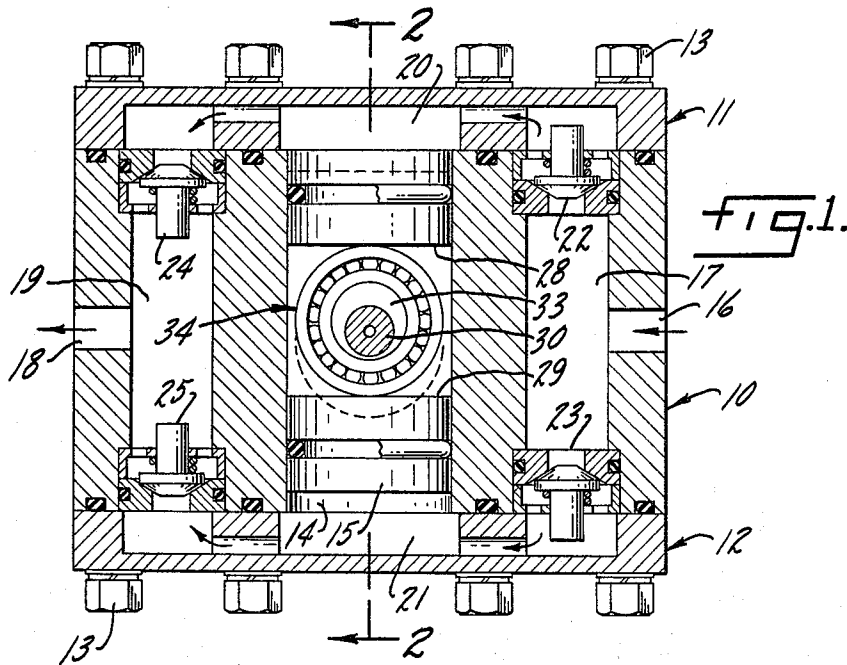


FIG. 2.

FIG. 3.

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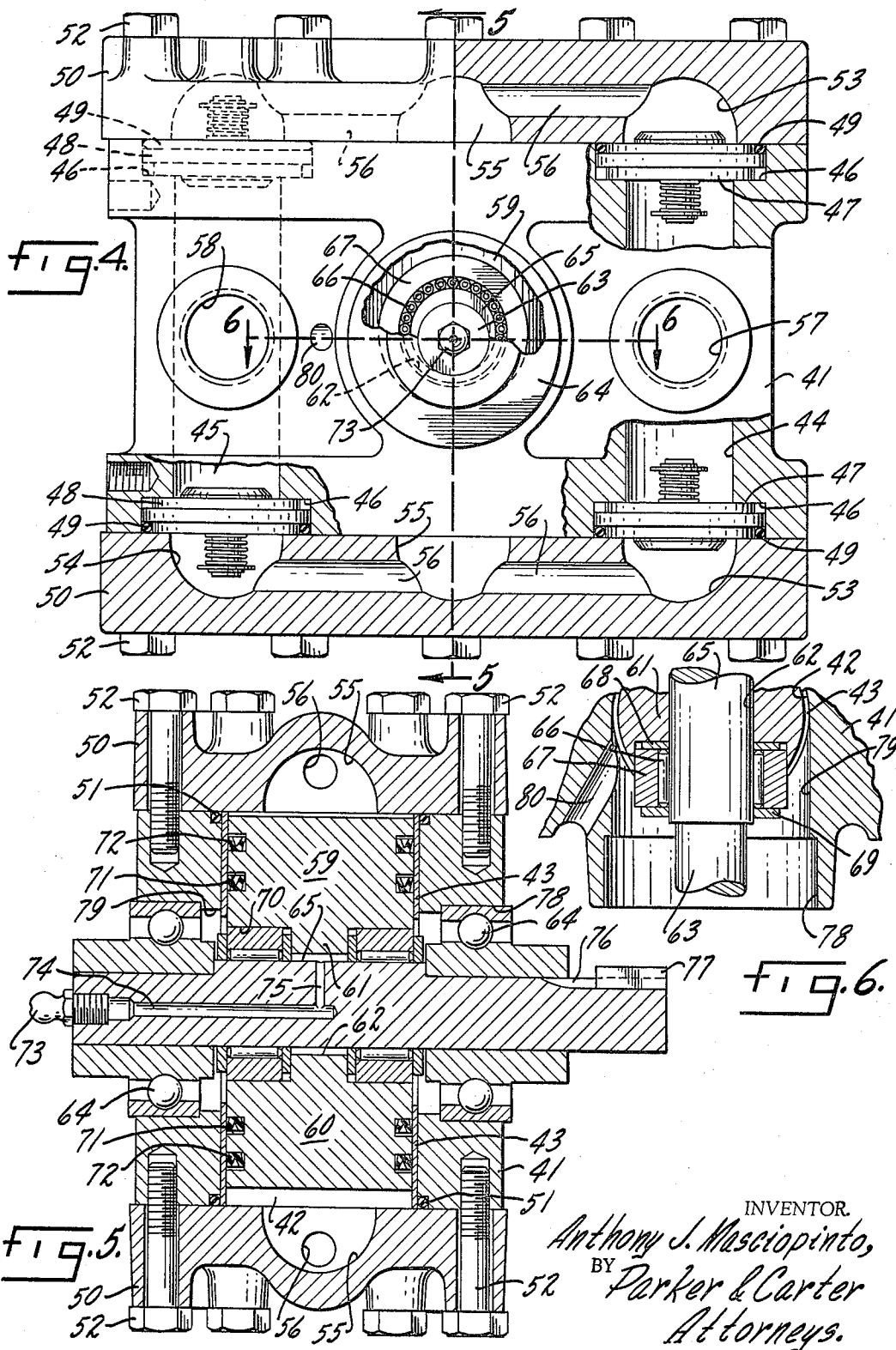
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ULTRA-HIGH PRESSURE PISTON PUMP

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Filed June 18, 1964, Ser. No. 377,456
8 Claims. (Cl. 103—171)

This invention is a continuation-in-part application of my co-pending application Serial No. 324,390, filed November 18, 1963, for "Piston Pump," now abandoned.

This invention relates to improvements in ultra-high pressure piston pump and has for one object to provide a double acting reciprocating piston pump wherein the piston travel is exceedingly short and wherein the piston can reciprocate at very high speed maintaining a substantially continuous high pressure output.

In conventional piston pumps, high fluid pressure delivery requires high input power. This in turn makes a high pressure pump relatively expensive in initial cost, as well as expensive to operate.

It is a prime object of the invention to provide a piston pump which will discharge fluid at very high pressure, yet which requires relatively low input power.

It is an additional object to provide a double acting high pressure pump in which the piston is positively moved in both directions by a power rotated eccentric cam which has direct contact with the piston throughout the length of both its strokes.

Other objects will appear from time to time throughout the specification and claims.

The invention is illustrated more or less diagrammatically in the accompanying drawings, wherein—

FIGURE 1 is a section through the line 1—1 of FIGURE 2;

FIGURE 2 is a section along the line 2—2 of FIGURE 1;

FIGURE 3 is an isometric view of the pump piston;

FIGURE 4 is a side elevation with parts in section of a modified form of pump;

FIGURE 5 is a section along the line 5—5 of FIGURE 4;

FIGURE 6 is a section along the line 6—6 of FIGURE 4 with parts omitted.

Like parts are indicated by like characters throughout the specification and drawings.

The pump body includes a central section 10, and cylinder heads 11 and 12, held in place by bolts 13. Central section 10 has a central cylindrical bore which serves as a working chamber 14 for pump piston 15, an inlet 16 communicating with an inlet chamber 17, and an outlet 18 communicating with an outlet or discharge chamber 19. The cylinder heads enclose at each end of the body section, fluid transfer passages 20 and 21, connecting respectively the inlet chamber 17, the working chamber 14 and the outlet chamber 19. Normally closed spring pressed check valves 22 and 23 control intake fluid flow between inlet chamber 17 and working chamber 14 through transfer passages 20 and 21. Normally closed spring pressed check valves 24 and 25 control discharge fluid from the working chamber 14 to outlet chamber 19 through transfer passages 20 and 21. The check valves prevent back flow in the usual manner.

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Piston 15 is initially a solid cylindrical bar of metal or plastic with a transverse central bore hole 26, the inner end of which centrally intersects a transverse channel or pocket 27, which is bounded by two longitudinally spaced, transverse, parallel, cam cooperating surfaces 28 and 29 which lie in planes normal to the central longitudinal axis of the piston.

The piston reciprocating mechanism includes a shaft 30 adapted to be rotated by any suitable power unit, not shown. Shaft 30 extends transversely through the transverse aperture 26, the pocket 27 in the piston and across the working chamber and is journaled on opposite sides of the piston in bearings 31 and 32 socketed in the central section 10.

An eccentric bushing 33 is rigidly attached to an intermediate portion of shaft 30 to rotate with it. The circular peripheral surface of bushing 33 carries an anti-friction bearing 34. The outside diameter of the outer race of bearing 34 is such that the race has a close working fit between the surfaces 28 and 29 to permit the bearing race to move transversely with respect to the piston as the shaft rotates. The bore hole 26, being considerably larger in diameter than shaft 30 allows the piston to reciprocate freely within the stroke limits determined by the degree of eccentricity of the cam. The eccentric cam which drives the piston is made up of the eccentric bushing 33 and the bearing 34. The bearing 34 is lubricated through grease fitting 35 on the end of shaft 30 and ducts 36 and 37 in the shaft.

In FIGURES 1 and 2 the piston 15 is shown at the upper end of its stroke. As shaft 30 is rotated, cam 33, 34 in positive contact with the surfaces 28 and 29 drives the piston 15 up and down. The position of the cam at the end of the down stroke is indicated by broken lines in FIGURE 1.

The low power input required to operate the described pump is accomplished through the mechanical advantage provided by the use of the circular eccentric cam acting directly on the piston to positively move it in both directions.

In the modified form of FIGURES 4 to 6 the cast pump body 41, centrally cylindrically apertured from top to bottom as at 42 contains cylindrical liner sleeves 43 to define upper and lower concentric, pump cylinders in the aperture 42.

Extending through the casting from top to bottom are an inlet chamber 44 and an outlet chamber 45. Cylindrical valve seats 46 are concentric with the inlet and outlet chambers, receive respectively inlet spring loaded poppet valve assemblies 47 at each end of inlet chamber 44 and similar outlet valve assemblies 48 at each end of outlet chamber 45. Seal rings 49 encircle the outboard sides of the valve assemblies.

The opposite ends of the casting are closed by cylinder heads 50. Seal rings 49 and seal rings 51 are compressed between the cylinder heads and the casting to make tight seals for the cylinders and the inlet and outlet chambers. The cylinder heads are held in place by cap screws 52.

Cast in the cylinder heads are intake valve pockets 53 in register with the intake valves 47, exhaust valve pockets 54 in register with the exhaust valves 48 and cylinder pockets 55 each in register with and open to a

pump cylinder. Ducts 56 extending across each cylinder head join the three pockets in each cylinder head in series. An inlet port 57 and exhaust port 58 communicate with the chambers 44 and 45 and may be threaded to receive pipe connections in the usual manner.

The one-piece monoblock piston has an upper piston head 59 and a lower piston head 60, joined by a central web 61 apertured at 62 to receive the drive shaft 63 supported in bearings 64 on opposite sides of the pump body. The drive shaft 63 is eccentric at 65 between the bearings 64. On both sides of the web 61 are anti-friction bearings including needles 66 riding on the eccentric 65 in outer races 67. Wear shims 68 encircle the eccentric and abut the inner ends of the needles and the inner sides of the races in opposition to retaining rings 69 which abut the opposite ends of the needles and the opposite sides of the outer races.

The outer bearing races 67 are received in pockets on opposite sides of the piston web 61. These pockets are defined at top and bottom by horizontal plane cam surfaces 70, the crank faces of the piston heads, the distance between the surfaces 70 being substantially equal to the outer diameter of the outer races 67. Thus as the eccentric shaft rotates moving the outer races up and down and laterally, they remain in constant camming contact with the surfaces 70 to impart a straight line reciprocation to the piston to cause it to pump in the usual manner.

As the piston moves up, fluid is forced by piston head 59 out through the upper cylinder pocket 55, duct 56 and exhaust valve pockets 54 to unseat the valve 48 and force liquid into the discharge or outlet chamber 45. Meanwhile the lower piston head 60 draws fluid in from the intake chamber 44 through lower inlet valve 47, inlet chamber 44, duct 56, cylinder pocket 55 into the lower cylinder. As the cam shaft rotates, these sequences follow in the usual manner.

The diameter of the piston is large in proportion to its stroke. The two piston heads are grooved at 71 to receive O-rings 72 in contact with the liners 43. O-rings of U-shaped cross section may be used. Two rings for each piston head are usually sufficient to make a tight packing.

Any suitable means, if desired a press fit, may be used for holding the bearings 64 in the pump body 41. A Zerk fitting 73 discharging into a duct 74 and a cross duct 75 conducts lubricant into the clearance space between the eccentric 65 and the aperture 62 in the web 61. As the eccentric rotates and the piston reciprocates, the clearance between the inner periphery of the aperture and the eccentric remains volumetrically constant but its position changes with the angular position of the eccentric. Pressure through the Zerk fitting fills this clearance and fills the clearances in the needle bearings. A weep hole 80 communicates with the inner chamber defined by the clearance and the bearing to protect the system against too great grease pressure. The cylinder liners terminate far enough away from the eccentric and the associated parts to provide adequate clearance as the eccentric rotates. The eccentric shaft is slotted at 76 to receive a key 77 for drive, preferably applied to that side of the casting opposite to the intake and exhaust ports 57 and 58.

In FIGURE 6, the bearings 64 are omitted in the interest of clarity, fitting into the socket 78, there being one on each side of the pump body and the two bearings together with the cylindrical walls 79 on both sides of the pump cylinder define a lubricant chamber enclosing the eccentric and the needle bearings.

I claim:

1. In a pump, a cast metal pump body cylindrically apertured from top to bottom to define a pump chamber, a double ended one-piece piston mounted for reciproca-

tion in the pump chamber including upper and lower piston heads and an apertured web joining them, a drive shaft extending through the pump body across the pump chamber and through the aperture in the web, bearings on opposite sides of the pump body for said shaft, eccentric driving means between the shaft and the piston on both sides of the web.

2. In a pump, a cast metal pump body cylindrically apertured from top to bottom to define a pump chamber, a double ended one-piece piston mounted for reciprocation in the pump chamber including upper and lower piston heads and an apertured web joining them, a drive shaft extending through the pump body across the pump chamber and through the aperture in the web, bearings on opposite sides of the pump body for said shaft, eccentric driving means between the shaft and the piston on both sides of the web,

the driving means including opposed cam surfaces on the piston on both sides of the aperture and on both sides of the web the driving means on both sides of the web engaging said cam surfaces and in eccentric relationship to the shaft.

3. In a pump a cast metal pump body cylindrically apertured from top to bottom to define a pump chamber, a double ended one-piece piston mounted for reciprocation in the pump chamber including upper and lower piston heads and an apertured web joining them, a drive shaft extending through the pump body across the pump chamber and through the aperture in the web, bearings on opposite sides of the pump body for said shaft, eccentric driving means between the shaft and the piston on both sides of the web,

the radius of the aperture in the web being greater than the maximum throw of the eccentric driving means.

4. In a pump, a cast metal pump body cylindrically apertured from top to bottom to define a pump chamber, a double ended one-piece piston mounted for reciprocation in the pump chamber including upper and lower piston heads and an apertured web joining them, a drive shaft extending through the pump body across the pump chamber and through the aperture in the web, bearings on opposite sides of the pump body for said shaft, eccentric driving means between the shaft and the piston on both sides of the web,

the driving means including opposed cam surfaces on the piston on both sides of the aperture and on both sides of the web, the driving means on both sides of the web engaging said cam surfaces and in eccentric relationship to the shaft,

said means including an eccentric on the shaft, needle bearings engaging the eccentric, races enclosing the needle bearings and engaging the cam surfaces.

5. A pump including a cast metal pump body cylindrically apertured from end to end, cylindrical liners enclosed in said aperture at each end thereof to define upper and lower aligned concentric cylinders, a two headed one-piece piston mounted for reciprocation in said cylinders, a two-headed one-piece piston mounted for reciprocation in said cylinders, a central web joining the piston heads, bearings removably mounted on the pump body on opposite sides of the axis of the cylinder, an eccentric drive shaft carried by said bearings extending across the pump body and through the web, and the web being apertured to receive the shaft, the radius of the aperture being greater than the distance from the center of the shaft to the maximum excursion of the eccentric, opposed cam surfaces perpendicular to the axis of the piston on opposite sides of the web on the under sides of the piston, anti-friction bearing members interposed between the eccentric shaft and the cam surfaces on opposite sides of the web.

6. The device of claim 5 characterized by the fact that said anti-friction bearings include needle bearings on the eccentric and anti-friction bearing races encircling the

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needles and in contact with the cam surfaces associated with the upper and lower piston heads.

7. The device of claim 5 characterized by the fact that the clearance between the aperture in the central web and the drive shaft defines a lubrication chamber for the needle bearings on both sides of the central web. 5

8. The device of claim 7 characterized by the fact that a weep hole extends through the wall of the pump body open to atmosphere at one end and at the other end in communication with the space between one of the needle bearings and the socket containing the bearings mounted on the pump body. 10

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MARK NEWMAN, *Primary Examiner*.

WARREN E. COLEMAN, *Examiner*.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,279,391

October 18, 1966

Anthony J. Masciopinto

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 20, after "web" insert a comma; lines 58 and 59, strike out "a two-headed one-piece piston mounted for reciprocation in said cylinders,"; line 63, strike out "and", second occurrence.

Signed and sealed this 5th day of September 1967.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents