Nov. 12, 1946. N. A. CHRISTENSEN 2,410,808

PUMP

Filed July 7, 1944 2 Sheets-Sheet 1

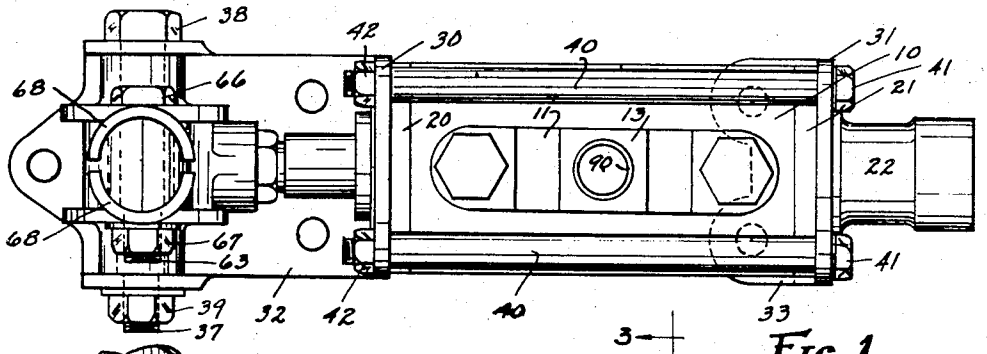


FIG. 1

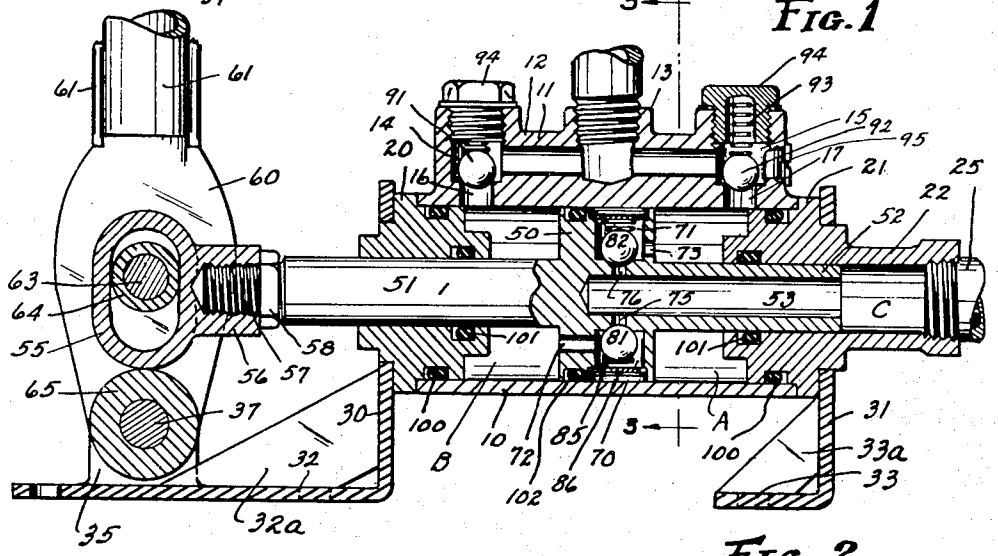


FIG. 2

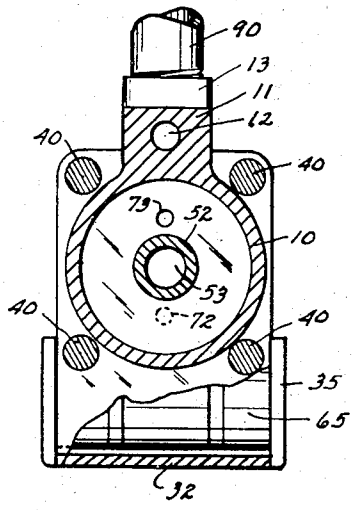


FIG. 3

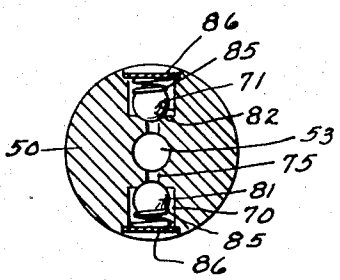


FIG. 4

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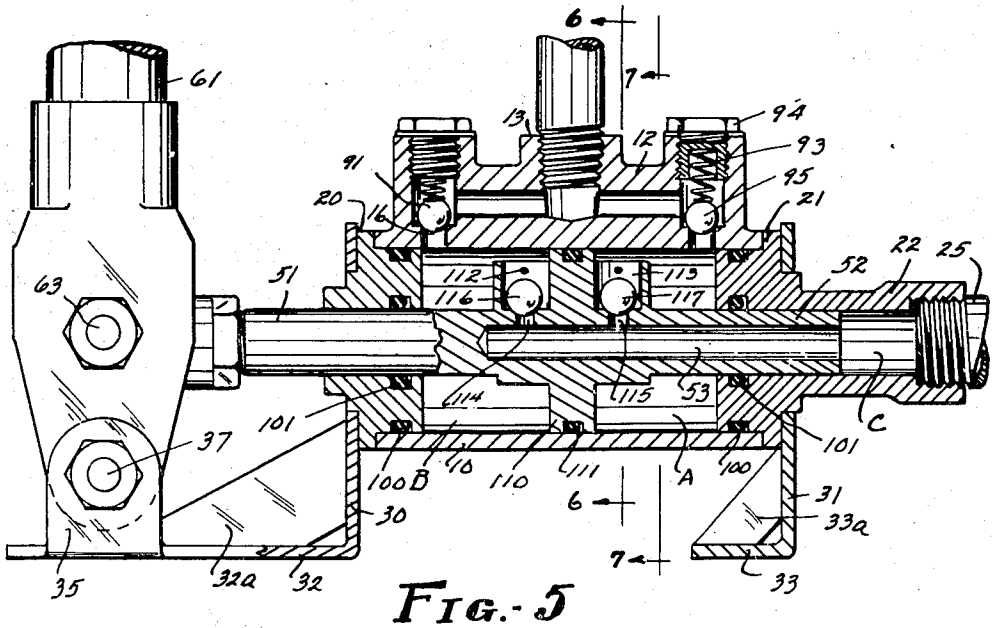


FIG.-5

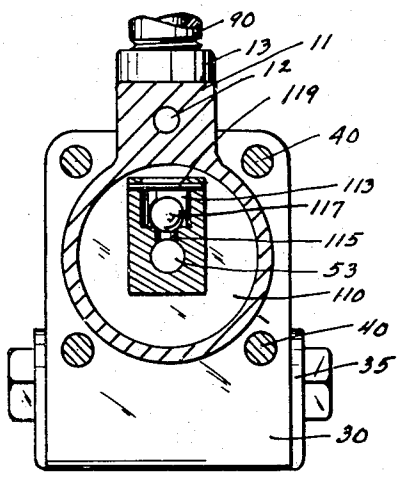


FIG.-6

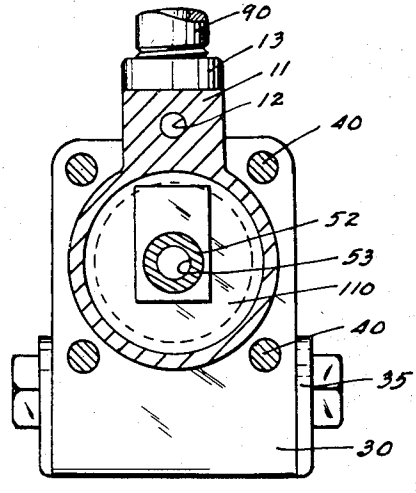


FIG.-7

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PUMP

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8 Claims. (Cl. 103—193)

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This invention relates to a double-acting piston pump, the general object being to provide such pump in a very simple form, efficient for propelling a continuous stream of fluid. Another object is to provide such a pump in the form which may be very readily disassembled for cleaning and reassembled, and will maintain itself tight in all locations where leakage might be liable to occur.

More particularly, my invention provides a cylinder with two removable heads and a piston in the cylinder carrying a feeding conduit projecting through one of the heads, the piston being hollow and having valve controlled passages to feed liquid to either side of the piston according to the direction of movement thereof, so that liquid may be received within the piston and forced first to one end of the cylinder and then the other, two ends being connected through two suitable check valves to a common discharge pipe. It is an object of the invention to provide such a pump with simple and at the same time effective valve means within the piston controlling the intake thereto and the discharge from the piston alternately to opposite ends of the cylinder.

The provision of a simple frame construction, readily separable but firm when assembled, and a simple and effective manual means for reciprocating the piston are also objects of the invention.

My invention is illustrated in two preferred forms in the accompanying drawings and its features will be more apparent from the following detailed description of those forms, it being understood that I do not limit myself to either specific form illustrated further than the appended claims and the prior art require.

In the drawings, Fig. 1 is a plan of a preferred form of hand operated pump embodying this invention; Fig. 2 is a vertical central section through such pump; Fig. 3 is a cross section in a vertical plane, as indicated by the line 3—3 on Fig. 2 looking toward the left; Fig. 4 is a vertical section through the piston shown in Fig. 2; Fig. 5 is a vertical longitudinal section of my pump having a different form of piston and valves; Figs. 6 and 7 are vertical cross sections of the pump shown in Fig. 5, the planes of the sections being indicated by the correspondingly numbered lines on Fig. 5.

The body of the pump, shown in Figs. 1, 2 and 3, comprises: a cylinder 10 with discharge passageways controlled by check valves; a pair of cylinder heads 20 and 21 adapted to seat in the

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cylinder and overlap the ends thereof; a pair of frame members 30 and 31 abutting the two cylinder heads, and a series of through bolts 40 extending alongside of the cylinder and passing through the frame members and having heads 41 at one end and carrying nuts 42 at the other end. The tightening of these nuts clamps the frame plates against the cylinder heads and th heads against the ends of the cylinder, to mak a simple stationary construction. Below the cylinder, the two frame plates are flanged into horizontal members 32 and 33 providing a suitable base carrying the pump with braces 32' and 33'.

Within the cylinder is a reciprocating piston 50 having on one side a solid rod 5 extending through the cylinder head 20 and on the other side a tubular rod 52 extending through the cylinder head 21. The cylinder head 21 is provided with a tubular extension 22 internally threaded at its end to receive a suction pipe 25. Such suction pipe communicates through the hollow rod 52 with the interior of the piston, thus supplying liquid to the pump, as hereinafter explained.

The rod 51 provides the means by which the piston is reciprocated. I have shown the pump as a hand operated device and in this case I provide an oscillating arm 60 pivoted to the base plate 32 and carried in an upwardly extending operating handle bar 61. The oscillating member 60 carries a cross pin 63 on which is a roller 64 occupying a scotch yoke 55 on the piston rod 51. The yoke is shown as having a strap portion with vertical parallel opposed faces engaged opposite sides of the roller 64 and having an internally threaded tubular extension 56 threaded onto an externally threaded reduced portion 57 of the piston rod 51. A nut 58 on this thread clamps the yoke tightly to the rod.

As shown in the drawings, the pivoting of the operating member is accomplished by a pair of frame ears 35 turned upwardly from the base plate 32 and carrying a cross pin 37 which occupies a tubular member 65 carried between and secured to the lower ends of the bifurcated arm 60. The bolt 37 is shown as having a head 38 on one end and a nut 39 on the other. Similarly the bolt 63 carrying the roller 64 has a head 66 on one end and a nut 67 on the other. The upper ends of the bifurcated operating member are curved inwardly and in a nearly semi-circular form, as indicated at 68 to rigidly embrace the operating handle 61. It will be seen that

the reciprocation of this handle operates to reciprocate the piston within the cylinder.

The piston 50 has within it the two diametrically opposed cylindrically-shaped chambers 70 and 71. The chamber 70 communicates with the portion of the cylinder toward the left, Fig. 2 (that is toward the operating member) by a port 72, while the cylinder 71 communicates at the opposite end of the cylinder by a port 73. The two chambers are both connected with the bore 53 of the tubular piston rod 52 by ports 75 and 76.

Each port 75 or 76 is normally closed by a ball valve 81 or 82 pressed inwardly by a compression spring 85, the inner end of which abuts the valve ball and the outer end of which abuts a stop plate 86 mounted in an enlargement of the cavity 70 or 71 of the piston. An abutment member 86 is a dished plate pressed inwardly to its seat so that its edge firmly engages the wall of the cavity it occupies, the plate thus forming an effective abutment for the spring without engaging the cylinder wall. The operation of these valves will be described later.

Rigidly formed on the exterior of the cylinder, either as a part thereof or permanently secured thereto, is a body 11 having a longitudinal passageway 12 communicating centrally with a hollow boss 13 into which is threaded the discharge pipe 90. The passageway 12 communicates at opposite ends with cavities 14 and 15 which communicate respectively with opposite end portions of the cylinder by ports 16 and 17. The two ports 16 and 17 are normally closed by ball valves 91 and 92 which are shown as seated by springs 93. Each spring bears at its inner end against the corresponding ball and at the outer end seats in a cavity in a screw plug 94 which is threadingly mounted in an internally threaded upwardly extending wall about the corresponding cavity 14 or 15. For convenience of formation, I extend the passageway 12 in the body 11 entirely to one end of such body and close it by a removable plug 95.

I provide suitable packings to maintain a fluid-tight connection between the cylinder heads and the cylinder wall, as shown at 100; also between the cylinder heads and the piston rods, as shown at 101; and between the piston and cylinder wall at 102.

As shown, each of the packings comprises an annular ring of rubber-like material normally round in cross section but somewhat flattened in position so as to partially occupy a groove in the member carrying it, of somewhat greater width than the ring. By this means the packing member is able to roll as it is moved along its contacting member, or such member moves along the ring. This rolling action kneads the material of the ring and maintains it in active condition over a long period of time. The rolling of the outer packing in the cylinder heads occurs whenever such heads are put into place in the cylinder and is also kneaded by pressure variation from the alternate pressure and intake strokes, and as to the other packings occurs with each stroke of the piston.

In the operation of the pump, shown in Fig. 2, if the handle 61 is moved to the left, reduced pressure results in the chamber A at the right of the piston. This results in the valve 82 lifting, while the valve 92 remains seated, producing suction in the conduit 53 and the communicating chamber C and in the suction pipe. At the same time, if there is liquid in the chamber B at the left of the piston, it is put under pressure, the valve 81 remaining closed and the valve 91 opening, and thus liquid is forced into the passageway 12 and up the discharge pipe 90.

On the return stroke, toward the right, the liquid which has filled the chamber A is put under pressure, the valve 82 seats and the valve 92 opens and such liquid is forced up into the passageway 12 and out of the pipe 90. On this right hand stroke the pressure in the chamber B at the left of the piston is reduced, the valve 91 seating, the valve 91 opening, and liquid from the suction conduit passing through the ports 75 and 72 into the chamber B, to be put under pressure on the subsequent left hand stroke of the piston.

It is to be understood that the suction pipe 25 is provided with a suitable foot valve not shown, opening toward the pump and effective to retain the fluid in the chamber C on the left hand stroke of the piston.

In the embodiment illustrated in Figs. 5, 6 and 7, the cylinder with its heads; the discharge valve features; the supporting brackets, and the operating mechanism, are all the same as that already described and the same reference characters apply. The construction in this modification differs merely in the piston and the valves therein.

As will be clearly seen from Fig. 5, I have in this embodiment provided a disc-like piston body 110 which may be integral with the two piston rods 51 and 52. This body engages the wall of the piston and has a peripheral groove in which seats a packing 111. On opposite sides of the body 110, above the piston rods, I have formed the construction into a pair of upwardly facing vertical chambers or cups 112 and 113 which constitute valve chambers. Each chamber has its own port 114, 115 communicating with the bore 53 of the hollow piston rod. Each chamber communicates individually with the space on that side of the piston rod, this communication being readily effected by terminating the tops of the chambers short of the cylinder wall.

The two valve chambers contain ball valves 116, 117 controlling the respective ports 114 and 115. The chambers extend vertically upward so that the balls normally rest by gravity on the seats, closing the ports. They may be moved upwardly away from the seat by fluid pressure but are retained within the cavity by cross rods 119 mounted in the walls of the cavity.

The construction of Fig. 5 is somewhat cheaper than that of Fig. 2 and is equally effective especially in installations where it is feasible for the wall cavities to retain the upwardly extending position. The operation of this embodiment is essentially the same as that of Fig. 2, namely, when the piston moves toward the left, the valve 116 remains seated due to the pressure on it, while the valve 117 lifts, due to the reduced pressure in the right hand portion of the cylinder. This supplies suction to allow the fluid to flow to the pump through the bore 53. Then, on the return stroke toward the right, the valve 117 is seated and the valve 116 lifts and allows fluid to pass into the left hand cylinder space.

It results therefore that as the handle is reciprocated back and forth, fluid is forced upwardly from opposite sides of the piston alternately past the two check valves into the delivery pipe to make a continuous stream.

My invention, while having a variety of uses is well adapted for pumping fluid under pressure as an emergency hand operation in airplanes in the case of failure of the automatic pumping. The mechanism shown with its effective packing en-

ables the ready pumping of such fluid under high pressure.

One of the objects of my invention, especially useful in airplane work, is to enable the ready disassemblage of the parts for cleaning or for replacement of any broken or injured part. Thus by merely unscrewing the nut **69** and taking out the bolt **65**, I can disconnect the operating mechanism from the piston. Then by detaching one of the frame members from its support, by the removal of the fastening bolts passing through the feet thereof, and the removal of the nuts **42** on the rods **40**, I can separate the frame plates from the cylinder heads and allow the cylinder heads to be separated from the cylinder and the piston removed. This leaves each packing duly exposed for the replacement. By taking out the plugs **94**, one obtains access to each of the discharge valves and by removing the abutment disc **70** or the stop pin the valves in the piston are freed for removal. It is a similarly simple matter to reassemble the pump. Accordingly, cleaning or repairs may be readily accomplished, as well as the replacement of any injured part.

I claim:

1. In a pump, the combination of a cylinder, a pair of heads therefor, a piston therein, a piston rod extending from the cylinder through one of the heads of the cylinder, a pair of frame brackets abutting opposite ends of the cylinder heads and having lateral extensions to provide a support, through bolts on the outside of the cylinder connecting the frame brackets and operating to hold the cylinder and the two heads and the two frame brackets as one stationary device.

2. In a pump, the combination of a cylinder, a pair of cylinder heads therefor, a pair of brackets on the outer side of the heads, through bolts tightening the two brackets against the heads and the heads against the cylinder, one of said brackets being flanged at its lower end to provide a supporting foot for the pump, a piston within the cylinder having an operating rod extending through one of the heads into position above said foot, and manual operating means for the rod mounted on said foot.

3. In a pump, the combination of a cylinder, a pair of heads extending into the interior of the cylinder and having flanges engaging the ends of the cylinder, through bolts on the outside of the cylinder adapted to force the heads toward each other, a piston within the cylinder having a rod slidable in one of the heads, said head having packings engaging the interior of the cylinder and the exterior of said piston rod.

4. In a pump, the combination of a cylinder having cylinder heads, a piston therein having a tubular portion extending slidably into one of the heads into communication with a supply conduit carried thereby, said piston having a pair of opposed radial chambers within it, each communicating by a port at the bottom of the chamber with the interior of said tubular portion, there being a port leading from one chamber to the space on one side of the piston and a port leading from the other chamber to the space on the other side of the piston, a ball valve in each radial chamber adapted to seat over the port connecting that chamber with the tubular member, a

compression spring in each radial chamber bearing against the exterior of the ball valve, and an abutment member in each radial chamber forming an abutment for the outer end of the spring, valve-controlled discharge passageways from the opposite ends of the cylinder, and means for reciprocating the piston.

5. In a pump, the combination of a cylinder, a piston in the cylinder having a pair of chambers spaced longitudinally of the piston extending outwardly to the periphery of the piston, a packing carried by the piston between said chambers, one of said chambers communicating with the space in the cylinder on one side of the piston and the other with the space from the cylinder on the other side of the piston, a tubular member leading from the piston passing through one of the cylinder heads and in communication with a supply pipe, there being ports within the piston from the respective chambers to said tubular member, each port being normally closed by a valve within the chamber, valve-controlled discharge passageways leading from the opposite ends of the cylinder, and means for reciprocating the piston.

6. In a pump, the combination of a cylinder having cylinder heads, a piston therein having a tubular portion extending slidably into one of the heads into communication with a supply conduit, said piston having a pair of upwardly extending chambers side by side longitudinally with the piston extending between them, a packing carried by the piston between said chambers each chamber communicating by a port with the interior of said tubular portion, each chamber terminating short of the cylinder wall and thus in open communication across the periphery of the piston with the cylinder space on that side of the piston, a valve in each chamber, valve-controlled discharge passageways from the opposite ends of the cylinder, and means for reciprocating the piston.

7. In a pump, the combination of a cylinder, a pair of heads extending into the interior of the cylinder and having flanges engaging the ends of the cylinder, means passing through the flanges to hold the heads in position, a piston within the cylinder having a rod slidable in one of the heads, said head having packings engaging the interior of the cylinder and the exterior of said piston rod.

8. In a pump, the combination of a cylinder, a pair of heads extending into the interior of the cylinder and having flanges engaging the ends of the cylinder, a piston within the cylinder having a pair of oppositely extending rods slidable in the respective heads, operating means engaging one of the rods, the other rod being tubular and a suction chamber in the head that rod occupies adapted to supply fluid to the tubular rod, there being passageways in the piston from the tubular rod to the opposite sides of the piston respectively, and valves within the piston controlling said passageways, each cylinder head having packings engaging the interior of the cylinder and the exterior of the corresponding piston rod.

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