

July 13, 1965

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3,194,446

PISTON PUMP

Filed Oct. 11, 1963

2 Sheets-Sheet 1

FIG. 1.

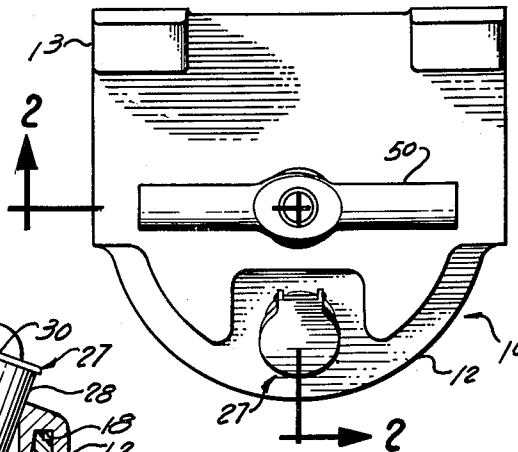


FIG. 2

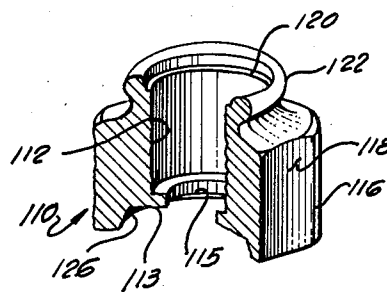
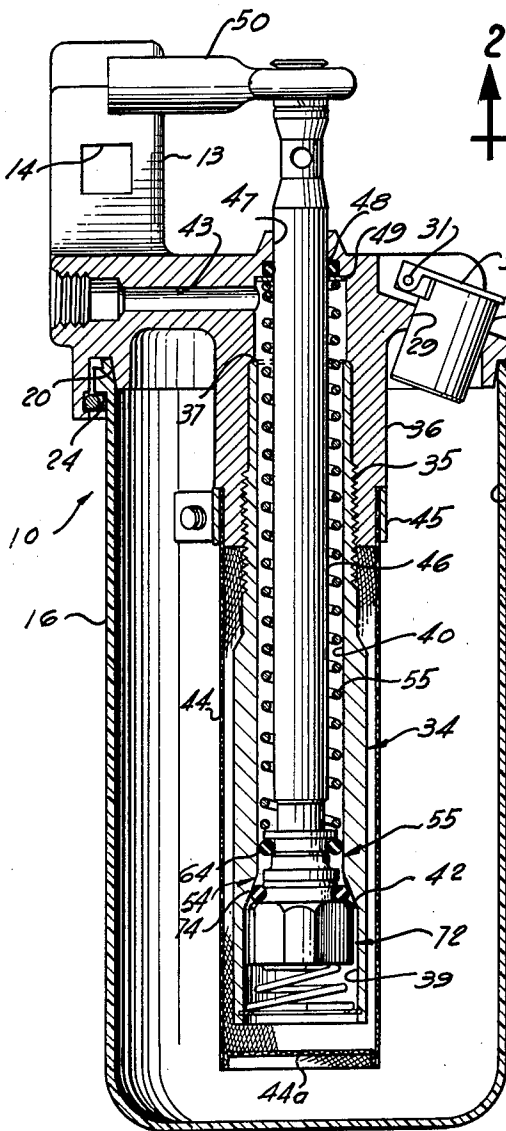


FIG. 5.

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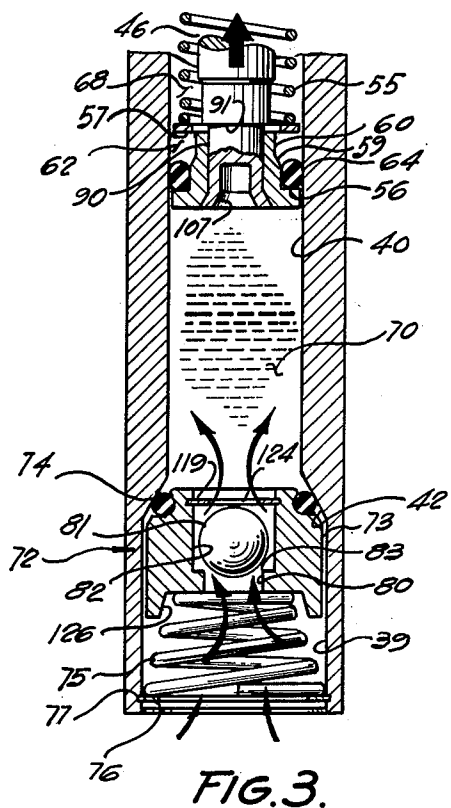


FIG. 3.

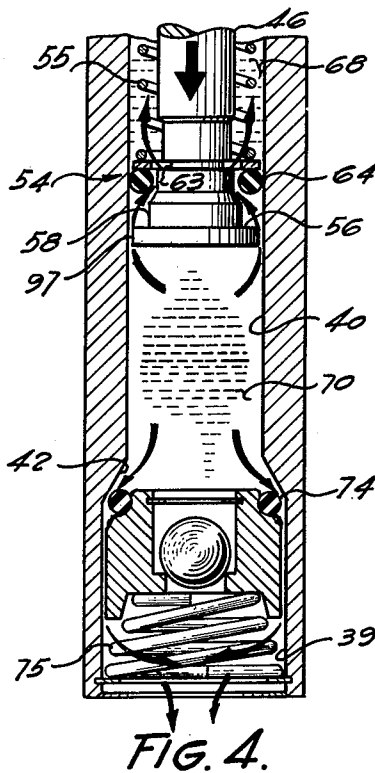


FIG. 4.

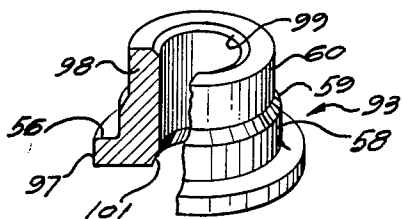


FIG. 6.

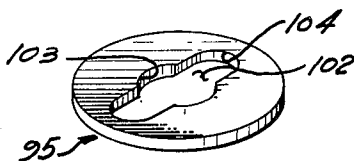


FIG. 7

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3,194,446

PISTON PUMP

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This invention relates to a piston-type pump, and more particularly, to a hand operated piston-type pump.

A piston-type pump includes a piston received in a bore and defining therein an expandable fluid pumping chamber. Reciprocation of the piston changes the volume of the pumping chamber to affect a priming stroke for charging the pumping chamber with the fluid, and a pumping stroke for discharging the fluid from the pumping chamber. Means such as check valves or the like regulate the fluid in its passage to and from the pumping chamber. Generally, the pump piston is always seated against its confining chamber wall for both the priming and pumping strokes.

An object of this invention is to provide a piston-type pump having a piston adapted to cooperate with the chamber wall in an improved manner to define the pumping chamber of the pump and to act as the fluid inlet check for fluid to the pumping chamber.

Another object of this invention is to provide in the pump a fluid check assembly located upstream of the cooperation of the pump piston with the chamber wall operable as an overpressure relief valve.

Another object of this invention is to provide a pump in which the pump piston cooperates in sealed relationship with the chamber wall only for the pumping stroke to define downstream thereof the pumping chamber and which otherwise permits fluid to pass from a priming chamber upstream thereof to the pumping chamber, and in which a fluid pressure check valve from the priming chamber operates as an overpressure relief valve on the priming stroke of the pump piston.

In order that these and other objects can be more fully appreciated, reference is herein made to the accompanying drawings, wherein:

FIG. 1 is a top plan view of a hand operated piston pump incorporating the preferred embodiment of the subject invention;

FIG. 2 is a sectional view as seen generally from line 2-2 of FIG. 1;

FIGS. 3 and 4 are enlarged sectional views of the lower portion of the pump as shown in FIG. 2, except with the components being in different operating positions corresponding, respectively, to the pumping and priming strokes; and

FIGS. 5, 6 and 7 are perspective views, FIGS. 5 and 6 each also being partly broken away and in section, of various parts used in the construction of the subject invention.

FIGS. 1 and 2 show a typical housing 10 for a hand pump within which the subject invention will be disclosed. The housing 10 includes a cover or mounting plate 12 having spaced mounting lugs 13 which are adapted to be secured to some appropriate structure (not shown) for support of the housing. Bolt holes 14 are provided in the lugs 13 for receipt of securing bolts (not shown) for this purpose. Bowl 16 is connected to the cover plate 12 within an annular recess 18 presented in the lower side of the cover plate. The connection between the bowl 16 and plate 12 is generally fluid-tight by providing a slight taper 20 on the inner well of the recess 18 against which the upper end of the bowl 16 seats. A snap ring 22 received within groove 23 on the outer wall of the recess 18 abuts rim 24 presented on the upper end of the bowl 16

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to maintain the bowl seated against the taper 20. The cover plate 12 and bowl 16 thus define together a closed reservoir 26 for holding the fluid to be pumped. An inlet 27 for the fluid is formed in the plate 12 and includes a tube 28 pressed into receiving opening 29 and having at its upper end a spring closed cap 30 pivoted to the tube 28 as at pin 31.

A pump cylinder 34 is secured to the cover plate 12 at the threaded connection 35 in annular wall 36 of the top plate. A tapered metal-to-metal seal 37 insures a fluid-tight connection between the top plate 12 and the cylinder 34. The cylinder 34 is hollow along its length and defines therein spaced concentric bores 39 and 40 separated by a tapered shoulder 42 diverging toward the open lower inlet end of the cylinder. Transverse bores 43 (only one being shown) in the top plate 12 communicate with the open upper end of the cylinder 34 and are threaded to provide for ready connection to an exterior fluid line or the like (not shown). A cylindrical filter screen 44 is secured by means of bracket 45 to the wall 36 of the top plate 12 in spaced adjacent relation to the cylinder 34. The screen also having a closed bottom 44a completely encloses the cylinder 34 so as to filter out foreign matter in the fluid in passing from the reservoir 26 to the open lower inlet end of the cylinder 34.

A stem 46 extends through opening 47 in the top plate 12 to within and the length of the bore 40 in the cylinder 34. O-ring 48 confined by washer 49 in an annular groove within the top plate 12 seals the stem 46 against leakage of fluid to the exterior of the pump. A handle 50 secured to the top of the stem 46 provides easy means by which an operator may manipulate the stem within the cylinder 34. A piston assembly 54 secured to the lower end of the stem 46 is adapted to reciprocate within the bore 40. Compression spring 55 interposed between the piston assembly 54 and the washer 49 biases the stem 46 and the piston assembly in a downward stroke as seen in FIGS. 2-4.

The piston assembly 54 includes axially spaced transverse shoulder surfaces 56 and 57 interconnected by axial guide surfaces 58, 59 and 60 to define an annular recess 62 open toward the periphery of the bore 40. The axial guide surfaces 58 and 60 are disposed generally parallel to the periphery of the bore 40 and are interconnected by tapered guide surface 59 converging in the direction away from the lower surface 56. The transverse surface 57 has openings 63 which provide for fluid communication between the volumes generally defined above and below the piston assembly within the bore 40.

An O-ring 64 fits within the recess 62 confined by the various surfaces 56-60 and is adapted to move relative to the surfaces upon various movements of the piston assembly 54 and stem 46 within the bore 40. The axial guide surface 58 is at such a distance from the periphery of the bore 40 so as to engage the O-ring 64 when the O-ring is positioned adjacent thereto, as can be seen in FIG. 3, operable to establish a seal between the piston assembly and the periphery of the bore 40. However, when the O-ring 64 is in the position adjacent the axial guide surface 57, as shown in FIGS. 2 and 4, the fluid is permitted to flow past the O-ring 64 through the openings 63.

The volume 68 above the piston assembly 54 between the stem 46 and the periphery of the bore 40 is the pumping chamber of the pump disclosed herein. Thus, upon upward movement of the stem 46 and piston assembly 54 within the bore 40 (FIG. 3) the fluid confined in the pumping chamber 68 is conveyed through one or both of the bores 43 to form the outlet of the pump. On the other hand, a downward stroke of the stem 46 and piston assembly 54 (FIG. 4) causes the fluid in the priming

chamber 70 below the piston assembly 54 to unseat the O-ring 64 and flow to the pumping chamber 63 above the piston assembly 54. As thus far described, the piston assembly 54 including the seatable O-ring 64 produces a pump having a pressure output which on the upstroke of the stem 46 is limited only by the blowby pressure of O-ring 64 and which on the downstroke of the stem is virtually bled past the unseated O-ring.

A check assembly 72 is positioned within bore 39 of the cylinder 34 adapted both to provide an inlet check for fluid passage to the priming chamber 70 and an over-charge by-pass check of fluid from the priming chamber, as required upon reciprocation of the stem 46 and piston assembly 54 within the bore 40. The check assembly 72 includes a frame 73 positioned loosely within the bore 39 and having an O-ring 74 adapted to seat on the tapered shoulder 42 between the bores 39 and 40. Spring 75 confined by spring retainer washer 76 in annular groove 77 on the cylinder 34 biases the O-ring 74 against the tapered shoulder 42. The frame 73 also includes an inlet check 80 formed by ball 81 confined movably within a limited size cavity 82 and adapted to seat against an inlet check surface 83.

The pump operates typically in the following manner. The reservoir 26 is filled with the fluid to be pumped through the inlet 27 in the top plate 12. The fluid thus bears against the underside of the inlet check 80. Upon an upward stroke of the stem 46 and piston assembly 54 (FIG. 3) the O-ring 64 on the piston assembly seals the periphery of the bore 40 and the piston assembly to reduce fluid pressure in the priming chamber 70 to draw fluid from the reservoir 26 past the unseated inlet check 80 into the priming chamber. The spring 75 maintains the O-ring 74 seated against the tapered shoulder 42 defining the lower limit of the priming chamber 70.

Upon a downward stroke of the stem 46 and piston assembly 54 (FIG. 4) the fluid confined as a column within the priming chamber 70 above the check assembly 72 unseats the O-ring 64 from the piston assembly 54 and flows past the piston assembly into the pumping chamber 63. However, since the pumping chamber 63 is much smaller in area than the priming chamber 70 only a portion of the fluid in the priming chamber is accepted into the pumping chamber. The excess fluid is discharged from the priming chamber 70 past the check assembly 72 back to the reservoir 26. This is accomplished upon creating a fluid pressure in the priming chamber 70 in excess of the holding capacity of the spring 75, thereby unseating the O-ring 74 from the tapered shoulder 42.

A subsequent upward stroke of the stem 46 and piston assembly 54 thus causes the O-ring 64 to seat against the piston assembly and chamber wall to pump the fluid trapped in the pumping chamber 63 from the outlet bores 43 and simultaneously to prime the priming chamber 70 as previously noted.

The check assembly 72 operates to maintain the priming chamber 70 filled regardless of the level of the fluid in the reservoir 26. For example, if the level of the fluid in the reservoir were too low once the O-ring 64 on the piston assembly 54 unseats, the column of fluid within the pumping and priming chambers could drain to the reservoir. The check assembly 72 also regulates the minimum fluid pressure on the outlet side of the pump as determined by the pressure capacity of the check assembly 72.

It will be appreciated that with this system a high pressure fluid outlet is possible almost instantaneously since the outlet side of the system is confined continuously with the fluid to be pumped. Furthermore, since the pump as shown is hand-operated on the pumping stroke the rate of increase of pressure and discharge from the system is dependent merely on the force exerted by the operator. The piston assembly and stem on the re-

turn priming stroke merely sink, as it were, into the column of fluid in the priming chamber 70 under the bias of the spring 55 and against the pressure resistance of check assembly 72.

Specific details of construction of the unit will now be discussed. It will be noted that the lower end of the stem 46 at the piston assembly 54 has a cylindrical shank 90 (FIG. 3) projecting from an annular shoulder 91. The piston assembly 54 itself is comprised structurally of guide member 93 (FIG. 6) and retainer member 95 (FIG. 7). The guide member 93 is annular having a planar ring 97 and a stepped and tapered cylindrical shank 98 projecting therefrom and defining bore 99. The end of the bore 99 adjacent the ring 97 is tapered at 101 and diverges away from the shank 98. The retainer 95 is annular and planar, and has a cross slot 102 formed therein. The slot 102 has a cylindrical portion 103 to receive snugly the shank 90, and elongated portions 104 larger than shoulder 91 to define the fluid openings 63 previously noted.

The guide member 93 and ring member 95 are received on the shank 90 of the stem 46 in abutting relationship. The shank 90 is hollowed out as at 107 (FIG. 3) to permit flaring of the end portion against the taper 101 of the guide member 93. This fixes the guide and ring members against the shoulder 91 of the stem and also acts to seal the guide member to the stem. The lower surface 56 of the recess 62 is defined on the ring 97 of the guide member 93 while the upper surface 57 is defined on the ring member 95. The shank 98 of the guide member 93 provides the axial guide surfaces 58, 59 and 60, previously mentioned.

The frame 73 of the check assembly 72 is composed of a valve member 110 (FIG. 5). The valve member 110 is annular having a bore 112 to ledge 113 and a central opening 115 through the ledge defining the valve seat 83. The base 116 of the member 110 is almost as large as bore 39, but it has flats 118 formed on the periphery thereof so as to provide by-pass of fluid when assembled in the bore. In operation the check ball 81 fits within the bore 112 of the valve member 110 and abuts the ledge 113 or valve seat 83 mentioned above. An internal toothed washer 119 (FIGS. 3 and 4) is positioned against shoulder 120 at the opposite end of the bore 112 and the lip 122 is staked over to secure the washer in place. The uneven center opening 124 of the washer 119 retains the check ball 81 in place within the defined cavity 82, and further provides adequate passage means past the ball for the fluid on the inlet stroke to the pump. The O-ring 74 is secured to the frame 73 between the enlarged lip 122 of the valve member and the base 116. The underside of the valve member 110 is counter-sunk at 126 to the ledge 113 and acts as a valve seat for the biasing spring 75.

While only a single embodiment of the subject invention has been disclosed it will be apparent that many modifications can be made therein without departing from the inventive scope of this disclosure. Accordingly, it is desired that the invention be limited only by the scope of the claims hereinafter following.

What is claimed is:

1. A pump, comprising a pump cylinder, a pump stem extending axially within the pump cylinder, a piston assembly secured and sealed to the pump stem, said piston assembly being operable in one position to be sealed across to the periphery of the cylinder to define between the cylinder and the pump stem an expansible fluid pumping chamber and being operable in a second position to be unsealed across to the periphery of the cylinder to permit priming flow of the fluid past the piston assembly to the pumping chamber, outlet means for the fluid from the pumping chamber, a check assembly for the pump cylinder adapted to define within the pump cylinder a priming chamber on the opposite side of the piston assembly from that of the pumping chamber, said check

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assembly being spring biased closed operable to maintain by means of the spring bias the priming chamber pressure confined up to a predetermined fluid pressure and thereafter to permit fluid by-pass from the priming chamber whereby said piston is adapted to be returned to a predetermined position irrespective of the length of travel of said piston in said pumping chamber in delivering said total volume of fluid and the difference in unit volume between said pumping and priming chambers, said check assembly also having therein an inlet check operable to admit fluid from a fluid source to the priming chamber for filling said priming chamber in response to the movement of said piston assembly for pumping said fluid past said outlet means, and means on the stem to reciprocate the pump stem and piston assembly in the pump cylinder.

2. A pump, comprising the combination of a reservoir for confining a fluid to be pumped, a pump cylinder disposed within the reservoir, a pump stem extending axially within the pump cylinder, a piston assembly in the pump cylinder, said piston assembly being sealed and secured to the pump stem and including axially spaced transverse surfaces adjacent the periphery of the pump cylinder interconnected by an axially extending guide surface to define an annular recess open toward the periphery of the pump cylinder, an O-ring disposed in the recess, said O-ring being movable in the recess to a first position adjacent one transverse surface whereat the O-ring forms a seal between the periphery of the cylinder and the piston assembly to define a fluid pumping chamber within the pump cylinder on the side of the O-ring toward the other transverse surface and to a second position adjacent the other transverse surface whereat the O-ring is unseated across the periphery of the cylinder and the piston assembly to permit flow of fluid past the piston assembly to the pumping chamber, outlet means from the pumping chamber downstream from the piston assembly through which only a limited volume of fluid is adapted to pass whereby travel of said piston assembly is terminated when a corresponding limited volume is dispensed through said outlet means and irrespective of the total volume of fluid available in said pumping chamber, inlet check means for the pump cylinder adjacent the bottom of the reservoir and upstream from the piston assembly defining a priming chamber within the pump cylinder upstream of the piston assembly and adapted to be open only when said piston assembly is dispensing said limited volume for filling said priming chamber with a volume of fluid greater than said dispensed volume, by-pass check means from the priming chamber, said by-pass check means being adapted to be unseated only upon the piston assembly being unseated from the periphery of the cylinder and upon the fluid confined in the priming chamber exceeding a predetermined fluid pressure whereby said piston assembly is enabled to be returned to an initial starting position irrespective of the inability of said pumping chamber to receive all of the fluid in said priming chamber, and means to reciprocate the pump stem and the piston assembly within the pump cylinder.

3. A pump, comprising the combination of a pump cylinder open at one end, a pump stem extending axially within the pump cylinder and through an opening in the otherwise closed opposite end, a piston assembly within the pump cylinder secured and sealed to the pump stem, seal means on the piston assembly operable in a first position to seal the periphery of the pump cylinder with the piston assembly to define a fluid pumping chamber within the pump cylinder on the stem side of the seal means and being operable in a second position to be unseated from the periphery of the cylinder to permit flow of fluid from the opposite side of the piston assembly to the pumping chamber to prime the latter, outlet means for the pumping chamber downstream from the piston

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assembly through which only a predetermined volume of said fluid is adapted to pass whereby travel of said piston assembly is terminated in response to the passage of said predetermined volume irrespective of the total volume available in said pumping chamber, check means for the open end of the pump cylinder operable to define a priming chamber within the pump cylinder upstream of the piston assembly on the opposite side of the seal means than said pumping chamber, said check means including an inlet check between a source of fluid and the priming chamber operable to admit fluid to the latter on the pumping stroke of the pumping chamber in a volume greater than said predetermined volume, said check means also including an outlet check from the priming chamber spring biased closed and operable to confine fluid within the priming chamber only to a given fluid pressure and thereafter to by-pass the fluid on the priming stroke of the pumping chamber whereby said piston is adapted to return to a predetermined position irrespective of the length of travel of said piston in dispensing said predetermined volume of fluid and the greater volume of fluid in said priming chamber, and means to reciprocate the pump stem and piston assembly within the cylinder.

4. A pump having a piston adapted to be moved in one direction for delivering fluid through an outlet port whereafter movement of said piston is terminated in response to the pressure developed in said delivered fluid, the improvement comprising a cylinder of substantially uniform bore through which said piston is adapted to be reciprocated, valve means carried by said piston and operable for delivering fluid on one side of said piston in said cylinder through said outlet port in response to movement of said piston in said one direction and operable to permit the passage of fluid from the other side of said piston to said one side in response to movement of said piston in the other direction, a stem connected to one side of said piston for enabling movement of said piston in said one direction but rendering the unit volume of said cylinder on said one side of said piston communicating with said outlet port smaller than the unit volume adjacent the opposite side of said piston, check valve means adapted to be opened for admitting a greater volume of fluid into said cylinder adjacent the opposite side of said piston than the volume of fluid delivered through said outlet port in response to movement of said piston in said one direction and thereafter adapted to be closed, and means for operating said check valve means in another direction in response to movement of said piston in said other direction for discharging fluid from said cylinder whereby said piston is adapted to be returned to a predetermined position despite the greater volume of fluid adjacent said other side of said piston.

5. In a pump as claimed in claim 4, a spring adapted to move said piston in said other direction with the spring constant of said spring being greater than the force normally preventing said check valve means from discharging said fluid from said cylinder.

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