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[54] **DOUBLE ACTING PUMP**
10 Claims, 6 Drawing Figs.

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F16k 15/04, F16k 21/04

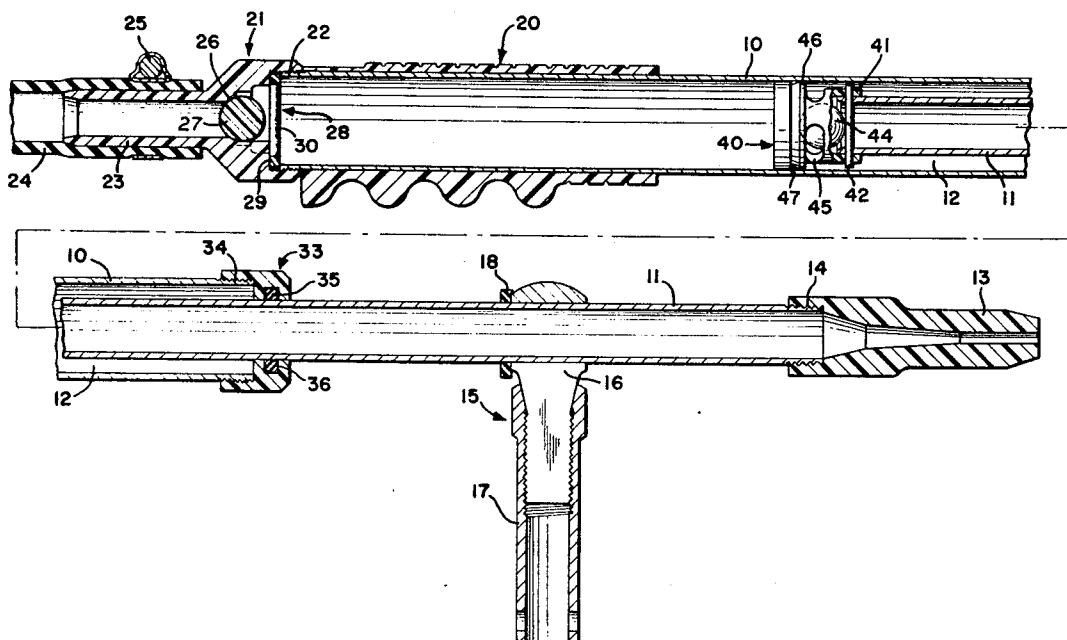
[50] Field of Search 417/554,
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ABSTRACT: In a double-acting hand pump in which a hollow plunger reciprocates within a hollow barrel and defines with it an annular space between them, a series of valves and seals are provided which permit fluid to be drawn into the barrel and expressed from the annular space outwardly through the plunger upon extension of the plunger and drawn into the annular space and expressed out of the barrel through the plunger when the plunger is retracted. The valves and seals are designed such that, although the required fluidtight engagement of the various components is obtained, the frictional forces generated by this engagement are relatively low so that the pump may be manually operated without undue physical exertion.



DOUBLE ACTING PUMP

BACKGROUND OF THE INVENTION

The advantages of a double-acting pump, that is, one which ejects fluid on both strokes of the pumping mechanism, have long been recognized and various designs have been proposed for obtaining this action. The U.S. Pat. to Raymond, No. 199,380, for example, shows a double-acting pump in which a hollow plunger and barrel are mounted in a hollow casing with three valves and a series of seals positioned between these components to permit fluid to be ejected from the pump on the retraction as well as the extension stroke. In a pump of this type, however, it will be seen that, in addition to the relatively large number of moving parts required, which present several possible sources of malfunction, the packing glands and seals are of the type which, in order to operate efficiently, must exert high frictional forces, necessitating commensurately great physical exertion in order to operate the pump.

SUMMARY OF THE INVENTION

A pump constructed in accordance with the present invention provides an easily portable, manually operable, double-acting pump which may be operated with relatively low physical exertion.

Additionally, the various valves and seals of the pump of the present invention are designed such that they are relatively maintenance free.

It will be further noted that if, however, replacement of any of the components of the pump becomes necessary, the pump may be readily disassembled and only the particular malfunctioning component replaced.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view of a pump constructed in accordance with the present invention;

FIG. 2 is a partial cross-sectional view showing a combination valve assembly and seal forming part of the present invention;

FIG. 3 is a view similar to FIG. 2 showing a second preferred embodiment of combination valve assembly and seal;

FIG. 4 is a view taken on line 4-4 of FIG. 3;

FIG. 5 is an enlarged view of a portion of the pump of FIG. 1 showing the inlet end thereof; and

FIG. 6 is an enlarged cross-sectional view showing a modified form of sealing ring.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As seen in FIG. 1 of the drawings, a pump according to the present invention includes an elongated hollow barrel 10 having an elongated hollow plunger 11 slidably received therein with the outer surface of the plunger 11 defining with the inner surface of the barrel 10 an annular space 12. The outer end of the plunger 11 terminates in a nozzle 13 attached to the plunger by means of a threaded connection, as at 14. Intermediate its ends the plunger 11 is also provided with a handle 15 which may include an upper split section 16 encircling the plunger 11 and threadedly received in a lower socket portion 17, while a resilient bumper washer 18 encircles the plunger 11 adjacent the handle 15.

The barrel 10 is provided with a handgrip 20 and an inlet valve housing 21. Valve housing 21 may be screw-threaded on the inlet end of the barrel, as at 22, and provided with a reduced portion forming a nipple 23 which is received in a hose 24 clamped to the nipple by means of a conventional close clamp 25. The hose 24, of course, will lead to a source of the fluid which it is desired to pump. Within the housing 21, a valve seat 26 is formed which is complementary to a ball valve 27. Also positioned within the housing 21 is a screen 28, including a supporting ring 29 and screening 30, with the support ring clamped between the inlet end of the barrel 10 and a shoulder 31 formed within the housing 21. It will also be noted from FIG. 5 of the drawings, that a series of rod members 32

extend longitudinally of the housing and project inwardly thereof to restrain lateral movement of the ball 27 and provide a cage therefor.

Mounted on the end of the barrel opposite its inlet end, is a collar 33 which may be threaded on the barrel as at 34 with a portion thereof extending outwardly of the barrel end in overlying relationship to the plunger 11. In the portion of the collar which overlies the plunger, a groove 35 is formed receiving a sealing ring 36 which bears against the plunger in sealing relationship thereto.

With reference to FIGS. 1 and 2 of the drawings it will be seen that the plunger 11, adjacent its inlet end, is provided with a combination valve assembly and seal 40. Member 40 includes a valve housing 41 which receives the inlet end of the plunger 11 and is secured thereto by means of a pin 42 passing diametrically through the housing 41 and the inlet end of the plunger. A portion of the inner surface of the housing 41 is relieved to form a valve seat 43 spaced from the inlet end of the plunger 11 and engageable by a valve ball 44 mounted in opposition thereto. A series of openings 45 are formed in the valve housing 41 intermediate the valve seat 43 and the inlet end of the plunger 11 to provide communication between the annular space 12 and the interior of the housing.

It will also be seen from FIG. 2 that a flange 46 is formed on the exterior of the housing in spaced relationship to the inlet end of the plunger 11 to provide a sliding seal between the housing and the interior of the barrel 10. The flange 46 may be conveniently formed by relieving the exterior of the housing by means of a first annular groove 47 and a second annular groove 48 which extends inwardly of the housing at an acute angle to the longitudinal axis thereof. Additionally, longitudinally extending rod members 49, similar to rod members 32, may be provided for restraining the valve ball 44 against lateral movement.

Turning now to FIG. 3 of the drawings, a second preferred embodiment of the combination valve assembly and seal will be described. As seen in FIGS. 3 and 4, the combination valve assembly and seal 50 may include a valve housing 51 receiving the inlet end of the plunger 11 and secured thereto by means of a pin 52 passing diametrically through the valve housing and the plunger. A valve seat 53 is formed within the housing 51 and is engageable by the valve ball 54 mounted in opposition thereto. Similarly to the embodiment of FIG. 2, a series of openings 55 are formed in the housing 51 intermediate the valve seat 53 and the inlet end of the plunger 11 to provide continuous communication between the annular space 12 and the interior of the valve housing. In the exterior surface of the housing 51, spaced from the inlet end of the plunger 11, one or more grooves 56 are formed, two being shown for purposes of illustration. In each of the grooves 56 a resilient split ring 57 is positioned with the outer surface of each ring in sliding contact with the inner surface of the barrel 10. It will also be seen that rod members 58 are provided extending longitudinally of the housing and restraining the valve ball 54 against lateral movement.

Turning now to FIG. 6 of the drawings, a second preferred embodiment of the collar forming the seal between the outer end of the barrel 10 and the outer surface of the plunger 11 will be described. As seen in FIG. 6, the collar 60 is similar to the collar 33 in that it encircles the outer end of the barrel 10 with a portion of the collar overlying the surface of the plunger 11. Additionally, the overlying portion of the collar is provided with a groove 61 receiving a sealing ring 62 which makes sliding contact with the exterior surface of the barrel. However, whereas the collar 33 was attached to the barrel 10 by means of threads, the collar 60 is provided with an annular bead 63 engageable in a complementary annular groove 64 formed in the outer end of the barrel 10. With this type of construction servicing of the pump is facilitated, since the collar 60 may be simply snapped into or out of place on the end of the barrel rather than threaded thereon. It should also be noted that although housing 21, FIG. 5 of the drawings, is shown as threaded onto the barrel 10, it may, similarly to col-

lar 60, be provided with an annular bead receivable in a complementary groove formed in the barrel.

Regardless of the particular embodiment of combination valve assembly and seal and collar utilized, however, in operation it will be seen that with the plunger fully extended and the barrel filled with fluid, retraction of the plunger 11 into the barrel 10 will cause the valve ball 27 to seat firmly against the seat 26 and effectively seal off the inlet end of the barrel. In this regard, it will be noted that the rod members 32 form a cage for the ball and prevent it from becoming lodged in unseated condition. At the same time the valve ball 44 or 54 is unseated from its seat 43 or 53, respectively, by the pressure within the barrel 10, allowing fluid within the barrel to simultaneously pass outwardly through the plunger and its nozzle 13 and through the openings 45 or 55 into the annular space 12 formed between the plunger and the barrel. The pin 42 or 52, in addition to securing the valve housing to the inlet end of the plunger 11, serves as a stop for limiting movement of the ball away from its seat.

When the plunger 11 has been fully retracted within the barrel 10, it will be seen that both the annular space 12 and the interior of the plunger 11 are now filled with the fluid. Subsequently, upon extension of the plunger 11, the fluid trapped within the annular space 12 flows therefrom into the valve housing through the openings 45 or 55. Since extension of plunger 11 causes valve ball 44 or 54 to seat against its respective valve seat, fluid entering the housing can only pass outwardly through the plunger and its nozzle 13. At the same time pressure generated within the barrel 10 causes the valve ball 27 to become unseated, allowing fluid to be drawn into the barrel through the inlet end of the barrel thereof. In this regard, the screen 28 serves to not only filter the fluid passing into the interior of the pump but also as a stop for limiting movement of the valve ball 27 in a direction away from its seat 26.

Thus, it will be seen that upon both the extension and retraction strokes of the plunger 11 liquid is expressed through the nozzle 13 of the pump. In this regard, it should be noted that in order to prevent excessive pulsating of the jet ejected from the pump, the components thereof may be advantageously dimensioned such that the volume displaced from the interior of the barrel when the plunger is retracted is approximately equal to the volume of the annular space 12 when the plunger is in the retracted position.

It will also be seen that while the valves and seals of the present invention effectively engage their opposite components to permit efficient operation of the pump, the seals are not wedged against the pump components in a manner such as to create high frictional forces requiring undue physical exertion to operate the pump.

Additionally, the pump of the present invention readily lends itself to fabrication utilizing conventional materials and construction techniques. For example, the barrel and plunger both may be constructed of a lightweight material, such as aluminum or plastic, while the nozzle, valve housing and handgrips may be formed of a conventional, durable plastic material. The pump, therefore, is lightweight and readily portable for manual operation.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention.

What I claim is:

1. In a double-acting pump including an elongated hollow barrel, an elongated hollow plunger slidably received in said barrel and defining with the inner surface thereof an annular space, a one-way check valve mounted at an inlet end of said barrel, and means forming a seal between an end of said barrel opposite said inlet end and the outer surface of said plunger, a

combination valve assembly and seal mounted on an inlet end of said plunger comprising:

- a. a hollow valve housing receiving said plunger inlet end therein,
- b. means mounted on said housing in spaced relationship to said plunger inlet end providing sealing engagement with said inner surface of said barrel,
- c. a valve seat in said housing spaced from said plunger inner end,
- d. means providing fluid communication between the interior of said housing and said annular space,
- e. a valve member contained within said housing in opposition to and engageable with said seat, and
- f. means for limiting movement of said valve member in a direction away from said seat.

2. The apparatus of claim 1 wherein said means providing sealing engagement with said inner surface of said barrel comprises:

- a. an annular flange formed integrally with said valve housing and extending outwardly thereof.

3. The apparatus of claim 2 wherein:

- a. said flange is defined by a pair of spaced annular grooves formed in said housing,
- b. one of said grooves extending inwardly of said housing at an acute angle to the longitudinal axis thereof.

4. The apparatus of claim 1 wherein said means providing sealing engagement with said inner surface of said barrel comprises:

- a. means defining an annular groove in said housing, and
- b. a resilient split ring received in said groove and extending outwardly thereof in engagement with said inner surface of said barrel.

5. The apparatus of claim 4 wherein:

- a. a plurality of grooves are provided in said housing, and
- b. a plurality of split rings are mounted in said grooves.

6. The apparatus of claim 1 wherein:

- a. said valve movement limiting means comprises a pin passing diametrically through said housing and said inlet end of said plunger.

7. The apparatus of claim 1 wherein said means forming a seal between said opposite end of said barrel and said outer surface of said plunger comprises:

- a. a collar mounted on said barrel opposite end in encircling relationship thereto,
- b. a portion of said collar extending outwardly of said barrel opposite end in overlying relationship to said plunger outer surface,
- c. means defining an annular groove in the interior surface of said portion of said collar, and
- d. a resilient ring received in said groove and engaging said plunger outer surface.

8. The apparatus of claim 1 wherein said one-way check valve comprises:

- a. a valve seat,
- b. a screen extending across said inlet end of said barrel in spaced relationship to said valve seat,
- c. a valve ball positioned intermediate said valve seat and said screen, and
- d. a plurality of rod members extending in spaced parallel relationship from said valve seat to said screen to define a valve ball cage.

9. The apparatus of claim 1 further comprising:

- a. means for maintaining said valve member in spaced relationship to the interior wall of said housing.

10. The apparatus of claim 9 wherein:

- a. said valve member is a valve ball, and
- b. said spacing means includes a plurality of rod members positioned in said housing and extending longitudinally thereof.