The present invention relates to fluid transfer apparatus and more particularly to fluid transfer apparatus which is adapted to effect a positive seal with containers or the like during the emptying or filling thereof with fluid.

The fluid transfer apparatus of the present invention is particularly suited for the filling of soft water service units. These units are commonly leased to the public and must be replenished periodically by soft water service companies. This is generally done by disconnecting exhausted units, replacing them with fresh units, and hauling fluid to a central service headquarters for recharging. It will be apparent from the description and appended drawings wherein is illustrated a preferred form of the invention, and in which:

Fig. 1 is a front elevation view of the fluid transfer apparatus of the present invention;
Fig. 2 is a view along the lines 2—2, Fig. 1;
Fig. 3 is a view along the lines 3—3, Fig. 1;
Fig. 4 is a view along the lines 4—4, Fig. 1.

Referring to the drawings, the present fluid transfer apparatus, designated 11, comprises generally an outer sleeve 12, which is adapted to be threadedly connected to a filling means and reservoir (not shown); a fluid conduit or inner sleeve 13, which is slidably mounted within outer sleeve 12; a piston or valve assembly 14 which is slidably mounted partially within both of sleeves 12 and 13; and an actuator assembly 15 which effects movement of valve assembly 14 and consequently inner sleeve 13.

A container or tank 16 is also illustrated, being shown in phantom outline for a filling operation by apparatus 11. Tanks 16 may be arranged on a suitable conveyor line or the like, and the conveyor line operated intermittently to bring each tank 16 below the outlet of apparatus 13 for only so long as the filling operation may take. As will be seen, the semi-automatic operation of apparatus 11 promotes quick and efficient filling of tanks 16 from the usual reservoir of recharging or regenerating material.

Outer sleeve 12 is an open-ended cylinder which is provided with an integral inlet fitting 17 which is preferably internally threaded for convenient connection to the recharging reservoir (not shown). Fitting 17 embodies a central opening 18 providing fluid communication between the interior of outer sleeve 12 and the recharging reservoir. Transversely disposed in the cylindrical interior of sleeve 12 is a centrally bored wall 19 which serves to define one end of both a lower pressure chamber 22 and an upper pressure chamber 21, the other ends of chambers 21 and 22 being formed by portions of inner sleeve 13 and valve assembly 14, as will be seen. Wall 19, as best seen in Figs. 2 and 3, is provided with a fluid passage 23 and a fluid passage 24 whereby fluid may be urged through passage 23 to pressurize chamber 21 and through passage 24 to pressurize chamber 22.

Fluid passages 23 and 24 carry pressure fittings 25 and 26, respectively, which are disposed through suitable openings in the walls of outer sleeve 12. Usual pressure lines connect fittings 25 and 26 to actuator assembly 15 which serves through the operation of a handle 27 to distribute pressurized fluid, such as water, to either of chambers 21 and 22 while venting the other of such chambers. The construction of assembly 15 is very conventional and will in the interest of brevity not be described in any great detail other than to describe it as a typical four-way valve. It is provided with two supply lines 28 for supplying fluid to chambers 21 and 22, as described (only one line 28 being illustrated in Fig. 1), and is also provided with a single drain line 29 for venting fluid from that one of chambers 21 or 22 while the other of said chambers is being pressurized.

Outer sleeve 12 is provided with a lubrication fitting 31 which opens to the interfaces of sleeves 12 and 13 to reduce friction therebetween. A vegetable base oil, rather than a petroleum base oil, is preferably employed to avoid possible contamination of the soft water recharging material as it passes through apparatus 11.

Inner sleeve 13 is slidably within outer sleeve 12, and is limited in its upward travel or stroke by engagement of the lower edge of sleeve 12 and an outer peripheral shoulder 32 provided on sleeve 13. The vertical location of shoulder 32, on sleeve 13, is preferably made such that a chamber 22 always exists; that is, the volume of chamber 22 is preferably never completely occupied on an upward stroke of sleeve 13.

Fluid tight or sealed relationship between sleeves 12 and 13 is afforded by sealing rings or elements 33 which are located in suitable peripheral grooves in sleeve 13 for slidable engagement of sleeve 12. In addition, the lower end of sleeve 13 carries a resilient sealing element 34 which is made of some yieldable material such as rubber or the like. Element 34 serves to sealably engage the rim of the neck or opening of tank 16, and thereby prevents the escape of recharging material, element 34 being urged into sealing position by a downward stroke of sleeve 13.

Relative rotational movement between sleeves 12 and 13 is prevented by a guide element 30, Fig. 4, whose inner end is vertically slidable within a guide groove 35 provided in inner sleeve 13, and whose outer end is fixed to outer sleeve 12 by a screw 36 which is threadably secured to sleeve 12. The restraint against relative rotational movement is important to maintain opening 18 of sleeve 12 in alignment with an elongated opening 37 provided in the wall of sleeve 13, whereby there is always fluid communication between the recharging or regenerating reservoir and the interior of inner sleeve 13. It is noted that opening 37 is sufficiently elongated that
there may be fluid flow into sleeve 13 regardless of the vertical relationship between sleeves 12 and 13. Inner sleeve 13 is bored at each end to provide an upper peripheral shoulder 38, which serves to limit the downward stroke of valve assembly 14, and a lower peripheral shoulder 39 which serves to limit the upward stroke of assembly 14.

Valve assembly 14 is made in several sections for ease of assembly and disassembly and includes an intermediate piston 41, which is slidable within the upper portion of sleeve 13 and limited in its downward stroke by engagement with shoulder 39; an upper piston 42, which is slidable within the portion of sleeve 12 above wall 19; and a lower piston 43, which is houseable within the lower end of sleeve 13 and extensible below sleeve 13 to permit fluid to flow out of sleeve 13. Each of pistons 41, 42, and 43 is provided with a sealing ring or element 44 carried in a suitable peripheral groove for maintaining a fluid-tight slideable relationship.

Intermediate piston 41 is provided with an integral piston rod extending both upwardly and downwardly from piston 41, piston 42 being secured at the top of the piston rod by a nut 45 which urges piston 42 into fluid tight relationship with a shoulder (not shown) of the piston rod. The lower end of the piston rod threadably carries a lower piston rod 46 which is secured in position by a lock nut 47, and piston 43 is suitably carried, as by swaging or the like, to the lower end of rod 46. It is neither intended nor considered material that piston 43 is provided with a lip portion 48 which acts with shoulder 39 of sleeve 13 to limit upward travel by piston 43.

In operation, handle 27 of actuator assembly 15 is manipulated to direct pressurized water through fluid passage 23 and into pressure chamber 21, while at the same time venting water from chamber 22 through fluid passage 24. The pressure of the water in chamber 21 acts against the underside of piston 42, moving piston 42 to the upward position illustrated in Fig. 1. This movement of piston 42 is transmitted through the piston rods of valve assembly 14 to pistons 41 and 43, and pistons 41 and 43 accordingly assume corresponding upward positions. By reason of its engagement with inner sleeve 13 at 39 and 48, piston 43 also serves to urge inner sleeve 13 to its upward position. Next, a tank 16 to be recharged or regenerated is moved into position beneath a nut 45, the distance that it preferably arranged to be as small as practicable to reduce the length of stroke of sleeve 13 necessary to contact tank 16.

Handle 27 of actuator assembly 15 is then manipulated to direct pressurized water through passage 24 and into chamber 22, and vent pressurized water from chamber 21 through fluid passage 23. The relatively high water pressure within chamber 22 acts immediately to move inner sleeve 13 downwardly since the fluid pressure acting against piston 41 is ineffectual at this time to move piston 41 downwardly independently of sleeve 13 by reason of the necessity for fluid pressure to be first vented from chamber 21, i.e., the restriction 23 impedes the flow of water from chamber 21 and thus retards the downward movement of pistons 42, 41 and 43. Accordingly, sleeve 13 is urged downwardly, and, as fluid is vented from chamber 21, shoulder 39 of sleeve 13 and lip 48 of piston 43 act to effect carriage of piston 43 downwardly with sleeve 13 until sealing element 44 rests in sealing relationship upon the neck or rim of tank 16. The downward movement of sleeve 13 is thus halted, but fluid continuing to flow into chamber 22 causes continued downward movement of piston 43 and consequent opening of a fluid passage from the recharging conduit through inner sleeve 13, and into tank 16. The handle is then moved to neutral position, in which position water is trapped in chamber 22.

Recharging material under pressure passes into tank 16 until tank 16 is full. At this time handle 27 of actuator assembly 15 is manipulated to pressurize chamber 21 from the source of high water pressure and vent chamber 22. This urges piston 42, and consequently piston 43, upwardly independently of sleeve 13. Sleeve 13 maintains its sealing relationship with tank 16 until shoulder 39 and lip 48 act as a sleeve 13 upon full upward engagement by piston 43, i.e., the restriction 24 impedes the flow of water from chamber 22 and thus retards the upward movement of sleeve 13. Thus, even though the recharging material is under pressure within sleeve 13, the effect of this unique operation is to prevent leakage of such material by reason of the sealing of piston 43 within sleeve 13 prior to upward movement of sleeve 13.

The continuing flow of fluid into chamber 21 then urges the components of apparatus 11 back into the positions illustrated, ready for the next cycle of operation. The handle 15 is then moved to neutral position, in which position the water is trapped in chamber 21.

While certain preferred embodiments of the invention have been specifically disclosed, it is understood that the invention is not limited thereto as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims.

I claim:

1. A fluid transfer apparatus for transferring fluid between a fluid reservoir and a fluid receptacle, said apparatus comprising a fluid conduit for fluid transfer engagement with said fluid receptacle andengageable therewith to prevent fluid leakage; closure means adapted for movement independently of said fluid conduit and normally movable with said fluid conduit to prevent fluid transfer through said fluid conduit; a first pressure chamber, said first pressure chamber being responsive to pressure in said first pressure chamber to render said closure means operative; a second pressure chamber, said fluid conduit being responsive to pressure in said second pressure chamber to move said fluid transfer engagement, said coupling means being responsive to pressure in said second pressure chamber to render said closure means inoperative; said fluid conduit having a source of high pressure; said fluid conduit comprising an elongated outer cylinder having an internal, transversely disposed wall; an inner cylinder slideable within said outer cylinder and adapted to receive fluid for transfer; a first piston defining a first pressure chamber with said outer cylinder and said wall thereof; a second piston defining a second pressure chamber with said inner cylinder and said outer cylinder and said wall thereof, said inner cylinder being responsive to pressure in said second pressure chamber to move said fluid transfer engagement with said fluid receptacle; closure means operable to prevent fluid transfer through said inner cylinder; coupling means connecting said first piston, said second piston, and said closure means for common movement; means for pressurizing said first pressure chamber to move said first piston to render said closure means operative; and means for pressurizing said second pressure chamber to move said inner cylinder to fluid transfer engagement with said fluid receptacle and to move said second piston to render said closure means inoperative whereby fluid may be transferred to said fluid receptacle.

2. A fluid transfer apparatus for transferring fluid between a fluid reservoir and a fluid receptacle, said apparatus comprising said fluid conduit for fluid transfer engagement with said fluid receptacle and engageable therewith to prevent fluid leakage; closure means normally engageable by said fluid conduit for common movement therewith upon movement
of said fluid conduit toward said fluid receptacle, said closure means being effective to prevent fluid transfer through said fluid conduit upon engagement therewith, said fluid conduit being normally engageable by said closure means for common movement therewith upon movement of said closure means away from said fluid receptacle; a first means selectively actuable to move said fluid conduit toward said fluid receptacle and, upon engagement therebetween, move said closure means independently of said fluid conduit, out of engagement with said fluid conduit, and into said fluid receptacle whereby fluid transfer is permitted; and a second means selectively actuable during engagement between said fluid conduit and said fluid receptacle to move said closure means away from said fluid receptacle whereby fluid transfer is prevented and said fluid conduit is moved out of engagement with said fluid receptacle.

4. A fluid transfer apparatus for transferring fluid from a fluid reservoir to a fluid receptacle, said apparatus comprising: an elongated, open-ended outer cylinder having an internal transversely disposed wall provided with a central opening, said outer cylinder further having a transverse passage communicating with its interior below said transverse wall; sealing means carried at the lower end of said outer cylinder; an inner cylinder slidable within said outer cylinder and having a transverse passage communicating with its interior, said passage being arranged in substantially superposed relation with said passage of said outer cylinder for receiving fluid for transfer; means connected between said outer cylinder and said inner cylinder to prevent relative rotation therebetween; a first piston slidable in said outer cylinder above said wall; a second piston slidable in said inner cylinder intermediate said transverse passage thereof and said wall; closure means at the lower end of said inner cylinder and operative to prevent fluid transfer through said lower end; means slidable in said central opening and connecting together said first piston, said second piston, and said closure means for common movement; means for admitting fluid under pressure into said outer cylinder between said first piston and said transverse wall to move said first piston upwardly to operate said closure means; and means for admitting fluid under pressure into said outer cylinder between said transverse wall and said second piston to move said inner cylinder and said second piston downwardly to seat said sealing means against said fluid receptacle and render said closure means inoperative whereby fluid may be transferred to said fluid receptacle.

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