

Nov. 10, 1959

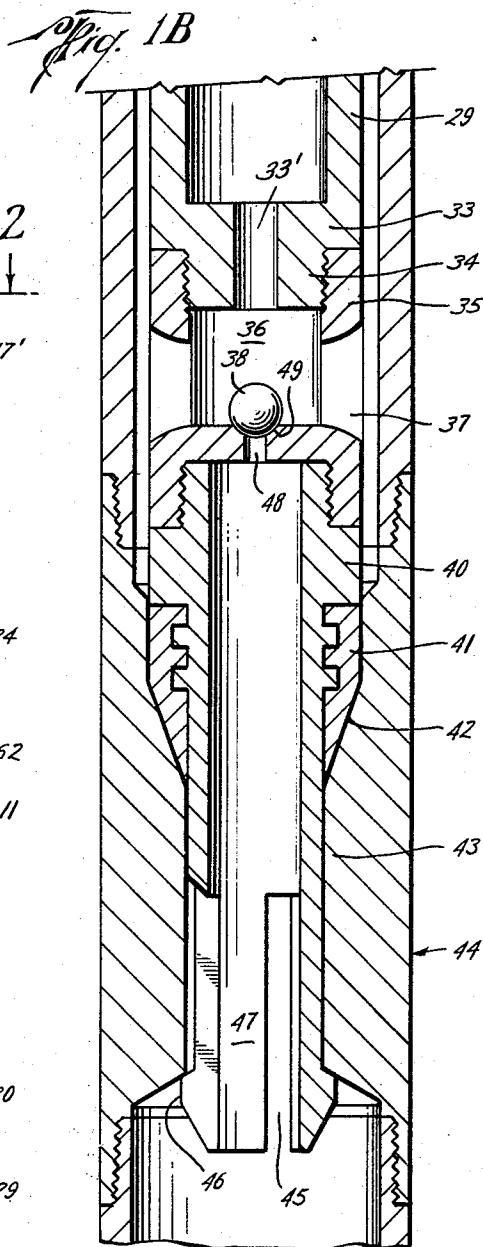
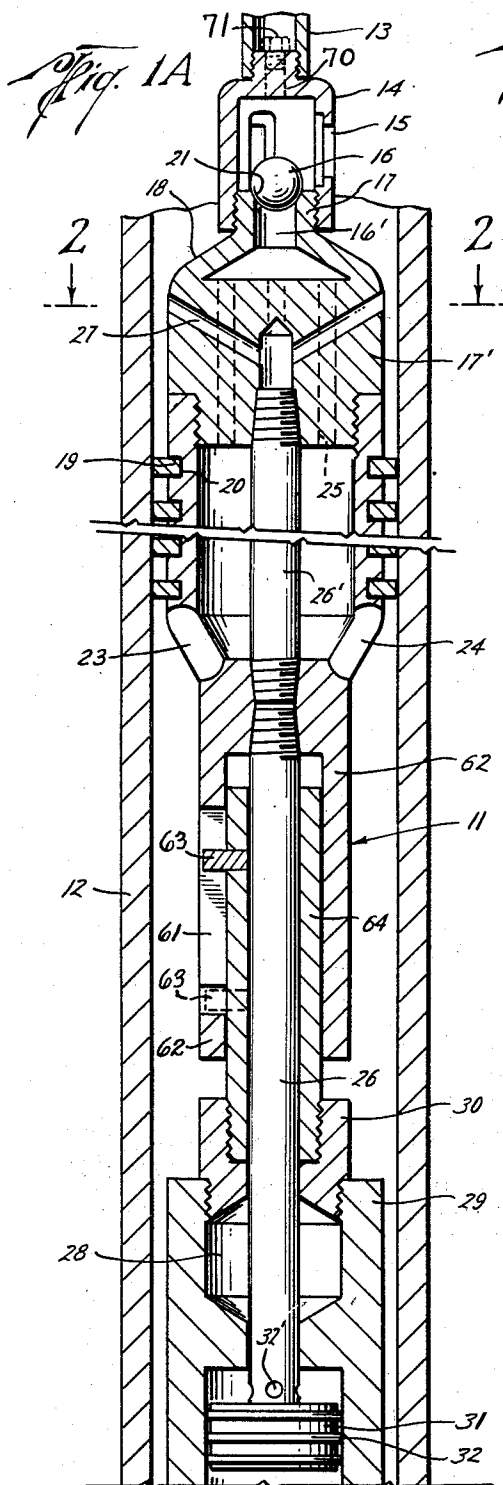
M. A. ADAMS

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VALVE SEAT WASHING PUMP AND CHEMICAL INJECTOR

Filed Feb. 25, 1957

3 Sheets-Sheet 1



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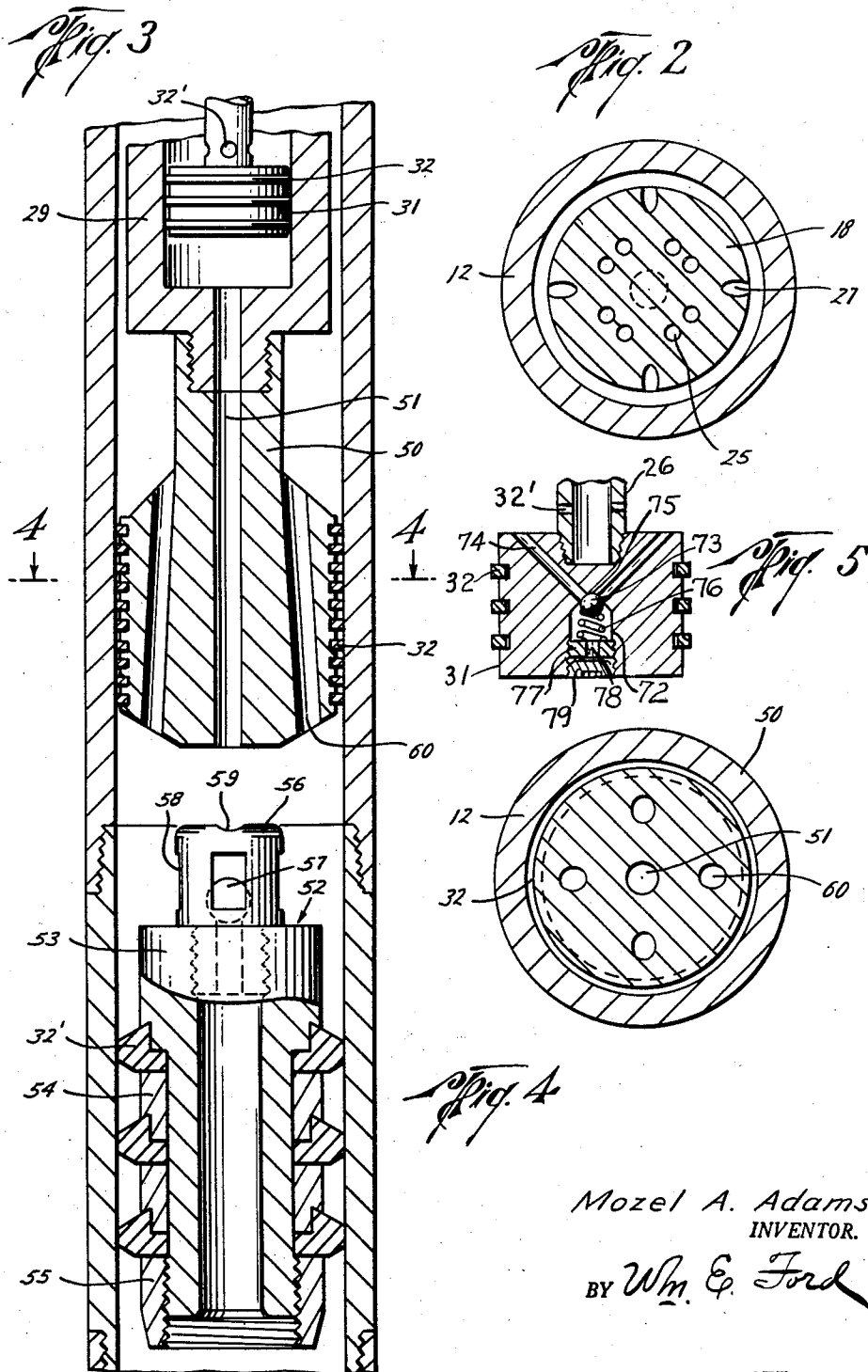
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Fig. 7

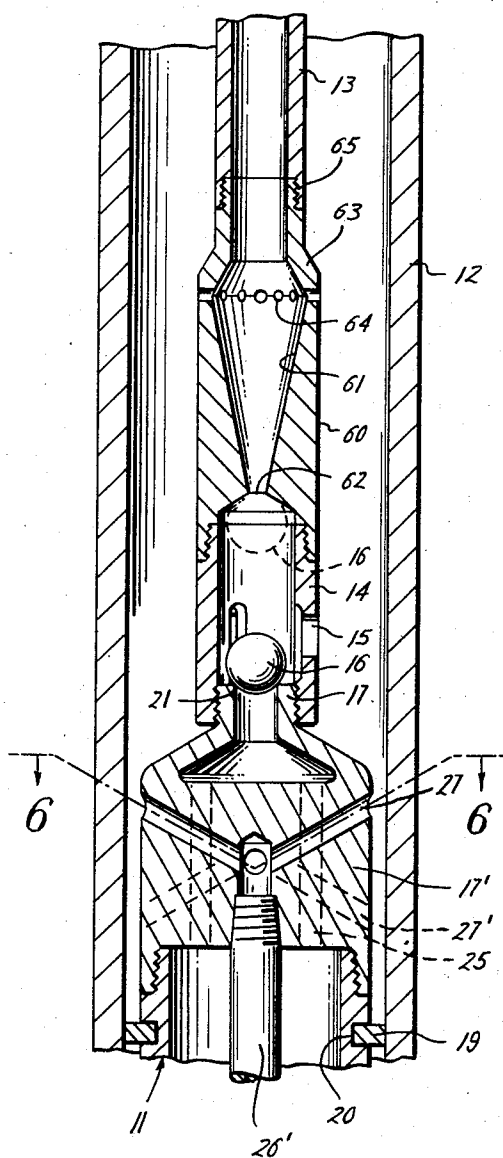


Fig. 6

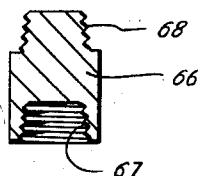
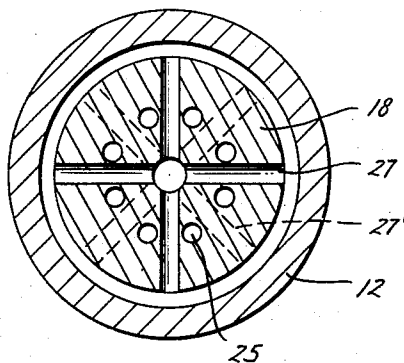


Fig. 8

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VALVE SEAT WASHING PUMP AND
CHEMICAL INJECTOR

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Application February 25, 1957, Serial No. 641,916

5 Claims. (Cl. 103—179)

This invention relates to a valve seat washing well pump and more particularly to such a pump which may be positioned in the well at a selected location and held at such position during operation.

It is therefore a primary object of this invention to provide such a pump adapted to wash its delivery valve on upstroke or delivery stroke and adapted to wash its inlet valve on downstroke or return stroke.

It is also an object of this invention to provide such a pump which may be placed in operation at a predetermined position in a well bore pipe string through cooperation with latching means provided in such pipe or optionally placed in operation at selective positions in the pipe string by frictional engagement with the pipe wall at such positions.

It is another object of this invention to provide a novel and improved self-cleaning pump which is especially suitable for use in an oil well, said pump being simple in construction, involving only a few parts, and providing an efficient self-cleaning action which frees the valves of the pump from accumulations of sand or other foreign materials in a continuous manner simultaneously with the normal action of the pump.

A further object of the invention is to provide an improved self-cleaning pump for use in oil wells and the like, said pump involving inexpensive components, being reliable in operation, being provided with means for continuously clearing the valve portions of the pump of sand or other foreign material, thus preventing the pump from becoming fouled, and being arranged so that floating sand and other fine powdered material encountered in the fluid being handled by the pump will be moved through the pump and will not settle or accumulate around the moving parts of the pump.

It is also an object of this invention to provide a pump of this class which may be adapted as a chemical injector to deliver chemicals to wash its valve seats.

Other and further objects and advantages will become apparent from the following description and claims, and from the accompanying drawings wherein:

Fig. 1-A is a sectional elevation of the upper part of the pump;

Fig. 1-B is a sectional elevation of the lower part of one modification of the pump;

Fig. 2 is a sectional plan view taken along line 2—2 of Fig. 1-A;

Fig. 3 is a sectional elevation of the lower part of another modification of the pump;

Fig. 4 is a sectional plan view taken along line 4—4 of Fig. 3;

Fig. 5 is a sectional elevation of still another modification of the invention adapted as a chemical injector;

Fig. 6 is a sectional plan view through the top of still another modification of the invention adapted as a chemical injector, the section being taken along line 6—6 of Fig. 7;

Fig. 7 is a sectional elevation of the modification of

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the invention of which Fig. 6 is a sectional plan view; and

Fig. 8 is a sectional elevation of an adapter employed to convert the chemical injector shown in Figs. 6 and 7 to use as a pump.

Referring to the drawings, the pump is designated generally as 11 and operates in a pipe string, casing, or tubing 12. A pump rod 13 is connected to the top of the pump and extends to the top of the well where it is connected to a conventional reciprocatory pump to move the rod 13 upwardly and downwardly and thereby force fluid from the well in the upstroke.

The top element of the pump 11 to which the rod 13 is connected comprises a ball cage 14, as shown in Fig. 1-A, such cage having apertures 15 therein and containing the ball valve 16 to seat upon a port 16' through the top of a hollow plunger 18, the ball cage 14 being threadedly engaged on a reduced, externally threaded top 17 of such hollow plunger 18 while the plunger slidably and sealably engages the pipe string 12, such plunger being provided with a plurality of annular sealing rings 19 secured in grooves 20 formed in the exterior of the hollow plunger 18. Such rings may be of any suitable material, such as fibre, or the like, adapted to slidably and sealably engage the inside wall surface of the pipe.

As shown in Fig. 1-A the top 17 of the plunger 18 is formed with an annular seat 21 on which the valve ball 16 sealably engages responsive to gravity and the weight of the column of fluid thereabove until lifted from the seat 21 by the force of fluid delivered upwardly thereby on the upstroke of the plunger 18, such fluid passing into the hollow plunger 18 through apertures 24 in the inwardly tapered lower end 23 of the plunger, and thence through ports 25 in the head 17' of the plunger 18 for delivery past the ball valve 16, the ports 25 and the port 16' thus constituting the port means establishing fluid communication between the tubing interior above the check valve 16 and the plunger interior therebelow.

A vertical conduit 26 is secured to the plunger 18 as shown in Fig. 1-A and communicating with the conduit 26 in alignment therewith and similarly secured to the plunger 18 is an upwardly extending vertical conduit 26' which has its upper end secured to the plunger head 17'. Such conduit 26' communicates with passages or passageways 27 in the head 17' and such passages extend outwardly through the wall of the head 17'.

The passages 27 thus place the conduit 26' in communication with the casing interior above the seal rings 19 and, as directed, upward fluid discharge therefrom may communicate with the interior of the ball cage 14 through the apertures 15 to wash the ball valve 16 when it is seated.

The depending vertical conduit 26 extends slidably and sealably through a stuffing box 28 in the top end of a vertical cylinder 29, the conduit 26 being received through a sealing gland 30 provided centrally in such top end, as shown in Fig. 1-A. Secured to the lower end of the conduit 26 is the circular piston 31, shown in Fig. 1-A, said piston being provided at its periphery with the resilient deformable annular swab element 32 which slidably and sealably engages the inside wall surface of cylinder 29.

As shown in Fig. 1-A, the lower end portion of the conduit 26 is provided adjacent the piston 31 with a plurality of passages or passageways 32', whereby the conduit 26 is in communication with the space in cylinder 29 above the piston 31. Thus, as will be presently explained, when the plunger 18 is moved upwardly the conduit 26 will be likewise urged upwardly with respect to the cylinder 29, and any material trapped in the cylinder 29 will be forced upwardly through the conduits 26 and 26', and through the passages 27 out into the casing and into the apertures 15 into engagement with the ball valve

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16, agitating the region around the valve ball and washing said ball free of any foreign material, such as sand and the like.

The bottom wall 33 of the cylinder 29 has an aperture 33' therethrough and is provided with a depending externally threaded conduit or boss 34 to which is threadably secured a valve member ball cage 35, the top portion of said ball cage being provided with an axial vertical passage 36 which is in communication with the space in cylinder 29 below piston 31, whereby said space is in free communication with the interior of the ball cage 35. The interior of the ball cage 35 is likewise in free communication with the space in casing 12 below plunger 18 by the provision of the apertures 37 in the ball cage, as shown in Fig. 1-B. The ball cage 35 contains the valve ball 38, as shown.

Threadedly secured to the lower portion of the ball cage 35 is the hold-down tube 40 which has installed thereon the lead seal 41 to seat on the upper tapered surface 42 of a hold-down ring 43 provided in a sub or joint 44 in the casing 12. The lower part of the hold-down tube 40 has vertically extending slots 45 therein with toes or lugs 46 on the lower ends of the prongs 47 between the slots 45. Thus when the hold-down tube 40 is thrust downwardly the prongs 47 contract responsive to the weight and thrust thereon and pass through the ring 43 and then the toes or lugs 46 spring outwardly and latch under the lower, tapered surface of the ring 43, while the lead seal seats upon the upper tapered surface of the ring 43 in tightly sealing engagement.

The ball cage 35 has a port 48 through the lower surface thereof, and a seat 49 is provided around the upper rim of such passage on which the ball valve 38 is sealably engageable and on which said ball valve 38 seats when the piston 31 moves downwardly to force fluid thereagainst. Thus the lower ball valve 38 is washed free of small particles as sand, on the downstroke and the interior of the ball cage is agitated and also washed free of any particles which might otherwise settle therein.

The operation of the pump is obvious. The working barrel in which the plunger works is provided by the tubing. On the downstroke the downward movement of the piston 31 washes the lower ball valve 38 while valve washing fluid from the casing above the plunger 18 is drawn in through the passages 27 to fill the conduits 26', 26 and to flow outwardly through the ports 32' to fill the cylinder 29 above the piston 31. The downstroke, which thus forces the lower ball valve 38 seated, also forces delivery fluid upwardly from the lower ball cage 35 and into the plunger 18 through the apertures 24 and thence through the plunger head passages 25 to lift the upper ball valve 16 and force fluid out the ball cage apertures 15 in the fluid delivery stroke.

On the upstroke the piston 31 forces the fluid out of the space of the cylinder 29 above the piston 31, which space is the reservoir for the upper valve washing fluid, and forces such valve washing fluid out through the passageways 27 against the wall of the tubing 12 to be ricocheted in a churning action to pass back upwardly and inwardly to wash the upper ball valve 16, and the interior of the upper ball cage 14. Also, on the upstroke, the upward movement of the piston 31 creates suction to draw the lower ball valve 38 off of its seat, such ball valve also being adapted to be unseated responsive to fluid pressure from below, and production fluid flows past the lower ball cage 35 and out into the annular space thereabove within the tubing 12.

A modification of the lower end of the pump is shown in Fig. 3 in which a friction shoe 50 is installed on the lower end 34 of the cylinder 29 having an axial passage 51 therethrough to communicate with the cylinder interior thereabove. Such shoe has a plurality of sealing rings 32 thereon of such number and contiguity that they can sealably anchor the shoe and the pump thereabove in position in the well bore to which the pump

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and shoe thereon may be urged. In such position the frictional engagement with the well bore casing will be sufficient to withstand the downward thrust movement of the piston 31 without being displaced thereby, and which can also withstand any upward movement of the piston without corresponding displacement.

Below the shoe 50 a conventional standing valve assembly 52 is positionable at any desired position and after the positioning force applying means is withdrawn the frictional seal rings 32' on the assembly 52 are capable of asserting and maintaining such sealing and frictional engagement with the casing 12 as to withstand displacement downwardly responsive to fluid pressure as urged by the pump downstroke, and so as to withstand displacement upwardly responsive to any suction effect created thereby.

The assembly 52 includes a tubular body 53 on which the seal ring 32' are slid and spaced by spacer rings 54 and threadably locked thereon by the bottom hold-down ring 55. A ball cage assembly 56 is installed in the top of the body 53 to control upward fluid passage therefrom by means of the ball valve 57, which when lifted, permits fluid to pass out through sideward apertures 58 and a top aperture 59.

The operation of this modification of the invention is obviously in correspondence with the operation hereinabove described since the fluid urged downwardly by the piston 31 seats the ball valve 37 as it washes it, and with the valve 37 thus closed, fluid is urged upwardly through passages 60 in the shoe 50 outwardly of the axial passage 51, and thence into the plunger 18 and therefrom as hereinabove described. On the other hand on upstroke the valve 57 lifts and fluid is drawn from therebelow into the casing above the standing valve assembly 52.

The modification of the invention including the friction shoe and standing valve assembly has the advantage of flexibility of position since the elevation at which the standing valve assembly and the spacing of the shoe therefrom are selective for any part of the casing. On the other hand, the modification of the invention requiring a latching ring at a pre-determined position in the casing does not admit of such selectivity but does have the advantage of being easily lowered into position as compared with the force required to locate the shoe and standing valve in the other form of the invention.

Each form of the invention permits full washing of both the upper and lower valves respectively controlling delivery and intake while these valves are seated and thereby offer decided advantages over pumps heretofore employed which operate on the lost-motion theory through not being able to anchor the lower parts of the pump with relation to the plunger and piston.

When it becomes necessary to withdraw the pump from the well it has been found preferable to provide some means to protect the piston 31 from lifting the weight of the cylinder 29 and parts therebelow. To this end a conventional L-slot 61 is provided in the lower end 62 of the plunger 18 and a lug 63 is provided in the sleeve 64 which extends upwardly from the gland 30 fixed to the cylinder 29. Thus with the plunger 18 rotated with relation to the sleeve 64 the lug 63 is moved into the horizontal leg of the L-slot and thereafter the pump may be lifted with the lower end 62 of the plunger carrying the weight therebelow through the lug 63.

The pump may also be adapted as a chemical injector to inject a chemical to wash the valve seats in cases where the pump is constructed to be lowered into the well bore on the hollow rod 13. In such case a bore 70 is provided in the top of the ball cage 14 and until used the bore 70 is closed by a plug 71 threaded thereinto. When chemical is to be injected the plug 71 is removed and chemical is pumped down the rod 13 to wash through the bore 70 and wash the ball valve 16 and its seat 21.

The piston 31 may also be modified to serve as a chem-

ical injector by boring and countersinking the piston head as shown at 72 in Fig. 5. The countersunk bore provides a valve seat 75 for a ball valve 73, fluid passages 74 extending from such valve seat 75 to the upper surface of the piston 31. The valve 75 is urged seated upwardly by a spring 76 which bears on a ring 77 threadable into the bore 72 and providing a flow passage 78 therethrough. A plug 79 is threadable into the bore 72 behind the ring 77 to close the piston 31 when it is not being used to inject chemical. Such plug is removed when chemical is to be injected, the chemical being pumped down the sucker rod or tubing string 13 from the top of the well to pass out through the ports 15 in the cage 14 on upstroke of the pump 11 to pass downwardly via the passages 27 and piston rod 26', 26 through the ports 32' into the cylinder 29 to unseat the ball valve 73 to permit the chemical to pass through the piston 31. Thereafter the ball valve 73 seats on the downstroke and the chemical washes the lower ball valve 38 or 57, as the case may be, and is distributed in the space exteriorly of the cylinder 29.

As best shown in Fig. 6, a modified type of chemical injector is shown in which connection is made to the upper ball cage 14 by an adapter 60 threadable upon the upper end of such cage, the lower end of such adapter 60 being bored, counterbored, and countersunk to provide an upper seating surface for the ball valve 16, as will be hereinbelow described, and to provide a communication orifice 62 between the ball cage interior and a tapered space 61 provided within the adapter 60. Connection between the adapter 60 and the hollow pumping rod 13 thereabove is threadedly effected at 65, and therebelow the adapter is tapered outwardly at 63 to larger diameter. At the greatest dimension of the tapered interior space 61 a ring of ports 64 is provided through the wall of the adapter.

On upstroke the ball 73 is unseated to let the chemical pass downwardly thereby and down through the piston into the space therebelow while the ball valve 38 therebelow (Fig. 1B), or the ball valve 57 therebelow (Fig. 3) in case this structure is used, is lifted by such upstroke. In this case, the ball 16 is seated by virtue of the pressure of the fluid thereabove acting thereon, and this ball 16 is also washed while seated, as the fluid into which the adapter 60 is lifted passes in through the ports 64 and downwardly and out through the orifice 62 to be directed on top of the seated ball 16.

On downstroke the ball 73 seats upwardly at 75 in the piston 31, and also the ball valve 16 seats upwardly as shown in dotted lines in Fig. 7, while the chemical pumped down the tube 13 passes out the ports 64 and into the space surrounding the upwardly travelling head 17', and into the passages 27 in the head 17', and through the piston rods 26', 26, and through the ports 32' in the piston rod 26 out into the space in the cylinder 29 above the piston 31, such piston being constructed as shown in Fig. 5.

It thus follows that with this form of the invention, as employed as a chemical injector, the upper ball valve 16 is washed on upstroke and the lower ball valve 38 or 57, as the case may be, is washed on downstroke.

When the pump 11 is to be returned to use as a well pump, it is only necessary to remove the adapter 60 and substitute a blank adapter 66, Fig. 8, internally threaded at 67 for connection to the top of the cage 14, and externally threaded at 68 for connection to the lower end of the pipe string or rod 13.

As shown in Figs. 6 and 7, the head 17' may preferably have the passages 27 therein extending upwardly, with alternately angularly spaced apart passage 27' extending downwardly, so that on upstroke the fluid directed upwardly through the passages 27 will wash the seated ball valve 16, while the fluid directed downwardly through the passages 27' will more readily wash away any sand

which might otherwise deposit above the upper sealing ring 19.

Broadly this invention covers a self-cleaning pump, which may also be used as a chemical injector, and while specific embodiments have been disclosed it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art and it is intended that no limitations be placed on the invention except as defined by the broad scope of interpretation claimed and merited for the appended claims.

What is claimed is:

1. The combination of a pump, a well bore pumping rod having a lower end to which said pump is connected, and a well bore tubing, said pump including a hollow plunger, seal means on said plunger establishing slidable contact with relation to said tubing and having a head providing a first port means therethrough establishing fluid communication between said tubing interior above the plunger seal means and the plunger interior and a downwardly seating upper check valve connecting said head to said lower end of said pumping rod and controlling fluid communication between said first port means and the tubing string thereabove, said plunger having aperture means therein between the plunger interior and the tubing interior below said plunger seal, a depending conduit connected to said head, a first passageway means through said head establishing fluid communication between the tubing string interior above said plunger and said conduit, a piston connected to the lower end of said conduit, a cylinder slidably housing said piston therein and having aperture means in the lower end thereof below said piston, a valve member below said cylinder having a second port means establishing fluid communication between the interior of said tubing therebelow and thereabove, means sealably anchoring said cylinder and said valve member in said tubing, a second passageway means provided between the interior of said conduit and the interior of said cylinder above said piston, and a downwardly seating lower check valve provided in said valve member to control said second port means, whereby on upstroke the lower check valve is lifted and production fluid is drawn into the tubing interior thereabove and upon downstroke said piston forces such production fluid to close said lower check valve and wash said lower check valve and pass upwardly into said plunger through said plunger aperture means and through said first port means to lift said upper check valve to pass into the tubing interior thereabove, said piston on downstroke drawing washing fluid from said tubing interior above said plunger through said first passageway means and said conduit and said second passageway means to reservoir in said cylinder above said piston, and on upstroke forcing such valve washing fluid out of reservoir through said second passageway means, said conduit, and said first passageway means into the tubing interior above said plunger to ricochet against the tubing wall in a churning action to wash said upper check valve.

2. The combination as claimed in claim 1 which includes latch means to releasably connect said plunger and said cylinder together whereby said pump may be withdrawn from the well with said piston spaced below the top of said cylinder.

3. The combination as claimed in claim 1 in which said cylinder includes a friction ring means connected thereto to stabilize it in said tubing and in which said valve member is spaced below said cylinder and includes a friction ring means thereon to anchor it in said tubing.

4. The combination as claimed in claim 1 in which said well bore tubing provides a ring therein, and in which said cylinder includes hold-down means cooperative with said ring to releasably latch said cylinder seated upon said ring.

5. The combination as claimed in claim 1 in which said pumping rod is hollow, and in which said upper check valve includes a cage as the element connecting said

pump to said hollow pumping rod, and in which said cage includes a valve element as the means controlling fluid communication between said first port means and the tubing interior, and in which said cage also provides an aperture through the top thereof to place the interior of said cage in fluid communication with the interior of said hollow rod, and in which said piston has a valve therein spring urged seated upwardly to control fluid passage downwardly therethrough from the interior of said conduit.

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