

June 9, 1953

M. A. ADAMS
STRIPPER PUMP

2,641,187

Filed April 10, 1951

2 Sheets-Sheet 1

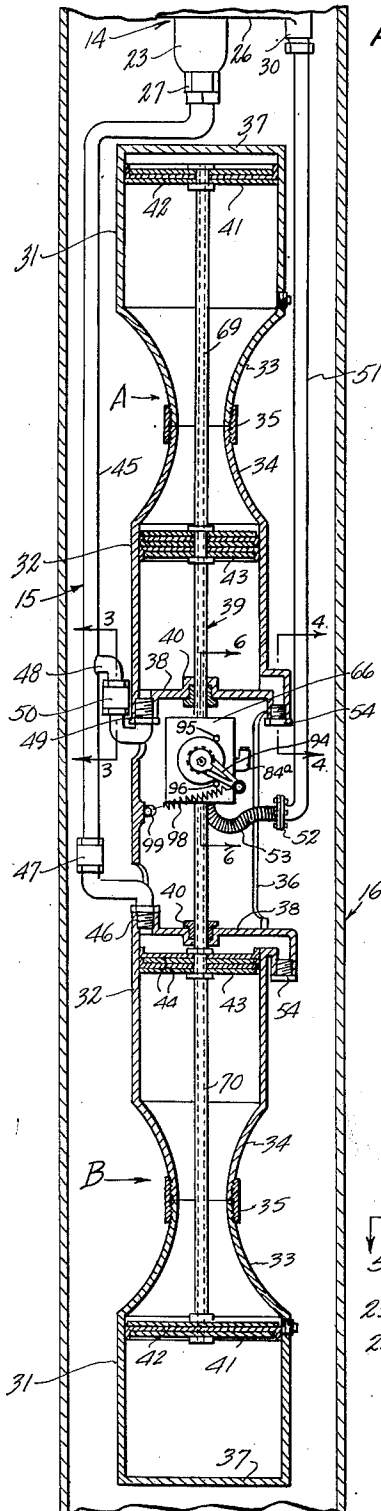


FIG. 1.

FIG. 2.

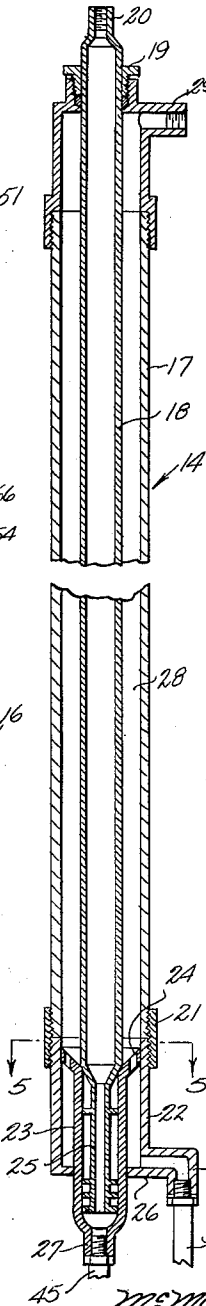


FIG. 3.

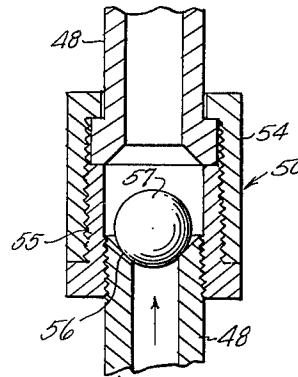


FIG. 4.

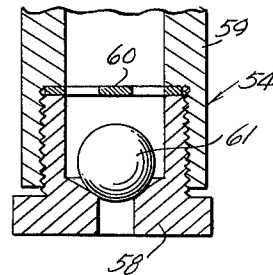
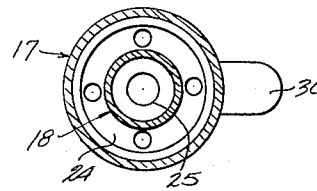


FIG. 5.



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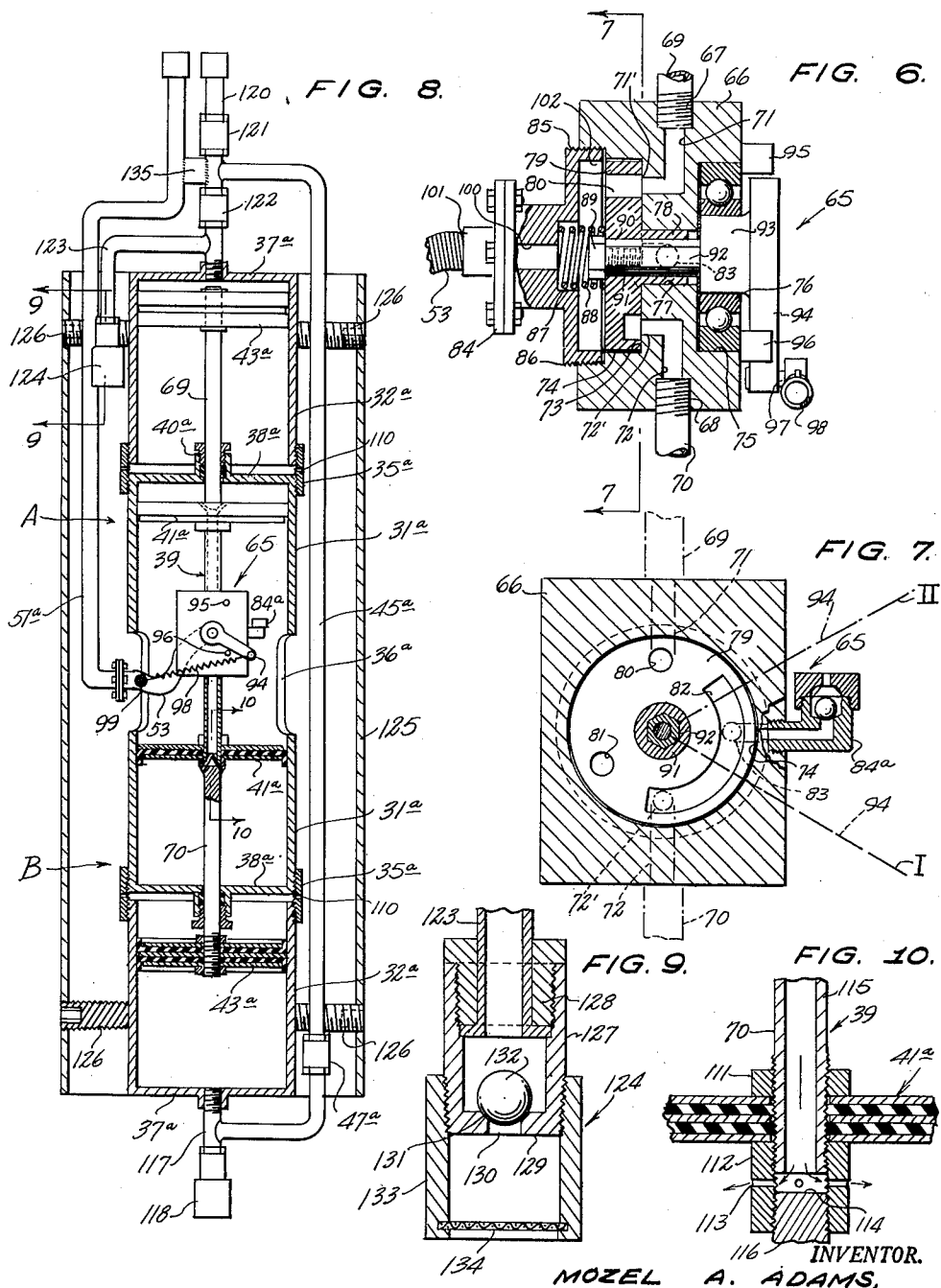
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2 Sheets-Sheet 2



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2,641,187

STRIPPER PUMP

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3 Claims. (Cl. 103—46)

1

This invention relates to improvements in fluid-actuated pumps, and more particularly to an improved single acting double plunger pump of this type suitable for use in deep wells, the primary object of the invention being to provide more efficient and reliable pumps of this kind having simplified structure and relatively few component parts which are readily serviced and/or replaced when necessary or desirable.

Other important objects and advantageous features of the invention will be apparent from the following description and the accompanying drawings, wherein, for purposes of illustration only, specific forms of the invention are set forth in detail.

In the drawings, wherein like or similar numerals designate like parts throughout the several views:

Figure 1 is a fragmentary transverse vertical section taken through one form of pumping mechanism;

Figure 2 is a similar view taken through the associated air and flow line assembly;

Figure 3 is an enlarged fragmentary transverse vertical section taken on the line 3—3 of Figure 1;

Figure 4 is a similar view taken on the line 4—4 of Figure 1;

Figure 5 is a horizontal sectional view taken on the line 5—5 of Figure 2;

Figure 6 is an enlarged transverse vertical section taken on the line 6—6 of Figure 1;

Figure 7 is a transverse vertical section taken on the line 7—7 of Figure 6, the two extreme positions of the valve lever being indicated by dotted lines;

Figure 8 is a transverse vertical section taken through another form of pumping mechanism;

Figure 9 is an enlarged transverse vertical section taken on the line 9—9 of Figure 8; and

Figure 10 is an enlarged fragmentary transverse vertical section taken on the line 10—10 of Figure 8.

Referring in detail to the drawings, and first to Figures 1 to 7 thereof, the form of the invention illustrated therein comprises an air-gas assembly 14 and a pumping mechanism 15, to be lowered into a well casing 16 by means of cables or wires (not shown) with lines of flexible pipes (not shown) extending thereto from the surface of the ground at the head of a well, one line being the air or gas line and the other line the discharge or flow line for the oil stripped by the action of the pumping mechanism from the well fluid in the casing into which the pumping mechanism has been lowered.

2

The air-gas or breaker assembly 14 comprises an outer cylindrical shell 17, through which a discharge pipe 18 extends axially in concentrically spaced relation to the side wall of the shell 17. An upper end portion of the pipe 18 passes through a packing gland 19 on the upper end of the shell 17 and terminates in a reduced nipple 20 for connection to a flexible pipe or line (not shown) leading to the ground surface at the head of the well. On the lower end of the shell 17 there is coupled at 21 a fitting 22 of the same diameter as the shell, containing a smaller diameter vertical, tubular seat 23 including a perforated bevel flange 24 on its upper end engaging the interior of the fitting 22. On the lower end of the discharge pipe 18 is a reduced diameter portion 25 extending in the seat 23 and open at its lower end within a lower end of the seat 23. The lower end of the seat 23 extends through the lower end 26 of the fitting 22 and has a nipple 27 for connection with a pipe of the pumping mechanism 15. The space 28 in the shell 17 between the shell and the discharge pipe 18 constitutes the discharge line of the assembly 14. Connection with this discharge line is made to a flexible pipe (not shown) leading to the ground surface by a nipple 29 leading from the side of the upper end of the shell 17, and connection is made to a pipe of the pumping mechanism by means of a downturned nipple 30 on the lower end of the fitting 22.

The pumping mechanism, generally designated 15, comprises upper and lower cylinder assemblies A and B, respectively, each including a relatively large diameter air or gas cylinder 31 and a smaller diameter fluid cylinder 32, these assemblies being hourglass in shape with their registered tapered portions 33 and 34, respectively, coupled together, as indicated at 35. The cylinder assemblies are secured in spaced axial alignment by an open sleeve 36 connected to the adjacent ends of the smaller fluid cylinders 32. The large cylinders 31 have heads 37 and the smaller cylinders have heads 38.

A sectional, tubular piston rod extends axially through all of the cylinders and the sleeve 36, passing slidably through packing glands 40 in the smaller cylinder heads 38. Within the larger cylinders 31 the piston rod 39 has fixed thereon suitable pistons 41 preferably involving single cups 42 facing the heads 37, while within the smaller cylinders 32 the rod 39 has fixed thereon suitable pistons 43 preferably involving two cups 44 facing the heads 38. A discharge pipe 45 is connected at its upper end to the nipple 27 on the lower end of the seat 23 of the air-gas assembly

3

14 and leads downwardly therefrom alongside the upper cylinder assembly A to the upper part of the cylinder assembly B. The lower end of the pipe 45 is connected at 46 to the head 38 of the smaller cylinder of the lower assembly B and has a one-way check valve 47 just above this connection.

A branch 48 of the pipe 45 leads therefrom above the check valve 47 to make a connection 49 with the cylinder head 38 of the smaller cylinder of the upper assembly A and the branch 48 has a one-way check valve 50 therein.

An air-gas pipe 51 has its upper end connected with the nipple 30 of the air-gas assembly 14 and leads downwardly along the side of the pumping mechanism 15 opposite from the pipe 45 with its lower end at a point intermediate the upper and lower ends of the sleeve 36 and coupled at 52 with a flexible tube 53. The smaller cylinders 32 have one-way fluid check valves 54 at one side of the heads 38 thereof communicating with the space outside of these cylinders.

The one-way check valves 47 and 50 are similar and are of the type shown in Figure 3, and comprise assembled housing members 54 and 55 interposed in the branch pipe 45 or 48, with the upper end of the lower pipe section formed to provide a seat 56 for the ball 57. The one-way check valves 54 are also similar to each other and comprise, as shown in Figure 4, a seat 58 threaded into a tubular extension 59 of the related cylinder head 38 and retaining a spider 60 above the ball 61.

As shown in Figure 6, the sectional tubular piston rod 39 has structurally incorporated therein at its middle an air-gas, two-position, snap valve assembly 65 comprising a block 66 formed in its upper and lower ends with vertically aligned, threaded bores 67 and 68 in which the adjacent ends of the upper and lower piston rod sections 69 and 70, respectively, are rigidly secured. L-shaped passages 71 and 72, respectively, lead from the bores 67 and 68 and open through the bottom 73 of a circular recess 74 formed in one side of the block 66, as shown in Figures 6 and 7 to provide diametrically opposed ports 71' and 72', respectively. Another circular recess 75 is axially aligned with the recess 74 and formed in the opposite side of the block 66 and accommodates an annular ball bearing 76. An axial bore 77 extends between the recesses 74 and 75 and acts as a journal bearing for the tubular axial stub shaft 78 on the flat cylindrical valve disc 79 which turns in the recess 74. The disc 79 has ports 80 and 81 formed therethrough to register with either the port 71' or the port 72', respectively, in the different extreme positions of the valve disc 79. The disc 79 has on the side thereof facing these ports an arcuate channel 82 adapted to register with either the port 71' or the port 72' and provide communication between these ports and another L-shaped port as passage 83 opening through a side of the block 66 and provided at its outer end with a one-way check valve 84a opening to the space within the open sleeve 36. The inner end of the passage 83 opens through the bottom 73 of the recess 74 at one side of the recess at a point between the ports 71' and 72'.

A cap 84 has an annular, externally threaded, peripheral flange 85 threaded in an enlarged portion 86 at the outer end of the recess 74 and has a central socket 87 in which is seated the adjacent end of a helical spring 88 bearing against the adjacent or outer side of the valve disc 79. A bolt has a head 89 bearing against a washer 90

4

engaging the outer side of the valve disc 79 and has a shank 91 threaded into the adjacent end of a shaft portion 92 extending through the bore of the tubular stub shaft 78. The shaft portion 92 is a part of a large diameter shaft 93 journaled in the ball bearing 76 and having a fixed valve lever 94 projecting radially therefrom. Upper and lower stop lugs 95 and 96, positioned on opposite sides of a perpendicular plane passing through the axis of the shaft 93 project from the side of the block 66 for engagement by the valve lever in extreme positions thereof. The outer end of the lever 94 has connected thereto at 97 one end of a helical contractile spring 98 having its other end connected at a point 99 on the side of the sleeve 36 whereby the lever 94 is moved past center to either of its extreme positions as the valve block 66 is moved to either side of the point 99 in the reciprocation of the pumping mechanism.

The cap 84 has an axial bore 100 extending therethrough and communicating with a nipple 101 to which is connected the flexible air or gas pipe 53. The inner end of the bore 100 opens into the space or chamber 102 between the cap 84 and the outer side of the valve disc 79. Air or gas under pressure entering the space 102 will pass through that one of the ports 80, 81 in the valve disc which happens to be registered with one of the valve block ports 71', 72', and therethrough to the related one of the sections 69 and 70 of the piston rod 39.

It will be apparent from Figure 1 that the pistons 41 and 43 of the larger and smaller cylinders 31 and 32, respectively, are in opposite phases, so that upon completion of an upward stroke of the piston rod 39, the pistons of the lower assembly B are at the upper ends of their cylinders and have completed power strokes, whereas the pistons of the upper assembly A are at the upper ends of their cylinders and are positioned to start their power strokes. With the pistons in these positions, the air valve assembly disc 79 is in the position II shown in Figure 7 wherein the air or gas under pressure supplied in suitable manner through the assembly 14 from above ground passes into the space 102 in the block 66, through the ports 81 and 72' and into the bore of the lower section 70 of the piston rod 39 and enters the space between the head 37 and the piston 41 of the larger cylinder 31 of the lower assembly B, well fluid having already been expelled from the companion smaller cylinder 32 into the discharge pipe 45 on the preceding upstroke of its piston 43.

In the same position II of the valve lever 94, the channel 82 is in registry with the valve block port 71', leading from the upper rod section 69, and with the air port 83, so that the air above the piston 41 of the upper cylinder 31 is exhausted therefrom through the check valve 84. In the course of reaching the positions of the pistons shown in Figure 1, the valve lever 94 is snapped over-center to the position I indicated in Figure 7, wherein the valve disc port 80 is registered with the valve block port 71' and the channel 82 is registered with the air exhaust port 83 and with the valve disc port 81. In this position of the valve lever 94, air or gas pressure is applied through the upper rod section 69 to drive the piston 41 of the upper cylinder 31 downwardly and thereby cause the piston 43 of the upper cylinder 32 to expel fluid from the upper cylinder 32 through the branch pipe 48, the check valve 50, and upwardly in the dis-

5

charge pipe 45. At the same time, well fluid is sucked through the check valve 54 into the lower cylinder 32. Also, at the same time, air behind the piston 41 of the lower cylinder 31 exhausts through the lower rod section 70, the valve block port 71', the channel 82, the port 83, and the check valve 84 on the block 66. As the lower cylinder assembly B moves toward its extreme depressed position, the valve lever 94 is snapped over to position II. These successive changes in position of the valve assembly 66 continue while air or gas pressure is applied through the flexible tube 53, so that the cylinder assemblies A and B are together continuously reciprocated.

The form of the invention shown in Figures 3 to 10 is adapted for use with or without the breaker assembly 14, and incorporates the valve assembly 65 described in connection with the form of Figures 1 to 7. The pumping mechanism of the form of Figures 8 to 10 operates in the same general manner as the form of Figure 1, but the fluid pumping cylinders are located above and below, respectively, the air or power cylinders 31 in contrast to the pumping mechanism of Figure 1.

Referring to Figures 8 to 10, the upper and lower cylinder assemblies A and B, respectively, comprise uniform and similar diameter fluid and air cylinders 32a and 31a, respectively, which are connected by couplings 35a. The axially outward ends of the cylinders 32a are closed by heads 37a; and the axially outward ends of the cylinders 31a are closed by heads 38a provided with packing glands 40a through which the related sections of the piston rod 39 works, the axially inward ends of the cylinders 31a being open and rigidly connected by the open sleeve 36a. The valve assembly 65 connects the inward ends of the piston rod sections 69 and 70, and its operating spring 98 is connected to a fixed member 99 on the sleeve 36a.

The ends of the piston rod 39 carry double cup pistons 43a working in the pumping cylinders 32a and single cup pistons 41a in the air cylinders 31a. The couplings 35a connecting the cylinders 32a and 31a have lubrication intake ports 110 communicating only with the cylinders 32a for intaking well fluid by suction.

As shown in Figure 10, the air cylinder pistons 41a are circumposed on the piston rod 39 with nuts 111 and 112 threaded on the rod and engaging opposite sides of these pistons. The nuts 112 are longer than the nuts 111 and are formed with lateral air ports 113 which are in communication with spaces 114 within the nuts 112. These spaces 114 are produced by having the piston rod formed of a tubular part 115 and a solid axially outward part 116, instead of entirely tubular as in the form of Figures 1 to 7 and spacing these parts within the nut 112. The nut 112 acts to connect the parts 115 and 116. The ports 113 serve to admit air or gas under pressure into the cylinders 31a from the bore of the tubular parts 115 of the piston rod, which connect with the passages 71 and 72 of the valve block 66.

The flexible air pipe 53 leading from the valve block 66 connects with the lower end of the air or gas pipe 51a which leads upwardly along one side of the upper cylinder assembly A and terminates at its upper end in a nipple for connection with a flexible air pipe (not shown) leading from the well head. The well fluid discharge pipe 45a extends vertically along both of the cylinder assemblies A and B on the side opposite the air pipe 51a and has its lower end connected

6

with a short central pipe 117 leading downwardly from the head 37a of the fluid cylinder 32a of the lower assembly B and having a one-way check valve 118 in its lower end, the lower end of the pipe 45a being connected with the short pipe 117 between the check valve 118 and the cylinder 32a. Another one-way check valve 47a is incorporated in the lower part of the fluid discharge pipe 45a. The upper end of the pipe 45a is connected to a short central pipe 120 leading upwardly from the head 38a of the cylinder 32a of the upper assembly A. One-way check valves 121 and 122 are incorporated in the short pipe 120 above and below the connection thereto of the pipe 45a. A relatively short pipe 123 depending along the upper cylinder assembly A has a one-way check valve 124 on its lower end and has its upper end connected to the short pipe 120 at a point between the check valve 122 and the head 37a of the cylinder 32a of the upper assembly. A protective, open-ended, tubular, cylindrical shell 125 spacedly surrounds the pumping mechanism and has Allen-type screws 126 threaded through upper and lower portions of the shell and engaging the sides of the cylinders 32a of both assemblies A and B and mounting the shell 125 in concentrically spaced relation to the assemblies.

The one-way check valve 124 is of the type shown in Figure 9, and comprises a tubular valve chamber 127 in whose upper end the pipe 123 is secured by a plug 128. The bottom 129 of the chamber 127 has an opening 130 including a valve seat 131 upon which a ball check 132 rests gravitationally and from which the ball is adapted to be raised by suction exerted through the pipe 123. A depending protective sleeve 133 is secured around the chamber 127 having a screened bottom 134.

With the pistons 43a of the upper assembly A has completed a pumping stroke and the piston 43a of the lower assembly B has completed a suction up-stroke, air or gas pressure having been exhausted from the cylinder 41a of the upper assembly A through the upper section 69 of the piston rod 39 through the valve assembly 65 and air or gas pressure having reached a maximum in the cylinder 41a of the lower assembly, all in the same general manner explained above in connection with the form of Figure 1.

Air or gas under pressure is beginning to enter the cylinder 41a of the upper assembly A through the ports 113 in the upper rod section A to drive the piston 41a, and hence all of the pistons, downwardly on a return stroke of the pumping mechanism, so that the well fluid present in the cylinder 32a of the lower assembly B sucked thereinto on the previous upstroke through the check valve 118 short pipe 117 is discharged upwardly through the pipe 45a and emerges through the upper short pipe 120 into the flexible hose (not shown), connected thereto and leading to the well head. The downstroke of the piston 43a on the cylinder 32a of the upper assembly A sucks well fluid into this cylinder through the check valve 124, pipe 123 and pipe 120 below the check valve 122, the check valve 122 being closed.

On the next upstroke of the pistons, the fluid discharged by the active fluid cylinder is passed upwardly through the pipe 120, the pipe 45a being closed by the check valve 47a. The intake check valves 118 and 124 close on alternate strokes of the pumping mechanism, as does the check valve 47a, and the check valves 121 and 122 open and close on alternate strokes of the pumping mechanism. The upper portions of the pipes 120 and

7

51a are parallel and laterally spaced and are rigidly connected by a member 135 which is adapted to be used for connection of a cable (not shown) for raising and lowering the device in a well.

It will be understood from the foregoing with respect to the action of the lower cylinder 32a that as the lower piston 43a moves upwardly from its depressed position toward the elevated position shown in Figure 8, valve 119 is opened by the suction produced, while valve 47a is closed or remains closed, so that well fluid and not fluid from the discharge pipe 45a is drawn into the lower cylinder 32a.

On the following downward stroke of the piston 43a, the valve 118 is closed and valve 47a is opened so that fluid in the cylinder 32a is forced upwardly through pipe 45a. The rise of fluid through the pipe 45a opens valve 121, valve 122 remaining closed, whereby the rising fluid passes through the pipe 120 to the discharge line.

With regard to the action of the upper cylinder 32a, on the downstroke of its piston 43a from the top position, shown in Figure 8, well fluid is drawn into the cylinder above its piston through the check valve 124, the valve 122 being in its closed position. On the next upstroke of the piston 43a in the upper cylinder 32a, the outgo of the fluid from the cylinder closes valve 124 and opens valves 122 and 121 so that the outgoing fluid passes upwardly to the discharge line, the valve 47a being held closed by the back pressure of fluid in the pipe 45a, so that practically all of the fluid forced out of the upper cylinder 32a passes to the discharge line. It is to be noted that the weight of fluid accumulated in the discharge line above and in the pipe 120 operates to keep the valve 121 closed except during a power or pumping stroke phase of one of the cylinders 32a.

It is to be observed that while the above-described forms of the invention are primarily intended for use in upright position in vertical well casings, these forms can be used in fluid containers other than vertical well casings, and in other than upright positions.

I claim:

1. In a single acting double plunger pump, first and second cylinder assemblies, means assembling said assemblies together in axial alignment and in axially spaced relation, each cylinder assembly comprising a fluid pumping cylinder and an air cylinder in end-to-end relation, pistons in said cylinders, and a piston rod tubular section connected to each of said pistons and having the end adjacent the air cylinder extending into the space between the cylinder assemblies, the pistons of said first and second assemblies being in opposite phase, an air valve assembly mounted on and in communication with said ends of said piston rod sections in the space between said assemblies, said valve assembly including a block having opposed passages, one of said piston rod sections being connected to one end of one of said passages and the other of said piston rod sections being connected to one end of the other of said passages, a shaft extending transversely through and rotatably supported in said block intermediate said passages, a disc secured to the end of said shaft adjacent the other ends of said passages, said disc having a pair of spaced ports registrable with either of the other ends of said passages, there being an arcuate channel in said disc spaced from each of said ports and registrable with either of the other ends of said pas-

8

sages, there being an arcuate channel in said disc spaced from each of said ports and registrable with either of the other ends of said passages, an operating lever secured to the end of said shaft remote from said disc and movable from the other end of one of said passages to the other end of the other of said passages, said block having a chamber adjacent said disc and in communication with said ports, a compressed air supply connected to said chamber, air exhaust means for said air cylinder, fluid intake means for said fluid pumping cylinders, and a fluid discharge means connected to said pumping cylinders to receive fluid discharged from the pumping cylinders as the pistons therein are operated to compress fluid therein intaken by suction through said fluid intake means.

2. In a single acting double plunger pump, first and second cylinder assemblies, means assembling said assemblies together in axial alignment and in axially spaced relation, each cylinder assembly comprising a fluid pumping cylinder and an air cylinder in end-to-end relation, pistons in said cylinders, and a piston rod tubular section connected to each of said pistons and having the end adjacent the air cylinder extending into the space between the cylinder assemblies, the pistons of said first and second assemblies being in opposite phase and an air valve assembly mounted on and in communication with said ends of said piston rod sections in the space between said assemblies, said valve assembly including a block having opposed passages, one of said piston rod sections being connected to one end of one of said passages and the other of said piston rod sections being connected to one end of the other of said passages, a shaft extending transversely through and rotatably supported in said block intermediate said passages, a disc secured to the end of said shaft adjacent the other ends of said passages, said disc having a pair of spaced ports registrable with either of the other ends of said passages, there being an arcuate channel in said disc spaced from each of said ports and registrable with either of the other ends of said passages, an operating lever secured to the end of said shaft remote from said disc and movable from the other end of one of said passages to the other end of the other of said passages, said block having a chamber adjacent said disc and in communication with said ports, a compressed air supply connected to said chamber, air exhaust means for said air cylinder, fluid intake means for said fluid pumping cylinders, and a fluid discharge means connected to said pumping cylinders to receive fluid discharged from the pumping cylinders as the pistons therein are operated to compress fluid therein intaken by suction through said fluid intake means, said pumping cylinder of each assembly being positioned axially outwardly from the air cylinder thereof.

3. In a single acting double plunger pump, first and second cylinder assemblies, means assembling said assemblies together in axial alignment and in axially spaced relation, each cylinder assembly comprising a fluid pumping cylinder and an air cylinder in end-to-end relation, pistons in said cylinders, and a piston rod tubular section connected to each of said pistons and having the end adjacent the air cylinder extending into the space between the cylinder assemblies, the pistons of said first and second assemblies being in opposite phase and an air valve assembly mounted on and in communication with

9

said ends of said piston rod sections in the space between said assemblies, said valve assembly including a block having opposed passages, one of said piston rod sections being connected to one end of one of said passages and the other of said piston rod sections being connected to one end of the other of said passages, a shaft extending transversely through and rotatably supported in said block intermediate said passages, a disc secured to the end of said shaft adjacent the other ends of said passages, said disc having a pair of spaced ports registrable with either of the other ends of said passages, there being an arcuate channel in said disc spaced from each of said ports and registrable with either of the other ends of said passages, an operating lever secured to the end of said shaft remote from said disc and movable from the other end of one of said passages to the other end of the other of said passages, said block having a chamber adjacent said disc and in communication with said ports, a compressed air supply connected to said cham-

10

ber, air exhaust means for said air cylinder, fluid intake means for said fluid pumping cylinders, and a fluid discharge means connected to said pumping cylinders to receive fluid discharged from the pumping cylinders as the pistons therein are operated to compress fluid therein intaken by suction through said fluid intake means, said air cylinder of each assembly being positioned axially outwardly from the pumping cylinder thereof.

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