Jan. 6, 1953 E. C. HALL 2,624,285

FLUID-OPERATED LIQUID PUMP

Filed April 11, 1951 2 SHEETS—SHEET 1

Fig. 1.

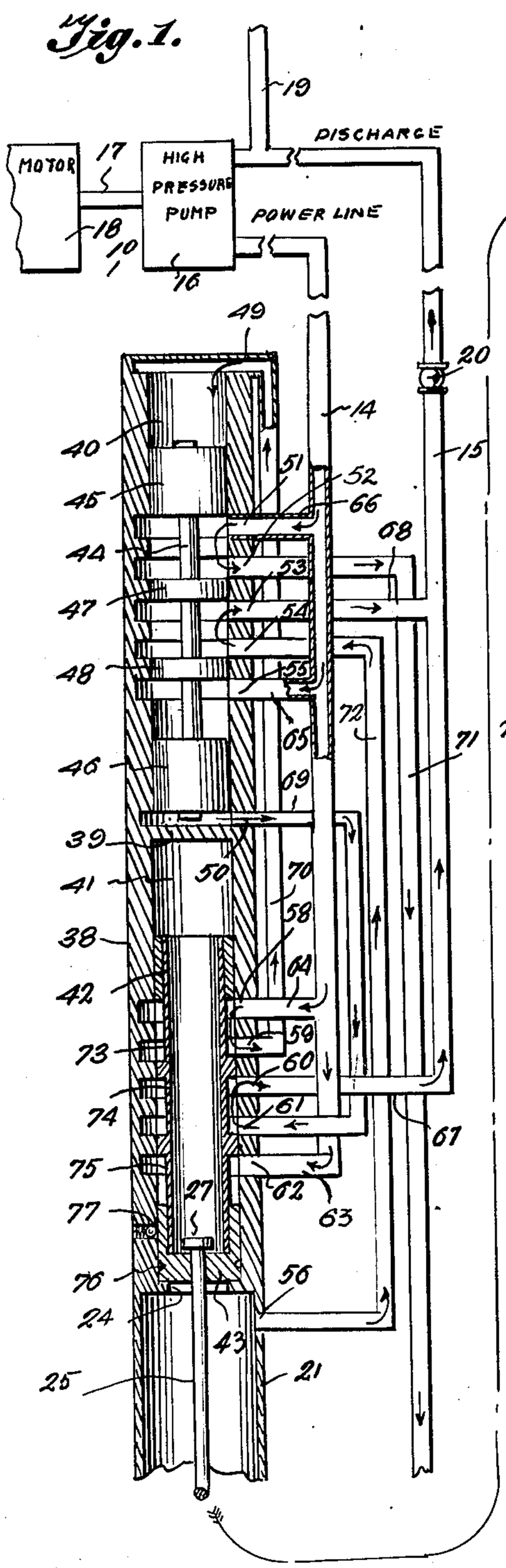

Fig. 1A.

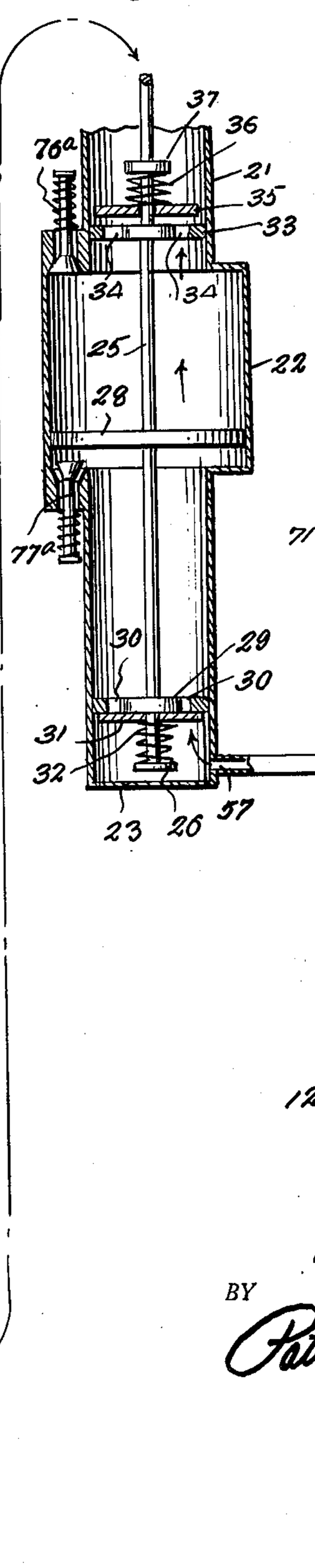

Fig. 3.

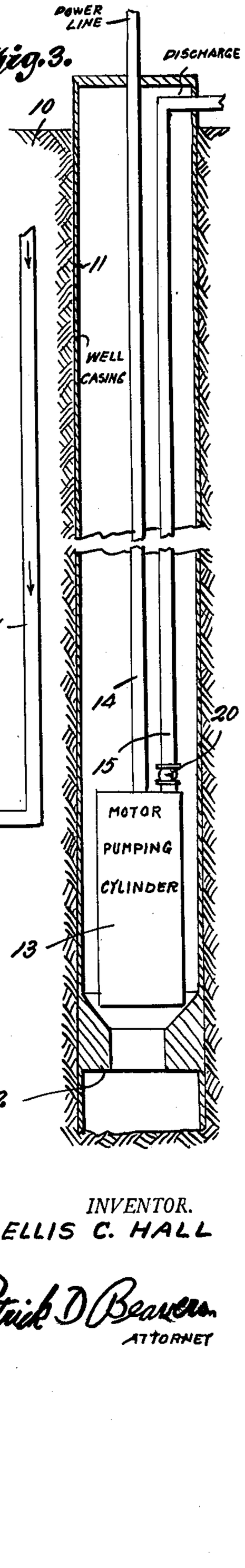

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Fig. 2.

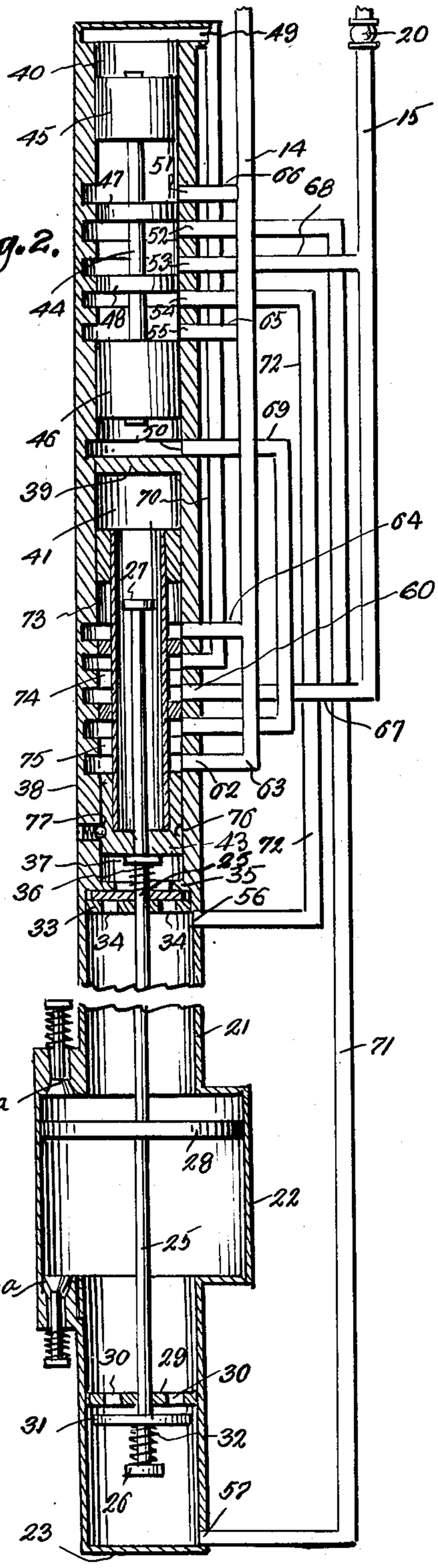
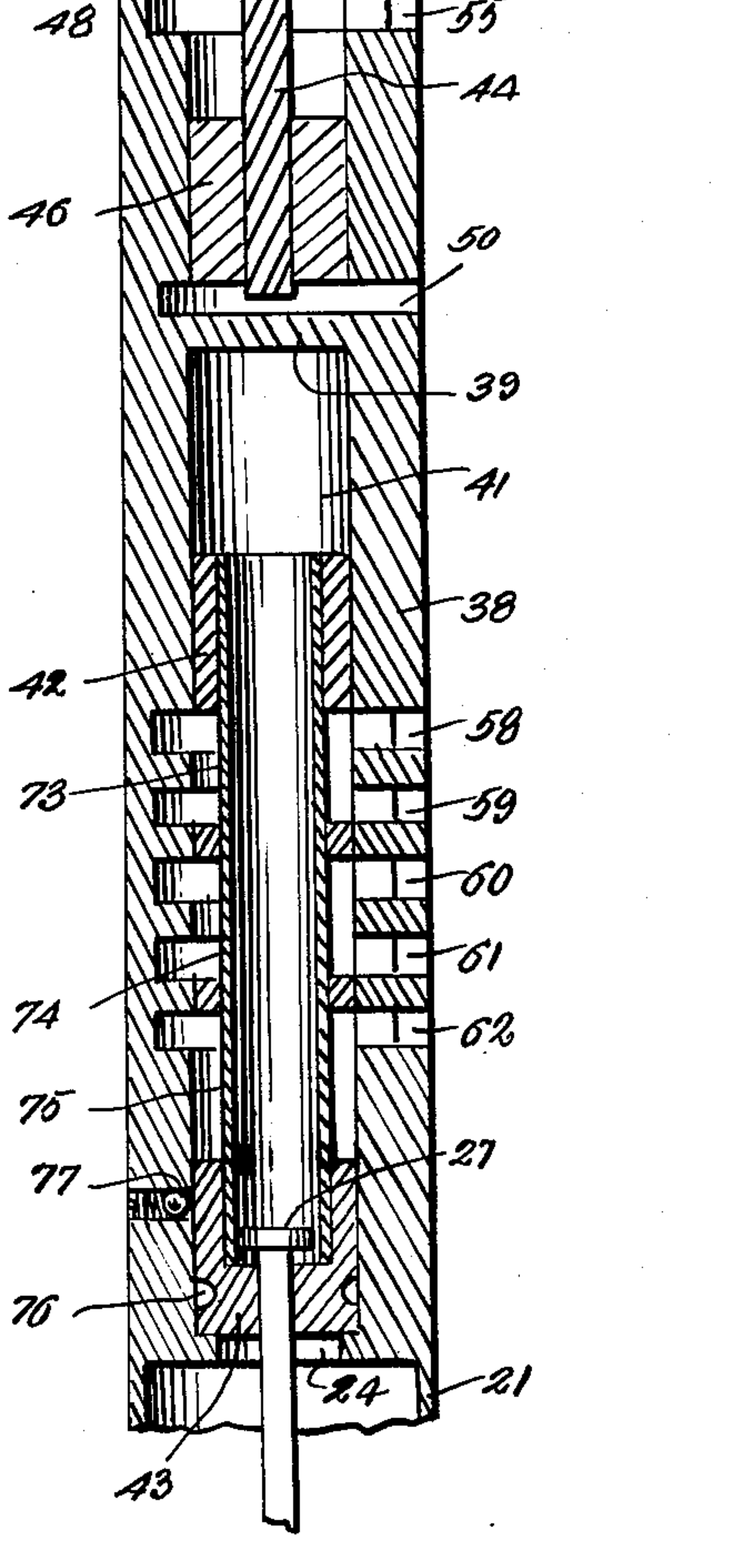


Fig. 4.



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2,624,285

FLUID-OPERATED LIQUID PUMP

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Application April 11, 1951, Serial No. 220,433

2 Claims. (Cl. 103—46)

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The present invention relates to a fluid-operated liquid pump and it consists in the combinations, constructions and arrangements of parts herein described and claimed.

Generally the present invention comprises an improvement over my pending application, Serial No. 187,594, filed on September 29, 1950, which application is entitled "Hydraulic Liquid Pump." And, while embodying several of the principles found in the earlier application, includes several features which are entirely new. Particularly new is the provision of a novel mechanism for operating a fluid pump of the general type found in my prior application. This new apparatus includes a novel arrangement of valves and ports therefor together with a pair of novel pistons one of which acts to reciprocate a pump arm in a novel manner. A novel arrangement of pipe and pipe connections is provided for the various ports of the pump-actuating apparatus.

It is accordingly an object of the invention to provide an apparatus of the character set forth which is comparatively simple in construction, easy to manufacture and yet effective and efficient in use.

Another object of the invention is the provision, in an apparatus of the character set forth, of novel means for the elimination of "knocking."

Another object of the invention is the provision, in an apparatus of the character set forth, of novel valves and novel means for operating the same.

A further object of the invention is the provision of an apparatus of the character set forth wherein packing is rendered unnecessary.

Other and further objects of the invention will become apparent from a reading of the following specification taken in conjunction with the drawings, in which:

Figure 1 is a fragmentary vertical sectional view, partly exploded, and partly in elevation, of a pump-operating mechanism forming a part of the invention and showing the same in one position which it may assume,

Figure 1A is a fragmentary vertical sectional view, partly in elevation, of a pump forming a part of the invention and showing the same as it would appear when connected with the apparatus shown in Figure 1,

Figure 2 is a fragmentary vertical sectional view showing the apparatus illustrated in Figures 1 and 1A but showing the apparatus therein in another position the same may assume during the operation thereof,

Figure 3 is an exploded vertical sectional view,

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partly in elevation, illustrating the manner in which the apparatus is positioned within a well casing, and

Figure 4 is an enlarged fragmentary vertical sectional view of a portion of the apparatus shown in Figure 1 but illustrating the same in greater detail.

Referring more particularly to the drawings, there is shown therein embedded in ground 10 a well casing 11 having adjacent its bottom end a well packer 12 upon which rests a cylindrical housing 13 for a pumping unit and pump such as is illustrated, for example, in Figure 2 of the drawings.

Extending from the housing 13 upwardly through the casing 11 a power line 14 and a discharge line 15 both of which are connected to a high pressure pump 16 on the surface of the ground which pump is operated by the shaft 17 of a motor 18. The discharge line 15 has tapped in thereto a discharge pipe 19 at the surface of the ground. A check valve is placed in the discharge line 15 preferably at a point adjacent to the upper end of the housing 13.

It is to be understood that the housing 13 is provided with a suitable opening in its lower end for the admission thereinto of oil or water as the case may be. In the lower end of the housing 13 there is mounted a pump which is best illustrated in Figure 1A and which consists of an elongated hollow cylindrical casing 21 having a centrally disposed enlarged portion 22. The casing 21 is closed at its bottom end, as indicated at 23, and open at its upper end, as indicated at 24. A vertically and centrally located shaft 25 extends through the pump casing 21 and is provided with a flange 26 at its lower end and a bumper 27 at its upper end. Substantially centrally affixed to the shaft 25 is a relatively large piston 28 whose outer periphery is in contact with the inner wall of the enlarged portion 22.

A piston 29 is provided in the lower portion of the pump casing 21 and is affixed to the shaft 25. The piston 29 is provided with a pair of openings 30 which extend therethrough. A circular valve 31 of flat material surrounds the shaft 25 below the piston 29 and is normally held against the under side of the piston 29 by a compression spring 32 which surrounds the shaft 25 and bears against the flange 26 and the valve 31.

A valve 33 is affixed to the shaft 25 in the upper portion of the pump casing 21 and is identical in structure with the valve 29. The valve 33 is provided with openings 34 which extend vertically therethrough and a valve 35 identical with

the valve 33 surrounds the shaft 25 above the valve 33 and is normally forced against the valve 33 by means of a compression spring 36 which surrounds the shaft 25 and bears against the upper side of the valve 35 and the underside of a bumper 37 which is affixed to the shaft 25 immediately above the normal position of the valve 35.

A pump-operating motor is provided and consists of an upward extension of the pump casing 21, as indicated at 38, and is centrally provided with a bulkhead 39 which divides the same into a pair of compartments 40 and 41, the compartment 41 being immediately above the pump and the compartment 40 being above the compartment 41.

A hollow cylindrical piston is vertically reciprocable in the compartment 41 and is indicated at 42. This piston 42 is provided with a closed lower end 43. The shaft 25 extends slidably through the closed end 43 of the piston 42 and it will be apparent that the bumper 27 lies within the piston 42 and above the closed end 43 thereof.

A shaft 44 is vertically and centrally disposed in the compartment 40 and has mounted thereon an upper piston 45 and a lower piston 46. Also mounted upon the shaft 44 in spaced relation to each other and to the pistons 45 and 46 are relatively smaller pistons 47 and 48 and it will be seen that the pistons 45, 46, 47 and 48 together with the shaft 44 will move reciprocally as a unit within the compartment 40.

The compartment 40 is provided with an upper port 49, a lower port 50 and five intermediate ports 51, 52, 53, 54 and 55. It will also be seen that the pump casing 21 is provided with an upper port 56 and a lower port 57 while the compartment 41 is centrally provided with a series of five ports 58, 59, 60, 61 and 62.

The lower end of the power line 14 is connected by a lateral pipe 63 with the port 62. It is also connected by a lateral pipe 64 with the port 58, by a lateral pipe 65 with the port 55 and a lateral pipe 66 with the port 51. The lower end of the discharge line 15 is connected by a lateral pipe 67 with the port 60 and by means of a lateral pipe 68 with the port 53. The ports 50 and 61 are interconnected by means of a U-shaped pipe 69 and the ports 59 and 49 are connected by an elongated U-shaped pipe 70. The ports 52 and 57 are interconnected by means of an elongated U-shaped pipe 71 while the ports 54 and 56 are interconnected by means of an elongated U-shaped pipe 72.

The piston 42 is provided with a series of three spaced cutaway portions, as indicated at 73, 74 and 75, and the enlarged portion 22 of the pump casing 21 is provided with an upper inlet valve 76*a* and a lower inlet valve 77*a*. An annular indentation 76 is provided in the piston 42 adjacent the lower end thereof and a spring-pressed ball 77 is mounted in the wall of the extension 38 and is adapted to latch the piston 42 in its uppermost position such as is indicated in Figure 2 of the drawings by engaging in the groove 76.

In operation, beginning with the positions of the various pistons, etc. as shown in Figures 1 and 1A, when the motor 18 is operated it will cause the fluid pressure pump 16 to furnish fluid under pressure to the power line 14 and thence through lateral pipe 64 to the port 58, thence through the reduced portion 73 to the port 59 and thence through the U-shaped pipe 70 to the port 49 where it will enter into the upper end of the chamber 40 to cause the pistons therein to

move downwardly to a point where the shaft 44 can no longer move in a downward position due to the same impinging against the bulkhead 39. Since in this position the ports 60 and 61 are in communication through the reduced portion 74, fluid which has been in the lower end of the compartment 40 beneath the piston 46 will be discharged through the port 50 into the pipe 69 and hence by means of the lateral pipe 67 to eventually discharge into the discharge line 15 whereupon it will be forced past the valve 20 which will prevent its return in any event in a downward direction. It will then return sufficient fluid to the pump 16 to insure the operation thereof and deliver any excess through the discharge pipe 19.

When the pistons in the chamber 40 are in their downward position, as shown in Figure 1, some of the fluid under pressure in the power line 14 will pass through the lateral pipe 66 into the port 51 and thence travel between the pistons 45 and 47 to the port 52 whence it will be led by means of the U-shaped pipe 71 to the port 57 in the lower end of the pump casing 21 thus causing the pistons 29, 28 and 33 to be lifted whereupon fluid will be drawn into the pump through the valves 77*a* from the interior of the well casing 11. At the same time valve 76*a* will be forced to a closed position and the valve 35 will be opened by this action thus forcing fluid which is present in the pump casing 21 above the piston 28 to be forced through the port 56 into the U-shaped pipe 72 and thence into the port 54 which is at this time in communication with the port 53 between the pistons 48 and 47. The fluid will thence be delivered to the lateral pipe 68 and finally to the discharge pipe 15 as aforesaid.

As the pistons 29, 28 and 33 rise the bumper 37 will eventually contact the underside of the closed end 43 of the piston 42 to thereby lift the same. This will cause the ports 59 and 60 to be in communication with each other through the reduced portion 74. It will also cause the ports 61 and 62 to be in communication with each other by means of the reduced portion 75. Hence pressure of fluid in the power line 14 will now be applied through the U-shaped pipe 69 to the underside of the piston 46 to lift the shaft 44 and all of its attached pistons. This will cause fluid entrapped in the chamber 40 above the piston 45 to pass through the port 49 into the U-shaped pipe 70 and through the port 59 to the port 60 utilizing the reduced portion 74 of the valve 42 for this purpose after which it will be delivered to the lateral pipe 67 and finally to the discharge line 15. Such action will, of course, permit the various pistons attached to the shaft 44 to take their uppermost positions as shown in Figure 2, for example. Ports 52 and 53 will be connected together through the space between pistons 47 and 48 and ports 54 and 55 will now be connected together between the pistons 48 and 46 thus reversing the direction of travel of the pistons 33, 28 and 29. Thus it will be seen that fluid will continuously be forced in an upward direction through the discharge line 15 through the action as above described even though the pistons 33, 28 and 29 are reciprocating in the pump casing 21. When the piston 42 is in its upward position it will be held there by the frictional engagement of the ball 77 in the groove 76 and it will be apparent that the device will be fully operative even though the shaft 44 and its pistons may

revolve upon their longitudinal axes or if the pistons 42 should revolve upon its axis. It will likewise be seen that the apparatus is capable of smooth operation since the flow of fluid in both the power line 14 and the discharge line 15 is a constant unidirectional flow.

The discharge line 15 as shown in Figure 3 may be eliminated by stopping this line above the check valve 20. This will let the fluid into the casing, which will act as a discharge line by having a well packer 12. By doing this one string of pipe in the well is eliminated. This arrangement can be used optionally.

While but one form of the invention has been shown and described herein, it will be readily apparent to those skilled in the art that many minor modifications may be made without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. An apparatus of the character described comprising a well casing extending vertically into the ground, a cylindrical housing positioned in the lower portion of said well casing, a high pressure fluid pump mounted above ground, a fluid supply conduit extending from said high pressure fluid pump through said casing into said housing, a fluid return conduit extending from said high pressure fluid pump through said casing into said housing, a discharge pipe connected to said fluid return conduit, a reciprocally operated fluid pump in the lower end of said housing, and fluid pressure operated means mounted in said housing above said reciprocally operated fluid pump for actuating said reciprocally operated fluid pump, said means having connection with the fluid supply and fluid return conduits, and said means including a hollow cylindrical body having a centrally disposed bulkhead dividing the same into an upper and a lower compartment, a piston reciprocally mounted in said lower compartment, a vertical shaft in said upper compartment, a plurality of pistons affixed to the shaft in the upper compartment, said piston in the lower compartment having a plurality of reduced portions, said body having a plurality of ports extending to the upper compartment and a plurality of ports extending into the lower compartment, a pipe connecting one of the ports of the upper compartment with the fluid return conduit, a pipe connecting one of the ports of the upper compartment with the upper end of said reciprocal pump, a pipe connecting a port of the upper compartment with the lower end of said reciprocal pump, a pair of pipes connecting ports of the upper compartment with the fluid supply conduit, a pair of pipes connecting ports of the lower compartment with the fluid supply conduit, a pair of pipes each interconnecting a port of said upper compartment with a port in said lower compartment, said pistons in the upper compartment acting as valves to interiorly and selectively interconnect pairs of ports of said upper compartment, and said reduced portions in said piston in the lower compartment acting as valves to selectively and interiorly interconnect pairs of ports of said lower compartment, and means connected with said piston in the lower compartment for actuating the reciprocal pump, and said reciprocally operated fluid pump including a vertically extending cylindrical pump housing having an enlarged cylindrical portion, a centrally disposed shaft in said pump housing, a piston affixed to said shaft in the upper portion of said pump housing, a piston affixed to said shaft in the lower portion of said pump housing, a relatively larger piston affixed to said shaft in said enlarged central portion, an inlet valve in the upper end of said enlarged portion, an inlet valve in the lower end of said enlarged portion, an upwardly opening one-way valve for the uppermost piston, a downwardly opening one-way valve for the lowermost piston, and fluid lines interconnecting the upper and lower ends of said pump housing with said fluid pressure operated means.

2. An apparatus of the character described comprising a well casing extending vertically into the ground, a cylindrical housing positioned in the lower portion of said well casing, a high pressure fluid pump mounted above ground, a fluid supply conduit extending from said high pressure fluid pump through said casing into said housing, a fluid return conduit extending from said high pressure fluid pump through said casing into said housing, a discharge pipe connected to said fluid return conduit, a reciprocally operated fluid pump in the lower end of said housing, and fluid pressure operated means mounted in said housing above said reciprocally operated fluid pump for actuating said reciprocally operated fluid pump, said means having connection with the fluid supply and fluid return conduits, and said means including a hollow cylindrical body having a centrally disposed bulkhead dividing the same into an upper and a lower compartment, a piston reciprocally mounted in said lower compartment, a vertical shaft in said upper compartment, a plurality of pistons affixed to the shaft in the upper compartment, said piston in the lower compartment having a plurality of reduced portions, said body having a plurality of ports extending to the upper compartment and a plurality of ports extending into the lower compartment, a pipe connecting one of the ports of the upper compartment with the fluid return conduit, a pipe connecting one of the ports of the upper compartment with the upper end of said reciprocal pump, a pipe connecting a port of the upper compartment with the lower end of said reciprocal pump, a pair of pipes connecting ports of the upper compartment with the fluid supply conduit, a pair of pipes connecting ports of the lower compartment with the fluid supply conduit, a pair of pipes each interconnecting a port of said upper compartment with a port in said lower compartment, said pistons in the upper compartment acting as valves to interiorly and selectively interconnect pairs of ports in said upper compartment, and said reduced portions in said piston in the lower compartment acting as valves to selectively and interiorly interconnect pairs of ports of said lower compartment, and means connected with said piston in the lower compartment for actuating the reciprocal pump, and said reciprocally operated fluid pump including a vertically extending cylindrical pump housing having an enlarged cylindrical portion, a centrally disposed shaft in said pump housing, a piston affixed to said shaft in the upper portion of said pump housing, a piston affixed to said shaft in the lower portion of said pump housing, a relatively larger piston affixed to said shaft in said enlarged central portion, an inlet valve in the upper end of said enlarged portion, an inlet valve in the lower end of said enlarged portion, an upwardly opening one-way valve for the uppermost piston, a downwardly

opening one-way valve for the lowermost piston, and fluid lines interconnecting the upper and lower end of said pump housing with said fluid pressure operated means, said last-mentioned means including a closed bottom for the piston in the lower chamber, said bottom having an opening for slidably receiving therethrough the upper end of the shaft of said reciprocal pump, a bumper affixed to the upper end of said pump shaft within the piston in said lower chamber, and a bumper affixed to the pump shaft below said bottom and in spaced relation to the first-mentioned bumper.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,857,405	Scott et al.	May 10, 1932
2,245,501	Richardson	June 10, 1941