This invention relates to improvements in vertical double action pumps and more particularly to a hydraulic pump of an improved and simplified type which is entirely practical and efficient when used for wells of any depth and which is adapted for pumping liquids of any density such as water, and different grades of crude oils, etc., which do not naturally flow to the surface owing to lack of pressure, or it may be even used for pumping with gas as motive power or compressed air as motive power, though the pump will give better results if hydraulic pressure is used, and preferably using a liquid similar to the liquid to be obtained from the well.

The present application involves the subject matter of a Mexican Patent No. 35,194, granted to me and bearing date of July 9, 1934.

There is also granted to me a Mexican Patent No. 34,943 bearing effective or legal date of April 21, 1934 in which is described a similar pump intended for the same purposes, though the pump of the present application is a modification thereof, involving certain advantageous improvements in the arrangement of the device shown in the Mexican patent were subject to deterioration, and such parts are now eliminated and replaced or augmented by others which operate automatically, thus rendering the operation and maintenance simpler and more effective, the positioning and arrangement of other parts having been arranged so as to produce greater efficiency and output. As in the case of the pump covered by my Mexican Patent 34,943 referred to above, the present pump has operating characteristics distinct from all similar pumps heretofore used and known and involves for its operation a pump or a compressor exteriorly located which will force water, petroleum or gas as the case may be, depending on the nature of the liquid it is intended to obtain from the well, into the device to operate the same, the result being to produce by any of these means the drive power to operate the improved pump at the bottom of the well.

The invention with its objects and advantages will be best understood from the following description taken in connection with the accompanying drawings, wherein:

Fig. 1 is a vertical sectional view through the entire device.

Fig. 2 is a fragmentary vertical sectional view through that part of the casing containing the operating piston and the two plugs forming the chamber for said piston, the parts being in a position with the piston moving upwardly.

Fig. 3 is a view similar to Fig. 2 but showing the piston in its upper position and with the valve members moved to a position to cause the piston to move downwardly.

Fig. 4 is a view similar to Fig. 3 but the section being taken at right angles to that of Fig. 3.

Fig. 5 is a fragmentary longitudinal sectional view of that part of the casing containing the pumping piston, the lower plug and the plug which separates the pumping chamber from the chamber containing the working or operating piston, this view also showing the pumping piston as moving upwardly.

Fig. 6 is a view similar to Fig. 5 with the section being taken at right angles to that of Fig. 5.

Fig. 7 is a fragmentary vertical sectional view showing the pumping piston with the parts in position they occupy when the piston is moved downwardly.

Fig. 8 is a fragmentary vertical sectional view through that part of the casing containing the top plug.

Fig. 9 is a section on line 9—9 of Fig. 8.

Fig. 10 is a section on line 10—10 of Fig. 6.

Fig. 11 is a section on line 11—11 of Fig. 8.

Fig. 12 is a section on line 12—12 of Fig. 6.

Fig. 13 is a section on line 13—13 of Fig. 2.

Fig. 14 is a section on line 14—14 of Fig. 4.

Fig. 15 is a section on line 15—15 of Fig. 3.

Fig. 16 is a vertical sectional view through the upper end of the main discharge pipe through which the liquid flows from the pumping chamber containing the pumping piston.

Fig. 17 is a view of the two elongated tubular valve members which are connected together.

Fig. 18 is a perspective view of one of the triggers.

Fig. 19 is a view of one of the tubular valve members of the pumping piston.

Fig. 20 is a view of the other valve member of said piston.

Fig. 21 is a fragmentary longitudinal sectional view through one of said valve members.

Fig. 22 is a view of one of the spring compression rods.

In these drawings, the letter A indicates the pump casing which is formed of a plurality of sections threaded together, the lower end of the casing being reduced and the lower part of the casing extending into the fluid to be pumped. The upper end of the casing is also reduced and a discharge pipe I is connected to the upper part of this reduced portion for leading the fluid to a tank or the like. A pipe line, a part of which is shown at 2, leads from a pump, compressor or other source of fluid under pres-
sure, through a plug 3 closing the top of the reduced upper portion of the casing into the upper portion of the wide part of the casing where the lower end of this part 2 is threaded into a stationary plug 4 which is supported in the casing in any suitable manner such as having an annular part clamped between two sections of the casing as shown in Fig. 3. The upper end of the plug is formed with a conical recess 5 terminating in a tapered threaded lower end for receiving the threaded tapered end of the part 2 of the pipe line, the conical part 5 acting as guiding means for the lower end of the part 2 to facilitate this plug forming with the plug 2 a chamber 5 for the pumping piston 6. A main discharge pipe passes through a vertically arranged hole 7 for the passage of fluid upwardly through the plug. The upper portion of the part 2 of the pipe line is offset as shown in Fig. 8 so that the lower portion of this part 2 is provided with a plug 8 located close to a portion of the internal wall of the casing and the lower end of this part 2 is threaded in a vertical passage 8 passing entirely through a plug 9 held stationary in the casing between two of the sections thereof, as shown more particularly in Fig. 8. A second plug 10 is also formed with a receiving chamber 10 between itself and the plug 4. A third plug 11 is held in a stationary manner between two of the sections of the casing and this plug with the plug 9 forms a chamber 12 for the working or operating piston 13. A second plug 14 is stationarily held in the casing between two of the lower sections thereof and this plug forms with the plug 11 a chamber 15 for the pumping piston 16.

A main discharge pipe 17 passes through a vertically arranged bore in the piston 13 and is fastened to the piston by a screw 17' as shown in Fig. 13 though if desired, this pipe 17 may be formed of upper and lower sections, the adjacent ends of which are threaded in the bore of the piston 13. The upper part of this pipe 17 extends into the chamber 10 and has a cage 18 threaded to its upper extremity in which is located a valve 19, the valve being arranged to permit fluid to discharge from the pipe 17 into the chamber 10 but prevents fluid from passing from the chamber back into the pipe. This pipe 17 has a close sliding fit in a vertical hole in the plug 9 and also a sliding close fit in a hole or bore passing through the plug 11, the lower end of said pipe 17 being threaded in the upper end of the pumping piston 16 as shown in Fig. 6, a passage 20 connecting said lower end of the pipe 17 with a chamber 21 in the piston 16. A passage 22 in the piston 16 leads from the chamber 21 through the lower end of the piston where it is in communication with a pipe 23 connected with the lower end of the piston and having a sliding close fit in a bore in the plug 14, said pipe extending into the reduced lower end of the casing and into the liquid in the well as shown in Fig. 1. A downwardly closing check valve 24 controls the passage 22. A chamber 25 intersects the passage 22 below the valve 24 and the piston 16 has a pair of vertically arranged holes 26 passing therethrough, each end of each of which has a sleeve 27 therein, the inner ends of the sleeves forming shoulders. A tubular valve closed at its inner end is located in one of the bores 26, this valve being taken at 28 and a tubular valve 29 is located in the other bore 28 and has its upper end held, the valves being limited in their vertical movement by the sleeves 27. These valves are held against rotary movement by the screws 30 threaded in holes in the piston 16 and entering grooves 31 in the valves as shown in Fig. 10, and the upper end of the chamber 21 is closed by a plug 31 as shown in Figs. 5 and 10. Each of the valves 28 and 29 has upper and lower ports 32 therein, one of which will communicate with the chamber 21 when the valve is in one position and the other one of which will communicate with the chamber 25 when the valve is in the other position and as will be seen from Figs. 5 and 7, when a port of one valve is in communication with a chamber, the corresponding port of the other valve will be out of communication with said chamber but will have its other port in communication with the opposite chamber.

A pair of elongated tubular valve members 33 and 34 are connected together adjacent their ends by the cross bars 35 shown more particularly in Fig. 17 and these tubular valve members 33 and 34 are carried with the upper portions of the bores in the piston 13 and the upper end of the tubular valve 33 has a sliding close fit in the bore 8 of the plug 9 and the upper end of the valve 34 has a sliding close fit in the vertical bore 9 in the plug 9 and located upper in the bore 8. The upper end of the bore 36 discharges into the chamber 10. A vertical chamber 37 is formed in the lower part of the plug 9 and opens out through the bottom of the plug into the chamber 12 and vertically offsets ports 38 connect the chamber 37 with intermediate parts of the bores 8 and 36. Ports 39 in the upper end of the valves 33 and 34 are adapted to register with these ports 38 when said valves 33 and 34 are in different positions. For instance, the port 39 of the valve 33 will register with the upper port 38 when the valves 33 and 34 are in their raised positions but the port 39 of the valve 34 will be out of register with the lower port 38 as shown in Fig. 5. Then when the valves 33 and 34 are in lowered position, the port 39 of valve 33 will be out of register with its port 38 while the port 39 of the valve 34 will be in register with its port 38 as shown in Fig. 2 and as the ports 38 are in communication with the chamber 37 which in turn is in communication with the upper end of the chamber 12 of piston 13, these valves 33 and 34 will control the flow of fluid into and from the upper end of the chamber 2.

The lower ends of the valves 33 and 34 extend into vertical bores in the plug 11, the lower ends of these bores being closed and a chamber 40 is formed in the plug 11 and opens out through the upper end of the plug into the chamber 12 and this chamber 40 is provided with the vertically offset ports 41 controlled by the ports 42 in the lower ends of the valves 33 and 34, the ports just described being so arranged that when an upper port of one of the valves 33 and 34 is in communication with a port 38, the port 42 of said valve is out of communication with the port 41 and when a port 42 is in communication with the port 41, a port 39 is out of communication with a port 38 as shown in Figs. 2 and 3. The piston 13 is formed with a centrally arranged vertical bore 43 in which is located a 70 spring 44 and plugs 45 close the ends of the bore 43 and have rounded heads projecting from the ends of the piston 13. A rod 46 passes slidingly through each plug 45 and has a head 47 at its inner end contacting an end of the spring and
each rod is so located that it will engage the cross bars 35 as the piston 13 nears the ends of its strokes. A spring-actuated latch 46 is pivoted to each of the plugs 9 and 11, a latch being shown in detail in Fig. 18 and each latch is provided with a shoulder 41 for engaging a cross bar 35 for holding the cross bar and therefore the valves 33 and 34 against movement towards that plug which carries the latch. Thus, as the piston 13 approaches an end of its stroke, a rod 46 will strike a cross bar 35 and as the bar 35 is held in movement by the rod 46 above the latch 46, the rod 46 is pushed inward so that its head will compress the spring and this action will continue until the piston reaches a position where a head of the plug 45 will engage the latch 46 and thus move it to releasing position and then the energy stored in the contracted spring 44 will cause the rod 46 to press the cross bar 35 and the valve members 33 and 34 towards the plug, towards which the piston 13 is moving, and therefore the valves 33 and 34 will be shifted to another position.

For instance, with the parts shown in Fig. 2, the propulsion fluid from the pipe line 2 will flow through the section 2' into the bore 8 through the valve 33 and pass from the valve through the port 42 at its lower end into the valve chamber 46 into the lower part of the chamber 12 so that the piston 13 is forced upwardly and the fluid or liquid in the chamber 12 above the piston 13 will pass therethrough and through the chamber 46 into the upper part of the chamber 10. Of course, the fluid entering the bore 8 cannot enter the upper chamber 37 as the left hand port 38 is closed as will be seen in Fig. 2. As the piston 13 nears the upper end of its stroke, the upper rod 46 will strike the upper cross piece 35 which is held against upward movement by the upper latch 46. Thus, the rod 46 will compress the spring 44 as the piston continues its upward movement and then when the head of the upper plug 45 strikes the upper latch 46, the latch will be released from the upper cross bar 35 and the energy stored in the spring will force the upper cross bar 35 and the valves 33 and 34 with the lower cross bar 35 upwardly and thus change the positions of the valves 33 and 34 as shown in Fig. 2 to that shown in Fig. 3. Then the fluid in section 2' of the pipe line will enter the bore 8 and the upper part of valve 33 as it cannot escape from the lower end of valve 33, the fluid will pass through the port 38 of valve 33, the upper port 38 in the chamber 37 and then flow from chamber 37 into the upper end of the chamber 12 so that the piston 13 will be moved downwardly. The fluid in the lower part of the chamber 12 will be forced by the downwardly moving piston 13 into the chamber 46 of plug 9 and through the right hand port 41 into the port 42 at the lower end of the valve 34 and then flows upwardly through the valve 34 and escapes from the bore 36 of plug 9 into the chamber 10. Of course, the spring 90 may be compressed as the piston 13 nears the lower end of its stroke, after which the lower latch 48 will be released by the lower plug 46 and then the valves 33 and 34 will be shifted to the position shown in Fig. 2. Thus, the piston 13 is reciprocated by the fluid flowing through the pipe line 2 and its section 2'.

As the piston 13 is reciprocated, it will impart a reciprocatory movement to the discharge pipe and as the lower end of this pipe 17 is connected with the pumping piston 16, then piston 16 will be reciprocated as well as the pipe 23.

As the piston 16 moves upwardly, it will compress the fluid above it in chamber 16 and this will move both of the valves 28 and 29 downwardly to the position they occupy in Fig. 5 so that the fluid above the piston 16 will enter the bore 26 and the valve 29 and pass through the upper port 32 of this valve 29 into the chamber 21 from which it will flow through the passage 20 into the pipe 17 and through this pipe 17, past the valve 16 into the chamber 10. Of course, this fluid will mix with the fluid passing from the bore 36 and plug 9 and which was used for reciprocating the piston 13 and this combined fluid will pass from the chamber 10 through the passages 7 in the plug 4 and up through the upper end of the casing 4 into the discharge pipe 1. Thus, it is preferable to use the same fluid for operating the piston 13 as that being pumped from the well.

As the piston 16 is moving upwardly, the lower port 32 of the valve 29 is in communication with the chamber 16 and the upwardly moving piston 16 causes a suction in that part of the chamber 15 below it so that a vacuum is created in the chamber 25 which produces a suction in the lower part of the passage 22 and in the pipe 23 so that liquid is drawn from the bottom of the well through the pipe 23 and passage 22 into the chamber 25 from which it flows into the valve 29 and from this valve it passes into the lower part of the chamber 15. Of course, when the piston 16 is moved downwardly, a suction is created in the upper part of the chamber 15 and a pressure in the lower part 15 and this downward movement reverses the positions of the valves 28 and 29, as shown in Fig. 7 so that the liquid or fluid in the lower part of the chamber 15 is forced through the valve 28, the upper port 32 thereof into the chamber 21 into which it flows into pipe 17 as before described, and the suction created in the upper part of the chamber 15 by the downward movement of piston 16 will be communicated to the chamber 26 through the lower port 32 of the piston 26 so that liquid from the well will be drawn into the upper portion of the chamber 15.

If gas or the like should occur in the well to create a pressure in the pipe 23, this pressure would force the valve 24 off its seat and thus the fluid under pressure would pass directly from the pipe 23 into the chamber 21 and from said chamber into the pipe 17.

Thus, it will be seen that the piston 13 is operated by the fluid introduced into the chamber 12 from the pipe line 2 and the reciprocation of this piston 13 is communicated to the pumping piston 16 so that the liquid or fluid is drawn from the well and discharged into the chamber 10 from which it flows through the upper part of the casing to the discharge pipe 1 which may lead to a tank or the like, the propulsion fluid for the piston 13 also discharging into the chamber 10 and flowing with the liquid from the well into the pipe 1. The main discharge pipe 17 acts as connecting means between the two pistons and the valve 34 permits discharge of fluid under pressure of the well into the discharge pipe without interfering with the pumping action of the piston 16 or with said piston interfering with the discharge of the fluid under pressure. However, when this occurs, the pump can be shut down and the well allowed to
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flow freely without necessitating any change or withdrawal of the parts of the invention, thus saving time and expense. This arrangement which includes the valve 24 will also prevent damage to the parts by a sudden rush of oil and gas as any pressure compensating the weight of the exhaust, will lift the valve 24. As soon as the flow of liquid or fluid under pressure ceases, then the pump can be started up without any delay or changing any parts.

The specific means of holding the various plugs in place by the threaded ends of the casing section will provide a smooth exterior for the casing which will permit greater internal diameter and avoid any shoulder trouble when inserting the casing into a well or drawing the casing from the well.

Attention is called to the fact that the valves of the pumping piston 16 are operated wholly by the pressure of fluid in the chamber 15 so that the operation of the valves is entirely automatic.

The device will provide a constant circulation or discharge of the fluid from the well so that any foreign matter such as sand in the fluid pumped from the well will readily pass with the fluid to the discharge and thus not collect in any of the parts to cause trouble. The elongated tubular valves not only act as valves but they also serve as conduits for the fluid and the valves 33 and 34 also act in conjunction with the pipe 17 as guiltes for the piston 13.

This invention also completely eliminates the pumping rod, walking beams and pull rods and the like and the means for operating the same and the invention can be used in crooked holes as well as straight holes. The invention can also be used in wells containing paraffin but in this case, the fluid used for operating the piston 13 should be hot, such as hot oil, so the paraffin will be melted and pass with the oil to the tanks. This invention can also be used on wells deeper than wells where the rod pumping system can be used as the column of fluid used for operating the piston 13 will weigh the same as the exhaust column, so that there is no back pressure to overcome and no dead weight to deal with as in the case of the rod system which can only stand a certain amount of weight on the rod string. Another advantage of the invention is that no matter how slow it operates, it will not stop if disarranged because the tubular distribution valves operate simultaneously and change positions in a snap fashion by means of the triggers and the spring means.

So by using the proper sizes of headed plugs 45, the parts can be adjusted to operate with absolute precision. It is thought from the foregoing description that the advantages and novel features of the invention will be readily apparent.

It is to be understood that changes may be made in the construction and in the combination and arrangement of the several parts, provided that such changes fall within the scope of the appended claims.

I claim:

1. In a pumping apparatus of the class described, a pump chamber, a discharge pipe extending into the chamber, a piston in the chamber, means for reciprocating the piston, said piston having upper and lower chambers therein, a discharge conduit connected with the upper chamber and with the discharge pipe and said piston having a pair of vertically arranged bores therein, a sliding elongated tubular valve in each bore, one having its lower end closed and the other having its upper end closed, a conduit connecting the lower chamber with the fluid to be pumped, each of the upper and lower chambers being in communication with the bores and each valve having upper and lower ports therein, the upper one of which communicates with the upper chamber while the lower one is out of communication with the lower chamber and the upper port of the other valve being out of communication with the upper chamber when the upper port of the other valve is in communication with the chamber and vice versa, said valves being moved by the fluid being pumped.

2. In a pumping apparatus of the class described, a pump chamber, a discharge pipe extending into the chamber, a piston in the chamber, means for reciprocating the piston, said piston having upper and lower chambers therein, a discharge conduit connected with the upper chamber and with the discharge pipe and said piston having a pair of vertically arranged bores therein, a sliding elongated tubular valve in each bore, one having its lower end closed and the other having its upper end closed, a conduit connecting the lower chamber with the fluid to be pumped, each of the upper and lower chambers being in communication with the bores and each valve having upper and lower ports therein, the upper one of which communicates with the upper chamber while the lower one is out of communication with the lower chamber and the upper port of the other valve being out of communication with the upper chamber when the upper port of the other valve is in communication with the chamber and vice versa, said valves being moved by the fluid being pumped.

3. A pumping apparatus of the class described, a pump chamber, a piston therein, means for reciprocating the piston, a discharge pipe connected with the piston, a suction pipe connected with the piston and a conduit between the suction pipe and the discharge pipe, said suction pipe having a pair of vertically arranged bores in communication with the suction pipe, said piston having vertically arranged bores therein in communication with the chambers of the piston, an elongated tubular valve in each bore, one valve having its lower end closed and its upper end open and the other valve having its upper end closed and its lower end open, each valve having a pair of ports therein, one for communicating with the upper chamber when the other is out of communication with the lower chamber and vice versa, said valves being operated by the fluid being pumped.

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