P. J. GILDEA.

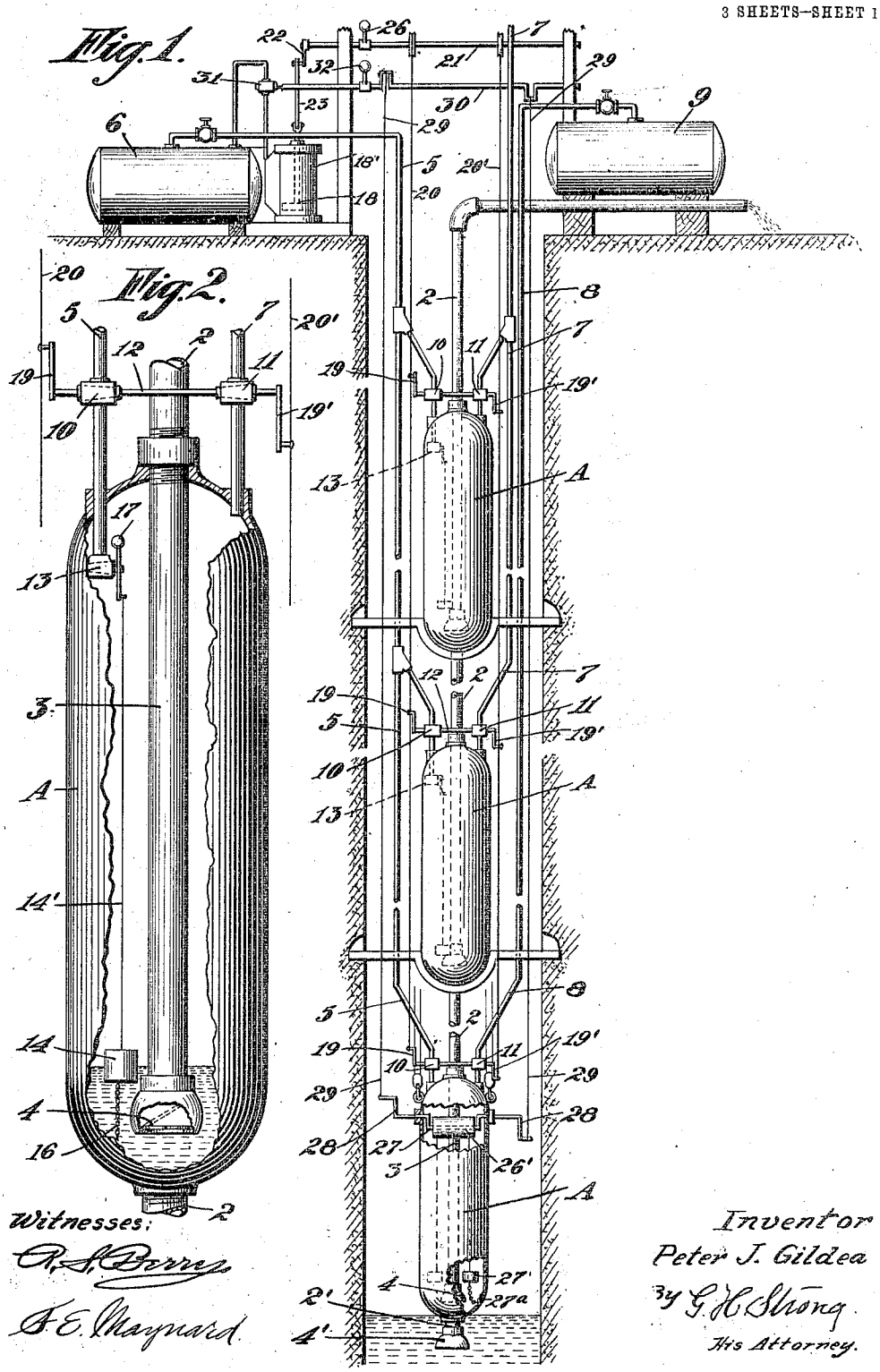
DEEP WELL PUMP.

APPLICATION FILED JUNE 1, 1910.

995,248. Patented June 13, 1911.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

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3 SHEETS—SHEET 2.

Fig. 3.

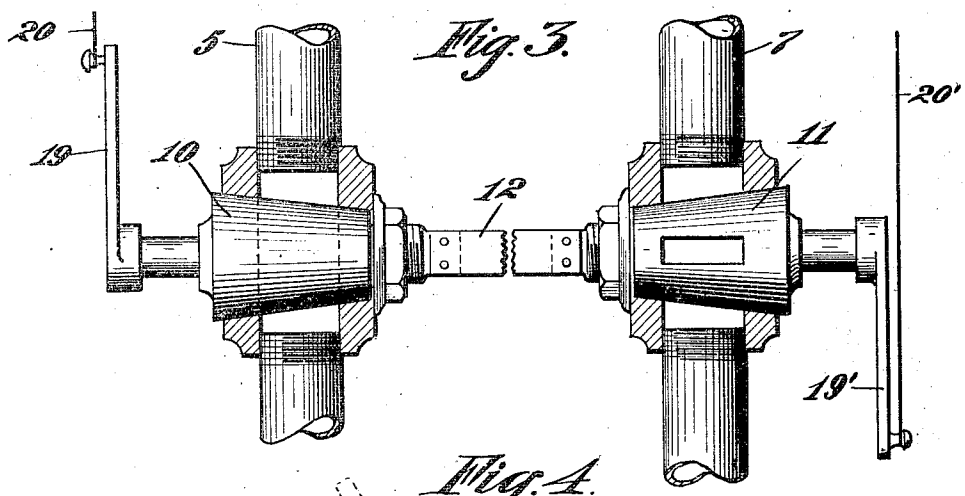
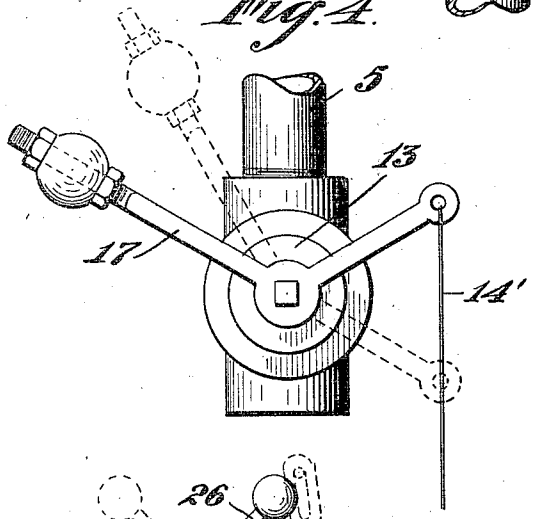


Fig. 4.



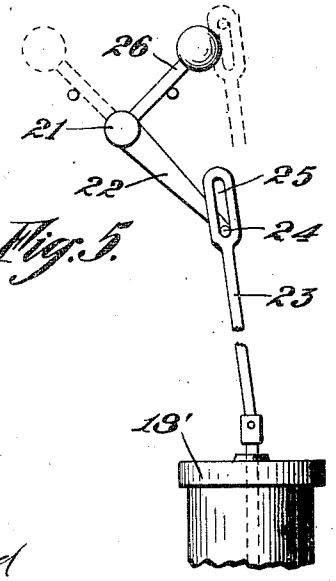


Fig. 5.

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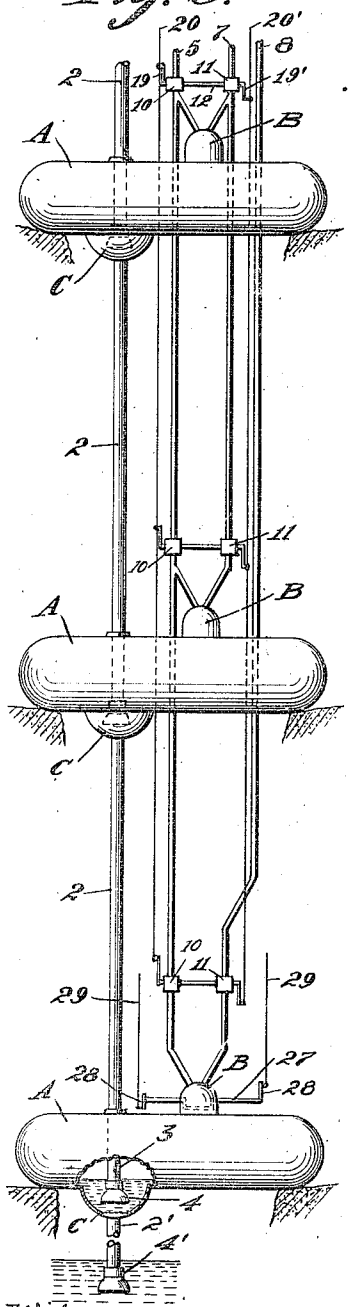
3 SHEETS—SHEET 3.

Fig. 6.



Witnesses;

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Fig. 7.

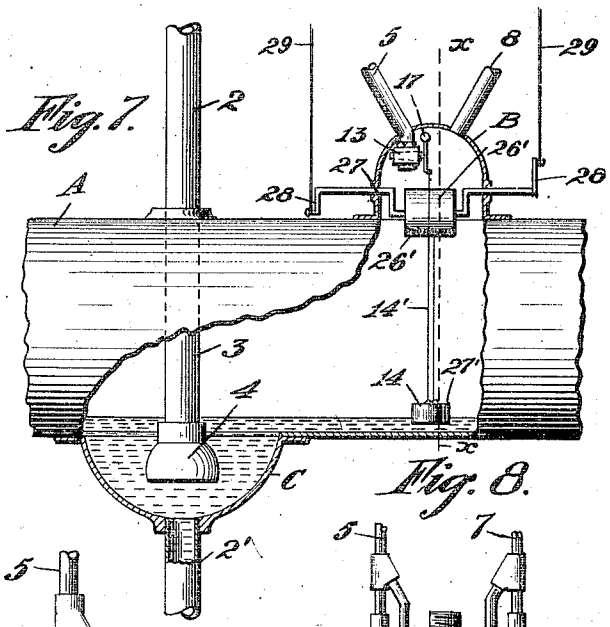
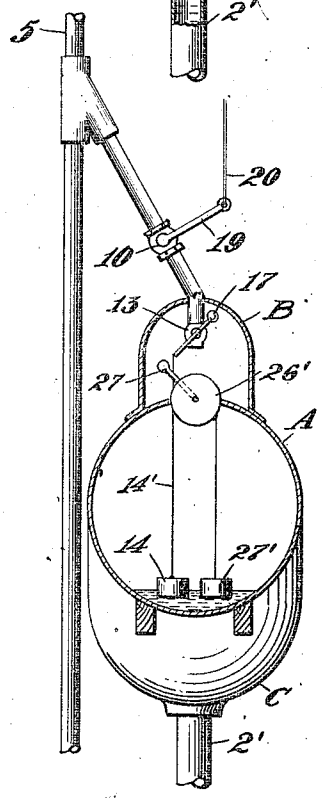
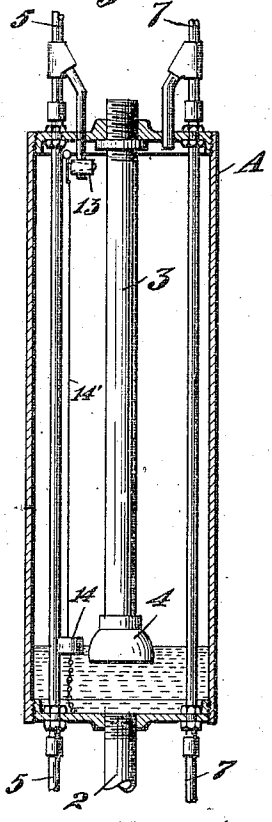


Fig. 8.

Fig. 9.





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UNITED STATES PATENT OFFICE.

PETER J. GILDEA, OF SAN FRANCISCO, CALIFORNIA.

DEEP-WELL PUMP.

995,248. Specification of Letters Patent. Patented June 13, 1911.

Application filed June 1, 1910. Serial No. 564,469.

To all whom it may concern:

Be it known that I, PETER J. GILDEA, citizen of the United States, residing in the city and county of San Francisco and State of California, have invented new and useful Improvements in Deep-Well Pumps, of which the following is a specification.

This invention relates to pumps, and particularly pertains to a pump for raising liquid in large volumes from great depth, such as is employed in mining operations and the like, and where the liquids are pumped in stages from one level to another.

It is the object of this invention to provide a deep well pump which is automatic in operation, simple in construction, and which has a large capacity and a high degree of efficiency.

A further object is to provide means by which large volumes of water, oil, and the like can be pumped and raised from a considerable depth by the combined use of compressed air and vacuum and means by which the air and vacuum may be handled automatically.

The invention consists of the parts and the construction and combination of parts which will be more fully explained by reference to the accompanying drawings, in which—

Figure 1 is an elevational view of the invention as applied. Fig. 2 is a detail of a pump section with parts broken away. Fig. 3 is a detail of the double valve. Fig. 4 is a detail of a cutoff valve. Fig. 5 is a detail of a valve actuating mechanism. Fig. 6 is a modified form of the invention. Fig. 7 is a detail of a pump section shown in Fig. 6, with parts broken away. Fig. 8 shows a form of constructing the pump sections when used in well casings of small diameter. Fig. 9 is a section on the line X—X, Fig. 7.

In the embodiment of my invention, as shown in Fig. 1, I employ a series of cylinders A, of any suitable number, which are disposed at suitable intervals or levels in a well casing or mine shaft at equal distances apart, and are connected together by pipes 2, as later described, with the lowermost cylinder contacting or wholly submerged in the liquid to be pumped. All of the pump cylinders A are of substantially the same construction, but it is necessary that the lower cylinder be provided with several attachments that are not employed in those above, which attachments will be described later in the description of the operation. Each cylinder A has a discharge pipe 3, leading from its upper end downward into the interior of the cylinder and terminating near the bottom thereof. The lower end of each pipe 3 is provided with a foot valve 4, of the ordinary flap valve type, which opens upward, or any other suitable valve may be employed. Each pipe 3 connects at its upper end with the conducting pipe 2, which leads up to and connects with the lower end of the next cylinder above, or in the case of the upper cylinder, leads to any suitable point of discharge. A compressed air feed pipe 5 leading from any suitable reservoir 6 or other source of air supply, extends downwardly and terminates in the top of the lower cylinder A, branches from this pipe 5 connecting with the upper end of each of the cylinders A in the series, for the purpose of admitting air under pressure to the cylinders, as later described. A vent pipe 7 connects with the top of each of the cylinders A, except the lower cylinder, and is disposed parallel with the air feed pipe 5. A suction pipe 8 connects with the lower cylinder A, and a vacuum tank 9 situated near the mouth of the well or shaft through which the air in the lower tank A may be drawn off and a vacuum created therein.

Cut-off valves 10—11 are provided in the pipes 5—8 or 5—7, respectively, at a point near their connections with the cylinders A, and are so disposed that the plugs of the valves 10—11 may be joined together by a bar or rod 12 extending from one valve to the other, so as to permit the valves 10—11 to operate in unison. These valves 10—11, while operating in unison, perform opposite functions, that is to say, the valve 10 is open to the air line 5 while the valves 11 are closed to the vent pipe 7 and vacuum pipe 8. Any suitable type of valve may be used. A supplementary cut-off valve 13 is disposed on the end of the pipe 5 where it extends into a cylinder A, which is designed to be automatically opened and closed independent of the valve 10 thereabove. This is accomplished by means of a float 14, suspended by a cord 14′ from a lever on the valve plug, the float opening the valve as it rises and closing it as it falls. The upward movement of the float 14 is limited by a chain 16

so as to insure the plug in the valve 13 not turning too far, and a weighted arm 17 is provided on the valve plug to insure its opening a sufficient distance as the float 14 rises. The float 14 and the weighted arm are balanced so as to operate smoothly and in accord. The valves 10 and 11 are designed to be operated automatically from above by means of a piston 18 in a cylinder 18′ operated from the compressed air supply 6. A crank 19—19′ is mounted on each valve 10—11, and a cord 20—20′, connecting with each crank 19—19′ leads upward to the top of the well or shaft and is attached to cranks on a crank shaft 21, which in turn is connected to the rod of the piston 18 by a crank arm 22, and a link 23, in such manner as to transmit a rocking movement to the crank shaft 21 as the piston 18 reciprocates. The link 23 is pivoted at one end to the rod of the piston 18, and is connected to the crank arm 22 by means of a pin 24 on the latter, which extends through a slot 25 on the upper end of the link 23, as shown in Fig. 5. A weighted arm 26 is so mounted on the crank shaft 21 that when the shaft is rocked or turned from side to side by the piston 18, the weight 26 will pass from one side of the center of the shaft 21 to the other, and on passing to either side will cause the movement of the shaft 21 to quicken, which movement is permitted by the slotted connection between the crank arm 22 and the link 23.

The operation of the invention is as follows: Assume the cylinders A to be empty, that is containing no fluid, but air, and the lowermost cylinder in contact with the liquid to be pumped; water being the commonest liquid will be spoken of as the medium being handled. A normally closed foot valve 4′ is provided on the lower end of the lower tank or cylinder A or on a pipe 2′ extending downward therefrom. This valve 4′ must be submerged in the water to be pumped. The valve 10 on the air pipe 5 above the lower cylinder A being closed, the valve 11 on the vacuum pipe 8 is open. The air in the lower tank A can now be drawn out through the vacuum pipe 7, which action creates a suction in the lower cylinder A, causing the water to be drawn through the foot valve 4′ into the interior of the cylinder until the valve 11 is closed. This is accomplished automatically by means of a float 26′ mounted on a crank on a shaft 27 extending through the upper portion of the lower cylinder A, in such manner that as the float 26′ is lifted by the water in the cylinder A it will rotate the shaft 27. Crank arms 28 mounted on the shaft 27 exterior of the cylinder A rotate with the shaft 27 and act upon cords 29, which extend upward to the top of the shaft and connect with a crank shaft 30, to rotate the latter in unison with the shaft 27 in the lower cylinder A. The outer end of the crank shaft 30 connects with an ordinary admission valve 31, which is disposed in the air supply pipe leading from the reservoir 6 to the cylinder 18′. As the crank shaft 30 is revolved by the float on the shaft 27, the valve 31 is opened to admit air under pressure to the cylinder 18′, which causes the piston 18 to rise and rotate the shaft 21 to close the valve 11 and open the valve 10. The opening of the valve 10 admits air under pressure to the lower cylinder A above the water therein, which forces the water downward in the cylinder and upward through the foot valve 4 into the pipes 3—2, the foot valve 4′ on the lower tank closing to prevent the water returning to the well. Water is thus conveyed from the lower cylinder A to the next cylinder above, the vent valve 11 in this cylinder being open to allow the air in the cylinder to escape while the water enters the lower end of the cylinder from the pipe 2. The second cylinder A becomes filled the moment the lower cylinder empties, and as the float 26′ falls and operates the valves 10—11, through the piston 18, as before described, the vent valve 11 is closed and the air inlet valve 10 is opened so as to admit air under pressure to the second cylinder A, which forces the water therein upward through the pipes 3—2 to the next cylinder above, and so on until the water is discharged.

From the foregoing, it will be seen that the cylinders operate in pairs, one emptying while the other is filling. In order to admit of this alternate action it is necessary that the valves 10 be connected to the cord 20 in such manner that adjacent valves will be operated alternately, that is, one valve remaining open while the next one adjoining is closed. The valves 11 will, of course, be mounted and operated in a similar manner.

As a means of preventing the float 26′ dropping so as to operate the valves 10—11 when the water in the lower cylinder A falls below their level, a weighted arm 32 is mounted on the crank shaft 30 in such manner as to counterbalance the float 27 and hold it in its uppermost position, and at the same time retain the valves 10—11 in their proper relative open and closed positions. An auxiliary float 27′ is suspended on a flexible cord from the float 26′, and is limited in its upward movement by a chain 27ª. This float is weighted so as to overbalance the weighted arm 32, and when the water in the lower tank A falls below the weighted float 27′ the latter moves downwardly, pulling the float 27 back to its lowermost position and throwing the weighted arm 32 to the opposite side of the center of the shaft 30 in the same manner as that described in relation to the weighted arm 26

on the shaft 21. The valve 13, before described, on the lower end of the air supply pipe 5 in each of the cylinders A is provided for the purpose of shutting off the incoming air at a moment when the water in the cylinder is forced downward to a certain level, thus preventing the water being forced below the foot valves 4.

It is obvious that the cylinders A may be disposed horizontally instead of vertically, where the width of the shaft will admit. In this case the invention would be constructed in the form shown in Figs. 6 and 7, in which the air supply and vent pipes would lead to a dome B on the cylinders A, and the crank shaft 27 and float 26′ would be mounted therein. The foot valve on the pipe 3 would extend into a pocket or trap C on the under side of the cylinders A, and the upper ends of the pipe 2 will connect with the pocket C at the lowest point. This pocket or trap C admits of the tank A being emptied without unsealing the valve 4.

Where the invention is applied to wells having narrow casings, the cylinder A may be constructed as shown in Fig. 8, in which form the air pipes 5 and vent pipe 7 pass through the interior of the cylinder A, thereby not taking up so much room as in the constructions previously described.

In practice, the lower cylinder A in the series, is connected to the cylinder above by flexible connections, and a portion of the air pipe and vacuum pipe adjacent the lower cylinder can also be flexible so as to admit of the lower cylinder being raised or lowered. A block and tackle arrangement is provided, whereby the position of the lower cylinder may be adjusted and raised or lowered to a desired degree. In the event the lower cylinder A can be wholly submerged in the water, the vacuum tank 9 can be dispensed with if desired as the water would flow into the cylinder through the valve 4′ and seek its normal level therein. The tanks are preferably spaced at equal distances apart so that even air pressure will operate each tank alike and thereby produce a uniform flow or discharge from the pump. Each tank in the series may be a trifle larger in size than the next one below so as to insure it containing all the charge delivered therefrom, and the apparatus may be worked at any angle by connecting the pipes to the tanks at advantageous points. As the air piston 28 is supplemental power for actuating the valves 10—11, it is obvious that electric or steam power may be employed for that purpose, and where the floats 26′ can be made large enough to operate the valves, supplemental power is not required and may be dispensed with altogether.

When it is desired to use this pump as it is shown in Fig. 6, in a shaft that is in process of sinking, the lower section shown in Fig. 1 may be used, as it is much easier to lower or extend downward.

Having thus described my invention, what I claim and desire to secure by Letters-Patent, is—

1. An apparatus to raise liquids, said apparatus comprising a series of superposed spaced cylinders or receivers, with connecting pipes and check and foot valves, means to fill the lowermost cylinder, connections through which air under pressure is introduced above the surface of the liquid to force the liquid successively from each cylinder to the one above, a valve-controlled air supply to said pressure connections, and means controlled by the level of the liquid in a cylinder for opening the air supply valve to admit air to said pressure connections.

2. An apparatus to raise liquids, said apparatus consisting of a series of superposed spaced cylinders or receivers, with connecting pipes and check and foot valves, a vacuum chamber connected with the lowermost cylinder to exhaust the air and permit the cylinder to fill with liquid, an air pressure device having connections with all the cylinders whereby liquid may be transferred upwardly from one cylinder to another, said connections including a pair of connected valves for each cylinder, float-actuated means controlling the air supply to a cylinder, and means actuated by the air-pressure for opening the air valve to the cylinder coördinately with the closing of the exhaust valve of the cylinder.

3. An apparatus to raise liquids, said apparatus consisting of a series of superposed spaced cylinders or receivers, with connecting pipes and check and foot valves, a vacuum chamber connected with the lowermost cylinder to exhaust the air and permit the cylinder to fill with liquid, an air pressure device having connections with all the cylinders whereby liquid may be transferred upwardly from one cylinder to another, a valve controlled air-supply to said presure device, means controlled by the level of the liquid in the cylinder for opening the air-supply valve to admit air to said air-pressure device, and means to allow the escape of air from each cylinder while being filled.

4. An apparatus to raise liquids, said apparatus comprising a series of superposed spaced cylinders or receivers, with connecting pipes and check and foot valves, a pipe connecting with the cylinders, an air supply-pipe, a pressure device connected thereto and to the first-named pipe, a valve controlling the air-supply pipe, and means controlled by the level of the liquid in a lower cylinder for opening the air supply to admit air to the said first-named pipe.

5. An apparatus to raise liquids, said apparatus, consisting of a series of superposed spaced cylinders or receivers, with connecting pipes and check and foot valves, an air supply pipe connecting with the lowermost cylinder and branches from said pipe connecting with the other cylinders, said pipes adapted to admit air pressure to transfer the liquid from each cylinder to the one above, air vent pipes connecting with each cylinder, valves operable in unison to alternately open and close the air pressure and vent passages of each cylinder, float actuating mechanism to automatically open and close the valves, a valve-controlled air supply connecting with said supply pipe, and means controlled by the level of the liquid in the lowermost cylinder for opening the air supply to admit air under pressure to said supply pipe.

6. An apparatus to raise liquids, said apparatus consisting of a series of superposed spaced cylinders or receivers, with connecting pipes and check and foot valves, means to apply air pressure to transfer the liquid from each cylinder to the one above, air vent pipes connecting with each cylinder, valves operable in unison to alternately open and close the air pressure and vent passages of each cylinder, crank arms upon the valve shafts, a weighted rising and falling float in the lower cylinder, and flexible cords or connections between the cranks and the float.

7. In a fluid elevating apparatus, the combination of a cylinder or receiver having an air-supply pipe connecting with the upper portion thereof, and a valved discharge, a valve in the supply pipe, a single stem directly connecting the air-supply and discharge valves, said valves being axially in line, a float in the cylinder for operating the valves in unison alternately to open and close the air-pressure and vent passages of the cylinder, a main air-supply having a controlling valve, and means controlled by the level of the liquid in the cylinder for opening the air-supply to admit air to the cylinder.

8. In a fluid elevating apparatus, a cylinder or receiver having a valved intake pipe and a valved discharge pipe, a pipe through which the air in the cylinder may be exhausted, to allow liquid to enter the cylinder through the valved intake pipe, means for delivering air under pressure to said tank to force the liquid out through the valved discharge pipe, coacting exhaust and pressure valves, means to simultaneously close one and open the other, said means including a float, a cranked valve actuating shaft turned by the rise and fall of the float, a cylinder with a pressure moved piston, and connections between said piston and the valves.

9. A fluid elevating apparatus comprising a plurality of cylinders or receivers connected in series and adapted to be lowered in a well, a liquid intake at the bottom of each cylinder, a valve discharge pipe extending into the interior of each cylinder and terminating near the bottom thereof, a valved vent pipe leading from each cylinder, a main supply pipe connecting with the cylinders, each of said cylinders having a valve controlling the admission of air thereto, said last-named valve and the valve in the vent pipe of the same cylinder being axially in line and connected to operate in unison, a main air-supply and a valve controlling the same, and means controlled by the level of the liquid in one cylinder for opening the air-supply to admit air to the supply pipe.

10. In a liquid elevating apparatus, the combination of a cylinder or tank, with a liquid inlet at the bottom of said tank, a discharge pipe extending into and terminating near the bottom of said tank, a foot valve in the lower end of said discharge pipe, a conducting pipe connecting with the upper end of said tank and said discharge pipe, a pipe connected to the top of said tank for admitting air under pressure thereto, a vent pipe for discharging air from said tank, a pair of connected cut-off valves in said feed and vent pipes, and means controlled by the level of the liquid in a cylinder for automatically operating said cut-off valves simultaneously so that one will open as the other closes.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

PETER J. GILDEA.

Witnesses:
CHARLES A. PENFIELD,
E. G. BLASDEL.