(No Model.)

H. O. THOMAS.

DOUBLE ACTING PUMP.

No. 546,362. Patented Sept. 17, 1895.

Fig. 1.

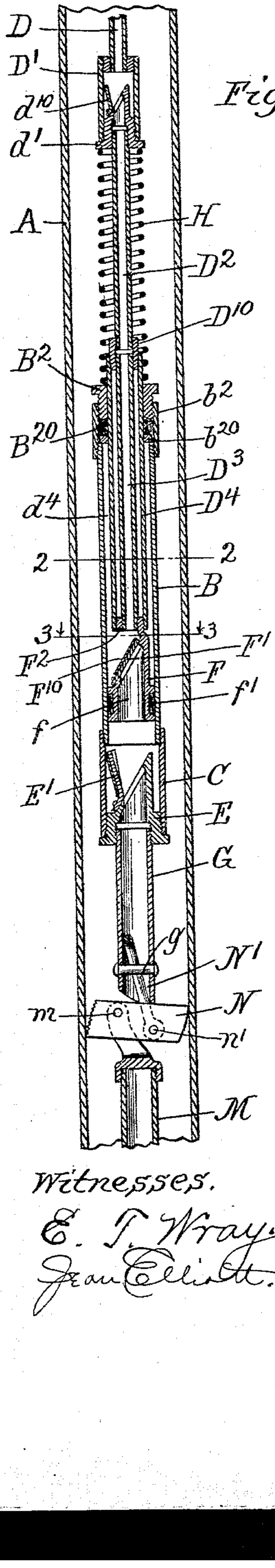


Fig. 4.

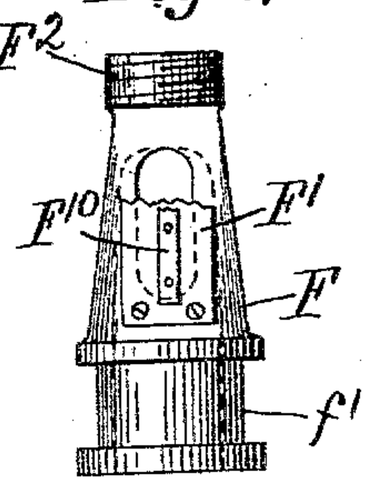
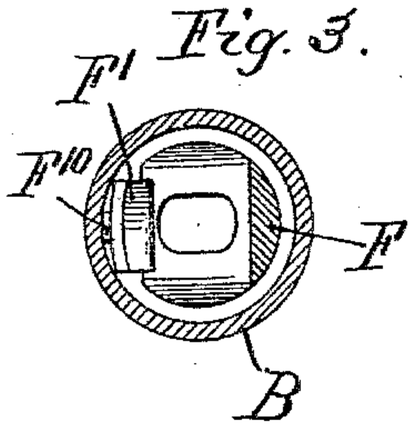


Fig. 3.



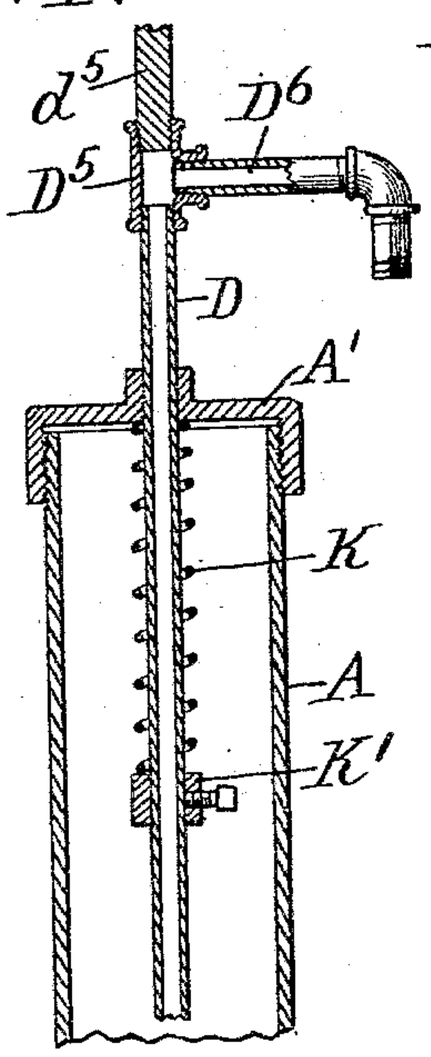
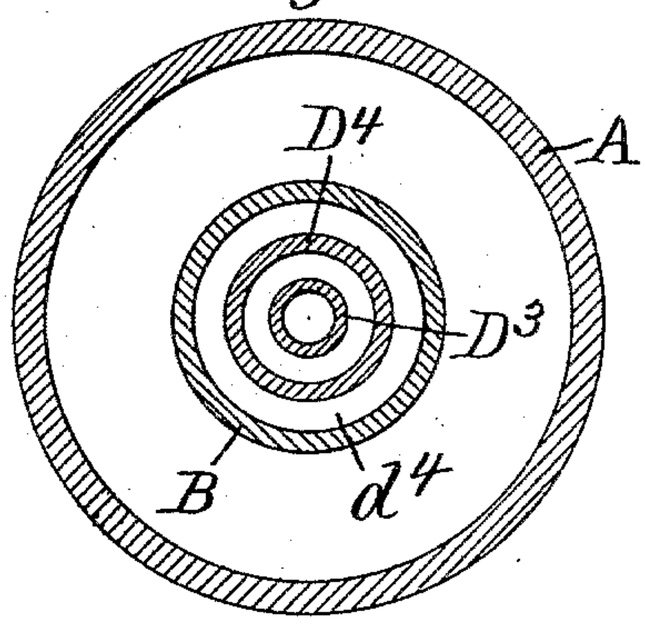


Fig. 2.



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UNITED STATES PATENT OFFICE.

HENRY O. THOMAS, OF CHICAGO, ILLINOIS.

DOUBLE-ACTING PUMP.

SPECIFICATION forming part of Letters Patent No. 546,362, dated September 17, 1895.

Application filed November 30, 1894. Serial No. 530,321. (No model.)

To all whom it may concern:

Be it known that I, HENRY O. THOMAS, a citizen of the United States, residing at Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Double-Acting Pumps, which are fully set forth in the following specification, reference being had to the accompanying drawings, forming a part thereof.

In the drawings, Figure 1 is a vertical section of a well-casing and the pump mechanism therein embodying my invention. This figure is broken, the upper part being set off alongside the lower by reason of the limitations of the length of the sheet. Fig. 2 is a detail section, upon an enlarged scale, at the line 2 2 on Fig. 1. Fig. 3 is a section at the line 3 3 on Fig. 1. Fig. 4 is a side elevation of the pump-piston on a larger scale than Fig. 1, the valve therein being partly broken away to show the seat and port.

This invention is designed to afford a pump which can be inserted in a driven or drilled well within the usual casing thereof, and it comprises devices for setting and locking the intake-pipe and piston chamber or cylinder at the proper position in the bottom of the well, so that the mechanism of the pump shall not either rest upon the rock or ground at the bottom or hang from its upper end on the top of the well-casing, the first method being faulty and unavailable in cases in which the bore ends in quicksand or other earth of insufficient solidity to support the entire weight of the pump mechanism and pipes and the second method being incompatible with the intended mode of operation of my device, as well as objectionable because of the danger of rupture to which any tubing long enough to be thus hung at the top of a deep well would be exposed by reason of the weight which it would have to carry. In other respects my invention is designed to produce a double-acting pump without involving operating parts in addition to discharge pipe or pipes and necessary valves—that is to say, I make the discharge-pipe serve as the connection for operating the piston.

Another feature of my invention involves and depends upon the use of compensating springs adapted to hold the piston normally at the middle of the stroke in the cylinder, so that the work to be done in giving the stroke in each direction is substantially the same so far as it depends upon the weight of the piston and its operating connections.

A represents a well-casing. It will be understood that if my pump were operated in an open well the well-casing is immaterial except in so far and as to so much as might be necessary to give a support to the lower end of the pump-tube.

B is the pump-cylinder.

C is a coupling which constitutes the walls of a chamber for an upwardly-opening check-valve E′, which is mounted and seats on a fitting E, which the coupling C connects to the cylinder B at the lower end of the latter.

G is a pipe screwed into the lower end of the fitting E, constituting a downward continuation of a pump-tube or water-way, said pipe being open at the lower end to admit the water and having the function of leading the water up to the valve E′. The upper end of the cylinder B is provided with a stuffing-box, through which the piston-stem, hereinafter described, reciprocates water-tight. This stuffing-box or piston-stem bearing is made up by means of the coupling b^2, screwed onto the upper end of the cylinder, inside the coupling, and the stuffing-box or packing-nut B^2, which is screwed into the upper end of the coupling b^2 and is adapted to compress the packing B^{20}. Without regard to the operation of the piston and discharge-pipe in connection with this cylinder it is adapted to be stopped and set in the well by means of a clutch device connected to the lower end of the water-way, of which the cylinder is a part and of which the lower section or piece is the pipe G. This clutching device comprises a bar N, which is of the nature of a link in that it constitutes part of a loose connection between the pipe G and a part M, which I term a "pilot-rod." This pilot-rod is pivotally connected to the clutch-link N at *m*, and a link N′, pivoted to said clutch-link at *n*,′ is loosely connected to the lower end of the pipe G, the specific form of connection being that the said link N′, which is an open loop, passes up freely into the pipe G, and a rivet *g*, inserted through said pipe and through the loop, prevents its escape, while permitting some longitudinal play and perfectly free pivotal

movement. When the cylinder, with the parts connected below it, as described, is dropped into the well, the weight of the pilot causes the clutch-link N to be held approximately lengthwise, the loop-link N′ hanging on the rivet *g*. When the pilot M reaches the bottom of the well, even though that bottom should be quicksand of so loose a character that the entire weight of the parts above would be sufficient to drive the pilot down into or through it, nevertheless if it is of sufficient density to support the weight of the pilot M the latter will be arrested by it, and the further downward movement of the parts above will cause the clutch-link N to be turned crosswise of the tube or casing A, and its dimensions being such that when thus turned crosswise it binds in the pipe and becomes a stop against further downward movement of the cylinder and any parts which can be connected with it above, and becoming set tightly by the further pressure of said parts, it fixes the position of the cylinder. In order to render its operation more secure, the end of the clutch-link N nearest where the pilot M is pivoted is preferably serrated, so that it will bite the casing A when it touches it. The other end, being smooth, serves merely to cause the clutch-link to be more tightly wedged as that end is pushed down, but does not prevent it from being pulled up and thereby releasing the clutch when desired. Since the clutch N can be most readily released by a quick tap or blow upward at the smooth end, I provide for its receiving such a blow instead of a steady pull when it is to be released by the form of the loop-link N′, which is adapted to move longitudinally in the pipe G a short distance before being stopped by encountering the rivet *g*.

F is the piston-head, adapted to reciprocate in the cylinder B, having a suitable seat for a water-tight packing *f′*, and having a central opening *f* for a water-way, and being cut away at an oblique angle to form the seat for the upwardly-opening valve F′, which is hinged to said seat at the lower edge and opened by swinging from oblique to substantially vertical position, in which latter position it leaves a direct water-way open upward, and this water-way is adapted to be the full size of the water-way below the valve-seat and to be direct—that is, without change of direction—because the valve F′, made of suitable heavy leather, is stiffened longitudinally—that is, from its hinge to its opposite edge—by a metal bar F^{10}, but is left free to fold transversely, so that when it is forced open by the upwardly-moving current of water it accommodates itself to the curved wall of the cylinder, against which it is thrown in opening, and leaves the cylindrical water-way through the piston-head absolutely unimpeded by reason of the valve. The piston terminates a tubular stem, which is also the discharge-pipe of the pump. This stem comprises the upper section D, which is shown as connected by a T-fitting D^5 to a solid stem d^5, extending upward, by which it may be operated by suitable mechanism or by hand, and to a horizontal discharge-stop D^6, which may have a downwardly-turned end for the discharge, as illustrated, for convenience. This section D passes through the cap A′, which closes the upper end of the well-casing A. Such cap, however, may represent generally any suitable guide-bearing for the upper section of the stem, rendered fixed in position in any suitable way and not necessarily by means of attachment, as a cap or otherwise, to a well-casing. At any convenient point in the well I connect the section D by coupling D′ and a valve-fitting *d′* to the next lower section D^2. This coupling and valve-fitting D′ *d′* are interposed for two purposes—in the first place, to serve as an upward stop for a spring H, whose function is hereinafter explained, and, second, to afford opportunity for a check-valve d^{10}, for which the coupling D′ serves as a chamber, and which, especially in deep wells, is desirable in order to divide with the piston-valve of the pump the responsibility of holding the column of water in the discharge-pipe, which might otherwise be more likely to force the joints in the parts below and cause excessive waste by leakage. The lowest section of the piston-stem and discharge-pipe comprises a section of pipe D^3, of the same size as D and D^2 and coupled to D^2 by a coupling D^{10}, which is interiorly threaded for the purpose of such connection in the usual manner, and also a section D^4, which is large enough to inclose the section D^3 and to be screwed onto the coupling D^{10}. The piston F terminates at the upper end in an annular boss F^2, which is threaded interiorly and adapted to have the inner section D^3 of the stem screwed into it, the outer diameter of said boss being such that the outer section D^4 of the stem fits accurately about it, and the parts may be screwed together at that point. It will be observed that this construction makes the lower end of the stem and discharge-pipe double—that is, provided with hollow walls—and this portion of the stem passes water-tight through the stuffing-box, already described, which terminates the cylinder at its upper end. It may be now understood that when the piston is first lifted from the lower limit of its stroke in the cylinder, at which it is shown in Fig. 1, water will be drawn in by suction or atmospheric pressure past the check-valve E′ and will fill the cylinder below the piston. When the piston, having been lifted to the upper limit of its stroke, is depressed, the water in the cylinder, passing by the valve F′, will occupy the annular space d^4 within the cylinder around the outer section D^4 of the hollow-walled stem, and so much of the water contents of the cylinder as cannot be accommodated in this annular space will occupy the discharge-passage in the stem, extending up thereinto to whatever height may be necessary to accommodate so much of the water as does not find accommodation in the annular space d^4. It will be seen that the

column thus compelled to occupy the central cavity of the discharge-pipe and stem will be higher than the water-level in the piston at the upper limit of the stroke of the latter by so much as the water displaced from the cylinder by the hollow-walled lower section of the discharge-pipe makes necessary. I design the displacement of this portion of the piston-stem and discharge-pipe to be half the water capacity of the cylinder, so that one-half the water drawn into the cylinder at its upward stroke will be displaced therefrom and forced upward within the discharge-pipe above the height at which it stood before the downward stroke of the piston commenced. The next upward stroke of the piston evidently will force the water that was in the annular space d^4 out therefrom, compelling it to enter the central cavity of the stem and discharge-pipe, raising the column in the latter by so much, and this entire column, it will be evident, is also lifted bodily at the same time the distance of the full upward stroke of the piston, so that at this upward stroke the water column is raised in the discharge-pipe, or the water is discharged therefrom at the upper end, to an extent equal to the other half of the capacity of the cylinder—that is, of the amount of water drawn into the cylinder at each upward stroke. I thereby produce a double-acting pump—that is, a pump which discharges upon each upstroke and each downstroke—and, provided the displacement of the portion of the piston-stem which intrudes into the cylinder at each downstroke is equal to half the capacity, as described, the discharge of water at each stroke is equal. I aim, however, by my invention not only to equalize the result produced in the discharge of water at each stroke in each direction, but also to equalize so far as possible the work done at each stroke. In so far as the work depends upon the height of water lifted, this is accomplished by the construction already described; but there is to be considered, further, the dead-weight of the entire piston and its stem, which constitutes the discharge-pipe. In the absence of any special provision to the contrary the work of lifting this weight will be added to the work on the upstroke, and the value of its weight as a motive power will be subtracted from the work to be done on the downstroke. In order to equalize the strokes in this respect, therefore, I provide the springs H and K. The spring H is stopped downwardly upon the upper end of the cylinder and is stopped upwardly by the flange of the valve-fitting d', which bushes the lower end of the coupling D′, or, virtually, the piston is stopped by the coupling. This spring is adapted in length, tension, &c., to sustain the weight of the piston and stem, and in the absence of the spring K it will hold the piston at the upper limit of its stroke. With this spring alone it would be necessary to do more work on the downstroke than upon the upstroke, and I compensate it, therefore, by the spring K, which is stopped by the collar K′ at the lower end and by any fixed stop, as the cap A′, at the upper end. This spring is adapted in length and tension to counteract the spring H to the extent of forcing the piston down to the middle of its stroke. When both springs are properly adjusted, therefore, the piston stops normally midway in the cylinder, and the springs are calculated in length and tension so that an equal force is necessary to move the piston to either end of its stroke, and I attain, therefore, by this means a pump whose work is equal upon each stroke in each direction and is as little as possible above the amount of work necessary to lift the water only—that is, there is eliminated to the last possible degree the effect of the weight of the parts as a cause of dead-work.

I claim—

1. In combination with the well-casing the pump tube and the pilot rod loosely connected at the lower end of the pump tube, the connection comprising a clutch adapted to be positively moved to the position in which it will grip the wall of the well casing by the arrest or upward movement of the pilot, substantially as set forth.

2. In combination with the well-casing the pump tube adapted to be inserted down thereinto, the pilot rod and a link connecting said pilot rod with the pump tube, said link being adapted to pass freely down into the casing when in the position in which it is normally held by the weight of the pilot and to extend across and bind at its ends against the opposite sides of the casing when the pilot and well tube approach each other, substantially as set forth.

3. In combination with the well-casing the pump tube adapted to descend freely therein, the pilot M, the clutch link N pivoted to the pilot, the link N′ pivotally connected to the pilot and to the pump tube at the lower end of the latter, substantially as and for the purpose set forth.

4. In combination with the well-casing the pump tube adapted to descend freely therein, the pilot M, the clutch link N pivotally connected to the pilot, the link N′ pivoted to the clutch link and having a loose connection with the pump tube adapted to permit said link longitudinal movement with respect to the latter, substantially as set forth.

5. In combination with the cylinder piston and piston rod springs reacting upon the piston rod, tending one to support the weight of the piston and rod, and the other tending to depress the same, said springs being proportioned to each other and to said weight to normally hold the piston at the middle of its stroke in the cylinder, substantially as set forth.

6. In combination with the well-casing the cylinder and suitable means for supporting it in the casing, the piston having a tubular stem constituting the discharge pipe and hav-

ing its walls which enter the cylinder chamber adapted to displace a portion of water therefrom at each downward stroke whereby the pump is adapted to elevate water at each stroke in each direction; a spring stopped at the lower end upon the cylinder and a stop on the stem thereabove against which said spring reacts upward, and a further spring stopped downward on the stem and upward against a stop fixed with respect to the well-casing, said springs being proportioned with respect to each other and to the weight of the entire piston, stem, and discharge pipe, to normally hold the piston at the middle of its stroke in the cylinder, substantially as set forth.

7. In a pump, in combination with the cylinder, the piston head F having the central water inlet *f*, and the tubular stem constituting part of the discharge pipe, the piston head being cut away obliquely at the upper part to form a valve seat below the attachment thereto of the tubular stem, and a transversely flexible valve hinged at its lower end at the lower side of said oblique valve seat; whereby such valve may be flexed transversely in a curve corresponding with the curvature of the cylinder when it is opened by the entering current of water, and the stream of water admitted through the valve seat may pass without deflection into the tubular stem; substantially as set forth.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, at Chicago, Illinois, this 26th day of November, 1894.

HENRY O. THOMAS.

Witnesses:
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