J. Old.

Oil Pump.

No. 34,444. Patented Feb. 18, 1862.

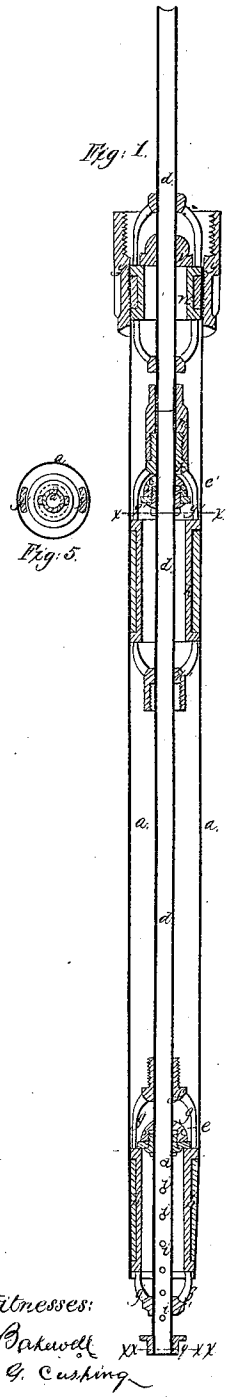


Fig: 5.

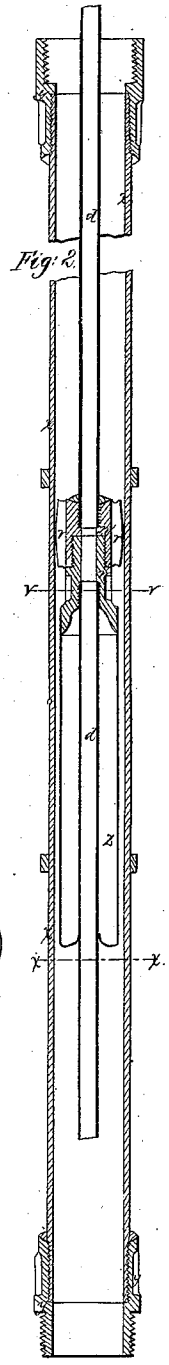
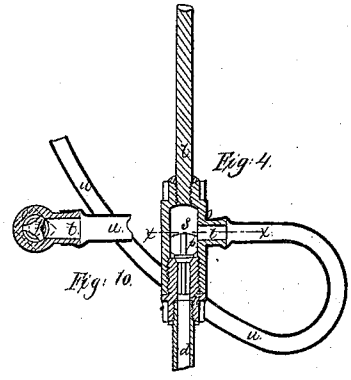


Fig: 7.

Fig: 8.


Fig: 6



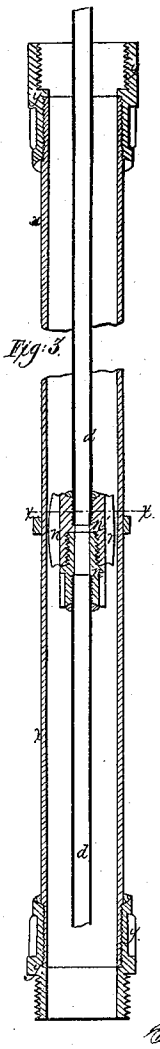


Fig: 9.

Witnesses:
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UNITED STATES PATENT OFFICE.

JAMES OLD, OF PITTSBURG, PENNSYLVANIA.

IMPROVEMENT IN PUMPS FOR DEEP WELLS.

Specification forming part of Letters Patent No. **34,444**, dated February 18, 1862.

To all whom it may concern:

Be it known that I, JAMES OLD, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Pumps, designed to be used in wells of extraordinary depth, such as oil-wells and salt-wells; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a vertical section of my improved pump. Fig. 2 is a vertical section of a portion of the tubing of the pump, the lower end of which is to be coupled to the top of the pump-chamber shown in Fig. 1, exhibiting also the hollow piston-rod with its air-vessel and coupling. Fig. 3 is a vertical section of another of the joints or pieces of the tubing of the well. Fig. 4 is a vertical section of the top of the hollow piston-rod. Figs. 5 to 10 are cross-sections of various parts of the pump and tubing, which will be explained more fully hereinafter.

In the several figures like letters of reference designate similar parts of the apparatus.

Oil and salt wells are usually from four to six inches in diameter, and are bored to great depths, varying from one hundred to four or even six hundred feet. These bores must necessarily pass through several veins of fresh water, which, unless prevented from so doing, would descend to the bottom of the well and require to be pumped to the surface, thus causing in oil-wells a great deal of extra pumping, and in salt-wells mixing with and diluting the salt-water. To prevent the passage of the surface and fresh spring water to the bottom of these wells, metallic tubes of smaller diameter than the wells are jointed together and passed down the bore, thus forming a continuous pipe to within a short distance of the bottom of the well. Around the lowest section or piece of this tubing is tied a bag of flax-seed. The water in the well causes the seeds to swell sufficiently to fill up the space between the tube and the circumference of the well, thus preventing the descent of water below that point outside the tube. The lowest section of this tube is the cylinder of the pump by which the well is to be worked, and as the space outside the pump is closed by the seed-bag, the passage of air and gas (as well as of water) is cut off, so that neither can pass up or down, excepting through the pump and the tube above it.

In oil and salt wells, but especially in the former, there is always more or less gas arising from fissures in the rock at the bottom of the well, which, having, as just explained, no other way of escape, must pass through the pump, interfering very considerably with its action. If the gas is evolved in small quantities and with slight pressure, it will, after passing up through the lower valve of the pump, accumulate in the pump-cylinder between the valves, being hindered from rising through the upper valve by the pressure of the column of fluid in the tube above the pump, which pressure is very great when the well is deep. This accumulation of gas in the pump-chamber acts as an air-cushion to impede the action of the lower valve. If, however, the volume of gas emitted from the well should be large and forced out with violence, as is often the case, the gas will make its way through both of the valves, keeping them open until the pressure is relieved, thus preventing the formation of a vacuum in the pump-chamber and completely stopping the action of the pump. In my improved pump I overcome this difficulty by using a hollow piston-rod or pipe, which passes through both the upper and lower valves of the pump, the lower extremity of the pipe opening below the lower valve, so as to convey the gas from the bottom of the well without passing into the chamber of the pump, and the upper extremity of the pipe or hollow piston-rod having a valve opening upward, thus enabling the pump to be operated notwithstanding the upward pressure of the gas in the well.

The presence of gas in oil-wells and in the fissures or veins in the rock through which the oil passes into the well renders it frequently necessary to use the pump to exhaust the air and gas out of the well, so as to promote the flow of oil into the well, for not only does the pressure of gas in the well drive back the oil into the fissures of the rock, so as often to depress the oil in the well below the bottom of the pump, but the gas in passing through the oil-veins remains at the highest points and interrupts the passage of the oil into the cavity of the well. To remedy this, it is necessary to draw the oil into the well by suction, when the pump, being no longer immersed in oil, acts as an air-pump. This

is the case also, though in a less degree, when there is a flow of oil into the well, but insufficient to fill the chamber of the pump at each stroke. In both of these conditions of things the upstroke of the plunger of the pump creates a partial vacuum in the pump-chamber, and whenever this is the case the pressure of the column of oil (or water, as the case may be) in the well-tube above the valves is a serious obstacle to the working of the pump. When there is no deficiency of oil in the well, so that the supply constantly keeps the lower extremity of the pump-chamber immersed in the fluid to be raised, and where there is no gas forced into the chamber of the pump, the column of oil or water in the pump-tube above the valves is raised by the elevation of the plunger, and the oil or water flows into the pump-chamber under the plunger, and, being prevented from returning by the closing of the lower valve, it sustains the plunger, on the descent of which the fluid passes above the plunger, thus preventing any descent of the column of water in the well-tube on the downstroke of the plunger; but whenever the extremity of the pump is not immersed and the pump sucks air and there is a partial vacuum in the chamber on the elevation of the plunger the pressure of the column of water or oil in the well-tube above the plunger has to be overcome by a dead-lift on every upstroke, and on the downstroke this pressure serves as an additional force to drive the plunger down. This of course causes the steam-engine by which the pump is operated to work very irregularly, the sudden jerk of the piston-rod on its descent frequently straining or breaking the engine and bursting the tubing of the well. Where the chamber of the pump is only partially filled on its upstroke, the oil or water which is raised as it passes up through the upper valve meets and must overcome the force of the descending column above, and there is a great loss of power in changing the direction of this high column of oil or water from a downward to an upward flow. For these reasons it is necessary to use a steam-engine of considerably greater power than would otherwise be requisite, and even then the difficulty is but partially overcome. The importance of remedying this evil is obvious when it is considered that in a well of five hundred feet deep the pressure of a column of water in the well-tube on the plunger is equal to two hundred and twenty-five pounds on a square inch. To overcome this, I place a stationary valve at the top, as well as at the bottom, of the pump-chamber, the valve at the top of the pump-chamber serving as a check-valve and the upper valve or plunger moving up and down between the two stationary valves. I have further improved the pump by the addition of an air-vessel attached to the piston-rod above the pump-chamber, which serves to lessen the downward force of the piston-rod and preserve an upward current of water or oil in the tube of the well. Without this addition the water or oil in the tube commences to fall on every downstroke of the piston whenever the pump-chamber has not been filled with oil or water on the preceding upstroke, so that the upward current is obliged to meet and overcome the force of the descending column, thus causing a great loss of power.

In order to enable others skilled in the art to make and use my improved pump, I will proceed to describe its construction and operation.

The chamber *a* of the pump is a metallic cylinder, usually of brass and of the ordinary construction. It is slightly tapered at its lower extremity to prevent the lower valve-seat *b* being forced through it. The lower valve-seat *b* is a metallic cylinder surrounded with leather, so as to make it air-tight, or ground into its seat in the lower extremity of the pump-chamber *a*. It has a valve *c*, opening upward, through which the hollow piston-rod *d* passes. The valve *c* works up and down on the hollow piston-rod *d*, and the valve is packed with leather at *c*, so as to make the valve tight when closed. The hollow piston-rod *d* passes through rings, one *f* above and the other *f'* below the valve-seat, which rings serve as guides for the piston-rod and are connected with the valve-seat by the arms *g g*, &c. The upper ring *f* is so placed as to give sufficient play to the valve *c*, and yet prevent its being raised up too far by the piston-rod *d*.

The piston-rod *d* is an iron or brass tube of small diameter, which extends upward to the top of the well and downward below the pump-chamber, as seen in Fig. 1. Near its lower end, which is open, it is perforated by holes *i i*, &c., to allow of the free entrance of gas into it. The lower extremity is furnished with a button *q* (see Fig. 6) to avoid injury to the pipe in case it should strike the bottom of the well and prevent the piston-rod being drawn up through the lower valve-seat. The hollow piston-rod is made in sections of convenient length, which are united by means of a screw-coupling (see Fig. 3) in two pieces *n n'*, into which the extremities of the hollow piston-rod are screwed, the coupling-pieces *n* and *n'* also screwing the one inside the other. The upper one *n'* of these coupling-pieces is furnished with three or four wings *r*, made of metal, wood, or other material, each wing projecting an equal distance from the coupling, their outer edges being in the line of a circle of somewhat smaller diameter than that of the tube in which they are to work, as seen in Fig. 9, which is a cross-section of the tube and coupling at *x x* of Fig. 3. By this arrangement, which occurs at every joint in the pipe, the hollow piston-rod is kept straight and in a central position in the tubing of the well, and the lateral strain on the coupling, which would otherwise be very great, is prevented.

At the top of the hollow piston-rod, (seen in

Fig. 4,) which rises above the top of the well, is a brass coupling *o*, into which the iron rod *l* is screwed, by means of which the piston-rod is attached to the machinery for working the pump. In this coupling is a cavity *s*, in which a light valve *p* works, which closes the top of the pipe forming the piston-rod. This valve rises by the upward pressure of the gas to allow the escape of gas from the well, and closes by its own gravity when there is no gas emitted, so as to prevent the descent of air into the bottom of the well, which would interfere with the raising of the oil or water. An orifice *t* is made through one side of the coupling into the cavity *s* of the coupling *o* at top of the piston-rod, to which is attached a flexible tube or hose *u*, by means of which the inflammable gas which escapes from the well is conducted away from the well, so as to prevent accidental explosions. It may be collected for illuminating purposes, or allowed to pass into the furnace of the steam-engine. Fig. 10 is a cross-section through the coupling *o* immediately above the valve *r* at the line *x x*, Fig. 4.

The upper or movable valve-seat *h* is similar in construction to the lower valve-seat *b*, excepting that it is of uniform diameter, and that instead of being loose on the piston-rod it is attached to it by the coupling *m* above the upper guide-ring *k*, so that the valve-seat *h* works up and down in the chamber of the pump. The valve *c'* of the movable valve-seat *h* works on the piston-rod, which passes through its center. It is packed around the piston-rod with a gasket at *e'* in like manner as the lower valve *c*. The lower ring *k'* of the valve-seat or plunger *h* is hollow for a short distance from below upward and has screw-threads cut in it, so as to take the upper end of the upper ring *f* of the lower valve-seat, so that when it is desired to draw out the lower valve-seat *b* from the pump it may be done by screwing the ring *k'* on the ring *f* and raising the two valve-seats together by means of the piston-rod *d*, which will also draw out the check-valve and its seat.

At the top of the pump-chamber *a*, which, as before stated, is the lowest section of the tubing of the well, is placed the check-valve *v*, its valve-seat *w* being inserted in the end of the tube or chamber *a*, which is made slightly flaring, so that the check-valve seat *w* may not be forced down into the chamber. The check-valve *v* is so constructed that it works loosely on the piston-rod *d*, which passes through it, as seen in Fig. 1.

The several pieces or sections of tubing *x x*, &c., and the pump-chamber *a* are united together at their extremities by a coupling *y* of peculiar construction, but which need not be here more particularly described, as it is the subject of a separate application for Letters Patent, and any other coupling may be used in connection with my improved pump.

It is not absolutely necessary that the piston-rod should be hollow all the way up to the top of the well, as the gas may be allowed to escape into the tubing of the well above the pump by making small holes in the hollow piston-rod above the pump-chamber and seating a small valve, like *p*, in the hollow piston-rod below the holes for the escape of gas, in which case the piston-rod may be made solid above the point where these holes cease; but as the free escape of gas from oil-wells is a fruitful source of accident it is better to construct the piston-rod hollow all the way up, so as to lead the gas away from the well, as before described.

It is obvious by reference to Fig. 1 (which represents the piston-rod and plunger raised up) that on the downstroke of the piston-rod it will protrude the length of the stroke below the lower valve-seat. This may in some cases, where the oil does not collect in a large quantity in the bottom of the well, be inconvenient, and the movement of the piston-rod through the lowest valve *c* may render it liable to leak, whereas it is more important to have the lowest valve tight than either of the others. These considerations may render it advisable to modify the construction of the pump somewhat by making the gas-pipe which passes through the pump-chamber and the upper and lower valves *c* and *c'* stationary and attaching the lower valve-seat *b* to this pipe, which must be made of smaller diameter than the hollow piston-rod, so as to pass up inside of it. The hollow piston-rod *d* is attached to the upper valve-seat or plunger *h*, as before described, and terminates at the lower ring *k'* of the upper valve-seat. The result of this modified arrangement is that the hollow piston rod passes like a telescope-slide over the short pipe which passes up through the pump-chamber *a*, and which is attached to the lower valve-seat *b*, and consequently the piston-rod does not project at any part of the stroke of the plunger below the bottom of the lower valve-seat. This involves no substantial variation from the construction and arrangement hereinbefore described, and may be adopted, if found preferable.

To the piston-rod *d* at a sufficient distance above the check-valve *v* to avoid contact with it on the descent of the piston-rod is placed an air-vessel *z*, which is a hollow metallic cylinder closed at the top and open at the bottom. This air-vessel is so attached to the piston-rod as to surround it, and is of such diameter as to leave sufficient space around it and between it and the sides of the tubing *x* to allow the oil or water forced up by the pump to pass upward through the tubing. It is also of sufficient length—say, ten to twelve feet—to contain air enough to operate by the elastic force of the air on the column of liquid in the well-tube, so as to keep up the upward flow of oil or water on the descent of the plunger of the pump. Fig. 8 is a cross-section of the well-tubing and hollow piston-rod immediately below the air-vessel at *x x*, Fig. 2, and shows the shape and construction of

the air-vessel *z*. Fig. 7 is a cross-section of the well-tube through the coupling *n* of the hollow piston-rod *d* at *v v*, Fig. 2, showing how the piston-rod coupling is squared below the guide-wings *r r*, so as to give a hold for the clamp by which the couplings are attached or detached. Fig. 6 is a cross-section through *x x x x*, Fig. 1.

The operation of my improved pump is as follows: A vacuum is formed in the pump-chamber by raising the plunger *h* in the ordinary way, when the oil or water raises the lower valve *c* and enters the chamber of the pump. On the descent of the plunger the lower valve *c* closes and the upper valve *c'* opens, causing the liquid to pass up above the upper valve. On the elevation of the plunger the check-valve *v* rises to allow the passage of the oil or water upward into the tubing above the pump-chamber, and as soon as the plunger begins to fall the check-valve closes, sustaining the entire pressure of the column of liquid in the well and relieving the plunger, thus allowing it to work on its down-stroke with the force given to it by the steam-engine and its own gravity only. This prevents the sudden jerk which is caused as soon as the engine passes its center and the piston begins to descend by the weight of the column of water or oil which the pump had to raise being instantaneously applied to aid the engine in depressing the piston-rod whenever the plunger is not sustained by the presence of oil or water in the chamber of the pump. When, as is often the case, this column of oil or water exerts a pressure on the plunger of the pump of two hundred and twenty-five pounds to the square inch, it requires a very strong engine to sustain the constant jar and strain, which I have just described; but by use of my improvement this difficulty is in a great measure obviated; but with the use of the check-valve, as described, the column of oil or water in the well-tube rises with the piston-rod, but stands still on its descent, and a great loss of power is experienced in consequence of the necessity of setting again in motion and giving an upward flow to the column of oil or water. This is greatly relieved by the use of the air-vessel *z*, for when the oil or water is rising in the well-tube on the upstroke of the plunger the contraction of the area of the tube by the air-vessel causes the liquid to be forced up into the air-vessel, compressing the air in it very greatly, and as soon as the piston begins to fall the air in the vessel *z* expands and tends to preserve the upward flow of the water or oil in the tube, notwithstanding the descent of the piston. The air in the vessel *z*, which is attached to the piston-rod *d*, also serves as a buoy or float to lessen the gravity of the piston-rod and retards its descent, thus still further overcoming its too rapid fall and rendering the working of the pump more uniform on its up and down stroke.

The hollow piston-rod, passing through the upper and lower valves of the pump, affords a means of escape for gas or fixed air from the bottom of the well, and as the pipe which forms the piston-rod, or which passes up into it, has no side openings in any part which traverses the space between the valves the gas is conducted away from the chamber of the pump and leaves it free to work, as described. The button *q* on the bottom of the piston-rod not only gives it strength, but serves to stir up any sediment at the bottom of the well and causes it to mix with the oil or water, so as to be pumped up with it, and thus prevents the choking of the well.

In some cases where there is only a small flow of oil into the well insufficient to fill the chamber of the pump at each upstroke of the plunger it may be desirable to allow a little air to pass into the pump-chamber, down the hollow piston-rod, so as to make the pump work more easily. This can be effected by making a small aperture through the valve *p* on top of the hollow piston-rod, which will allow the plunger to rise easily, even if there be not sufficient oil to fill the pump-chamber on each stroke of the pump.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The use of a hollow piston-rod or pipe extending through the lowest valve as well as through the upper valve or plunger of pumps and furnished with a valve at top, of the hollow piston-rod or gas-pipe, constructed and arranged, substantially as described, for the purpose of allowing of the escape of gas or fixed air from the bottom of deep wells without interfering with the operation of the valves of the pump.

2. The combination of a hollow piston-rod for the plunger of a pump, passing through all the valves of the pump-cylinder, with a flexible tube and valve at the top of the hollow piston-rod, constructed substantially as and for the purpose hereinbefore described.

3. The use of a check-valve seated in the pump-chamber directly above and in addition to the ordinary upper and lower pump-valves for the purpose of sustaining and relieving the plunger of the pressure of the column of oil or other liquid in the pump-tube above the valves when there is a partial vacuum in the pump-chamber on the upstroke of the plunger.

4. The use of an air-vessel attached to the piston-rod of a pump for the purpose of checking the too rapid descent of the plunger and of keeping up the upward flow of the column of water, oil, or other liquid in the pump-tube above the valves during the descent of the plunger, substantially as hereinbefore described.

In testimony whereof I, the said JAMES OLD, have hereunto set my hand.

JAMES OLD.

Witnesses:

M. G. CUSHING,

A. S. NICHOLSON.