3 Sheets—Sheet 1.

C. SWAN.

MACHINERY FOR DRILLING OIL AND OTHER ARTESIAN WELLS.

No. 188,316. Patented March 13, 1877.

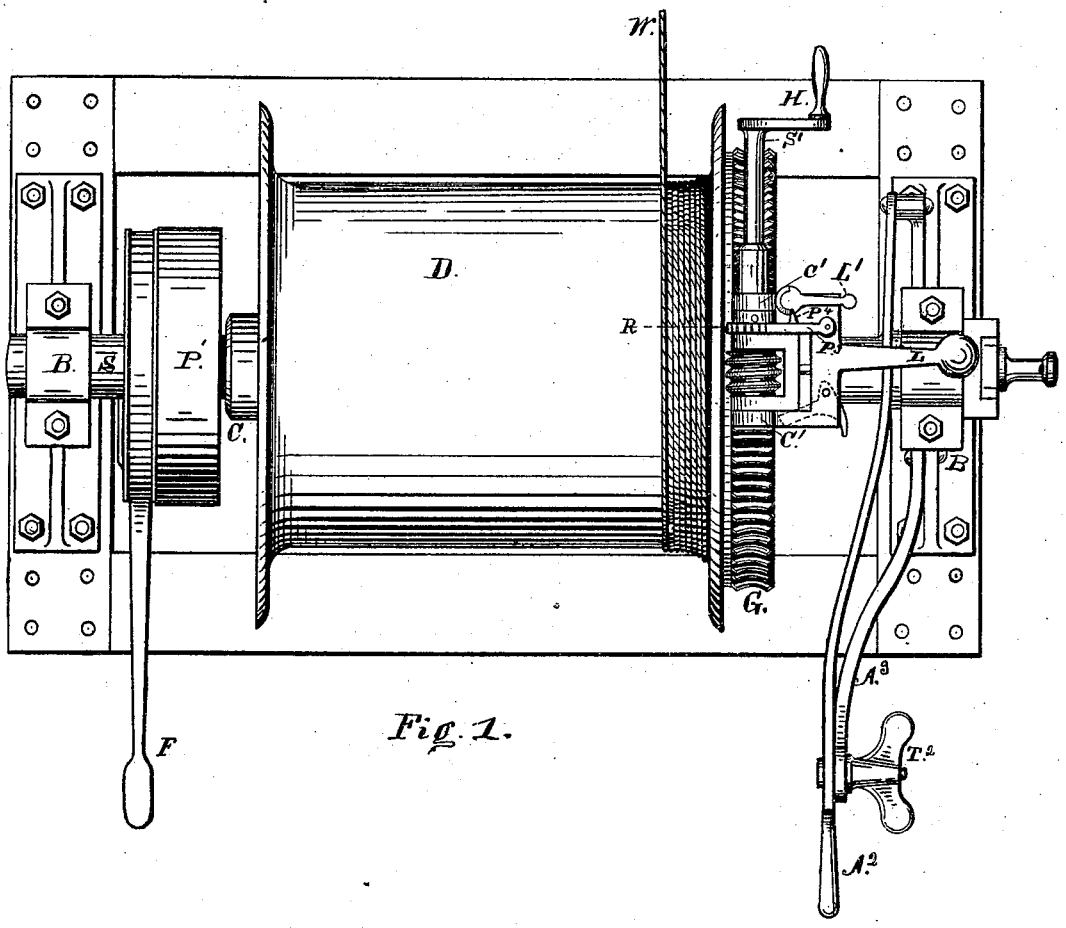

Fig. 1.

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Fig. 2.

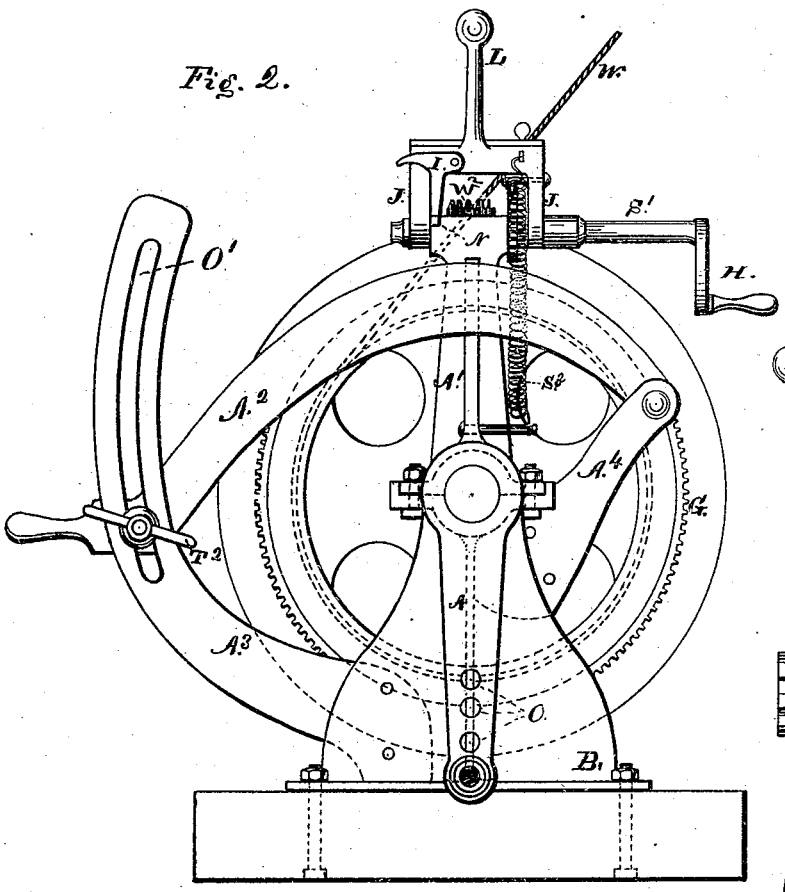

Fig. 3.

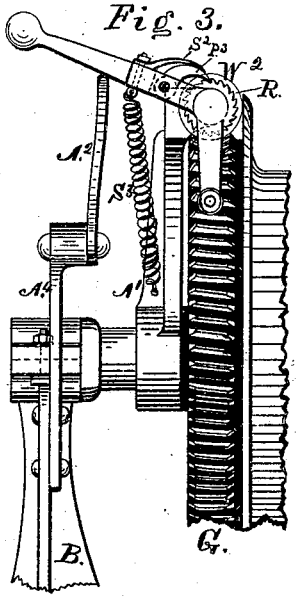

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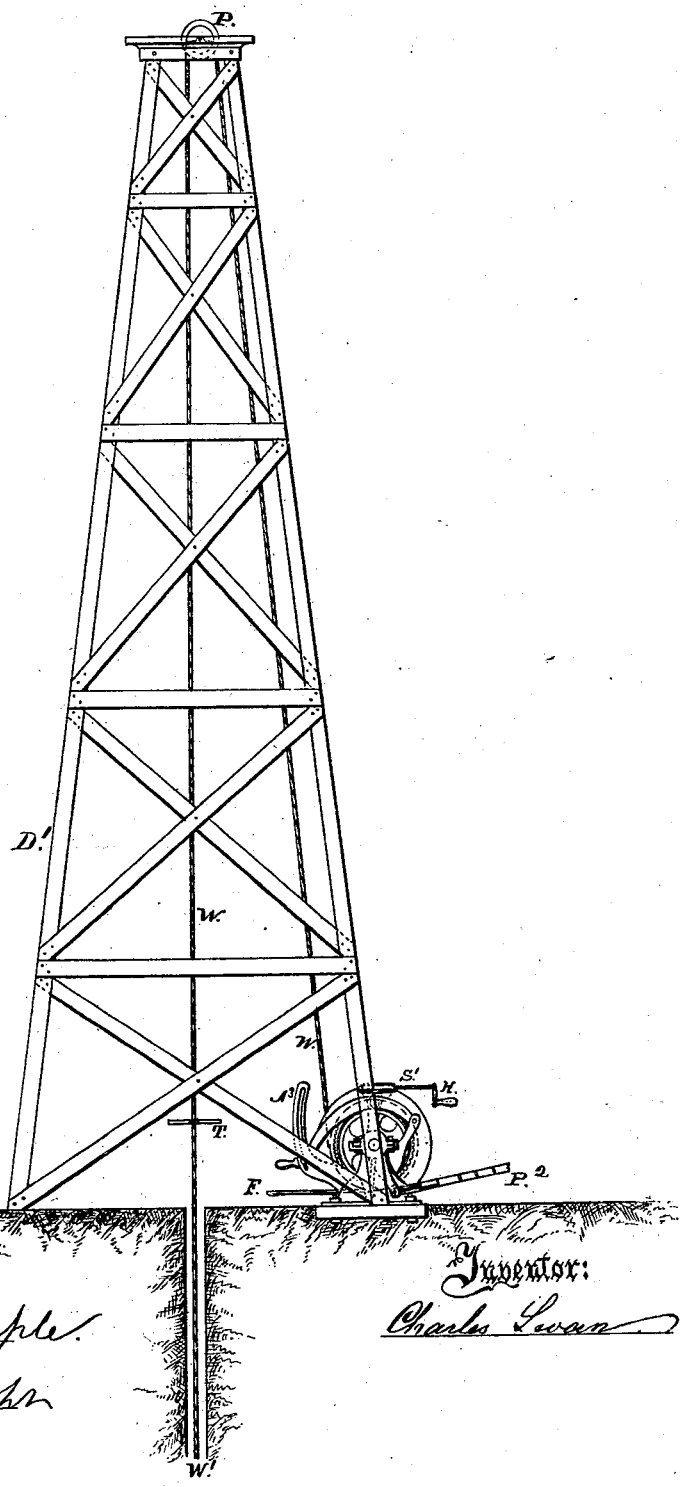
Fig. 4.



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UNITED STATES PATENT OFFICE.

CHARLES SWAN, OF TRENTON, NEW JERSEY, ASSIGNOR TO THE JOHN A. ROEBLING'S SONS COMPANY, OF SAME PLACE.

IMPROVEMENT IN MACHINERY FOR DRILLING OIL AND OTHER ARTESIAN WELLS.

Specification forming part of Letters Patent No. **188,316**, dated March 13, 1877; application filed August 12, 1876.

To all whom it may concern:

Be it known that I, CHARLES SWAN, of Trenton, Mercer county, New Jersey, have invented a new and useful Improvement in Machinery for Drilling Oil and other Artesian Wells, which improvement is fully set forth in the following specification, reference being had to the accompanying drawings.

The object of my invention is to facilitate the boring of artesian or other wells—usually of small diameter and of great depth—by the substitution of a drum, a wire rope, and automatic feed devices for the walking-beam, hemp rope, and short male and female hand feed-screw now generally employed for the purpose.

The invention consists in the several combinations named, and as they are set forth in the several claims forming a part of this specification.

Figure 1 represents the drum D, which turns on its shaft S, and is given either a vibratory or rotatory motion at will, and the feeding devices controlling the same, all supported on pillow-blocks B B by the drum-shaft S, and connected firmly with the well-derrick; also, the wire rope W passing directly from the drum D without bend or loop, otherwise over the derrick-pulley P, and thence into the well W^1 in a perpendicular line. T is a turning-bar for turning or twisting the rope by hand, and thereby moving or shifting the drill around, so as to cut a circular hole in the rock or earth being operated upon. The derrick D′ is of the usual construction, say seventy feet high, and, consequently, the twists given to the rope for this purpose by the turning-bar T may distribute themselves above the turning-bar, as well as below it, and over the derrick-pulley P to the drum D, a distance of one hundred and forty (140) feet, more or less, which, in the case of wire rope, prevents all tendency to kink and become set, whereby it would be injured, if not ruined.

The drum D—top view, Fig. 2, front view, Fig. 3—has two rotatory motions, viz., one around the shaft S in boring only, and another with the shaft S in continuous withdrawal of the rope from the well or admission thereto. It also has a partially rotatory motion back and forth, which I call a vibratory motion, and which is concerned in lifting and dropping the drill by means of the rope. The drum carries the drill-rope coiled thereon. It slips onto the drum-shaft S, so as to be capable of rotatory motion thereon, and is held in place between the two collars C C, which are secured to the shaft S. This first rotatory motion around the shaft in feeding is imparted to it by the lever L, worm W^2, and its worm-wheel G, disposed in a circle around and at one end of the drum D. The pulley P^1 is fixed on the shaft S. It is connected by belt with the motor, and its function is to operate the drum D for the purpose of withdrawing the rope and drill from the well, and also for the purpose of admitting them into the well. During the continuous rotatory motion required in these two operations the drum D is held stationary on the shaft S by the feeding devices. These devices are arranged, adjusted, and prevented from operating as feeding devices in a manner to be described hereafter. This continuous motion of the drum D is, in a functional sense, secondary to that around the shaft in feeding the drill to the work. The vibratory motions of the drum D are imparted from the engine and pitman P^2 through the arm A, which is provided with several holes, O O, to vary the point of attachment of the pitman and the length of the vibrations. The worm W^2 is held in the jaw-bearings J J projecting from the top of the arm A^1, (which is rigidly attached to the shaft S by a collar and screw,) toward the drum D. They hold the worm in permanent engagement with its gear on the drum D. The worm-shaft S^1 projects through the jaw-bearings J J at one end far enough to receive the hand-crank H and let it clear the rim of the drum. It also receives outside the jaw-bearings J J, the jaw-collars C′ C′ of the lever L, which carries the pawl P^3 and spring S^2, so placed as to operate the ratchet-wheel R on the worm-shaft S^1, and thereby the drum D in feeding or yielding rope as fast as the work proceeds; and it also carries the stop I′ for holding the lever L upright, as shown in Fig. 2, by engaging its lower point in the notch N cut in the top side of the jaw-bearing J, the stop being attached to the

lower side of the lever L. The lever L also carries the side eccentric lever L^1 used to lift the pawl P^3 out of action by contact with the pin P^4 on the pawl P^3, so that the worm and drum may be turned backward when required by the hand-crank H.

The arms A^3 and A^4 are secured to one of the pillow-blocks B, the latter having pivoted to its upper end an adjustable arm, A^2, which is eccentric and deflected toward the drum. A^2 is the feed-regulating and operating arm, on which the long arm of the lever L rides back and forth (rising and falling for that purpose with the eccentric and deflected outline) in contact with the lever. The arm A^3 has a long curved slot, O′, for the thumb-screw T^2 and guide-pin which controls the arm A^2. A spring, S^2, holds the lever L on the arm A^2, during the vibratory motions. The foot-brake F controls the drum and the rope W when running out and down into the well. The lever L operates and controls the ratchet, worm, gear, and drum.

The operation of the invention is as follows: The rope W is wound on the drum D, thence over the pulley P, and the drill is attached to its extreme end. Vibratory motion is given to the drum from the pitman P^2, which has a rocking instead of a rotatory action. This action causes the drill to rise and fall on the rock or earth beneath it. Meanwhile the superintending engineer twists the drill slightly, by means of the drill itself at first, and by the turning-bar T after the drill has cut its depth of the well; and thus the drilling proceeds. The drum D being so arranged as to revolve on the shaft S under the control of the worm W^2 at each upward vibration, the lever L, riding on the arm A^2 and toward the end of the vibration, operates the pawl, ratchet, worm, and the drum D, in order, the last slightly, and so as to give up a short length of rope to the drill in proportion as it cuts, the increased feed required in rapid and easy cutting being produced by raising the arm A^2, and thereby lifting higher the lever L at each stroke. The variation of the length of the vibratory motion by changing the pin of the pitman in the holes O also modifies the feed, increasing it by a long stroke and a long slide of the ratchet-lever L on the feed-regulating arm A^2, and diminishing it by a short one in like manner.

The operation of drilling the well is performed by the repetition of these vibrations to the end, and removing the sand as usual. I use a wire rope (although a hemp rope may be used, if desired) because it is more positive and durable, yet sufficiently elastic; and the workman can ascertain by it more certainly what his drill is doing. My wire rope W has no bend or loop between the drum and the drill, except that over the derrick-pulley P, and is thus kept free from kinks, whereas loops are necessary, in other known systems, between the lifting devices and the drill, other than that above named. These loops increase the wear of the rope by increasing and localizing the friction in them as they are developed along the whole length of the rope before it enters the well to perform its proper functions there.

The twists necessarily given to the rope and the drill, as described, pass into these loops whenever they exist, and develop coils of rope under foot with kinks more or less numerous and injurious. In wire rope, especially, the results have been found injurious, and have hitherto prevented its use for such well-boring. The shortness of the loops, the constant twisting and untwisting, and the want of a free distribution of the twists along a sufficient length of rope, all tend to kink, set, and injure or destroy it, and render its use impracticable. Hence, I make but one bend between the drum and the drill, and that over the derrick-pulley, through which all twists pass and distribute themselves freely.

In order to prevent undue strain on the rope by weight and drop of the drill, I make use of the "jars" usually employed for that purpose, which consist of two long iron links interposed between the drill and the rope, and I make both the drop and the hoist of the rope to exceed by six inches or so that of the drill, as an allowance. Using wire rope, which is less elastic than hemp rope, but sufficiently so, the workman can tell, by the feeling of the rope in his hand, more accurately what the tool is doing, while the allowance above mentioned, the stretch of the rope, and the unnecessary work usually done to compensate for them are all diminished. If the rope should catch in the well it might be broken. This I prevent by adding the hand-crank H to an extension of the worm-shaft S^1, by the hand turning of which the rope may be relieved in season to prevent breakage.

When it is desired to introduce the drill into the well, or to withdraw it, I throw up the lever L into the position shown in Fig. 2. It is then not subject to the control of the feed-regulating arm A^2, but is free to revolve in common with the drum D, shaft S, arms A and A^1, and attachments, and in fixed relations thereto. The drum in this condition may be used like an ordinary drum, and the usual sand-pump may be operated by the same combination of devices, in the same positions. The brake is intended to control these movements, and the power to produce them operates through a belt running on the pulley P^1.

Where the walking-beam is used to lift the drill, as is now the common practice, it is necessary to allow one or more loops of slack-rope between the point of suspension to the walking-beam and the derrick-pulley, over which it passes to an ordinary drum employed only for withdrawing from or admitting to the bottom of the well the drill and the sand-pump. The feed in this case is effected by means of a screw—say four feet long—placed between the walking-beam and the rope. This screw

requires readjustment every four feet or less that is drilled, and the drilling must be stopped for that purpose. The loop of slack-rope is necessary both to allow the lift and the fall of the rope, and to permit its twist and the turning of the drill. In these loops of slack, wire rope especially receives the injury before described. It is also necessary, in this case, to begin the well by hand-work, and continue until the top of the drill (thirty feet long, more or less) sinks below the walking-beam and screw-feed. The difficulties thus caused by the slack rope, and the delay mentioned, I avoid, as I discard the loops, the walking-beam, and the feed-screw named, and substitute therefor the appliances herein described.

I set up the drill in the derrick, secure it to the end of the wire rope, and, commencing the well at the surface, by raising and dropping the drill, as described, I proceed continuously, my feeding devices being so arranged as to run off automatically from the drum the entire length of rope required to finish the well. I can also recover, or take in and onto the drum, any extra rope which may have run or been fed off the same, by means of the hand-crank H and the worm W^2.

The worm W^2 may be operated in a variety of ways known to ordinary practice, so as to revolve the drum D automatically, step by step; but I prefer the method shown, as simple, and permitting the entire intermission of feeding action, by lifting the lever L out of contact with the arm A, and so out of all functional action, as described.

I claim as my invention—

1. The wire rope W, leading from the operating-drum directly over the pulley P, and to the drill without other loop or bend, in combination with the drum D, operating the drill-rope in drilling by vibratory motion, and also, in feeeding the drill and rope as the well deepens, by rotatory motion.

2. The wire rope W, leading from the operating drum directly over the pulley P and to the drill without other loop or bend, in combination with the drum D, arranged to operate the wire rope W, for three purposes, as follows: first, to drill by vibratory motion; second, to feed the rope, in drilling, by rotatory motion; third, to withdraw the rope and drill by rotatory motion.

3. The drum D, arranged to revolve around the shaft S in feeding the drill-rope W, step by step, as the boring proceeds.

4. The drum D and shaft S in combination, the drum D having rotatory motion thereon, and also rotatory and vibratory motion therewith, at will, as set forth.

5. The drum D, carrying the drill-rope W, and automatically feeding the same at each vibration, in the manner and for the purpose set forth.

6. The drum D, provided with the worm-wheel G, in combination with the worm W^2, operating upon the drum so as to revolve it around the shaft S in feeding the rope and drill as the well deepens.

7. The lever L, worm W^2, worm-wheel G, in combination with the drum D, for the purpose of revolving the drum around the shaft S in feeding the rope and drill as the well deepens.

8. The lever L and arm A^2 in combination, when operating, through the worm W^2, worm-wheel G, and drum D, to feed the rope W as the drill sinks in the well.

9. The worm-shaft S^1, supported by bearings in the arm A^1, attached to the shaft S, moving therewith in the rotatory and vibratory motions, as described, and provided with the hand-crank H, for the purpose set forth.

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