(No Model.) 2 Sheets—Sheet 1.

F. H. MERRILL.

LIQUID RAISING APPARATUS AND PROCESS.

No. 534,984. Patented Feb. 26, 1895.

Fig. 1

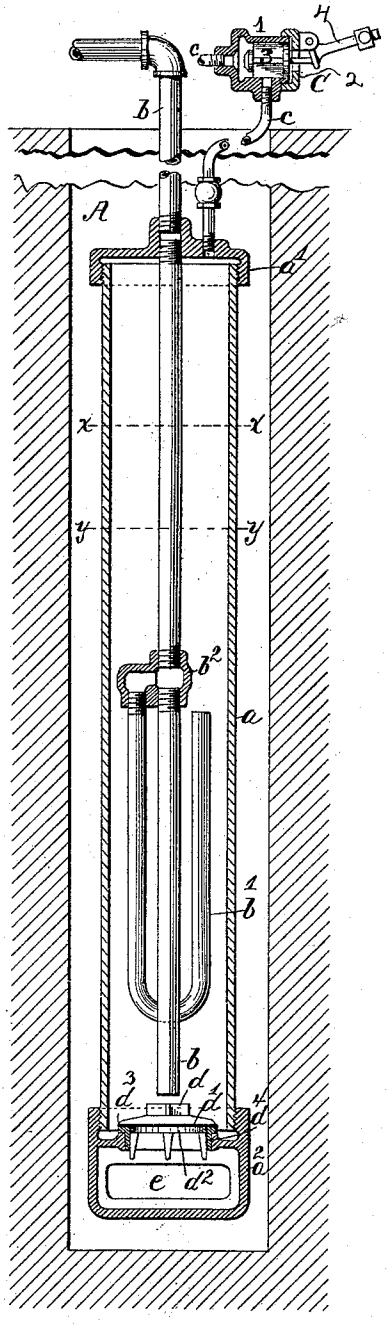
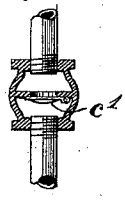


Fig. 3



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(No Model.) 2 Sheets—Sheet 2.

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LIQUID RAISING APPARATUS AND PROCESS.

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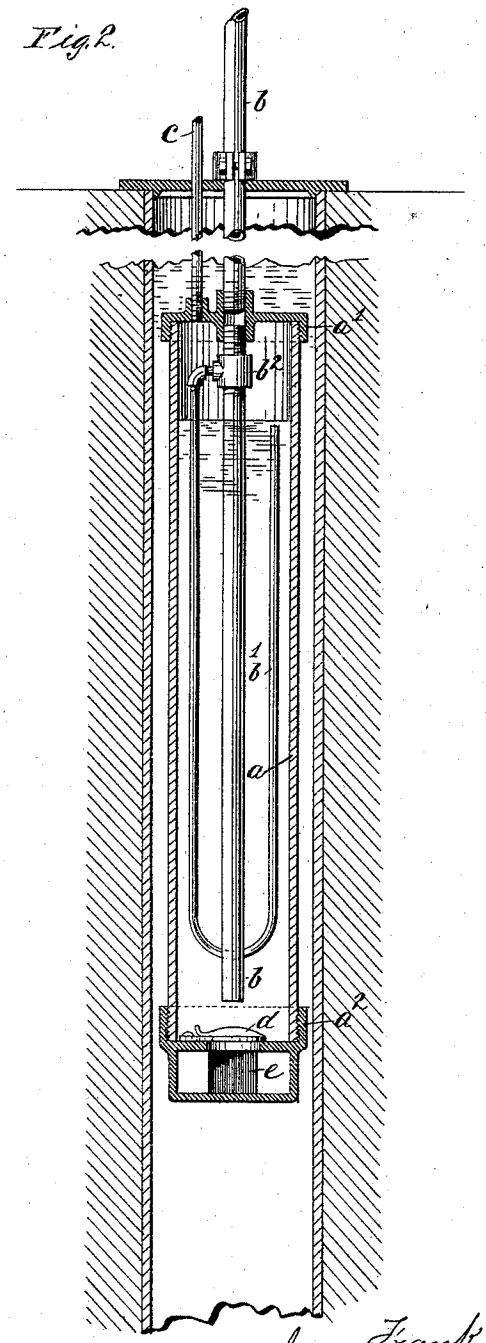
Fig. 2.



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UNITED STATES PATENT OFFICE.

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LIQUID-RAISING APPARATUS AND PROCESS.

SPECIFICATION forming part of Letters Patent No. 534,984, dated February 26, 1895.

Application filed June 24, 1892. Renewed July 25, 1894. Serial No. 518,590. (No model.)

To all whom it may concern:

Be it known that I, FRANK H. MERRILL, of Bound Brook, in the State of New Jersey, have invented a new and useful Improvement in Liquid-Raising Apparatus and Processes, of which the following is a specification.

In the accompanying drawings, I have shown in vertical section (Figures 1 and 2) two forms of apparatus containing my invention immersed in the water of a tubular well. Fig. 3 is a detail.

I will first describe the form shown in Fig. 1 which I prefer. It consists of a piece of four inch pipe *a*, eight feet long and screw threaded at each end to receive the heads a' and a^2. The head a' is constructed to receive the water delivery pipe *b* and the compressed air supply pipe *c*. The head a^2 is adapted for inlet valve *d* and the water openings *e* which are preferably on the side because if they were on the bottom, any floating object, as a small piece of board, would be very liable to lie against the bottom when the apparatus is lowered in the well and obstruct the opening; thereby preventing the water from flowing freely into the apparatus, which is a very essential feature.

The inlet valve *d* consists of the disk d' having on the upper side a star shaped projection which forms a stop which strikes against the end of the water delivery pipe *b* and prevents the valve from raising too far. On the lower side of disk d' is screwed the guide disk d^2. Between the two disks is a leather washer d^3. A flanged bushing d^4 in the head a^2 forms a seat for the valve *d*. d^4, d' and d^2 are preferably made of brass to prevent corrosion which would tend to stick the valve *d*.

The water delivery pipe *b* extends downward to near the bottom of *a*. A U-bent pipe b' is connected with *b* by the casting b^2 which is located about half way down on *b*. The bend of b' is a little above (say ten inches) the end of *b*, as shown. A check valve c' (Fig. 3) is located in the air supply pipe just above the head a'. As shown, this check valve closes upward and opens downward. A pressure valve C is shown on the main air supply pipe, the object of which I will explain later on.

I will now explain the operation. Assume the apparatus to be placed near the bottom of well A six inches in diameter, fifty feet deep and containing thirty feet of water, from which the water is required to be elevated fifty feet above the top of the ground; also assume *a* to be full or nearly full of water with no regard to the pressure valve C, as it will work without it. Admit the air into *a*. The water will begin to discharge into and through *b* continuing until the water falls below the bend of b'. Then the air will exhaust through b' and follow the water from b^2 up the delivery pipe, when the water will begin to rush into *a* with great velocity past valve *d*, owing to the thirty feet of water above the valve *d*. The air in *a* is freely escaping through the U-pipe and water discharge pipe until the water gets up to the end of U-pipe b'. Then the escape of air is cut off. The water, however, is rising rapidly with considerable velocity and will continue upward above the end of pipe b' compressing the air contained in the upper part of *a*. Check valve c' closes. This compression is similar to the compression in a hydraulic ram in which every ten feet in the head elevates water one hundred feet or compresses the air in the air globe to more than fifty pounds. Now, we have thirty feet of head. Suppose that the water rushes up to some point (as the line $x\,x$) having compressed the air sufficiently to overcome the velocity. This compressed air will begin to react and force the water out through *b* down to say the line $y\,y$. The air pressure having now decreased to the working pressure will just balance the water in discharge pipe. Now, the air during this time in pipe *c* above check pipe c' will be compressed by air compressor and when it is sufficiently great it will open check valve c' and force the water out of *a* from the line $y\,y$ down to the bottom of U pipe b', and then the operation will be repeated. The water discharged by the reaction is done at the expense of the velocity of the inflowing water and is therefore a net gain. The compression, of course, is due to the head of water—the more head the more compression, and, the more compression, the more reaction and gain of water. The line of compression $x\,x$ and reaction $y\,y$ is to me purely imaginary.

The pressure valve C is used where the air

compressor is a long distance from the well. It consists of the casing 1 adapted to receive the air supply pipe *c c* and the head 2, and contains the valve puppet 3. The casing 1 is seated for the puppet 3 and when the puppet rests against this seat, it prevents the air from passing through; and when it is in the reverse position, it allows the air to pass through, as shown. The puppet 3 is a star shaped casting flanged at each end; the beveled end being somewhat smaller than the other end. Between the head 2 and casing 1 is a leather washer. The head 2 also supports by two ears, the weighted lever 4 which acts against the stem of the puppet 3 and tends to shut off the air. When the air in *a* exhausts and the pressure has slightly decreased, the weight overcomes the puppet 3 and forces it against the beveled seat and closes the air supply. It will require an increased pressure to move the puppet because of the difference in area of the two flanged ends. This valve acts as a storage valve and prevents the air pressure from running down to a low pressure in the whole line of air pipe. While the apparatus is reacting the compressed air is increasing and being stored up beyond the valve C.

The form of apparatus shown in Fig. 2 will answer when there is less depth of water in the well and therefore less head for filling the chamber *a*. It operates on the same principle as the first form excepting that the open end of pipe *b'* being near the top of the cylinder *a*, the same provision is not made for the compression of the air at the top by the inflowing water.

The pipe *b'* should be materially less in diameter than the pipe *b* and I have found a convenient size to be one-half inch for pipe *b'* and one inch for pipe *b*.

Having thus described examples of apparatus embodying my invention, I do not wish to be understood as limiting myself to that form since I am well aware that elements may be modified or even eliminated without departing from the principle of my invention.

The pipes employed obviously form only one way of partitioning off the requisite passages and no limitation is intended to that way of forming the passages.

I claim—

1. In a liquid raising apparatus in combination, a liquid compartment provided with a liquid entrance opening and a compressed gas entrance opening, a liquid delivery passage extending to near the bottom of said compartment and a U-shaped passage having its bend above the mouth of the liquid delivery passage and its extremities extending upward, and having one end connected with the liquid compartment and the other with the liquid delivery passage, substantially as described.

2. In a liquid raising apparatus in combination, a liquid compartment provided with a liquid entrance opening and a compressed gas entrance opening, a liquid delivery passage and a passage connecting therewith and having its mouth elevated, its lower portion above the level of the mouth of the liquid delivery passage and having means whereby it is connected with the liquid delivery passage substantially as described.

3. In a liquid raising apparatus in combination, a liquid compartment provided with liquid and gas inlets, a liquid delivery passage having its mouth near the bottom of said compartment, a gas escape passage having its mouth at or near the middle of said compartment and extending thence downward to a level above the mouth of the liquid delivery passage and a connection with the said delivery passage, substantially as described.

4. In a liquid raising apparatus in combination, a liquid compartment provided with liquid and gas inlets, a liquid delivery passage having its mouth near the bottom of said compartment, a gas escape passage having its mouth at an elevated point in said compartment and extending thence downward to a level above the mouth of said delivery passage a connection with said delivery passage, a gas supply passage and a check valve therein, substantially as described.

5. In a liquid raising apparatus in combination, a liquid compartment provided with liquid and gas inlets, a liquid delivery passage having its mouth near the bottom of said compartment, a gas escape passage having its mouth at an elevated point in said compartment and extending thence downward to a level above the mouth of said delivery passage, a connection with said delivery passage a gas supply passage and a check valve and storage valve therein, substantially as described.

6. In a pumping operation, the process of filling and evacuating a chamber with liquid which consists of admitting the liquid into said chamber under a sufficient momentum to compress gas in said chamber, permitting said compressed gas to start the evacuation and then continuing the evacuation by forcing compressed gas into said chamber, substantially as described.

FRANK H. MERRILL.

Witnesses:
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