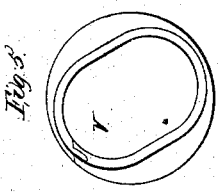
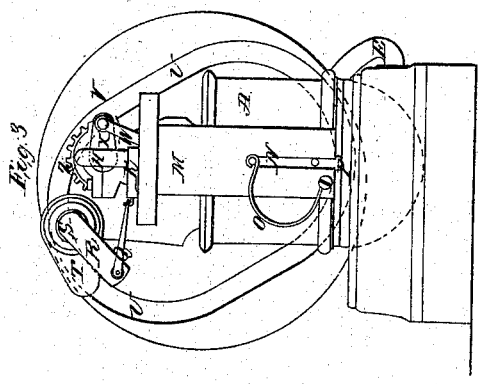
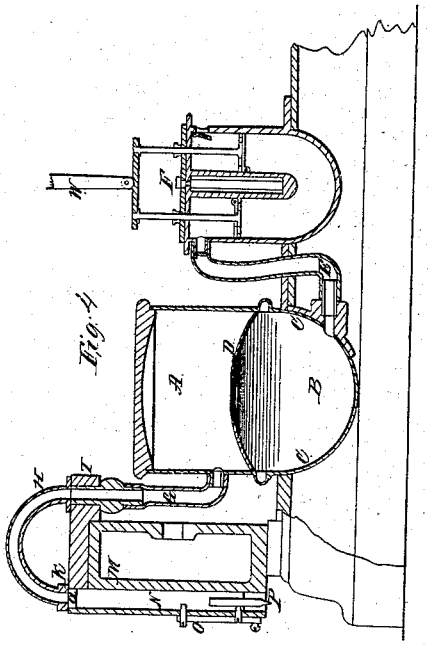
D. BICKFORD.

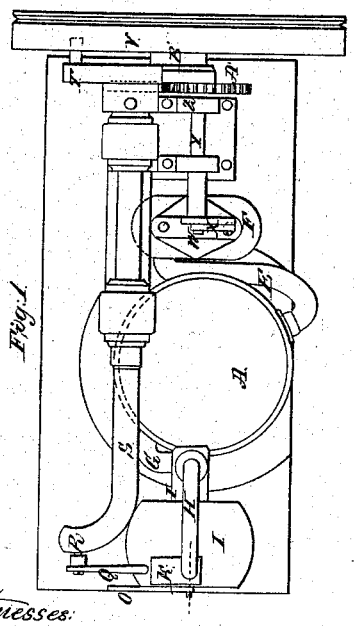
AIR ENGINE.

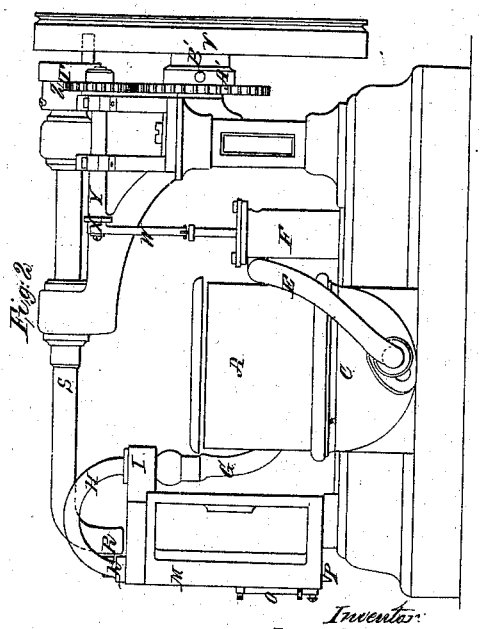
No. 48,043. Patented June 6, 1865.











Witnesses:
Francis Curtis
A. P. Hale Jr.

Inventor:
Dana Bickford
by his Attorney
R. Ridley

UNITED STATES PATENT OFFICE.

DANA BICKFORD, OF BOSTON, MASSACHUSETTS.

IMPROVEMENT IN AIR-ENGINES.

Specification forming part of Letters Patent No. **48,643**, dated June 6, 1865.

To all whom it may concern:

Be it known that I, DANA BICKFORD, of Boston, in the county of Suffolk and State of Massachusetts, have made a new and useful invention having reference to air-engines, for operating drills, hammers, or various other mechanism with a quick reciprocating rectilinear motion; and I do hereby declare the same to be fully described in the following specification and represented in the accompanying drawings, of which—

Figure 1 is a top view, Fig. 2 a side view, Fig. 3 a front end elevation, and Fig. 6 a longitudinal section, of part of an engine provided with my invention, the longitudinal section being taken through the cylinder, the vibratory conduit, the flexible tube of such conduit, the reservoir for compressed air, the air-pump, and the pipe leading therefrom into the said reservoir.

I have found that when air is being forced into a close reservoir it may be condensed therein to much better advantage if, on its entrance into the cylinder, it is made to pass through a mass of liquid covering the mouth of the induction-pipe and situated in the cylinder, and with its surface above the level of the said mouth of the said pipe. Therefore, in carrying out my invention, I so combine with the reservoir for holding the compressed air a body of liquid (which may be either water, oil, or mercury, or other proper substitute therefor) that the air while being driven into the receiver shall be caused to pass through the liquid contained within such reservoir or in a chamber below and opening into it; and, furthermore, I combine with the compressed air-reservoir, and with an opening-cylinder and its piston, a vibratory conduit and gate together, and to the seat of the opening of the cylinder, substantially as hereinafter described. I also employ, in connection with the apparatus for operating the piston in one direction by the force of compressed air, a pin or its equivalent for moving the piston in the opposite direction.

In the drawings, A denotes a cylinder or reservoir for holding compressed air, there being a mass of liquid, B, within such reservoir, or in a chamber or space, C, situated below a perforated septum, D, extending across the reservoir. An eduction-pipe, E, from an air-pump, F, leads into the bottom of the reservoir, and opens directly into the mass of liquid. A flexible pipe, G, leads out of the air-space of the reservoir and to a curved inflexible conduit, H, which is supported by and so as to extend through or into a plate, I, as to be capable of being turned therein as a journal turns in its box or bearing. The pipe H is connected to and opens through a gate or valve, K, which rests on the upper surface of the plate I, and by the movement of the pipe H is carried over and off a passage, *a*, leading out of a vertical cylinder, M, provided with a piston, N, to whose rod a lifting-spring, O, is applied. A hammer or drill, P, may project from the lower end of the piston-rod. The opening *a*, leading out of the upper end of the cylinder, is intended to have a diameter corresponding with that of the bore of the cylinder, in order to enable the air to flow from the cylinder with as little obstruction as possible when the gate may be off the opening or be in the act of uncovering it. A connecting-rod, Q, jointed to the gate K, leads therefrom to a crank, R, carried by a rocker-shaft, S, arranged as shown in the drawings. A crank, T, from the rocker-shaft has its pin extended into a cam-groove, U, formed in the side of a fly-wheel, V, as shown in Fig. 5.

The forcing-pump shown in the drawings is of the kind invented by William T. Vose, and described in the specification of Letters Patent No. 12,566, granted to him on March 2, 1855, its pistons being moved by a connecting-rod, W, applied to a crank, X, extending from a shaft, Y. This shaft carries a gear, Z, which engages with another gear, A′, fixed on the shaft B′ of the fly-wheel. By revolving the fly-wheel and its shaft, not only will air be forced into the air-receiver, but the pipe H will be moved so as to carry the gate K alternately over and off the escape-passage *a* of the cylinder. By the said operation of the pipe H and the gate K, air from the reservoir will be forced into the cylinder, so as to suddenly depress the piston therein, and such air will be allowed afterward to as suddenly escape from such cylinder, out of which it will be driven by the piston elevated by the reacting power of the spring O. The flexible pipe, which connects the curved inflexible pipe H with the air-reservoir, will allow of said movement of the pipe H.

The perforated septum, composing the top of the liquid-chamber C, is advantageous in maintaining the liquid in close contact with the air-induction opening, and causing such air to properly spread into and pass through the liquid before entering the air-space above such liquid and in the reservoir.

The air-engine, as above described, is specially useful for drilling rock in a tunnel or elsewhere, and it also may be used to great advantage in operating a hammer or die when applied to its piston. By forcing the air through the mass of liquid B, used in the cylinder A or the chamber C thereof, the liquid not only prevents the back flowage of air into the pump, but serves to keep the piston tight, and is of service in other respects in the matter of effecting compression of the air.

I claim—

1. The combination of the hollow vibrating conduit H, the gate K, and the lifting-spring O with the piston and cylinder provided with vibratory conduit H and gate K, as described.

2. The combination of the hollow vibratory conduit H and the gate K with the air-compressing reservoir A and the open cylinder M, and the piston N thereof.

3. The combination of the vibratory conduit H and gate K with the flexible conduit G, the gate-seat I, and the opening *a* thereof, the whole being substantially as and so as to operate as set forth.

4. The employment of the mass of liquid in the reservoir B, with the air-pump combined therewith, as set forth, and a piston and cylinder connected therewith and having a conduit, H, and gate K, (or their mechanical equivalents,) as specified.

DANA BICKFORD.

Witnesses:
R. H. EDDY,
F. P. HALE, Jr.