J. F. HASKINS.

Improvement in Pneumatic-Engines.

No. 115,198. Patented May 23, 1871.

Fig. 1.

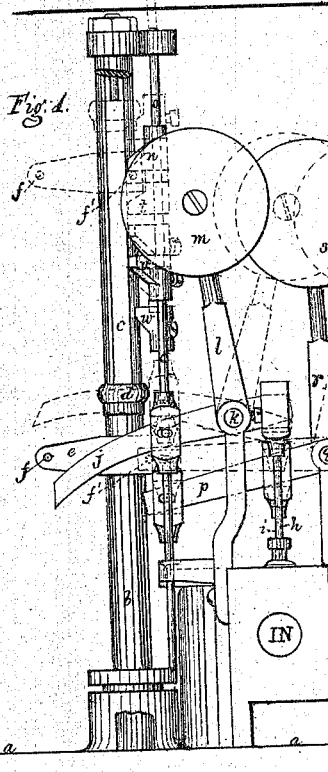


Fig. 2.

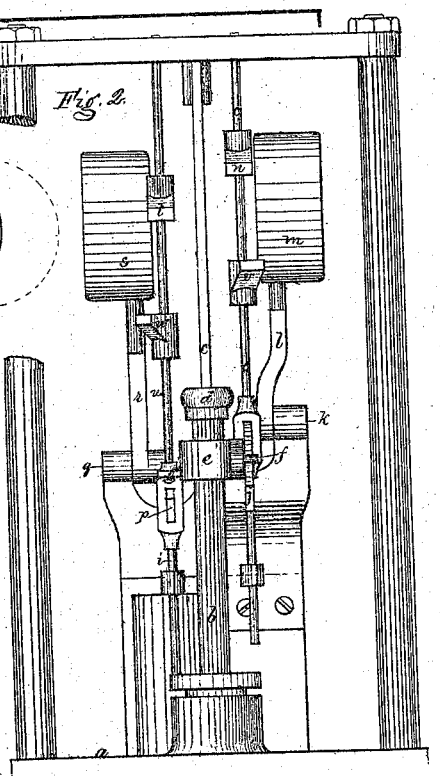
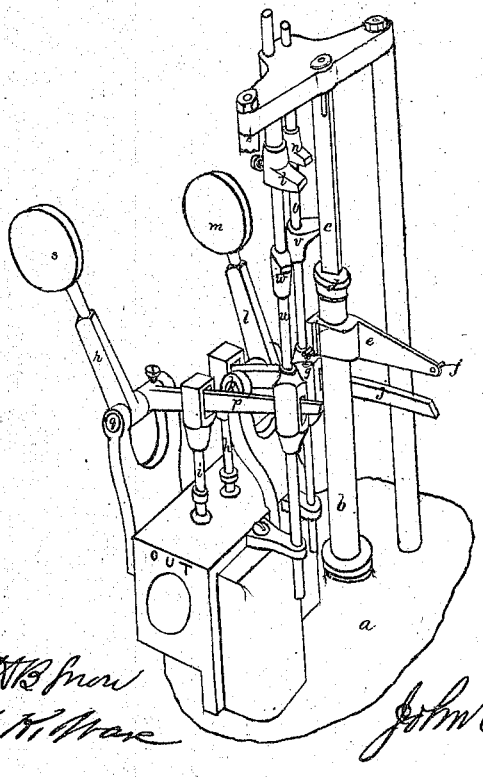


Fig. 3.



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A.M. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS.)

UNITED STATES PATENT OFFICE.

JOHN F. HASKINS, OF FITCHBURG, MASSACHUSETTS.

IMPROVEMENT IN PNEUMATIC ENGINES.

Specification forming part of Letters Patent No. 115,198, dated May 23, 1871.

To all whom it may concern:

Be it known that I, JOHN F. HASKINS, of Fitchburg, in the county of Worcester and State of Massachusetts, have invented an Improvement in Pneumatic Engines; and I do hereby declare that the following, taken in connection with the drawing which accompanies and forms part of this specification, is a description of my invention sufficient to enable those skilled in the art to practice it.

December 14, 1869, Letters Patent of the United States were granted to Robert Spear, of New Haven, for his invention of an engine operated by compressed air to raise water, in which he uses a vertical cylinder with a hollow buoyant float or piston, the movement of which operates the valves to admit water and air alternately.

My invention may be stated as an improvement upon Spear's, in that, instead of opening the air inlet and exhaust valves simultaneously, as Spear's does, or proposes to do, I close my air-exhaust valve before I open my air-inlet valve when beginning to force water out of the engine; and when filling the engine with water I shut my air-inlet valve before I open my air-exhaust valve, and thus I prevent loss of compressed air, which occurs in engines made as specified in Spear's aforesaid patent, which engines do not operate practically, because the air-inlet and air-exhaust valves being opened at the same time the compressed air passes directly from the inlet-pipe into the cylinder and out of the open exhaust-valve, and blows to waste without overcoming the resistance which the water offers to elevation. In my invention I keep the cylinder and guided buoyant piston described by Spear, and place on the piston-rod tappets, which operate against parts which are connected with the air inlet and exhaust valves to open and close said valves. Each air-valve is worked from a rocker-shaft having thereon two rocker-arms, one bearing an elevated weight, by which the valve is opened or closed when the weight is moved slightly one way or the other out of the vertical plane passing through the rocker-shaft. The other rocker-arm of each valve is operated directly or indirectly by the tappet on the piston-rod to shift the weight before mentioned, so that it will move by gravity beyond the distance which the tappet moves it.

I will now describe in detail a mechanism shown in the drawing which embodies my invention.

Figure 1 shows in side elevation my improved mechanism for operating the air-valves of an engine having a cylinder and piston like those shown in Spear's patent, Fig. 2 showing said mechanism in front elevation, Fig. 3 showing said mechanism in perspective.

The lines *a a* denote the top of the cylinder-head. *b* is the piston-rod, which is hollow for the purpose of receiving a guide-rod, *c*, preferably made as a wide thin rectangular bar, which fits a cap, *d*, secured to the top end of the piston-rod. By this device of the combination of the hollow piston-rod *b* with the guide-rod *c* I am enabled to reduce the space occupied by the machine in its working to an amount nearly equal to the length of the stroke of the machine, and in said combination one part of my invention consists. *e* is a piece adjustably fixed on the piston-rod, and in said piece are secured pins *f* and *g*, which respectively operate to cause motion of the air-inlet and air-outlet valves. Said valves may be of any known kind, but for the purpose I prefer balance-poppets, and they and the valve-chests and the air inlet and outlet valves may be connected to the cylinder-head, or to the upper part of the cylinder, in any convenient location and by any suitable means. The stem *h* is connected to the air-inlet valve, and the stem *i* to the air outlet or exhaust valve. The rocker-arm *j* is secured to the rocker-shaft *k*, which also has adjustably secured thereunto the rocker-arm *l*, which carries the weight *m*, all of said parts being operative to move the inlet-valve stem *h* when the tappet *f* strikes the upper edge of arm *j* or the lower edge of the lifter *n*, which is adjustably fixed on the guided rod *o*, which is connected to rocker-arm *j*. The inlet and outlet air-valves are so arranged that when the piston-rod is moving downward near the last part of its stroke the inlet-valve closes, after which the outlet-valve opens; and when the piston-rod rises the outlet-valve is closed near the last part of the upward stroke, and after said valve is closed the inlet-valve is opened. The rocker-arm *p* is secured to the rocker-shaft *q*, which also has adjustably secured thereunto the rocker-arm *r*, which carries the weight *s*, all of said parts being oper-

ative to move the outlet or exhaust valve-stem *i* when the tappet *g* strikes the upper edge of rocker-arm *p*, or the lower edge of the lifter *t*, which is adjustably fixed on the guided rod *u*, which is connected to the rocker-arm *p*.

In the arrangement shown the inlet-valve opens by a downward movement and closes by moving upward, and the outlet-valve also opens and closes similarly.

In Fig. 1 the position of the parts shown in full lines is that in which the piston-rod *b* is depressed to the greatest extent, the weights *m* and *s* being both thrown forward, and the outlet-valve open and the inlet-valve closed, so that, the cylinder being wholly or partly immersed in water, the liquid will flow in and will raise the buoyant piston until tappet *g* strikes lifter *t*, which causes weight *s* to assume the position shown in dotted lines in Fig. 1, which closes the outlet-valve, after which tappet *f'*, which is fixed in the piece *e* near the piston-rod *b*, strikes lifter *n* and causes weight *m* to assume the position seen in Fig. 1 in dotted lines, which opens the inlet-valve, and the compressed air enters the cylinder and expels the water, the piston in the cylinder descending by its weight until tappet *f* strikes arm *j*, which throws weight *m* forward from the position shown in dotted lines to that shown in full lines, Fig. 1, closing the air-inlet valve; and immediately after tappet *g* strikes arm *p* and throws weight *s* forward from the position shown in dotted lines to that shown in full lines, Fig. 1, opening the outlet-valve, whereupon the piston in the cylinder begins to rise, expelling the air contained above the piston in the cylinder; and thus the mechanism will continue to act so long as compressed air is supplied.

In mines it is desirable to have this pump located in a sump below the level to which the mine is to be kept drained, and while, if the exigencies of the case require, the piston may move through the length of the cylinder, as before explained, there are cases and times when it is desirable to lessen the piston-stroke so as to keep the discharging action of the pump only equal to or but slightly in excess of the supply of water, thus using the pump constantly instead of intermittently, and consuming no more compressed air than is required to keep the water at or below a convenient level.

To effect the purpose of shortening the distance from the top of the cylinder, which can be filled with compressed air—or, in other words, to shorten the stroke of the pump, and to reduce the quantity of air taken to perform each stroke, and to reduce the amount of water delivered by each stroke—I place on the rods *o* and *u* lifters *v* and *w*, so arranged that they may be adjusted up and down on said rods, and so that they may be fixed where the tappets *f'* and *g* will strike them or will pass clear of them, as may be desired. It will now be clearly seen that if the lifters *v* and *w* are turned on the rods *o* and *u* so as to be situated similarly to the lifters *n* and *t*, it will be on lifters *v* and *w*, and not on lifters *n* and *t*, that the tappets *f'* and *g* operate. Hence the nearer the lifters *v* and *w* are set to the cylinder-head *a* the shorter will be the stroke of the pump and the less will be the quantity of water delivered by each stroke.

It should be borne in mind that the function of the piston in the cylinder is merely that of a buoyant loose-fitting float, which moves with the direction of the motion of the water in the cylinder, and with force sufficient only to move the weights *m* and *s*, so that they will fall or tip by gravity. It will also be seen that all of the lifters are so arranged relatively that the outlet-valve is closed before the inlet-valve is opened, and that the inlet-valve is closed before the outlet-valve is opened, so that at no time can there be a free communication established with the atmosphere through the pump from the air compressor or reservoir.

For convenience in regulating the movement of the valves the weights *m* and *s* are made adjustable on the arms *l* and *r*.

I claim—

1. In an apparatus for delivering liquids under and by the action thereon of compressed air or gases, the valve-operating mechanism combined and arranged substantially as shown and described.

2. In combination with said mechanism, the intermediate lifters *v* and *w*, arranged as specified.

3. The combination of the hollow piston-rod *b* with the cap *d* and guide *c*, as and for the purpose specified.

JOHN F. HASKINS.

Witnesses:
T. K. WARE,
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