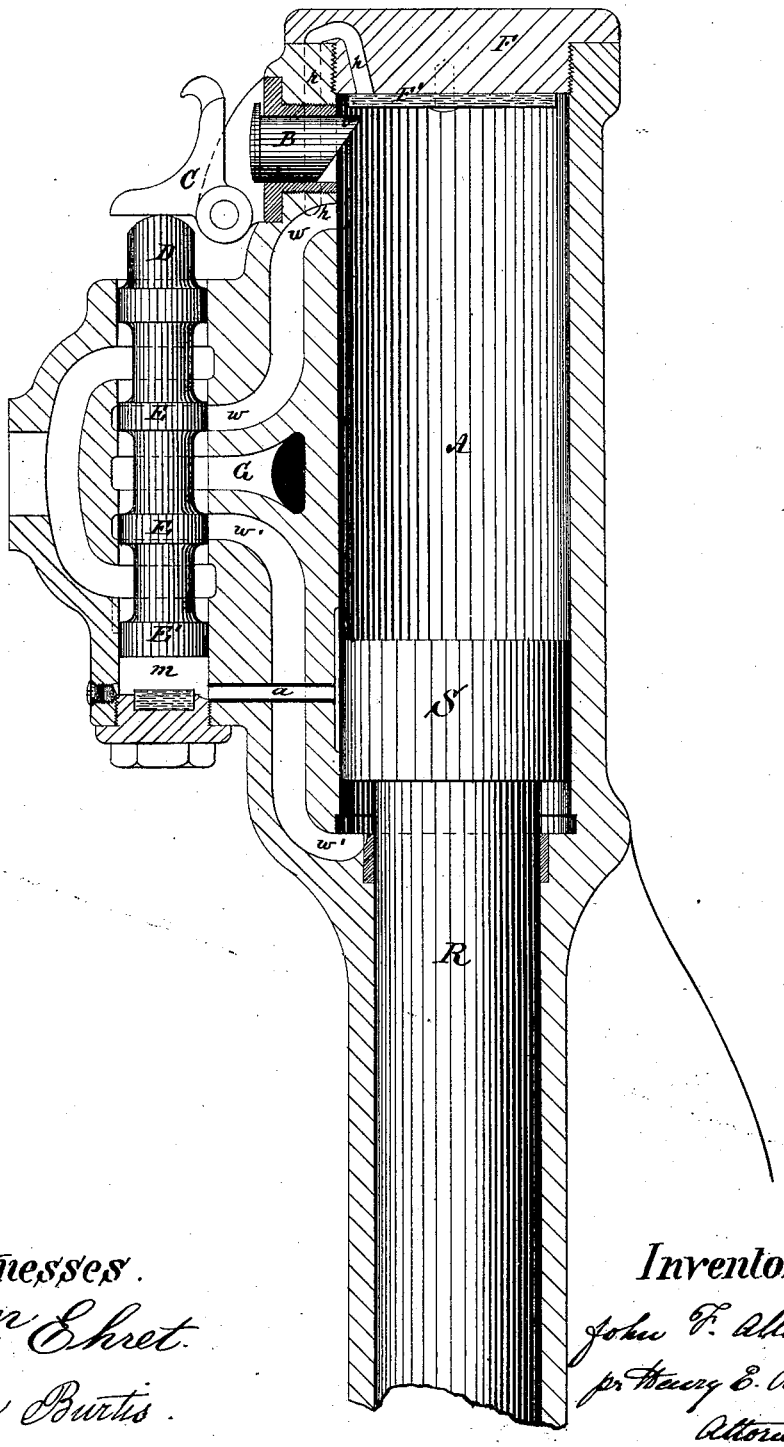
J. F. ALLEN.

PNEUMATIC ENGINES.

No. 193,631. Patented July 31, 1877.



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JOHN F. ALLEN, OF NEW YORK, N. Y.

IMPROVEMENT IN PNEUMATIC ENGINES.

Specification forming part of Letters Patent No. **193,631**, dated July 31, 1877; application filed November 2, 1876.

To all whom it may concern:

Be it known that I, JOHN F. ALLEN, of New York, in the State of New York, have invented a new and useful Improvement in Pneumatic Engines, of which the following is a specification:

The nature of my invention consists in the manner of operating the valves in engines, arranged or provided with a hammer or any other suitable tool, attached at the end of its piston-rod for the purpose of striking a blow.

The invention consists in arranging the port at the upper end of the cylinder, so that the piston, in its upward motion, will cover the same, thereby cutting off all connection between the top of the cylinder and the exhaust-passage, and thus causing the accumulated and increasing pressure, resulting from the farther moving of the piston, to act upon a suitable mechanical contrivance, whereby the position of the valve will be changed, so as to admit the pressure upon the top of the piston for the purpose of changing its direction of motion before the same will come in contact with the top of the cylinder; and, further, in the arrangement of an auxiliary port near the bottom of the cylinder, connected with a space below the slide-valve, which, while being uncovered by the piston when near its bottom stroke, will allow the pressure in the cylinder acting upon the piston to pass into this space below the valve, and thus move the same upward, so as to change its position in relation to the main passages, and thereby change the direction of the pressure from acting upon the top of the piston to act against the bottom of the same and cause the piston to be moved upward.

By this arrangement of operating or changing the position of the valve when the piston has arrived close to its top stroke, so as to admit the pressure upon the top of the piston by the accumulated and constantly-increasing pressure produced in the cylinder between the top of the piston and the top end of the cylinder, after all other escape is closed, I obtain a sudden, quick—similar to a positive mechanical—motion for this purpose, and while this thus-accumulated pressure acts as a cushion between the top of the piston and the top end of the cylinder the sudden changing of the valve will admit the full pressure against the top of the piston as soon as the pressure in that space above the piston falls below the pressure in these passages; and by the arrangement of operating the valve by means of the regular pressure in the cylinder, whenever the piston comes near its bottom stroke, and thereby opens the passage leading below the valve, so as to change thereby the direction of the pressure from acting upon the top of the piston to act against the under side of the same, a slower motion will result from this elastic medium, in consequence of which the necessary time will be obtained for the hammer or other tool to produce the full force of the blow resulting from the pressure acting upon the piston and its accumulated momentum, even if a slight variation should be necessary in the required length of the stroke of the piston for this purpose.

In the accompanying drawing, the cylinder, with valve, and mode of operating the same, is represented in section arranged for a riveting-machine.

A is the cylinder; E, the valve for the admission and exhaustion of the pressure to operate the piston S. R is the piston-rod, the end of which forms the hammer-head. The valve E, which is circular, is provided with a rod, D, passing through the top of the valve-case, and, with a piston, E′, at its lower end, working in the cylindrical chamber *m* arranged in the bottom of the valve-case. In the upper end of the cylinder, above the main passage *w*, a plug, B, is arranged, part of which projects into the cylinder. This plug B acts against a lever, C, arranged to act upon the valve-rod D. From the main upper steam-passage *w* one or more passages, *h*, are arranged, passing into the cylinder-cover F, and through the same into the top of the cylinder. The ends of these passages *h* are closed by a flexible valve, F′, made of leather, india-rubber, or its equivalent, attached to the inside of said cover. Near the lower end of the cylinder a passage, *a*, is arranged, connecting the inside of the cylinder with the chamber *m* in the bottom of the valve-case.

The main upper passage *w* is so arranged that the piston S will cover and close the same before arriving at its top stroke, and the aux-

iliary passage *a* is so arranged that the piston S will uncover the same when near its bottom stroke. When the piston S arrives near the end of its top stroke the same will cover the passage *w*, closing, thereby, all escape for the pressure, which still remains above the piston, compressing, thereby, this remaining pressure, which will soon increase in density, acting as an elastic cushion between the top of the piston and the end of the cylinder, and at the same time acting against the plug B, forcing the same outward, and operating, through the lever C, upon the valve-rod D, to change suddenly the position of the valve E in such a manner as to cause the pressure to pass into the top passage *w*.

This passage being closed by the position of the piston S over its opening, the pressure will pass through the auxiliary passages *h*, and through the cover upon the piston S whenever the pressure above the piston falls below that in the passages, and thus change its motion, and cause the same to move downward. When the piston has passed the opening of the main passage *w* the pressure will pass through the same in the usual manner, while the ends of the passages *h* will be closed by their valve F′.

Whenever the machine is constructed to operate downward the passages *h*, and, consequently, valve F′, may be dispensed with, as the accumulated pressure, together with the weight of the piston and piston-rod, will be found, in that case, sufficient to bring the piston past the port *w* for the pressure to enter and continue the motion.

To prevent any possible accident, and insure the motion of the valve E at the exact desired moment, the end *v* of this plug B is made to project into the cylinder, so that the end of the piston S can operate the same, so as to force the same outward, and thus operate the valve E, as above described, before the piston arrives at the end of its stroke, in case the accumulated pressure should not have previously operated said plug, as above mentioned.

When the piston S arrives near its bottom stroke it uncovers the auxiliary passage *a*, allowing, thereby, the pressure from the inside of the cylinder to pass into the chamber *m* in the valve-case under the ring E′ of the valves, moving, thereby, the valve E upward, and thus changing the direction of the pressure, so as to pass into the lower end of the cylinder through the lower main passage *w′*, and act against the under side of the piston S, at the same time forming a communication between the upper part of the cylinder and the exhaust-passage G through the valve in the usual manner.

The effective area of this ring E′ is greater than the effective area of the top ring E or the top of the valve, as the area of the rod D must be subtracted from the area of the top ring E, and the diameter of the plug B being made smaller than the diameter of the rod D will facilitate and enable this operation of moving the valve upward.

This effective area of the ring E will require to be raised somewhat by reducing or enlarging the diameter of the rod D according to the pressure to operate the machine for the work intended; for, the higher the working-pressure, the greater will be the effect upon the difference of area. In the interior of cylinder-surface a groove should be cast, running from the opening *a* downward, and of a length a little more than the depth of the piston, to allow a continued passage for the working-pressure to act against the bottom of the valve E′ after the same has been moved upward, while the piston S passes over the passage *a* in its upward motion.

This elastic medium of the pressure in the cylinder to operate the valve upward acts slower than if a positive mechanical arrangement would be employed for that purpose, in consequence of which the necessary time will be obtained for the hammer or other tool attached to the end of the piston-rod to strike the required blow, and at the same time allow a slight variation in the length of the stroke of the piston, which might be necessary for that purpose, before the pressure admitted into the bottom of the cylinder will act against the bottom of the piston.

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

The combination, in a pneumatic engine, of valve E, provided with piston E′ and rod D, lever C, and plug B, the passage *a*, and port *w*, with or without the passage *h* and valve F′, substantially as and for the purpose set forth.

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Witnesses:
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