C. P. LEAVITT.

Hot-Air Engines.

No. 133,649. Patented Dec. 3, 1872.

Fig. 2.

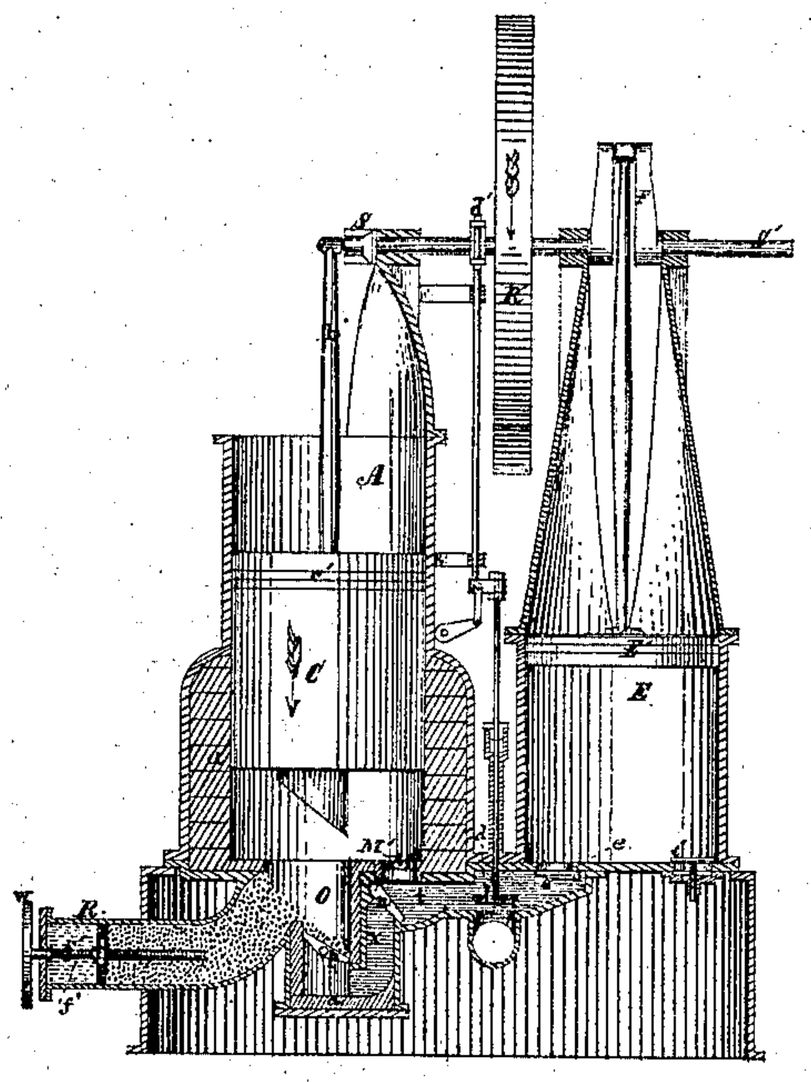
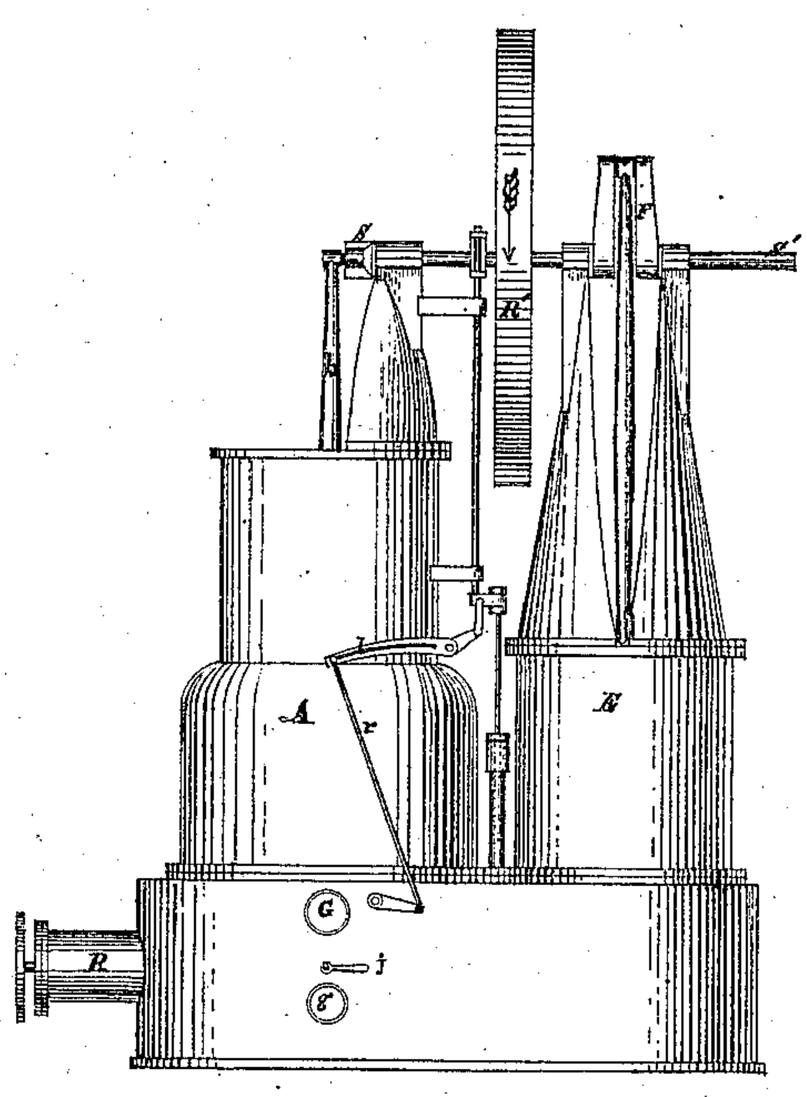


Fig. 1.



Witnesses

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IMPROVEMENT IN HOT-AIR ENGINES.

Specification forming part of Letters Patent No. **133,649**, dated December 3, 1872.

To all whom it may concern:

Be it known that I, CHAS. P. LEAVITT, of New York, in the county and State of New York, have invented a new and useful Improvement in Hot-Air Engines; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawing and to the letters of reference marked thereon forming a part of this specification.

My invention relates to that class of hot-air engines where the product of the combustion of the fuel enters the cylinder of the engine.

The principal features of my engine are, first, the direct passage of the product of the combustion of the fuel into the cylinder without the interposition of a valve, which would always be liable to derangement on account of the heat to which it would be subjected; second, constructing the pump of an equal capacity with the cylinder and discharging a portion of its contents under the exhaust-valve to keep it cool and free from dust and ashes; this feature also gives the engine less negative force than any other form of air-engine using a pump; third, means for supplying the fire regularly with fuel without stopping the engine or in any way interfering with its perfect action.

To enable others skilled in the art to make and use my invention I will now describe its construction and mode of operation.

In the drawing, Figure 1 is a side elevation of the engine, and Fig. 2 is a vertical section through the center.

Both views are drawn in the same plane, and similar letters refer to similar parts.

A is the main cylinder, which is more than twice the stroke of the crank in length, and is considerably larger in diameter at the lower part than it is at the upper part. This is to allow the cylinder to be lined in its lower part with the non-conducting material *a*, to resist the passage of heat. When this lining has been introduced the cylinder becomes of a uniform bore throughout. The lining *a* also extends over the lower head and the surface of the fire-box O, as shown. Fitted within the cylinder A, so as to be as large as possible without touching it, is the piston or plunger C. This is, in depth, greater than the stroke of the piston, and is mainly composed of a non-conducting material. The upper end is made of metal, neatly fitting the cylinder, and is packed with the ring of cupped leather C′. The plunger has a small prolongation to descend into the fire-box O, and thus diminish the amount of clearance. The plunger is hollow, to allow the lower end of the connecting-rod *b* to be jointed as low as possible, and thus diminish the vertical height of the engine. This rod connects in the usual manner with the crank S at its upper end. By this arrangement the piston-packing C′ always travels on the upper end of the cylinder, the metal of which is cold. In the hot portion of the cylinder there is no friction, since the plunger C does not touch the cylinder. E is the barrel of the pump, E′ the piston, and F the crank that drives it. This crank is at right angles (more or less, according to the amount of heat given to the air) to the crank S, and follows it. The pump induction-valve is marked *i*, and the eduction-valve *e*. The valve *d* is the exhaust-valve, and is so moved by the rolling cam *d′* that it is open when the piston C is descending and closed when it is ascending. M is an opening through which the air, in leaving the cylinder A, passes to the passage *t* and the exhaust-valve *d;* and *x* is a continuation of the passage *t* leading under the grate *p* of the fire-box O. Whether the air, on entering or leaving the cylinder, passes through the passage M or the passage *x* depends on the position of the valve *n*. This valve, being pivoted on one side, can be made to close either passage. It has a motion coincident in time with the valve *d*, being moved by the same cam, (see Fig. 1,) and on the downstroke of the engine always closes the passage *x*, as shown in Fig. 2. In Fig. 1 *r* is the rod that gives motion to the valve by acting on the arm fixed to its axis, where it extends beyond the base, as shown. The upper end of this rod connects with the link *l*, which receives its motion from the cam-rod of the cam *d′*. The upper end of the rod *r* may be secured at any portion of the slot within the link, and while, if secured at the extreme end, as shown in the drawing, the valve *n* will, on the descent of the valve *d*, be lifted so as to effectually close the passage M, compelling all the air which enters the cylinder to pass through the fire; yet, if secured

at any point nearer the axis of *l*, will only partially close that passage. This valve thus serves to regulate the amount of air that must pass through the fire to enter the cylinder. In order to supply the fire with fuel the horizontal tube R is arranged in connection with the fire-box O. This tube is fitted with the piston *f*, tapped to fit the screw *f'*, by which it is moved. The pipe R is fitted with a detachable head, through which the screw passes to receive the wheel W, by which it is turned. G is an opening, closed by a proper valve or hand-plate, by which access is given to the fire-box above the grate for kindling the fire; and *g* is a similar opening to admit of cleaning below the grate. The handle *j* is for the purpose of shaking the grate, it being pivoted in the usual manner for that purpose. R' is the fly-wheel, and *h* the pipe that conveys away the exhaust air.

In using this engine the piston *f* in the pipe R is screwed back against the head and the space in front of the piston filled with coal. As much water is then introduced into the pipe R as it will contain without overflowing into the fire-box, the water being introduced to prevent the coal taking fire and to reduce the clearance. The pipe is of sufficient capacity to hold enough coal to run the engine twelve hours, or more, if desired. It will now be clearly seen that by turning the screw in the proper direction the piston *f* will be forced with great power against the coal, thereby forcing it up the bent portion of the tube and out of the water, when it falls onto the fire-grate, as shown in the figure. The screw can be turned at a given rate by the engine itself, when the firing will become automatic. At the moment of revolution, shown in the drawing, the piston C is falling and the heated air is being forced out from beneath it through the passage M and the valve *d*. The pump-piston E', immediately following, also forces cold air into the passage *t*, which mingles with the air from the cylinder A and escapes with it. When the piston C is at the bottom of its stroke the current of hot air from the cylinder A ceases, and, as at that time the pump-piston is only half down and moving with its greatest velocity, the last air passing through the valve *d* is pure and cold. At this instant the valve closes, and, at the same time, the valve *n* is lifted, opening the passage *x* and closing or partially closing the passage M. The closing of the valve *d* prevents the escape of any more air from the engine, and the half-cylinder of air thus confined in the pump is made to yield before the advance of the piston E', partly by condensation and partly by escaping through the eduction-valve and the passages, shown through the fire, to the cylinder A, the piston of which at once begins to rise. When the piston E' is at the bottom of its stroke the piston C is half way upon its return stroke. The air which was in the pump on the closing of the valve *d* has been transferred to the cylinder A without change of final volume. The air being heated, its pressure is, say, doubled. The air then expands to the end of the stroke within the cylinder A, when its pressure falls to that of the atmosphere, the pump, meantime, making half its up stroke, drawing air through the induction-valve *i*, the eduction-valve being held closed by the pressure within the cylinder A. The valve *d* then opens as before, the valve *n* closes over the passage *x*, and, on the descent of the piston C, the air escapes, as already described, the air from the cylinder being mixed with, and then superseded by, the air from the pump during and after the last half-down stroke of the piston C.

Although I have described the crank F as at right angles to the crank S, and have supposed the pressure of air to be duplicated, it was merely for convenience of description. It is not likely that such a result will be often reached; and, as it is not desirable that the terminal pressure in the cylinder A should fall below the atmosphere, these cranks will most frequently have a greater inside angle than ninety degrees and less than one hundred and thirty degrees.

This engine admits of the introduction of the regenerator between the passage M and the valve *d*.

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

1. The cylinder A and the pump E, of equal size, combined, arranged, and operated substantially as described.

2. The arrangement, in the air-engine herein described, of the tube R, fitted with the piston *f*, submerged in water, and the screw *f'*, constructed substantially as and for the purpose specified.

3. The valve *n*, in combination with the passages M and *x*, arranged substantially as described, and for the purpose as set forth.

4. The valve *d*, in combination with the pump E and the cylinder A, arranged substantially as described, and for the purpose as set forth.

CHARLES P. LEAVITT.

Witnesses:
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CHAS. HALLETT CLARK.