S. H. ROPER.

HOT AIR ENGINE.

No. 34,333. Patented Feb. 4, 1862.

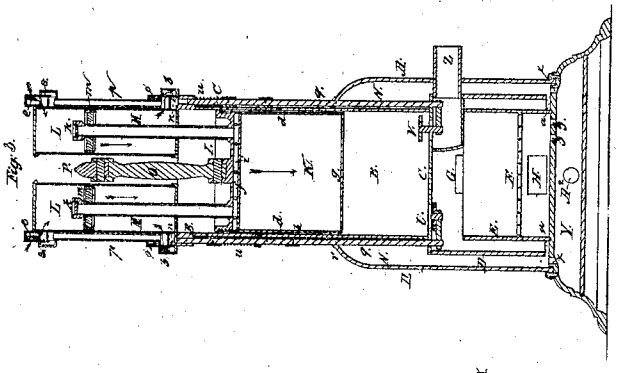

Fig. 3.

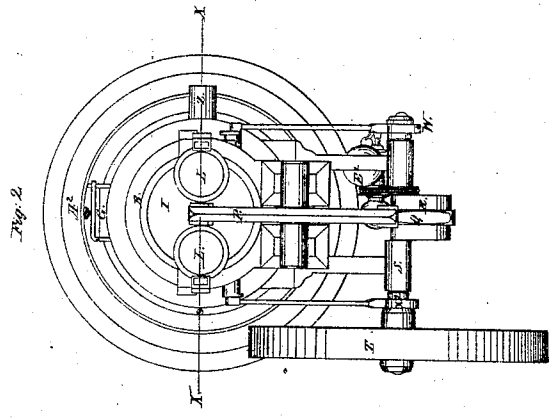

Fig. 2.

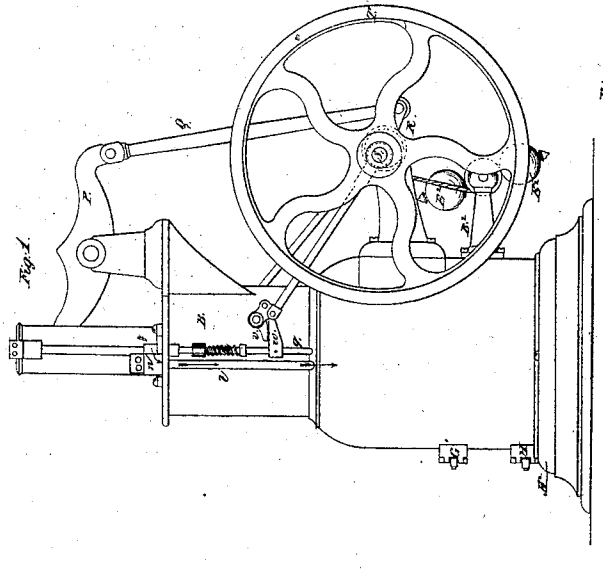

Fig. 1.

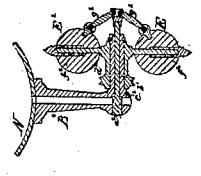

Fig. 4.

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IMPROVEMENT IN HOT-AIR ENGINES.

Specification forming part of Letters Patent No. **34,333**, dated February 4, 1862.

To all whom it may concern:

Be it known that I, S. H. ROPER, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Hot-Air Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1 is an elevation; Fig. 2, a plan; Fig. 3, a vertical central section upon the line X X of Fig. 2; Fig. 4, a section through the regulating apparatus.

The first part of my invention has for its aim the double object of keeping the cylinder and piston cool and of preventing the entrance of cinders or dust from the fire between the cylinder and the piston. To accomplish this end, I force a thin stratum of air down between the cylinder and the prolongation of the piston and in a direction contrary to that in which the hot air enters from the fire-box, and thus cool the parts and effectually prevent the products of combustion which may be admitted to the cylinder from coming in contact with that part of the cylinder adjacent to the piston.

My invention also consists in certain other improvements upon hot-air engines, which will be pointed out in the course of this description.

In the accompanying drawings, A is the exterior wall of the furnace, upon the top of which is supported the working-cylinder B, the bottom of which is closed by a tight-fitting head C, from which is suspended a cylinder D, which descends to within a short distance of the base, so as to leave a passage *a* of one-fourth inch, or thereabout, around its bottom edge. The interior of the cylinder D forms the fire-chamber, within which is placed the fire-pot E, which rests upon the base, as seen in Fig. 3, and rises to within eight inches, or thereabout, of the bottom of the cylinder.

F is the grate, G the fire-door, and H the ash-door.

The working-piston I fits tightly within the cylinder B, the packing (cast-iron or composition rings) being seen at *c* in Fig. 3. The piston I is lubricated from above by hand or by any suitable arrangement or apparatus. Beneath the piston is a cylindrical prolongation or chamber K, formed of cast-iron heads *f* and *g* and sheet-iron sides *h*, there being a space or shallow chamber *i* between the piston and the upper head *f*, the sides of which are formed by the continuation of sides *h* of the chamber K. The prolongation K of the piston fits loosely within the main cylinder, so as to leave a very narrow passage *d* all around between it and the cylinder. The sides of the space *i* are perforated with numerous small holes 1, through which a current of air is forced into and through the passage *d*, as will be hereinafter more fully explained.

The pumps L, by which the air for the support of the combustion and for driving the engine is forced in, are situated immediately over the main cylinder, to which they are secured.

In Fig. 3 the pistons *m* are represented as descending, the air entering by the valves *e*, as indicated by the arrows, and passing out from beneath the pistons by the valves *b* into the boxes *n*, whence it passes by the pipes *l*, Fig. 1, to the top of the chamber N, surrounding the fire-chamber and cylinder. On the ascent of the pistons *m* the air enters by the valves *o* and leaves the pumps by the valves *s* and pipes *p*, and thence by the box *n* and pipe *l* to the chamber N, as before.

The piston-rods M, Fig. 3, are hollow, and are furnished at their upper extremities with valves *k*, which open downward. The lower ends of the hollow piston-rods open into the space *i*, and thus as the pistons ascend a portion of the air from the pump-cylinders L passes through the valves *k* and hollow piston-rods M to the space *i*, and thence by the openings 1 into the space *d* between the prolongation K of the piston and the cylinder, by which means a double end is gained. First, the piston and the working portion of the main cylinder are kept cool and may be lubricated with oil, as in an ordinary steam-engine; second, the thin film of air descending through the space *d* effectually drives back any cinders, dust, or grit which may rise from the fire, and prevents it from coming in contact with the working-surface of the cylinder. I have thus attained the great desideratum so long sought for by builders of hot-air engines—viz., the entire exclusion of the cinders and grit from between the piston and the cyl-

inder, and the cooling of the piston and cylinder without waste of heat or power.

The piston-rod O is connected with the beam P in the customary manner, and the latter by means of the rod Q with the crank R upon the main shaft S, which carries a fly-wheel T.

U is the induction-valve upon the end of a rod q, which passes through a suitable stuffing-box at r and is held up by a spring t. The rod is depressed at the proper time by a tappet v and toe w, the tappet being operated by an eccentric X^2 upon the shaft S, Figs. 1 and 2.

The exhaust-valve V opens upward, and is forced down upon its seat by a spring u upon its rod q. This valve is raised at the proper instant by a tappet and toe upon the opposite side of the engine, operated by the eccentric W. The exhaust takes place through the pipe Z.

Beneath the ash-pit is a tight chamber Y, which communicates with the chamber N through the openings x and with the ash-pit through the openings z. The fire is thus surrounded by air, and the cinders and dust are not raised, as would be the case were it passed directly through the fire.

A^2 is the door through which the chamber Y may be cleaned out should it at any time become clogged with dust and ashes.

For the purpose of regulating the engine to the work to be done I employ a ball-governor arranged in a peculiar manner, which I will now proceed to describe. From the chamber N issues a pipe B^2, the outer end of which is commanded by a cylindrical valve a^2, the stem b^2 of which is connected with the governor in the following manner.

c^2 is a cylindrical bearing secured to the pipe B^2, within the interior of which slides the valve-stem b^2, and upon the exterior of which revolves the sleeve d^2, that carries the governor, the balls E^2 of which slide upon rods f^2, and are forced toward the sleeve by springs. (Seen in Fig. 4.) By means of joint-links g^2 the balls are connected with the valve-stem b^2 in such a manner that as the balls recede from the sleeve, under the centrifugal action generated by their revolution, the valve a^2 is removed from over the opening in the pipe B^2, and air from chamber N is allowed to escape, by which the pressure within the furnace is diminished and the action of the engine is regulated.

By the arrangement herein described of the working-cylinder, main piston, and force-pumps great economy of construction and space is effected, the pistons m being connected directly with the main piston I by the piston-rods M without intermediate connections or joints, while the pumps are supported directly upon the cylinder without the necessity of other foundation or base for the purpose.

I am aware that in hot-air engines motion has been given to a piston by two separate currents of compressed air, said currents having different temperatures and both assisting in raising the piston. This I do not claim; but

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

1. The employment of a current of air forced in between the prolongation of the piston and the cylinder in a direction counter to that entering from the fire-box, for the purpose described.

2. The air-space within the piston, in combination with the double-acting pumps and hollow pistons for pumping cool air therein and therefrom for the purpose of preserving the packing cool, as set forth.

3. Regulating the engine by exhausting the air from the fire-box by means of a governor, as set forth.

4. Placing the force-pumps upon the top of the cylinder and attaching the piston-rods M directly to the main piston, for the purpose described.

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Witnesses:
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