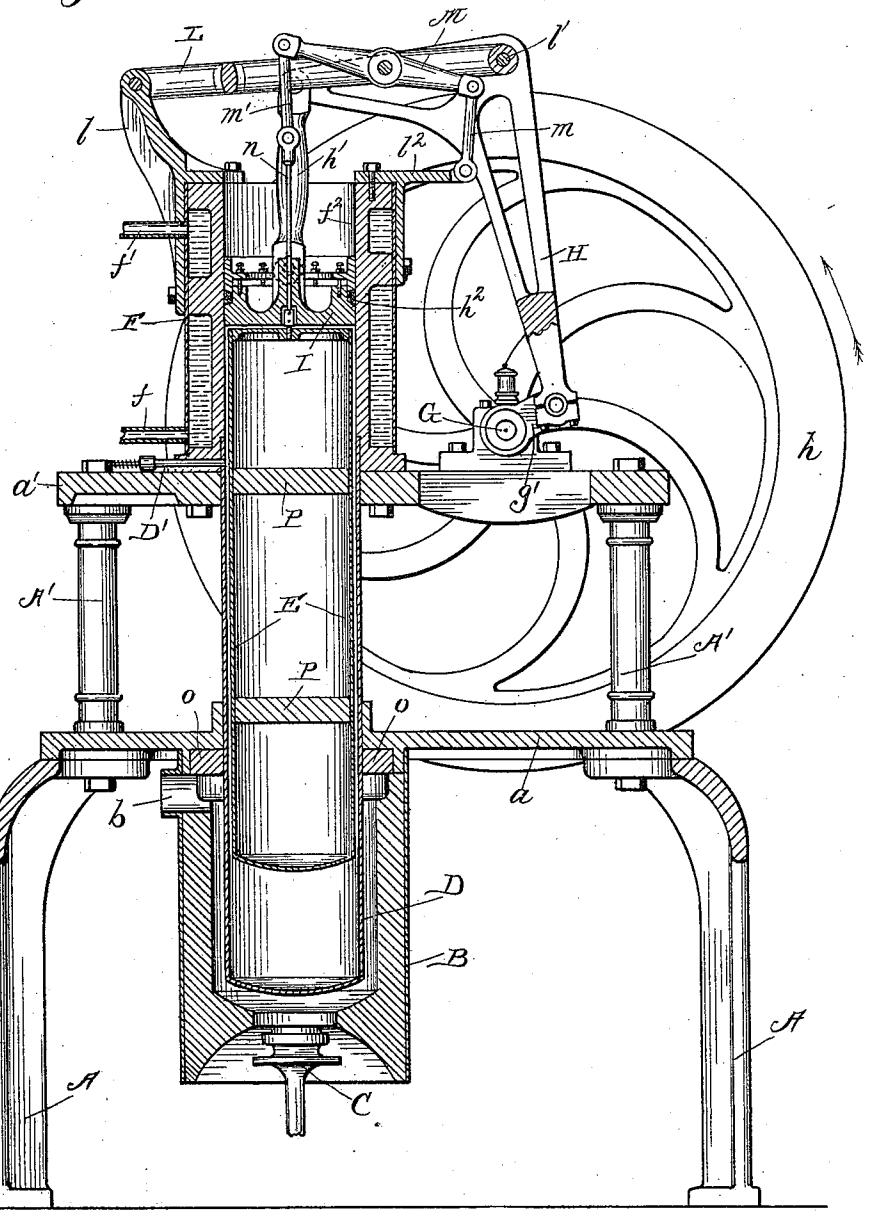
(No Model.) 2 Sheets—Sheet 1.

C. A. ANDERSON & E. A. ERICKSSON.

HOT AIR ENGINE.

No. 579,670. Patented Mar. 30, 1897.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

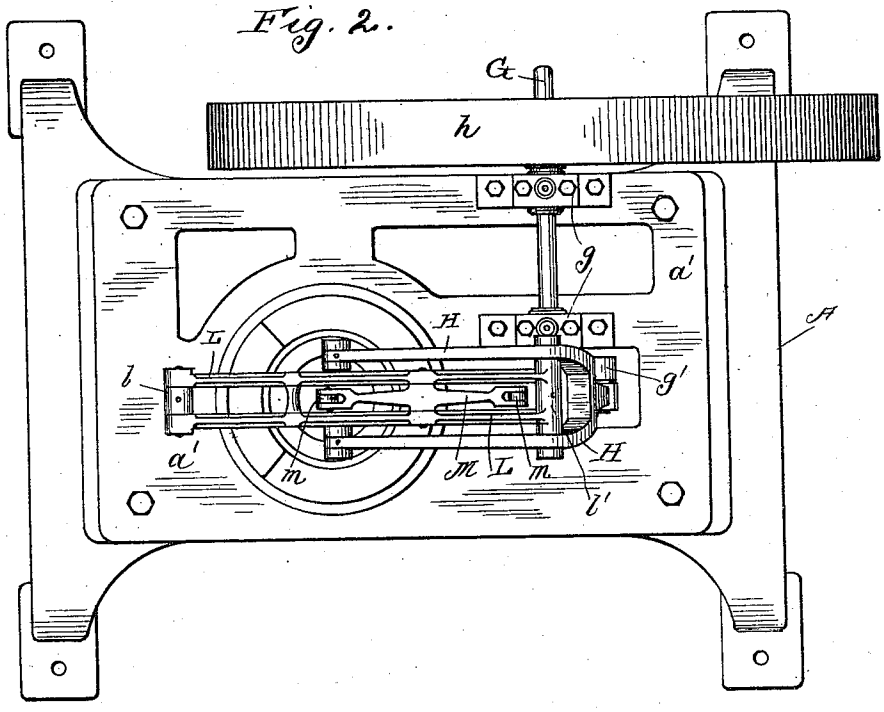


Fig. 3.

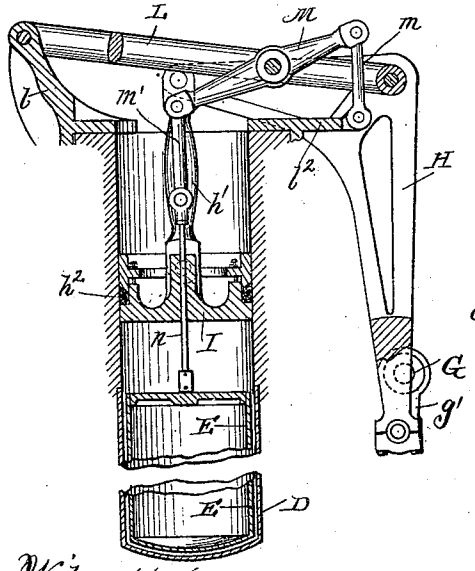
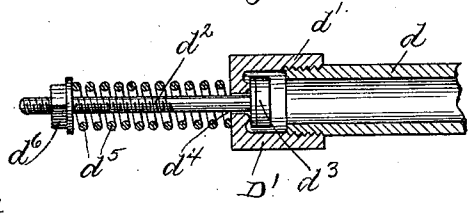


Fig. 4.



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UNITED STATES PATENT OFFICE.

CHARLES A. ANDERSON AND ERICK A. ERICKSSON, OF CHICAGO, ILLINOIS.

HOT-AIR ENGINE.

SPECIFICATION forming part of Letters Patent No. 579,670, dated March 30, 1897.

Application filed May 11, 1896. Serial No. 591,018. (No model.)

To all whom it may concern:

Be it known that we, CHARLES A. ANDERSON, a citizen of the United States, and ERICK A. ERICKSSON, a subject of the King of Sweden and Norway, both residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Hot-Air Engines, of which the following is a specification.

This invention relates to improvements in hot-air engines; and it consists in certain peculiarities of the construction, novel arrangement, and operation of the various parts thereof, as will be hereinafter more fully set forth and specifically claimed.

The objects of our invention are, first, to provide an engine to be operated by means of air which shall be simple and inexpensive in construction, strong and durable, and effective in operation, and, second, such an engine in which the heating and cooling of the air, in order to create the necessary expansion and contraction or compression thereof, are effected in a most reliable, simple, and efficient manner.

Other objects and advantages will appear in the description hereinafter set forth.

In order to enable others skilled in the art to which our invention pertains to make and use the same, we will now proceed to describe it, referring to the accompanying drawings, in which—

Figure 1 is a vertical central sectional view of our engine, showing the parts in position ready for use. Fig. 2 is a plan view of the engine. Fig. 3 is a vertical sectional view of a portion of the operating mechanism, showing the air-cylinder and plunger foreshortened for the convenience of illustration and illustrating the parts in a lowered position and nearly opposite from that shown in Fig. 1 of the drawings; and Fig. 4 is a detached sectional view of a valve to admit air to the air-cylinder.

Similar letters refer to like parts throughout the different views of the drawings.

A represents the base or pedestal, upon which is mounted the frame A′ to support the different parts of the engine, which pedestal and frame may be of any suitable size and construction. Beneath the lower surface of the platform *a* of the pedestal or base is located a fire-box or furnace B, which is provided at its upper portion with a flue *b* for the escape of the smoke and gases from the fuel, which may be of any suitable kind, but usually gas, properly supplied or furnished in the lower portion of the fire-box by means of a burner C, or other device if other fuel than gas is employed to heat the air. Extending through the top *a′* of the main frame A′ and the platform *a* of the base and into the hollow of the fire-box or furnace is an air vessel D, made of any suitable size, form, and material, but preferably of metal and cylindrical in shape, which we shall herein designate as the "air-cylinder." The bottom of this cylinder is closed, while its top is open, as shown in Figs. 1 and 3 of the drawings, to receive the plunger E, which is cylindrical in shape or of proper form to conform to the shape of the air-cylinder D and is somewhat smaller than the latter in order to permit of its free movement therein and to furnish a space between its walls and the walls of the air-cylinder for the passage of the air.

The upper end of the cylinder D extends a slight distance beyond the top *a′* of the main frame and is surrounded by a hollow water-jacket F, which the main frame supports and into the hollow of which the upper portion of the plunger E may extend. Communicating with the lower portion of the water-jacket F is a pipe *f*, used for supplying water to the jacket, and which is connected at its other end to a tank or other suitable source of supply. The upper portion of the water-jacket is provided with an outlet-pipe *f′*, through which the water may escape, thus creating circulation within the jacket and keeping it continually supplied with cold water. At a suitable point and usually near its upper end the air-cylinder D is provided with a valve D′ to admit air into the cylinder, but to prevent its escape therefrom. This valve may be of any suitable construction, but in the drawings we have shown one composed of a tube *d*, which communicates with the cylinder D and has secured on its outer end a hollow cap *d′*, through which passes a valve-stem d^2, having on its inner end a flexible piece d^3 to close the opening d^4 in the cap, through which the air is admitted. Around the stem d^2 is placed a spiral spring d^5, the

tension of which may be regulated by means of a nut d^6 on the outer end of the stem. On the main frame, in suitable bearings g, is journaled a shaft G, which may be provided with a balance-wheel h and pulleys or gear (not shown) for imparting power to the mechanism to be operated by the engine. To this shaft is secured a crank g', to which is pivotally connected a bell-crank lever H, which is preferably bifurcated, as shown in Fig. 2 of the drawings, and has pivotally secured about its upper end or ends, when bifurcated, connecting-rods h', which are likewise pivoted at their lower ends to the piston-head I, which fits and operates in the hollow f^2 of the water-jacket. The piston-head is provided with suitable packing h^2 to prevent the escape of air. On the upper portion of the water-jacket F is located a bracket l, to which is secured one end of a parallelogram or bifurcated lever L, which is fulcrumed at its other end, as at l', to the bell-crank lever and usually about its elbow. On the opposite side of the upper portion of the water-jacket from the bracket l is another bracket l^2, to which is pivoted one end of a connecting rod or link m, which is pivotally united at its other end to one end of a walking-beam M, journaled on the lever L, and to the other end of said walking-beam is pivotally secured a link or rod m', pivoted at its lower end to a rod n, which passes through an opening in the piston-head I and is secured to the top of the plunger E, as is clearly shown in Figs. 1 and 3 of the drawings. At the upper portion of the fire-box or furnace B and surrounding the air-cylinder D is placed a ring or piece o, of asbestos or other non-heat-conducting material, to prevent the heat ascending as much as possible on the walls of the cylinder. The plunger is provided in its interior with one or more partitions P, of asbestos or other suitable non-heat-conducting material, so as to divide the plunger into compartments and to prevent its upper portion becoming heated.

From the foregoing and by reference to the drawings it will be seen and readily understood that when the plunger is in the position shown in Fig. 1 of the drawings the air in the cylinder D will become heated through the medium of the fuel in the furnace or fire-box and thereby create expansion of the air, which will force the piston-head I upward until it reaches the topmost limit allowed by the bell-crank lever H and its connecting-rods h', and the plunger will likewise and simultaneously be forced upward till it reaches the topmost limit allowed by the walking-beam M and the connecting-rods m' and n, when it will be forced downward by the action of the crank g', lever H, and walking-beam M until it reaches its lowest limit, as illustrated in Fig. 3 of the drawings, which operation will force the heated air from the lower part of the cylinder into the space between the top of the plunger and the piston-head I, where it will become cooled and reduced in volume by the action of the cold water in the jacket F, thus creating a partial vacuum which will aid in drawing the piston-head downward, which action compresses the air, and together with the compound movements of the bell-crank lever H and walking-beam M and other connections will cause the plunger to again rise in the air-cylinder and force the air into the bottom thereof, thus allowing it to become again heated, when the same operation as above described will be repeated, with the effect to give momentum to the fly-wheel h and to impart power to the driving-shaft G, to which pulleys or gears may be applied for imparting power to the machinery to be operated.

Having thus fully described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. The combination with a supporting-frame, of an air-cylinder mounted thereon, an apparatus to heat the cylinder at its lower part, and a device to cool its upper portion, a plunger located in the cylinder, a piston-head located in the air-cylinder above the plunger, a main shaft journaled on the supporting-frame, a bell-crank connected to said shaft and to the piston-head, a lever pivoted at one of its ends to the bell-crank and at its other end to a fixed support, a walking-beam fulcrumed on said lever and pivotally connected at one of its ends to the plunger and at its other end to a fixed support, substantially as described.

2. A compound mechanical movement comprising a bell-crank lever, a main shaft, a crank uniting the shaft and one end of said lever, a pivoted connection at its other end, the lever L, fulcrumed at one of its ends to the bell-crank lever and pivoted at its other end to a fixed support, a walking-beam fulcrumed on the lever L, and having one of its ends pivotally connected to a fixed support and its other end connected to a movable object, substantially as described.

3. In a hot-air engine, the combination of an air-cylinder, with a plunger and a piston-head located in said cylinder, a main shaft journaled on the supporting-frame, a bell-crank connected to said shaft and to the piston-head, a lever pivoted at one of its ends to the bell-crank, and at its other end to a fixed support, a walking-beam fulcrumed on said lever and pivotally connected at one of its ends to the plunger and at its other end to a fixed support, substantially as described.

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