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F. W. MORSE & F. B. HUBBARD.

HOT AIR ENGINE.

APPLICATION FILED SEPT. 9, 1904.

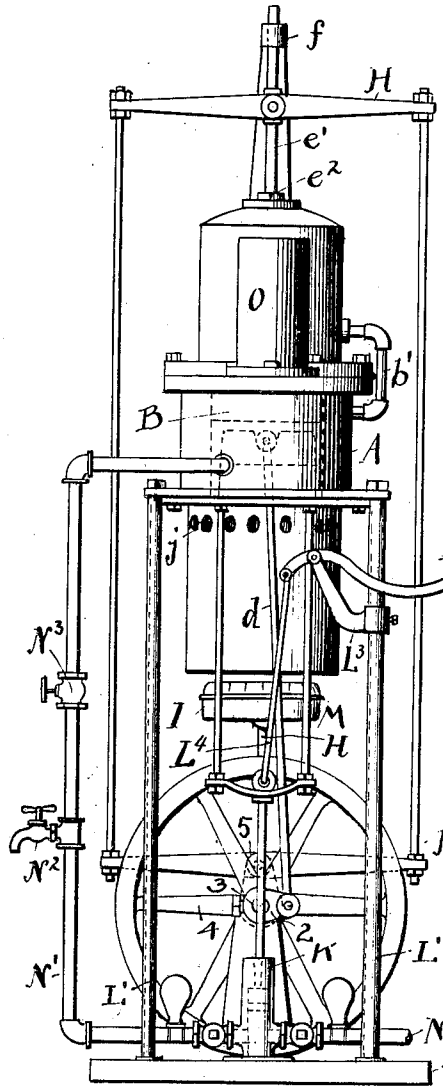


Fig. 1

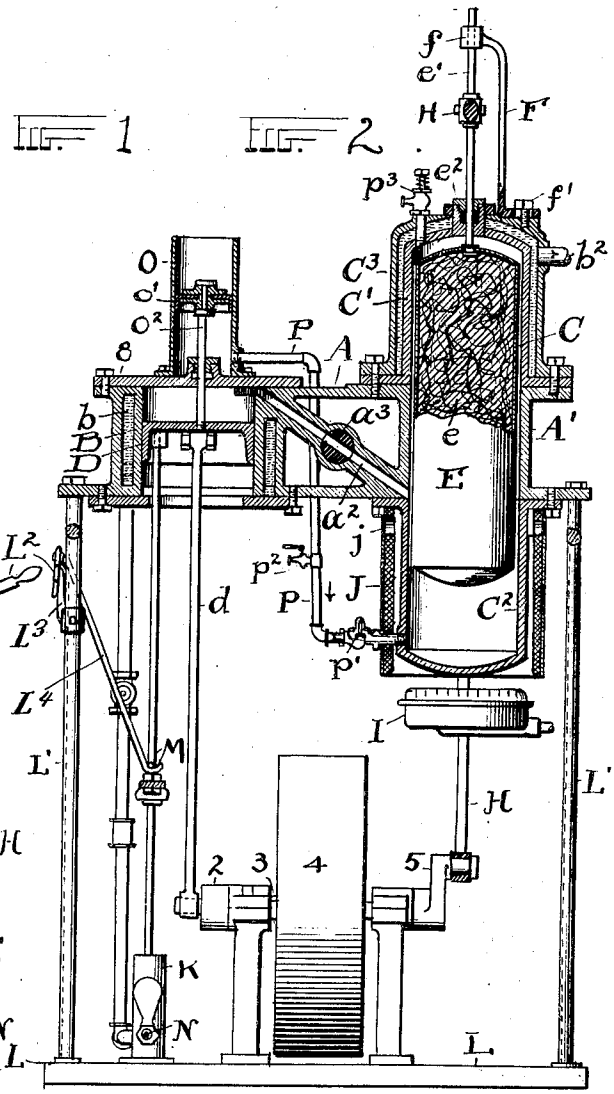


Fig. 2

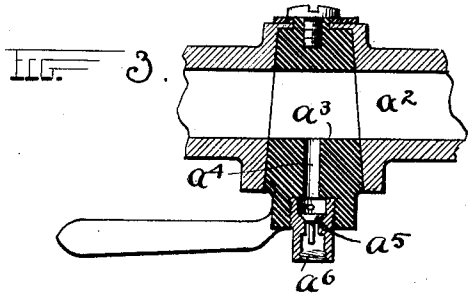


Fig. 3

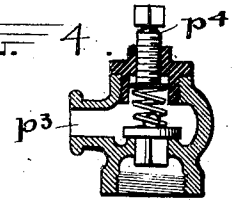


Fig. 4

WITNESSES:

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HOT-AIR ENGINE.

No. 822,463. Specification of Letters Patent. Patented June 5, 1906.

Application filed September 9, 1904. Serial No. 223,840.

To all whom it may concern:

Be it known that we, FRANK W. MORSE and FRANK B. HUBBARD, citizens of the United States, residing at Warren, in the county of Trumbull and State of Ohio, have invented certain new and useful Improvements in Hot-Air Engines; and we do declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to improvements in hot-air engines; and the invention consists in the novel arrangement of parts substantially as hereinafter shown and described, and more particularly pointed out in the claims.

Our object is embodied in a hot-air engine adapted to give increased power over other known forms of hot-air engines, especially in the small types.

Accessibility to the interior of the working cylinders and convenience in making repairs is an object also embodied in the construction.

We aim to produce an engine adapted to have a constant and fresh air supply, and thereby maintain an even running of the engine continuously without loss of power.

In the accompanying drawings, Figure 1 is a side elevation of our improved engine, and Fig. 2 is a central sectional elevation of the engine at right angles to Fig. 1. Fig. 3 is an enlarged sectional detail of the controlling-valve located in the main port between the air-cooling cylinder and hot-air cylinder. Fig. 4 is a sectional view, enlarged, of the air-pressure relief-valve for the hot-air cylinder.

The engine comprises a main casting A, made in one piece with a working cylinder B and a hot-air cylinder portion A′ at opposite ends and with a connecting duct or passage a^2 leading from the upper end of working cylinder B down and into the lower end of portion A′ of hot-air cylinder C. Removable extensions C′ and C^2, bolted upon the upper and lower faces, respectively, of casting A, complete cylinder C, and a water casing or jacket C^3 is also mounted upon and incloses upper extension C′. A plug-valve a^3 is mounted in passage a^2 to regulate the speed and power of the engine and is provided with an air-intake passage a^4 and a check-valve a^5 to prevent escape of air from port a^2. A suitable pump connection is made with the screw end a^6 of said valve, and air is forced into the cylinders before starting the engine. Thereafter check-valve a^5 remains closed from the pressure within.

Working cylinder B is provided with a piston D, connected by rod d with crank 2 on shaft 3, which carries balance-wheel 4 and which shaft is mounted in bearings supported by base L. Hot-air cylinder C is provided with a very light weight hollow plunger E, which is filled with asbestos e or like material and is of less diameter than the interior of said cylinder. Plunger E has an upper vertical stem e', adapted to slide in bearings e^2 and f to keep the plunger in perfect running alinement and out of contact with the cylinder. Bearing f is part of standard F, adjustably mounted upon a water-jacket C^3 by bolt f', and this jacket is removably secured to the flanges of extension C′. A yoke H pivotally connects stem e' with crank 5 on shaft 3, and said crank is set at substantially eighty-five or ninety degrees in advance of crank 2. A heater of any suitable construction, such as a gasolene-burner I, is located immediately beneath the lower end of cylinder C, and a heat, confining jacket or casing J depends from the flange of cylinder extensions C^2 and is spaced apart from said cylinder and provided with openings j at its top for the escape of the heat from burner I.

The engine as thus constructed is designed, primarily, for operating a water-pump K, mounted upon base L of the engine, and said pump is connected by a yoke connection M with piston D. Pump K is located in the line of water-supply N and forces the water through pipe N′ into the water-jacket b of working cylinder B, and thence through pipe-coupling b' into water-jacket C^3 of extensions C′, and thence through outlet-pipe b^2 to its ultimate destination.

For greater efficiency and power we have also provided an auxiliary air-pump O, having a flap-valve piston O′, said pump being mounted upon head 8 of working cylinder B and having its piston O′ connected with piston D by short shaft o^2. An air-pipe P connects pump O with the lower portion of cylinder extension C′ and conducts the cool air which is taken from the outer atmosphere past the piston O′ into the lower end of cylinder extension C^2, and a check-valve P′ prevents the return of the air to the pump. To guard against an overpressure of air within cylinder C, we provide a spring-controlled relief-valve p^3, located at the upper end of cylinder C, and said valve automatically opens to

relieve the pressure in the upper end of the cylinder when the pressure exceeds a predetermined amount and is controlled by set-screws p^4 on said valve.

Main casting A is supported above base L by four tubular uprights L′, one at each corner, and a hand-lever L^2 is pivoted upon a bracket L^3, secured to one of said uprights, and a link or other suitable connection L^4 is detachably connected to yoke M of pump K to operate the pump by hand power through lever L^2 when the engine is not running. A faucet N^2 is attached to pipe N′ for the withdrawal of water, and a check-valve N^3, placed in said pipe, prevents a backflow of water from water-jackets b and C^3.

To start the engine, air is first forced into passage a^2 and the cylinders by means of a separate air-pump, which is attached to valve a^3. Burner I is then started and lower extension C^2 of cylinder C heated to a high degree. Thereupon the engine starts running upon an initial movement given to fly-wheel 4 and continues to run until valve a^3 is closed or constant open connection is established with the outer atmosphere. As piston D rises the cool air in cylinder B is forced through duct or passage a^2 into cylinder C beneath plunger E. As plunger E rises the heated air passes into working cylinder B and acts upon the piston therein. The upper portion of cylinder C is water-jacketed to cool the air at that end, and when the plunger rises the cool air is displaced and forced down to the lower end of said cylinder. Balance-wheel 4 acts to carry the plunger over the dead points. A fresh supply of air is taken in from the outside from time to time, and any surplus is also automatically disposed of. The first-named result is obtained by air-pump O, which forces a supply of air from connection P into cylinder C, and relief-valve p^3 is utilized to the latter end.

What we claim is—

1. In a hot-air engine, the combination of a working cylinder with an air-heating cylinder, an open passage connecting said cylinders, a plunger in said air-heating cylinder and a piston in said working cylinder and crank connections for the same, a heater for said air-heating cylinder and an auxiliary air-pump connected with said piston, air connections between said pump and air-heating cylinder, a check-valve in said connections, and an air-pressure relief-valve for said air-heating cylinder.

2. In a hot-air engine, a casting with a working cylinder and a portion of an air-heating cylinder embodied therein, separate upper and lower extensions to complete said air-heating cylinder, a water-jacket for the upper extension and a heater-casing for the lower extension, a heater beneath said air-heating cylinder, a piston for said working cylinder and a plunger for said air-heating cylinder, a crank-shaft and balance-wheel thereon and crank connections between said crank-shaft and said piston and said plunger, an auxiliary air-pump for said engine and air connections between said auxiliary air-pump and the lower end of said air-heating cylinder, and means to control the flow of air to said heating-cylinder from said auxiliary pump, and an automatic air-relief valve for the upper end of said air-heating cylinder.

In testimony whereof we sign this specification in the presence of two witnesses.

FRANK W. MORSE.
FRANK B. HUBBARD.

Witnesses:
R. B. MOSER,
H. T. FISHER.