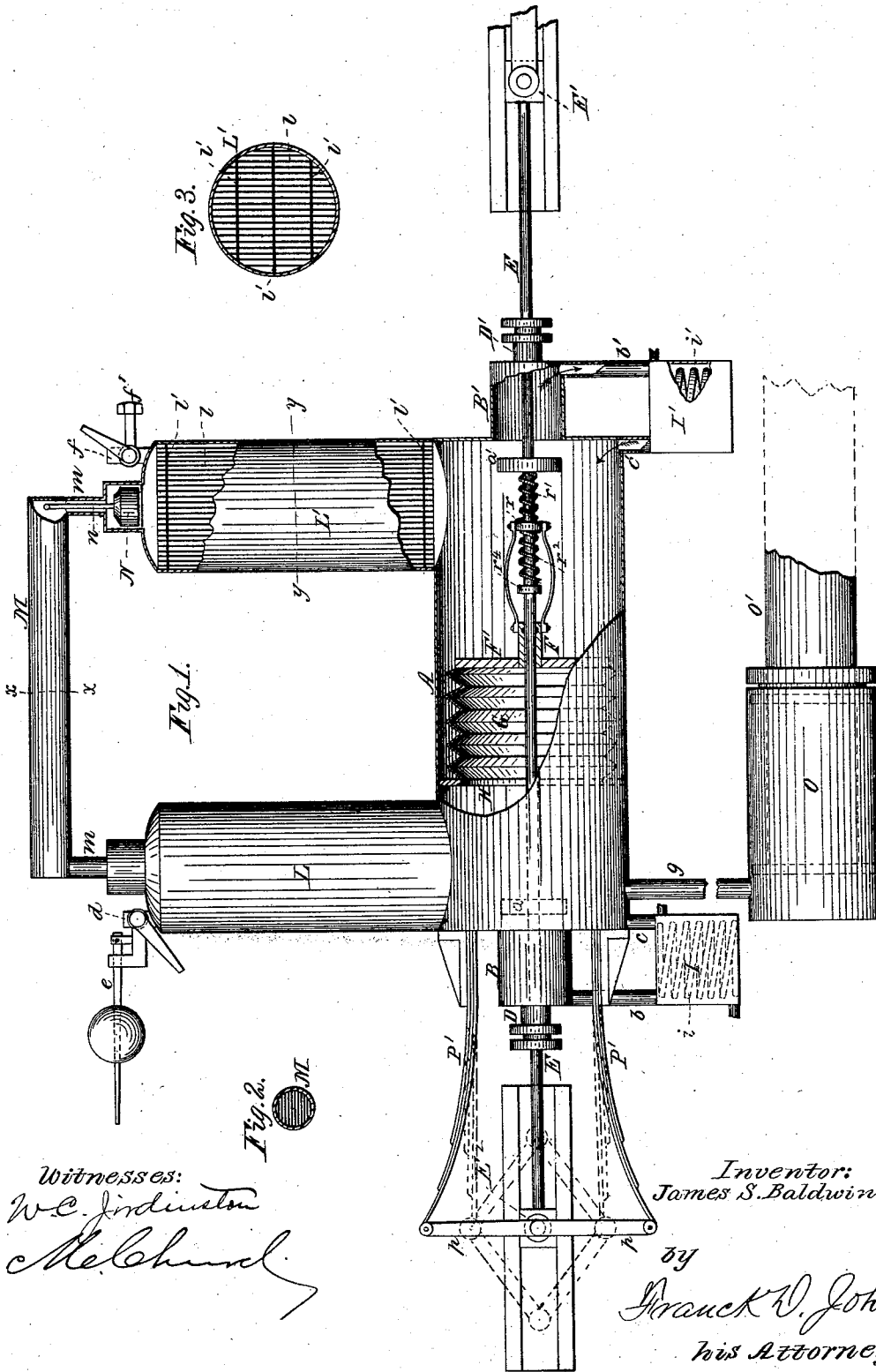


(No Model.)

J. S. BALDWIN.
HOT AIR ENGINE.

No. 292,400.

Patented Jan. 22, 1884.



Witnesses:
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UNITED STATES PATENT OFFICE.

JAMES S. BALDWIN, OF NEWARK, NEW JERSEY, ASSIGNOR OF TWENTY-ONE TWENTY-FIFTHS TO SAMUEL A. FARRAND, OF SAME PLACE, AND BENJAMIN W. BRADFORD, OF NEW YORK, N. Y.

HOT-AIR ENGINE.

SPECIFICATION forming part of Letters Patent No. 292,400, dated January 22, 1884.

Application filed June 2, 1883. (No model.)

To all whom it may concern:

Be it known that I, JAMES S. BALDWIN, a citizen of the United States of America, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Hot-Air Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification, and in which—

Figure 1 is a side elevation with partial longitudinal section. Fig. 2 is a cross-section of the regenerator, taken on line *xx* of Fig. 1; and Fig. 3, cross-section of one of the vertical chambers, taken on line *yy* of Fig. 1.

My invention relates to an improved apparatus for heating and cooling air or gas for the production of power; and it consists of certain novel construction and arrangement of parts, whereby I am enabled to control the temperature and tension or pressure of a mass of air or gas and readily apply the power obtained from the same to practical uses. It relates especially to that class of air or gas engines in which the same body of air or gas is used over and over.

The construction of the various parts I will now proceed to describe.

Referring to the drawings, similar letters of reference indicate like parts.

A is a cylinder, made of sheet metal; B B' two smaller extensions or prolongations at each end of the cylinder A, said cylinder A and extensions B B' having a common axis.

D D' are stuffing-boxes at the outer ends of the extensions B B'. Through these stuffing-boxes D D' passes the piston-rod E. Mounted upon the piston-rod is the sliding collar F, which carries the plate F'.

G is a bellows, one end of which is secured to and closed by the plate F', the other and open end being attached to the ring H, which is fastened to the inside of the cylinder A. Said bellows G is made of any suitable ma-

terial which is water-tight and at the same a poor conductor of heat.

a a' are disks or piston-heads which alternately enter the extensions B B' as the piston-rod E works back and forward.

b b' are pipes which connect the boxes I I', in which are placed the heating and cooling coils *i i'*, with the extensions B B'.

c c' are pipes which connect the boxes I I' with the cylinder A.

E' is a cross-head on one end of the piston-rod, moving in guides and connected with a crank or other suitable machinery for operating the same, and so arranged as to receive a regular reciprocating motion and thus actuate the bellows G as the piston-rod moves back and forward.

L L', are vertical chambers secured to the top of the cylinder A and opening into the same by openings nearly their full size. Said chambers L L' are filled with vertical iron plates *l*, supported by rods *l'*.

M is a regenerator connecting the two chambers L L' and opening into each by the pipes *m*.

N are float-valves suspended by rods *n*, which valves close the pipes *m*. The regenerator M is filled with horizontal metal plates, closely spaced, as shown in Fig. 2.

d is a pipe or inlet, provided with a suitable stop-valve, and through which any liquid or other substance can be introduced into the chamber L.

e is a safety-valve branching off from the pipe *d*. *f* is a similar pipe, for introducing liquid into the chamber L'; and *f'* is a pipe or inlet for the introduction of gas or air, and is provided with a suitable screw-cap for closing the same.

g is a pipe connecting the cylinder A with the cylinder O.

O' is a plunger working in the cylinder O. Said plunger O' is connected with any suitable device for transmitting power and thus operate any desired machinery. It is especially adapted for working a punch, shears, or similar machine. The piston-rod E and bellows G being at mid-stroke, the apparatus is charged through the openings *d* and *f* with any suit-

able liquid, preferably diluted glycerine or slightly alkaline water, until the cylinder A is completely filled and the chambers L L' are half full. The water-valves are then closed, and air or gas is forced in through the opening f' until the desired pressure or tension is attained. The valve is closed and the cap is then screwed on said opening f' , and the whole apparatus made perfectly air and water tight.

Hot water or steam, preferably the exhaust-steam of an engine, is caused to pass through the heating-coils i , and cold water through the cooling-coils i' . The disks or piston-heads $a a'$, alternately entering the extensions B B' at each stroke of the piston-rod, cause the contents of the latter to pass through the hot and cold coils, and thus maintain the liquid on each side of the plate F at the desired high or low temperature. The piston-rod E being operated and thus actuating the bellows, the liquid will alternately rise and fall in the chambers, and consequently there will be a transfer of the entire gaseous contents from one chamber to the other at each stroke of the piston-rod. The float-valves N will prevent the passage of any liquid into the regenerator. The metal plates which fill the vertical chambers L L' will thus be immersed at each stroke of the piston-rod in hot or cold water, and are thus brought to and maintained at the temperature of the liquid in which they are immersed, thus enabling the air or gas to advantageously expand and contract, as required, for the purpose set forth. The large moist surface of the hot-air chamber would tend to generate and charge the warm air with vapor, which, condensing in the regenerator, would cause trouble and a loss of heat. To obviate this, I use a thick stratum of melted paraffine, which, floating on the hot water, completely films over the sheets of iron and prevents vapor from rising into the regenerator. When desired, a stratum of paraffine-oil can be used. A hydrocarbon gas may in some cases be advantageously used in place of air.

To operate my apparatus, motion is imparted to the piston-rod E. The bellows is thus actuated, and drawing the plate F' toward the extension B', the cold liquid is forced up into the chamber L' and the air or gas passes through the regenerator into the chamber L, where coming in contact with the hot metal plates, it expands, and, operating against the surface of the water in the cylinder A, it drives the same down through the pipe g into the cylinder O, and forces the plunger O' out to position shown in dotted lines. On the backstroke of the piston the water is forced up into the chamber L, again heating the plates in that chamber, and the air or gas passes through the regenerator into the chamber L', and, coming in contact with the cold plates, contracts; and this operation of the alternate expansion and contraction of the air or gas is repeated at each stroke of the piston. I am thus enabled to utilize the entire power developed by the expansion

of the air or gas as it comes in contact with the hot surface in the chamber L.

As the power required to operate the piston-rod E varies at different portions of the stroke, I use an apparatus which I will now describe to regulate or equalize the same.

P' are springs secured to the frame-work of the cylinder A. p are rods connecting said springs with a cross-head E² on one end of the piston-rod E, by means of which springs a resistance is offered when the weight of the liquid aids the action of the bellows, and a like assistance is rendered when the weight of the liquid resists the action of the bellows and piston. The centers and positions of the springs at different portions of the stroke are shown by dotted lines.

I do not confine myself to this specific form of springs for the equalizing apparatus. Any equivalent for the same may be used; or, if desired, a weight, to be raised and lowered, can be substituted for the springs.

If desired, the entire apparatus may be duplicated, and the plunger in the cylinder O may enter at its other end into a similar cylinder connected with the duplicate apparatus, and thus be driven back and forward, the air or gas in one apparatus contracting while it expands in the other; or the plunger O' may be connected with suitable springs or weights for forcing it back into the cylinder O, when the tension of the expanding air or gas is reduced or removed, and thus drive the water from the cylinder O back into the cylinder A.

To enable the bellows to accommodate itself to the inequalities of volume resulting from the overflow of the liquid from the cylinder A to the cylinder O, and the return of said liquid from the cylinder O to cylinder A, the sliding collar F and plate F' are maintained in their approximate position by the sliding collar r and spiral springs r' and r'' , the spring r'' abutting against the fixed collar r' . If desired, a similar device could be placed outside of the cylinder A, near the cross-head E'.

By the use of this apparatus, a small amount of power communicated to the piston E is greatly multiplied when transmitted through the plunger O'.

My apparatus is also adapted to act as an accumulator of power by the use of additions, which will be made the subject of a subsequent application.

Having thus fully described my invention, I claim as new and desire to secure by Letters Patent—

1. The cylinder for holding a fluid, and means for heating the fluid in one end of the cylinder and cooling it in the other, in combination with the vertical chambers, connected by the regenerator, and a bellows separating the hot from the cold fluid, and means for operating said bellows, whereby the fluid can be alternately raised and lowered in the vertical chambers, and the air or gas caused

to rise or fall in tension as it comes in contact with a hot or cold surface, substantially as shown and described.

5 2. The cylinder A, for holding a liquid, provided with means for heating the liquid in one end of the cylinder and cooling it in the other, in combination with the vertical chambers L L', filled with metal plates *l*, and connected by the regenerator, said cylinder A
10 having the bellows G, and means for operating the same, substantially as and for the purpose shown and described.

3. The vertical chambers L L', having the plates *l*, and connected by the regenerator M,
15 filled with metal plates, and having the float-valves N, in combination with the cylinder A, having the bellows G, and means for operating the same, substantially as and for the purpose shown and described.

20 4. The vertical chambers L L', opening into the cylinder A, said cylinder A having the extensions B B' and hot and cold coil boxes I I', connected with the extensions and cylinder, in combination with the piston-rod E,
25 carrying the disks or piston-heads *a a'*, and the plate F', attached to the bellows, and means for operating said piston-rod, substantially as shown and described.

5. The cylinder A and piston-rod E, carrying the plate F', and means for operating said
30 piston-rod, in combination with the springs P P and rods *p*, substantially as and for the purpose shown and described.

6. The cylinder A and piston-rod E, carrying the sliding collar F and plate F', and disks
35 *a a'*, in combination with the sliding collar *r*, springs *r' r''*, and stationary collar *r'''*, substantially as and for the purpose shown and described.

7. The vertical chambers L L', connected
40 by the regenerator M, the cylinder A, having extensions B B', bellows G, piston-rod E, carrying the plate F' and disks *a a'*, and means for operating the piston-rod, in combination with the cylinder O, having the plunger O', and
45 means for forcing the plunger back when the pressure of the air or gas is reduced or removed, substantially as and for the purpose shown and described.

In testimony whereof I affix my signature in
50 presence of two witnesses.

JAMES S. BALDWIN.

Witnesses:

OBA WOODRUFF,
J. C. DUNN.