

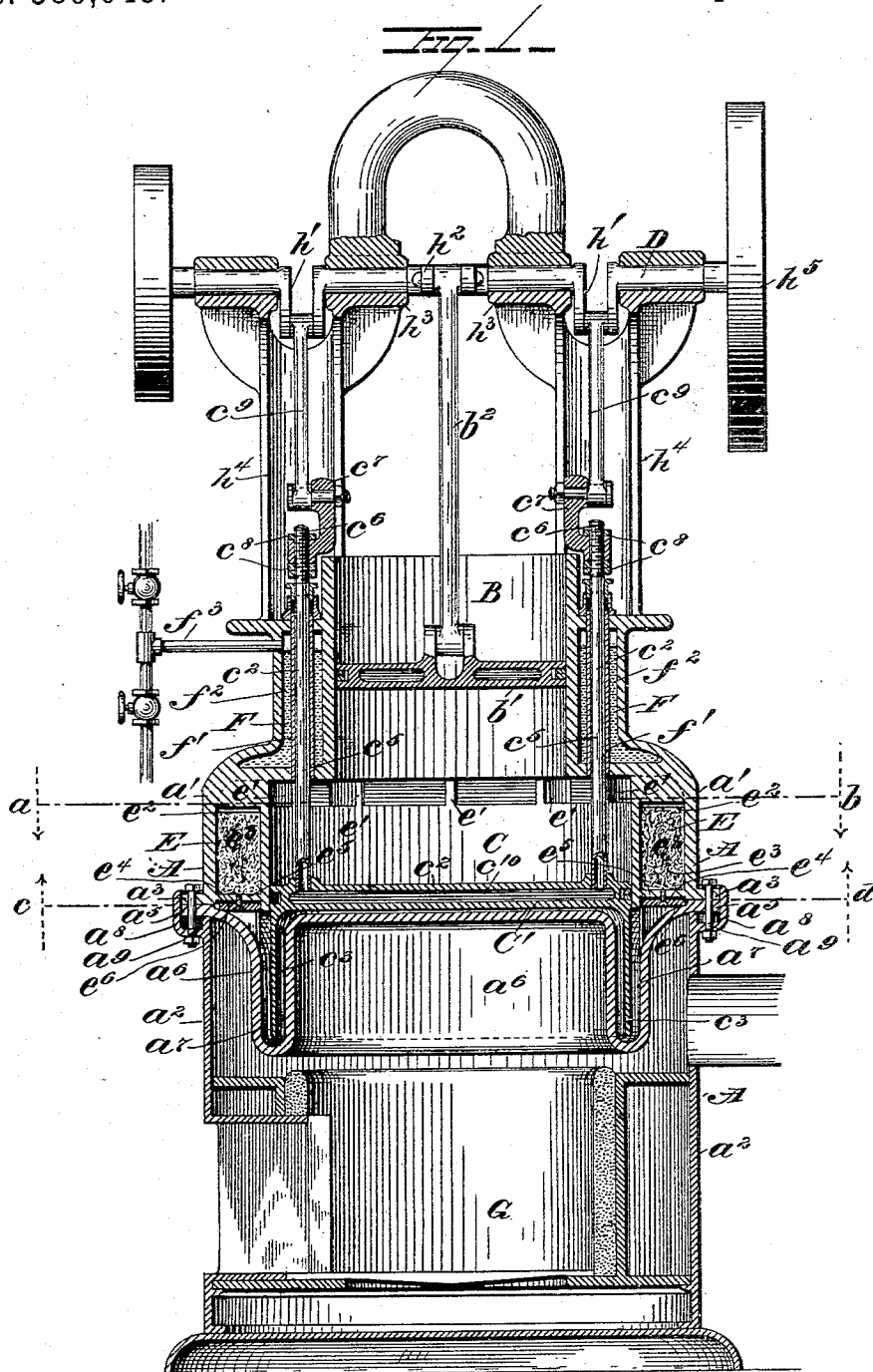
(No Model.)

3 Sheets—Sheet 1.

J. L. BAIR.
HOT AIR ENGINE.

No. 389,045.

Patented Sept. 4, 1888.



WITNESSES:

Wm. Keen,
F. Norman, Dixon

INVENTOR,

Joseph L. Bair,
per Joshua Pusy,
Att'y

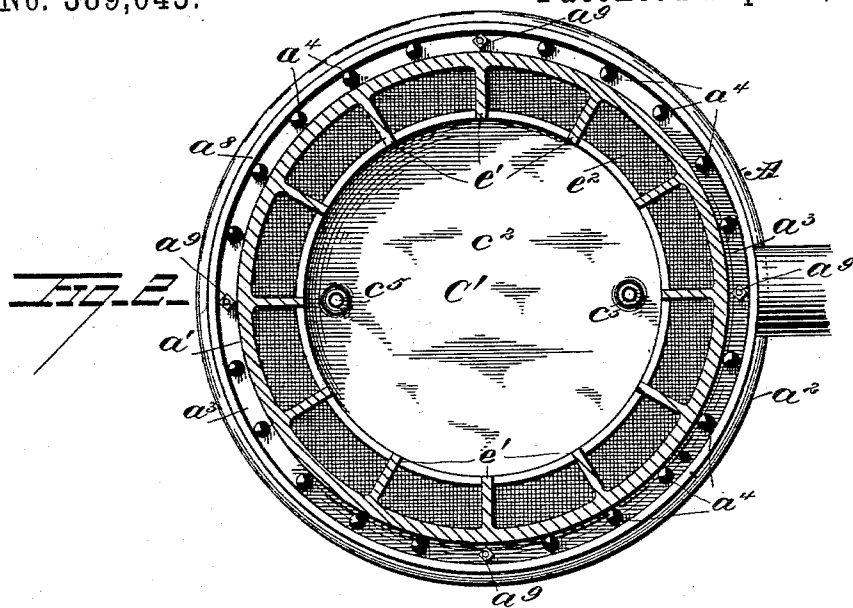
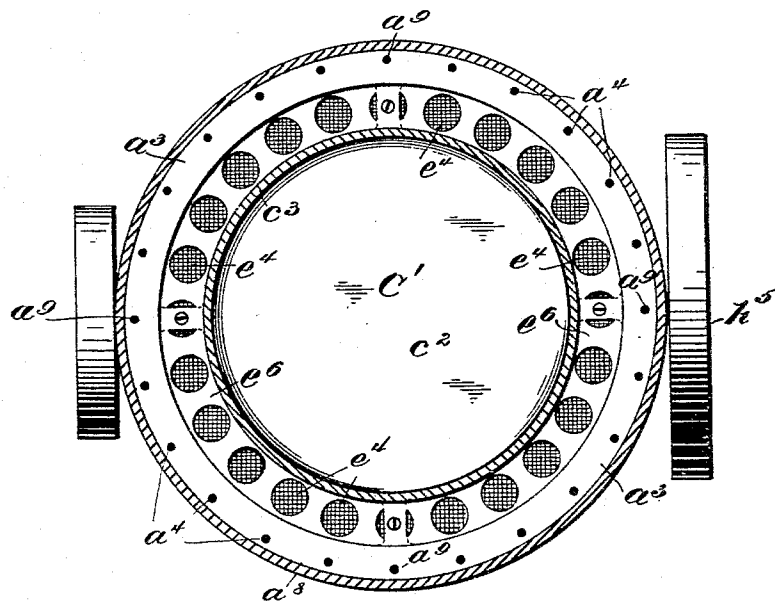
(No Model.)

3 Sheets—Sheet 2.

J. L. BAIR.
HOT AIR ENGINE.

No. 389,045.

Patented Sept. 4, 1888.



WITNESSES:

Geo. Nolan,
J. Norman, Dixon,

INVENTOR,

Joseph L. Bair,
per Joshua Busby,
Att'y.

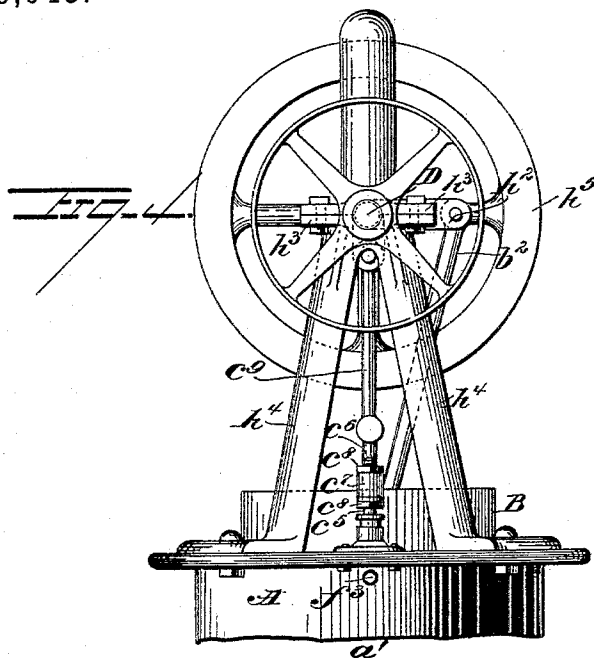
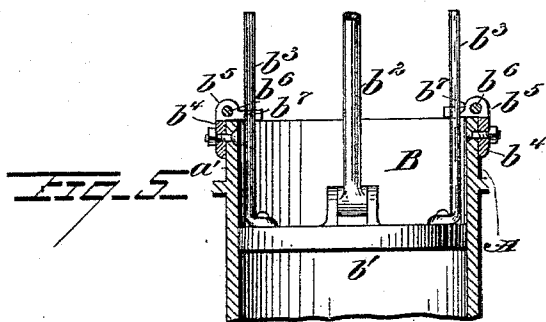
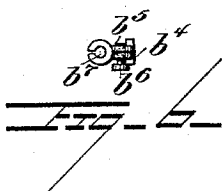
(No Model.)

3 Sheets—Sheet 3.

J. L. BAIR.
HOT AIR ENGINE.

No. 389,045.

Patented Sept. 4, 1888.



WITNESSES:

Geo. Nolan
H. Norman, Suffolk.

INVENTOR,

Joseph L. Bair,
per Joshua Pusy,
Att'y.

UNITED STATES PATENT OFFICE.

JOSEPH L. BAIR, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO JOSEPH J. WHITE, OF NEW LISBON, NEW JERSEY.

HOT-AIR ENGINE.

SPECIFICATION forming part of Letters Patent No. 339,045, dated September 4, 1883.

Application filed October 28, 1887. Serial No. 253,577. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH L. BAIR, a citizen of the United States, residing in the city and county of Philadelphia, and State of Pennsylvania, have invented certain new and useful Improvements in Hot-Air Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, of which—

10 Figure 1 is a longitudinal vertical sectional elevation of an air-engine, in which my invention is embodied, showing the position of the parts when the displacer is at its lowest point. Figs. 2 and 3 are sections taken, respectively; 15 on the lines *a b* and *c d*, Fig. 1. Fig. 4 is a front elevation of the upper part of the engine. Fig. 5 is a vertical section of the upper part of the piston-chamber, showing the piston-head provided with vertical guide-rods. 20 Fig. 6 is a plan of guide-bracket, detached.

This invention relates to that well-known class of air-engines wherein a confined volume of air is alternately heated and cooled within a suitable chamber, in order by its expansion 25 and contraction to successively reciprocate a working and a displacing piston connected with a suitable driving-shaft.

The object of my invention is to improve the general construction and operation of engines of the class referred to; and to this end my invention consists in a certain arrangement and combination of devices, which will be hereinafter fully set forth, and be pointed out in the claims.

35 Referring to the annexed drawings, A represents the exterior cylindrical casing; B C, the central chambers formed therein for the piston *b'* and displacer *C'*, respectively; D, the shaft to which the piston-rod *b''* and displacer-rods *c'* are connected; E, the annular regenerating-chamber between the casing A and chamber C, and communicating at each end with said latter chamber; F, the circumferential water-chamber surrounding the piston-chamber B, and G the furnace below said chambers. 45

In order that the internal chambers and devices working therein may be readily connected together for operation or be detached 50 for inspection or repair, I form the casing A

in two sections, *a' a''*, the upper section, *a'*, containing the chambers B, C, E, and F, and the lower section, *a''*, the furnace G. The section *a'* is provided at its lower end with an outer flange, *a'''*, to which is secured, by bolts *a'''*, or otherwise, a flange, *a''''*, on an introverted cylinder, *a''''*. The annulus *a''''*, formed between the introverted walls of this cylinder, comprises the lower part of the displacer-chamber C. Depending from the displacer-head *c''* 60 into said annulus is an annular collar, *c'''*, whose function will be hereinafter explained. The lower section, *a''*, of the casing A is provided at its upper end with an exterior upturned flange, *a''''*, to which the united flanges *a'''' a''''* on the upper section, *a'*, are firmly secured by bolts *a'''*, or otherwise. Thus it will be seen that when the piston *b'* is in place the interior chambers, B, C, E, and F, are perfectly air-tight. 70

The construction of the regenerator or heat-economizer is as follows: At the top of the annular chamber E, between the walls of the chamber B and casing A, are radial wings or arms *e'*, upon which is supported, before the section *a'* and cylinder *a''* are bolted together, 75 an open wire ring or screen, *e''*. The chamber is now filled with finely-divided metal pieces, such as lathe or planer chips *e'''*, and a similar ring or screen, *e''''*, is placed upon the cross-pieces *e'''*, formed at the lower end of the chamber, an annular perforated ring, *e''''*, being screwed or otherwise suitably secured to said cross-pieces. (See Fig. 3.) Thus the chamber E is laterally separated from the chamber 85 C, but is in open communication therewith at its upper and lower ends.

By constructing the regenerator in the manner just described there is attainable more positive and satisfactory results than by the 90 previous constructions.

Projecting vertically from each side of the displacer-head *c'*, up through a tube, *f'*, in the water-chamber F, is a rod, *c''*, whose upper end, *c'''*, is screw-threaded, as seen. Secured 95 to the end *c'''* of each rod *c''* is a yoke, *c''''*, which may be nicely adjusted vertically by set-nuts *c''''*. The yokes *c''''* are pivotally connected with cranks *h'* on the shaft D by means of rods *c''*. The rods *c''* are preferably hollow, as shown, 100

and communicate with an interior chamber, c^{10} , formed in the displacer-head c^2 , in order to allow a current of cool air to circulate through said chamber, so as to keep the head c^2 in a comparatively cool state. These rods c^5 may, however, be solid, thus making the chamber c^2 air-tight, the confined air therein acting as a non-conductor between its upper and lower walls.

- 10 On the shaft D, about midway between the cranks h' , but at right angles thereto, is also formed or secured a crank, h^2 , which is connected with the piston-head b' by a rod, b^2 . Said shaft D runs in boxes h^3 , supported by

- 15 In order to steady the reciprocating piston-head b' , I sometimes provide the same with vertical rods b^2 , which work in guide brackets b^4 , secured to the upper edge of the walls of the chamber C. The head b^5 of these brackets is slit or divided, as shown, and provided with an adjustable screw, b^6 , whereby the guide-hole b^7 may be nicely adjusted to adapt it to the rods b^2 .

- 25 The water f^2 is fed to the chamber F through a pipe, f^3 , connected with an adjacent pump or reservoir.

The above is a description of the construction of the engine. Its operation is as follows:

- 30 A volume of air is confined within the communicating chambers B C. The lower end of the chamber C is kept in an intensely hot state by the furnace, G and the chamber B is kept in a comparatively cool state by the water f^2 in the surrounding jacket F. Said air is alternately driven from the hot end a^6 of the chamber C to the cool chamber B, and vice versa, by means of the reciprocating displacer C' . When the air reaches the hot surface a^6 , it is instantly

- 40 heated and expanded. The pressure due to this expansion acts directly upon the working-piston b' , giving it a powerful upward impulse, and imparting motion to the driving-shaft D through the crank h^2 and connecting-rod b^2 .
45 By reason of the cranks h^2 h' , to which the piston and displacer rods b' c^5 , respectively, are connected, being at right angles to each other, as shown and described, when the said piston b' nears the end of its upward stroke the displacer C' will descend and drive the heated air below the same through the regenerator E to the chamber B, where it will be instantly cooled and contracted, thus removing the pressure from the working-piston and allowing the fly-wheel h^5 to complete the downward stroke of said piston. A downward impulse is also imparted to the working-piston by reason of the rarefied air beneath it exerting less pressure than the atmospheric air above.

- 60 The regenerator acts as an economizer of heat, because it assists in cooling the air while on its way to the cool chamber B and in heating it while on its way to the hot surface of chamber C, the heat being alternately taken up and given out by the finely-divided metallic chips e^2 .

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

1. In a hot-air engine, the combination of the body A, composed of two sections, a' a^2 , 75 provided with flange a^3 and covering-flange a^4 , respectively, the upper section, a' , having formed integral therewith the chambers B, C, E, and F, and having secured thereto an introverted cylinder, a^6 , forming a part of said chamber C, the displacer, the piston, the crank-shaft with which said displacer and piston are connected, and the regenerative material in said chamber E, together with the furnace, 80 substantially as and for the purpose set forth.

2. In a hot-air engine, the combination, with the piston and displacer chambers, of a regenerative chamber laterally separated therefrom, but communicating at its upper end directly with the piston-chamber and at its lower end 85 by an indirect and devious passage with the displacer-chamber, substantially as described.

3. In a hot-air engine, the combination therein, with the piston and displacer chambers, of an annular regenerative chamber surrounding the displacer-chamber, but laterally separated therefrom, said regenerative chamber being filled with metallic particles and communicating at its upper end directly with the piston-chamber and at its lower end by an indirect and devious passage with the displacer-chamber, substantially as described. 95

4. In a hot-air engine, the combination, with a displacer provided with the introverted cylinder, and the displacer-chamber, of a regenerative chamber filled with metallic particles laterally separated from the displacer-chamber, but communicating at its upper end directly with the cylinder-chamber and at its lower end by an indirect and devious passage with the displacer-chamber, said passage being formed in part by the introverted cylinder of the displacer and a screen supporting the metallic particles of the regenerative chamber, substantially as described. 100

5. In a hot-air engine, the combination, with the regenerating-chamber thereof, of the metallic material—such as chips—in said chamber, the wire screen e^4 , and the perforated ring supporting said screen and chips, substantially 105 as and for the purpose set forth.

6. The combination, with the regenerating-chamber communicating at its upper and lower ends with the chamber C, and the introverted bolted cylinder, of the radial pieces at the upper and lower ends of said regenerating-chamber, the metallic chips, the wire screens e^2 e^4 , and the perforated supporting-ring, substantially as and for the purpose set forth. 120

7. In a hot-air engine, the combination, with the piston working in the chamber B, of the divided brackets secured to the top of the walls of said chamber, the adjusting-screws in said brackets, and the vertical rods extending from said piston up through guide-holes in said brackets, substantially as and for the purpose set forth. 125 130

8. In a hot-air engine, the combination, with the displacer working in the chamber C, provided with the central air-space, of the tubular rods connecting with the said displacer and its central air-space and extending outside of said chamber, the adjustable yokes, and the rods connecting said yokes with the crank-shaft, substantially as described.

9. The combination, with a displacer-chamber and an annular regenerative chamber surrounding the same, of a piston-chamber, a water-jacket surrounding the piston-cylinder, having its base extending above the regenerative chamber, and passages leading from the regenerative chamber into the piston-chamber, the lower wall of the water-jacket forming the upper wall of said passages, substantially as described.

10. In a hot-air engine, the combination, with the piston and displacer, of the common fly-wheel shaft provided with three cranks, the said piston being connected by a single connection with one of said cranks and the displacer connected with the others, the said

crank-shaft being provided with supporting-bearings on each side of and adjacent to each of said cranks, substantially as described. 25

11. In a hot-air engine, the combination, with the piston and displacer chambers and the piston and displacer, of a common crank-shaft provided with three cranks, the said piston being connected with one of said cranks and the displacer with the others, and a support for said crank-shaft having its base portion consisting of two parts attached to the cylinder-chamber, and provided at its upper part with bearings for said crank-shaft on each side of and adjacent to each crank and the yoke connecting the two portions, substantially as described. 30 35 40

In testimony whereof I have hereunto affixed my signature this 18th day of October, A. D. 1887.

JOSEPH L. BAIR.

Witnesses:

JNO. NOLAN,
GEO. W. REED.