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C. W. BALDWIN.

HOT AIR ENGINE.

No. 48,639. Patented July 11, 1865.

Fig. 1.

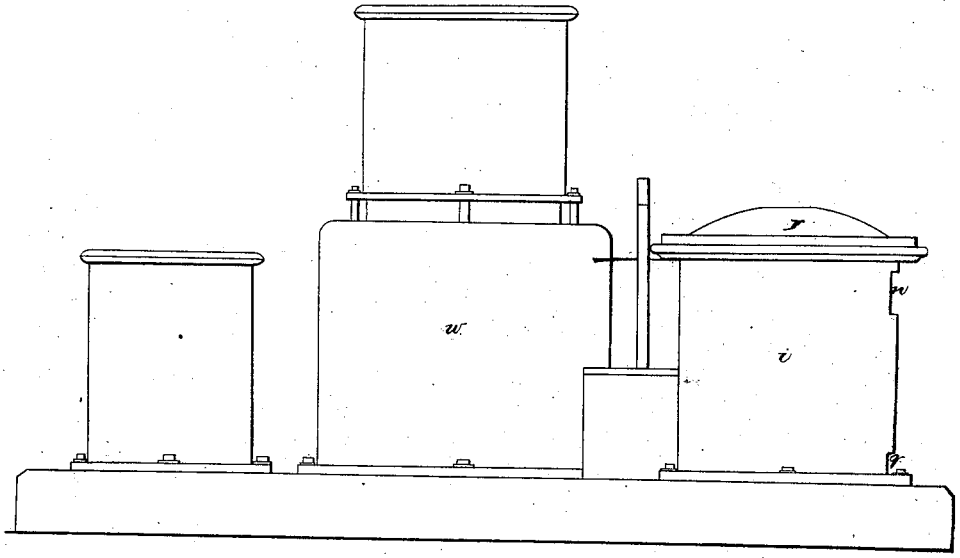

Fig. 8

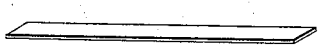

Fig. 9

Fig. 2.

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Fig. 3

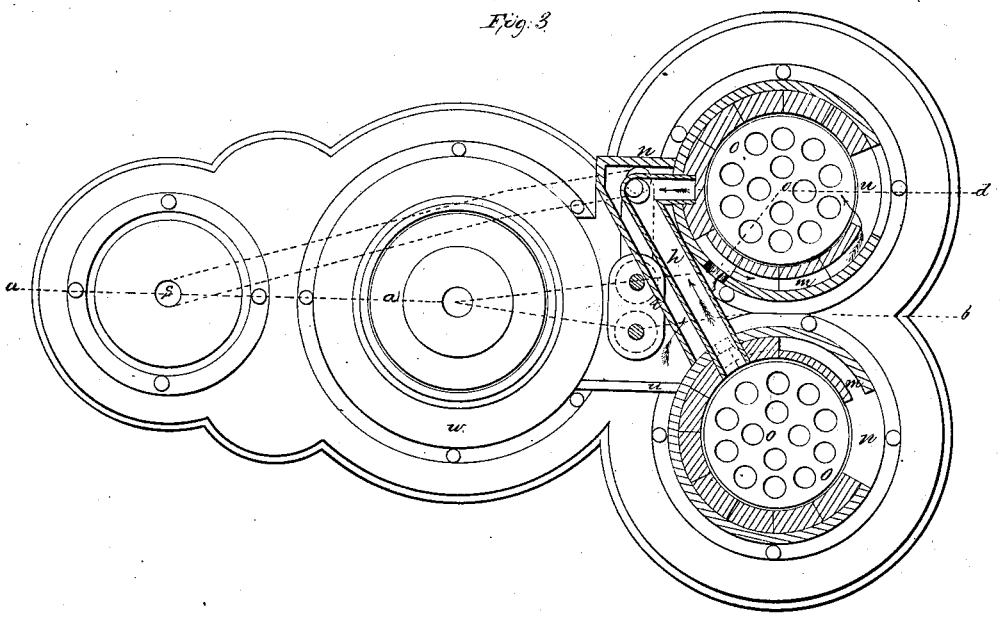
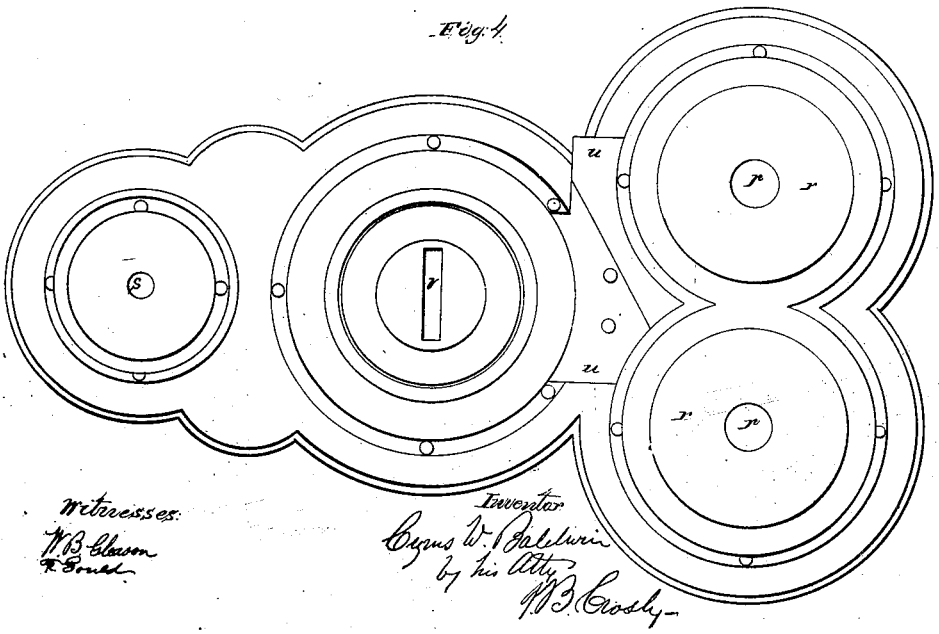


Fig. 4



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3 Sheets—Sheet 3.

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HOT AIR ENGINE.

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Fig. 5

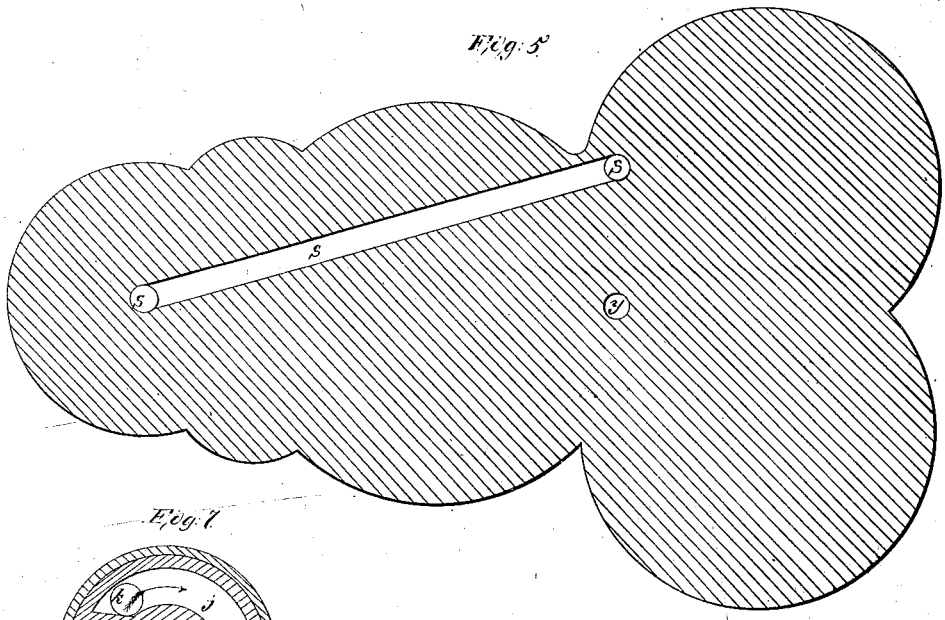


Fig. 7

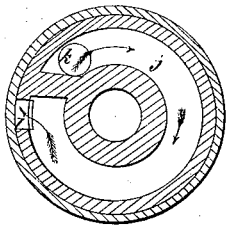
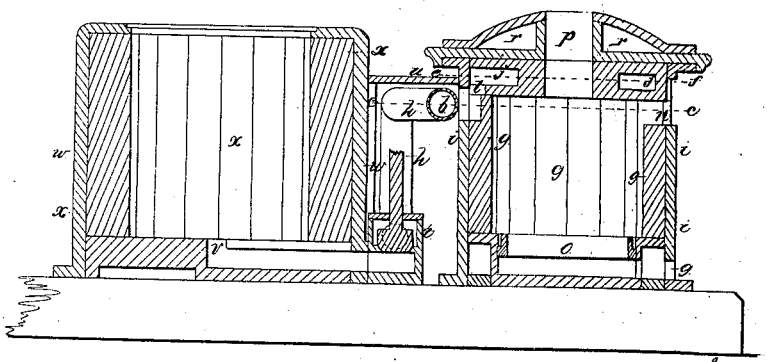


Fig. 6



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UNITED STATES PATENT OFFICE.

CYRUS W. BALDWIN, OF BOSTON, MASSACHUSETTS.

IMPROVEMENT IN HOT-AIR ENGINES.

Specification forming part of Letters Patent No. 48,639, dated July 11, 1865.

To all whom it may concern:

Be it known that I, CYRUS W. BALDWIN, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Hot-Air Engines; and I do hereby declare that the following, taken in connection with the drawings which accompany and form part of this specification, is a description of my invention sufficient to enable those skilled in the art to practice it.

This invention relates to details and arrangements of parts by which the action of hot-air engines is improved and their durability increased.

Of the drawings, which embody and illustrate this invention, Figure 1 is a side elevation of those main parts of an engine within which my invention is incorporated. Fig. 2 is a vertical sectional view taken in the irregular line *a b*, seen in Fig. 3, the section showing the piston-packing, the exhaust-valve and passage, the air-pump and its delivery-passage, &c. Fig. 3 is a plan and a partial horizontal section taken in the line *c c*, seen in Figs. 2 and 6, said figure showing particularly the system of air-passages. Fig. 4 is a plan with the working-cylinder and its piston removed. Fig. 5 is a section taken horizontally through the bed-plate, which is shown in inverted position, the section discovering the cold-air passage from the pump and the exhaust-passage *y* from the engine-cylinder. Fig. 6 is a vertical section on the line *a d*, seen in Fig. 3, showing particularly, in connection with Fig. 7, the construction of the top of the fire-box. Fig. 7 is a horizontal section taken on the line *e f* seen in Fig. 6. Figs. 8 and 9 are perspective views showing the leather piston-packing.

Practical experience has shown me that for heating large quantities of air, such as are required for the supply of hot-air engines, the purpose is better accomplished in small furnaces than it is in one large one of the same cubic capacity with two or more small ones. The reason for this, I apprehend, is that air being a poor conductor of heat prevents the heating of a large body uniformly throughout, while in a number of smaller furnaces all portions of the air therein would be nearer the fuel or the heated furnace-boundary than some of them would be if the body of air were not subdivided, and consequently the air will thus be more uniformly heated throughout.

One portion, then, of my invention consists in the arrangement for each cylinder of a hot-air engine with two or more fire-boxes, the aggregate capacity of which is equal to the supply of heated air to the requirements thereof, each cylinder being supplied on one side only of its piston from said two or more fire-boxes.

In the drawings, *g g* shows the non-conducting lining of the furnaces, two being shown. These furnaces deliver their heated air into a pipe, *h*, which is common to both furnaces, and which supplies one engine-cylinder. As this pipe affords means for free communication between both furnaces it will be evident that the pressure obtained in one will also be obtained in the other. In said pipe might be placed stop-valves, so arranged that one furnace could be shut off from the other or others while replenishing the fuel in the furnace thus detached, or while it is undergoing repairs, the engine in the meantime being supplied from the furnace or furnaces not shut off.

To cut off the blaze proceeding from the fuel from the engine-supply valve, which blaze, with some kinds of fuel, is very long, and also to intercept ashes and other solid matters, so as to prevent them from being carried to the valves and cylinder, I make a tortuous passage around the top of the furnace for the volatile products of combustion and the heated air, and in this consists another portion of my invention.

Above the lining *g* of the furnace, and resting thereupon in the outer casing, *i*, is a hollow head, *j*, (see Figs. 6 and 7,) in which is a passage into which the current from the furnace enters through the opening *k*, and moving through the passage in *j* in the direction shown by the arrows, (see Fig. 7,) discharges through the opening *l* into pipe *h*.

A coiled iron pipe, protected by a plate or diaphragm from the direct action of the heat, might be employed in lieu of the head *j*.

Still further to keep ashes and solid matter from being carried into the engine-cylinder and the valve-seats, I introduce all of the air, both that which is heated and expanded merely and that which supports combustion, wholly above the fuel. By so doing I avoid the up-

ward blast of air through the fuel, which necessarily carries with it a considerable amount of solid matter into the supply-passages of the engine-cylinder, and at the same time find no difficulty in maintaining combustion. In this arrangement for the introduction of all of the air which leaves the fire-box above the fuel consists a part of my invention, to practice which it matters little how the air is introduced, provided it does not pass among the fuel in entering the furnace.

In Fig. 3 it will be seen that the air-supply passages for the furnace are marked *m*, and they debouch into the openings *n* in the vertical walls of the furnaces, through which fuel may be introduced to rest upon the grate *o*. Besides the opening *n* into the furnace, there is another, (shown at *p*,) through which fuel can be supplied, but these openings, as well as that seen at *q*, through which the ashes are removed, must be closed to the atmosphere when the engine is set in operation.

To utilize the heat radiating from the top of the furnace it may be provided with a hollow cap, *r*, designed to be kept supplied with water, so that the escaping heat shall be utilized by vaporizing the water, which may be employed as is needed, either by introduction into the furnace to aid and support combustion, or otherwise, as may be deemed desirable.

Much trouble has hitherto been caused by oxidation and wear of valves and valve-seats, consequent upon excessive heating of the same. To avoid the troubles consequent upon heating of said parts I incase them and the pipe leading thereunto from the furnace, and admit into the space surrounding the valve-chest and supply-pipe the cold air which is supplied by the force-pump, so that said air as it moves toward and into the furnaces shall surround the valve-chest and supply-pipe and shall absorb the heat radiated therefrom, thus keeping down the temperature which they would otherwise have, the heat so abstracted not being lost, as it passes with the air into the furnaces. It is in thus incasing the valve chest and causing the air from the force-pump to surround said chest on its passage to the furnace that another portion of my invention consists.

The passage from the force-pump to the casing about the valve-chest is marked *s*. (See Figs. 2, 3, and 5.) The valve-chest is marked *t*, and the casing surrounding it is marked *w*.

The pistons of hot-air engines, being guided less perfectly than those of steam-engines, on account of using yielding packings of leather instead of metallic packings, are more apt to be deflected and made to wear sidewise from slight causes than are metal-packed pistons. Heretofore it has been considered sufficient to introduce the impelling medium anywhere into the cylinder below the bottom of the engine-piston, and hence the port has been made to open into the cylinder on the side nearest the source of supply.

One portion of this construction shows a manner of supplying the impelling medium so that it will act squarely and centrally upon the piston; and it consists in locating the entrance-port directly under the center of the piston, by which location I find a material improvement in the working of the engine and a saving in the wear of the piston-packing. This port is marked *v*, and is seen in Figs. 2, 4, and 6.

The cylinders of hot-air engines are made in two parts—an upper one, which is bored smooth for a packed piston to work in, and a lower one, which is left larger in diameter, and into which the extension part of the piston descends without touching. This lower cylinder has heretofore been formed of iron, and it has been encompassed by an iron casing, the space between the two iron parts having been in some cases left vacant, or rather filled with air as a non-conductor of heat, and in other instances the space has been filled up with suitable solid non-conductors, as fire-brick, for example.

This part of my invention consists in dispensing with the use and cost of the inner iron cylinder and in filling the space left between the casing *w* and the piston, when at its lowest stroke, with soapstone, fire-brick, or other suitable solid non-conductor, taking care that the interior diameter of the lower part of the cylinder is such as to give a clearance to that part of the piston which enters therein.

The outer casing of the lower part of the cylinder is marked *w*, and the filling which makes the lower cylinder is shown by *x*. In this connection it may be remarked that the lower boundary of the cylinder may be advantageously and cheaply made, including the port *v*, of masonry, resting on the iron bed-plate, thus rendering the use of iron plates and a cellular structure unnecessary.

As the pistons of hot-air engines are packed with leather, and as such packings require to be renewed frequently, and as the pistons are of considerable size for the power obtained, as compared with steam-engine pistons, and as said leather packings have hitherto been cut out of large disks of leather, involving considerable waste and cost, it is a desideratum to obtain a leather packing which shall be of less cost, and this may be accomplished by taking a plain strip of leather, like a piece of belting, and of width sufficient to lap over the top of the piston and be secured thereupon under and by the follower, (see Fig. 2,) and also to make a right-angled turn and encompass the working-face of the piston, in the manner of the common cup leather packing. This strip, which in the plain form is shown by Fig. 8, is moistened and crimped or bent to a flat ring of the right diameter, care being taken to have the ends meet with a good joint. In this condition it is secured to the piston by the follower, and the projecting edge of the leather ring is then bent downward by forcing upon the piston from above and over the leather a suitable ring

or band, which is allowed to remain until the leather dries, when it will retain the form given it.

Instead of using the piston and follower to prepare the packing, a block and ring of the diameter of the piston and follower may be used.

I claim—

1. In a hot-air engine, the arrangement, substantially as described, by which a single cylinder is supplied on one side only of its piston from two or more furnaces, which are separate from each other as to the means for the reception in each of fuel and air, but which discharge their gaseous products of combustion into said cylinder, as stated, through a common valve-chamber.

2. Providing at the top of the fire-box of a hot-air engine a passage around the same for conducting the gaseous products of combustion to the cylinder, so as to cut off therefrom and from the valve-chamber actual flame, and to cause deposit of solid matter, substantially as specified.

3. The arrangement for supplying the air for the support of combustion, and to be heated to fill the cylinder by passing the whole of it into the fire-box above the fuel, instead of passing the whole or a portion thereof through the fuel, as previously practiced.

4. Incasing the valve-chest and passing the cold air from the force-pump on its way to the fire-box into said casing and around, and for the purpose of cooling the chest, substantially as specified.

5. The arrangement of the lower part of the cylinder without any metallic inner boundary, and of fire-brick or other suitable non-conductor supported by a metallic casing, substantially as specified.

In witness whereof I have hereunto set my hand this 18th day of March, A. D. 1865.

CYRUS W. BALDWIN.

In presence of—
J. B. CROSBY,
W. B. GLEASON.