4 Sheets—Sheet 1.

C. W. BALDWIN.

HOT AIR ENGINE.

No. 46,320.

Patented Feb. 14, 1865.

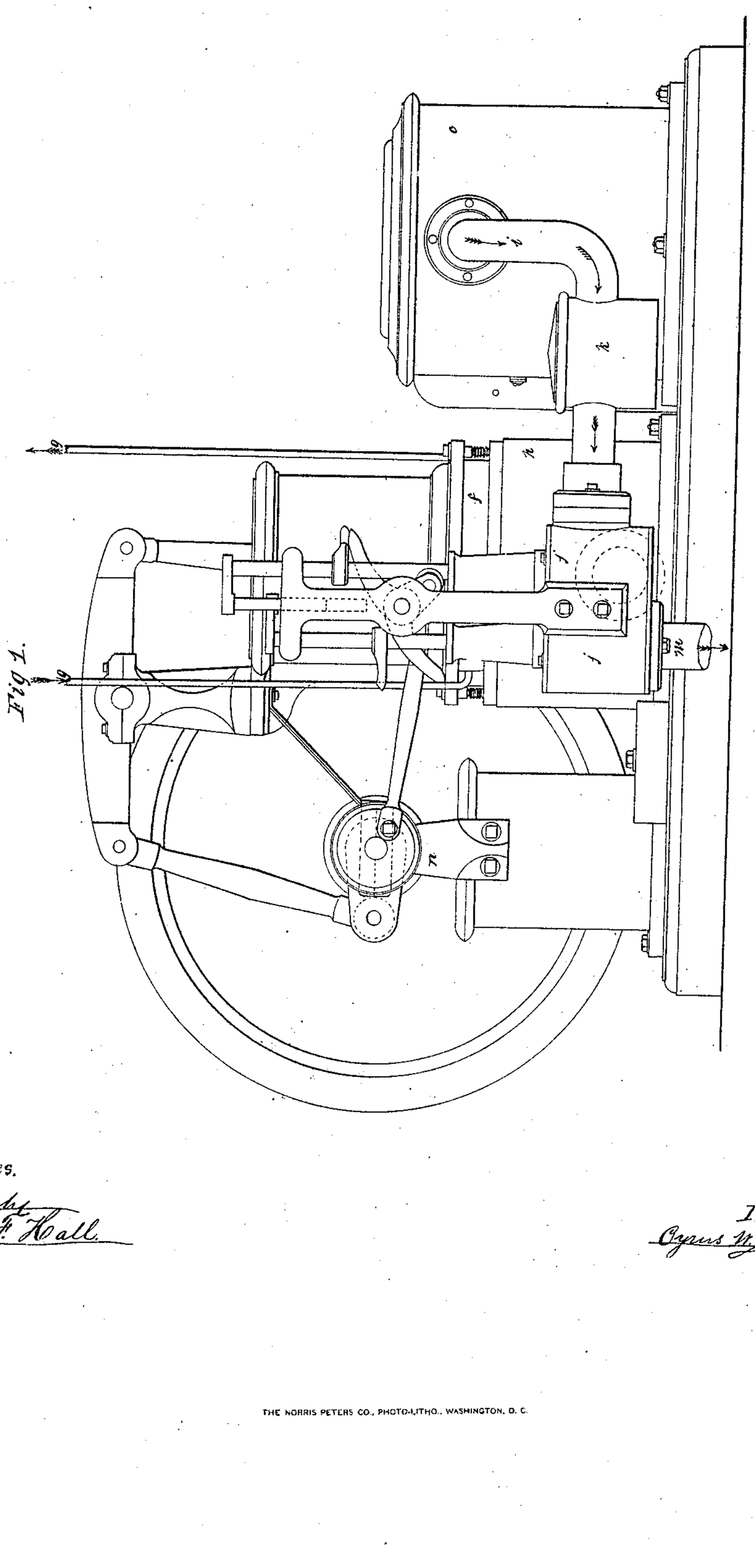

Fig 1.

Witnesses.
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Inventor.
Cyrus W. Baldwin

4 Sheets—Sheet 2.

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Fig 1.

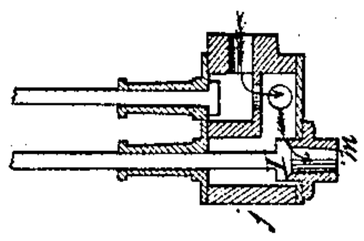

Fig 2.

Witnesses.

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4 Sheets—Sheet 3.

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Fig 4.

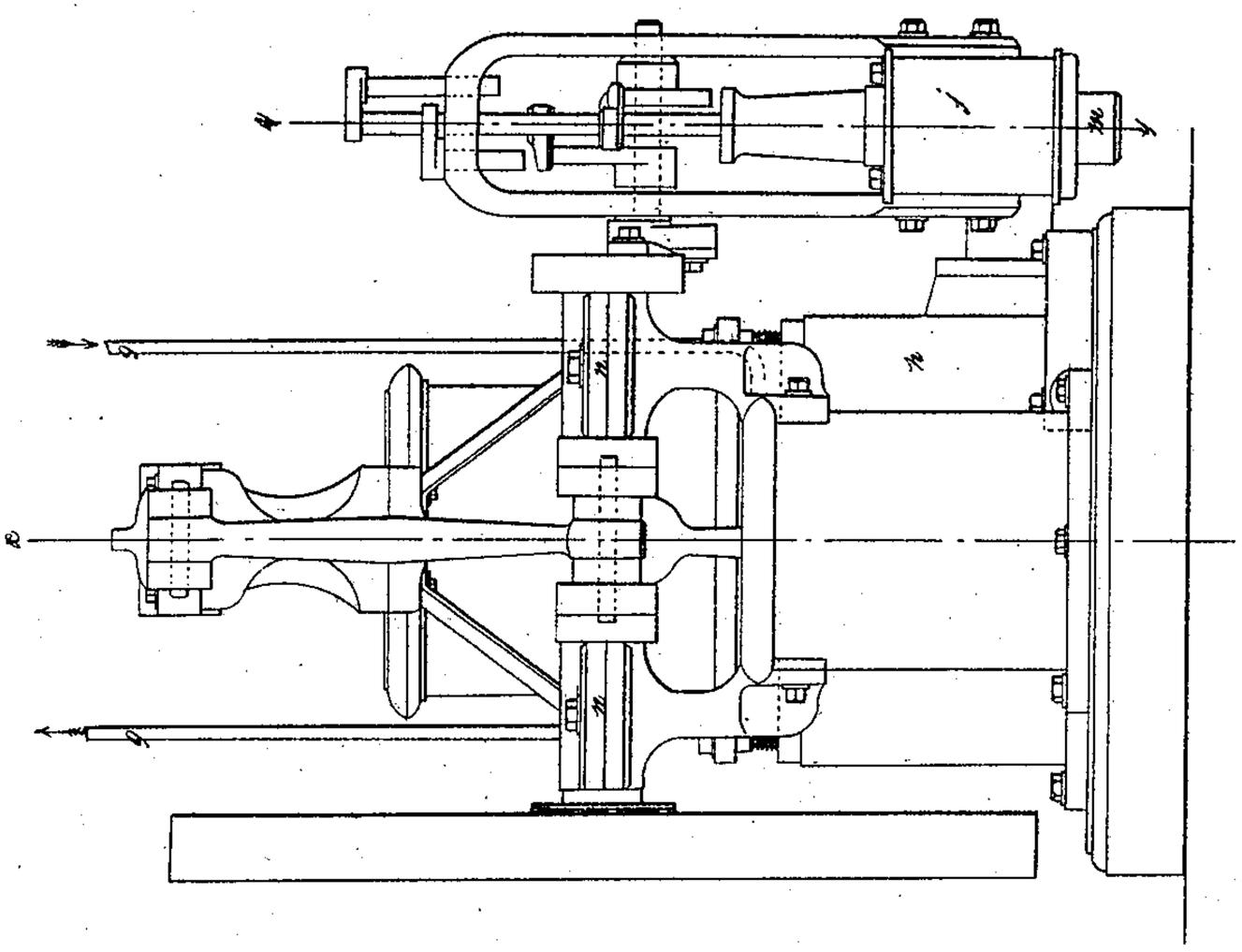
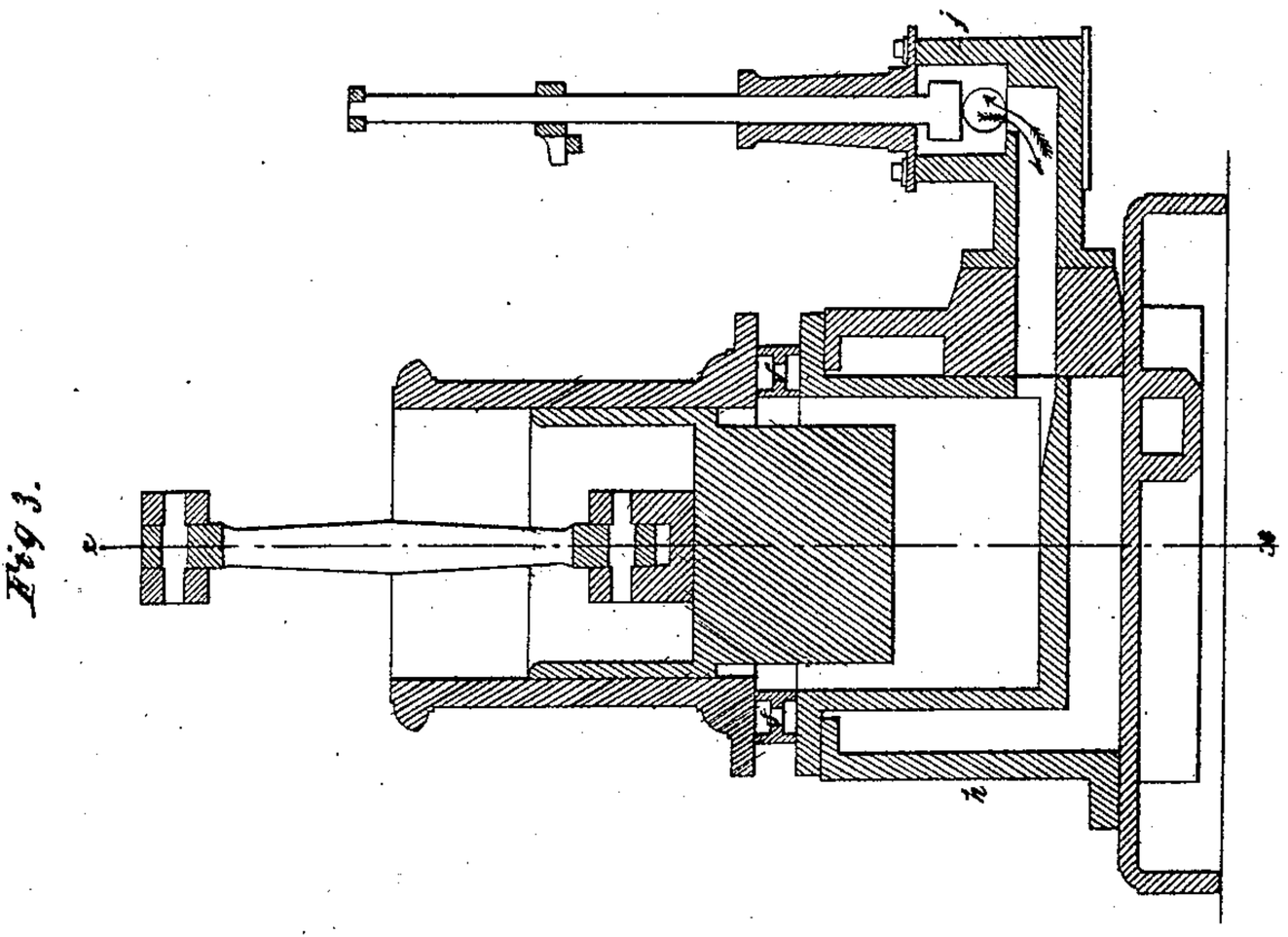


Fig 3.



Witnesses.
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4 Sheets—Sheet 4.

C. W. BALDWIN.

HOT AIR ENGINE.

No. 46,320. Patented Feb. 14, 1865.

Fig 6.

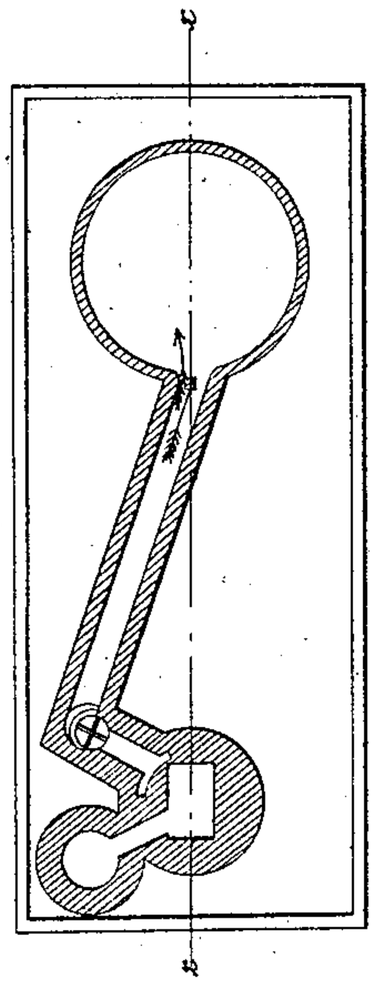


Fig 8.

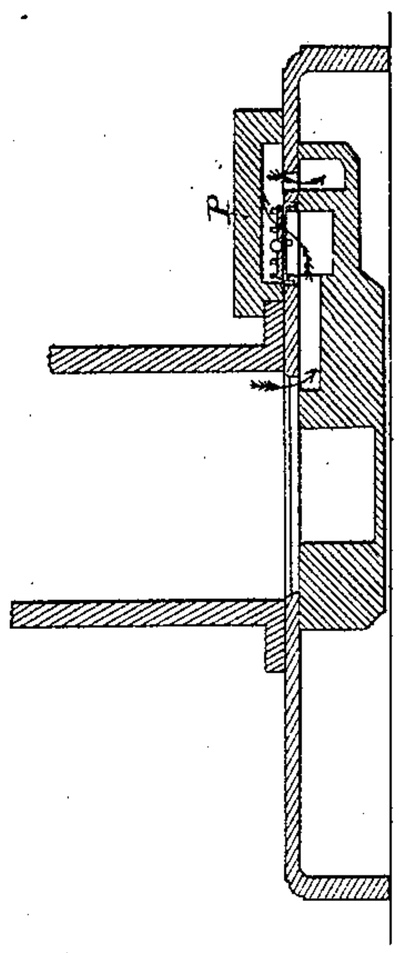


Fig 5.

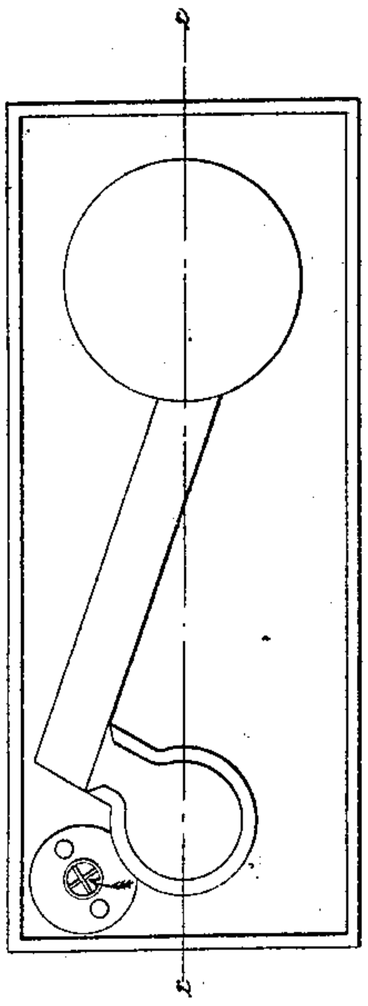
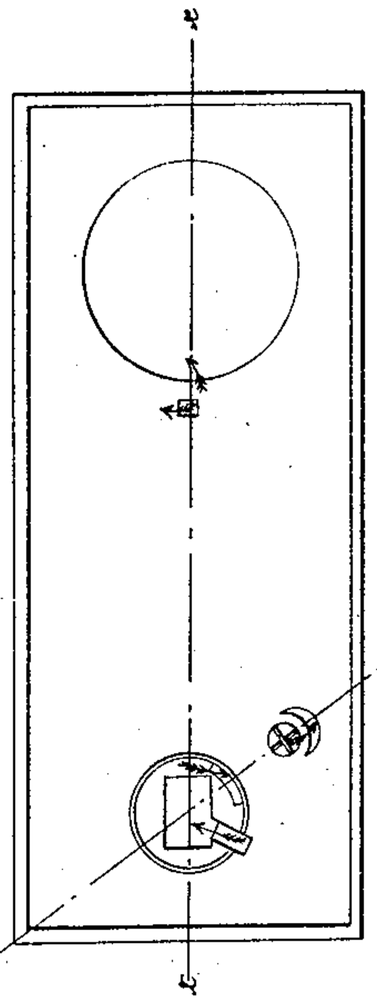


Fig 7.



Witnesses.
W. Brooks
Albert F. Hall

Inventor.
Cyrus W. Baldwin

UNITED STATES PATENT OFFICE.

CYRUS W. BALDWIN, OF CHARLESTOWN, MASSACHUSETTS.

IMPROVEMENT IN HOT-AIR ENGINES.

Specification forming part of Letters Patent No. **46,320**, dated February 14, 1865.

To all whom it may concern:

Be it known that I, CYRUS W. BALDWIN, of Charlestown, in the county of Middlesex, in the State of Massachusetts, have invented 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 such improvements in the detail of construction and arrangement of parts in hot-air engines as render their operation more certain and powerful, reduce the cost of construction, and at the same time simplifying and improving it reduce the liability to rapid deterioration from heat, and afford facility for replacement of parts which wear or burn out.

The invention consists in the peculiar arrangement of a disk-valve so as to be guided at its periphery in connection with the casing and passages making the valvular system; also, in the introduction of a secondary fire-box into the passage between the main fire-box and the valve-chamber, so that by means of a flame created in said secondary fire-box the unconsumed gases escaping from the primary fire-box may be burned by coming into contact with the flame in the secondary fire-box, which flame may be produced by ignition of gas-jets, oil, petroleum, or other combustible matter, and in making the passage through which the air is supplied above the grate to the fuel so that the air-passage can be interchanged with the rings of the furnace-lining, and thus be made to pass air into the furnace higher or lower into the fuel or entirely above it, as the circumstances attending the work to be done, the fuel used, and experience may dictate or require.

Four sheets of drawings accompany this specification, on which sheets Figure 1 represents a general side elevation of an engine embodying my improvements. Fig. 2 is a vertical longitudinal section of the same, the section being taken in the plane of the lines *x x*. (Seen on Sheets 3 and 4.) Fig. 3 is a vertical cross-section of the same, the section being taken in a plane passing through the axes of the cylinder and of the induction-valve stem. Fig. 4 is an end elevation of the same looking at the air-pump end of the engine. Fig. 5 is a reversed plan of the engine bed-plate and Fig 6, a horizontal section taken through the bed-plate in its reversed position, said figures and Fig. 7, which is a plan of the engine bed-plate stripped of the air-pump, engine-cylinder, and furnace, illustrating the valvular system and air-passages pertaining to the air-pump. Fig. 8 is a vertical section taken in the plane of the line *a b*. (Seen in Fig. 7.) Fig. 9, Sheet 2, is a vertical section taken through the engine-valves and valve-chest, in the plane of the line *y y*. (seen in Fig. 4.)

As the general organization and method of operation of hot-air engines is now well known, the description which follows, relating to construction and operation, as illustrated by the drawings, will be confined nearly as possible to the embodiment of my invention before stated.

c is the outer casing of the furnace. *d* is the lining thereof, made in separate rings and in segments. *e* is the passage by which air is supplied to the fuel above the grates. Both the passage *e* and the lining *d* are removable, and it will be obvious that *e* may be placed next above the grate and below all of the lining-rings *d*, or it—the passage *e*—may be placed between any of the lining-rings *d*, as may be desired.

The wall of the furnace has a slotted opening into the air-supply pipe, or perforations are made through the wall into said pipe, so that wherever the ring *e* is placed the air will flow freely into it from the supply-pipe.

The engine-cylinder, as is usual, is divided into two parts, an upper and a lower one, the upper part of the piston being packed in the upper part of the cylinder, as is usual, and the lower part of the piston working loosely in the lower part of the cylinder, as usual. Between these two parts of the cylinder is located a water-passage, *f*, which in section is H-formed and extends entirely around the cylinder as a ring between the two parts. In the middle or connecting piece of this passage *f* are holes, (see Figs. 2 and 3,) which permit free circulation of water therein, this being supplied to *f* in a cold state by one of the pipes *g*, and taken therefrom when heated by the other pipe *g*, these pipes *g* being arranged as is usual in heated-water circulation systems. Thus the heat which would without intervention of *f* be conducted from the lower to the upper part of the engine-cylinder is intercepted and carried off by the water passing through *f*,

and experience shows that the heat which the upper part of the cylinder receives from direct contact with the hot products of combustion from the furnace is kept down by radiation therefrom, so that the leather packing of the piston is not burned thereby.

While it is a desideratum to keep the upper part of the cylinder cool, it is also of importance to prevent loss of heat from the lower part of the cylinder, which I surround with a casing, *h*, the space between which and the cylinder and between the cylinder and the bed-plate I fill or partially fill with fire-brick or other good non-conductor. Hot-air engines have had the furnace thereof directly in the lower part of the cylinder, or beneath it, or incased with it in such a manner that by reason of unequal expansion of parts and conducted heat the deterioration of the engines has been very rapid, owing to the burning out of the working parts and the breakage and leakage consequent upon unequal expansion. To remedy these difficulties I isolate my furnace from the cylinder and the engine valve-chest, the bed-plate being the only means of conducting heat between the cylinder and furnace, and the pipe *i* the only means of communication between the furnace and the valve-chamber *j*. As the tendency of heat is upward, and as the space in the furnace below the grates is supplied with cold air from the air-pump, no heat, it is found in practice, is communicated to the cylinder from the furnace by the connection of the bed-plate.

To allow of expansion and contraction the pipe *i* is made of considerable length, with crooks or curves therein, and of thin metal, so that of itself it conducts but very little heat, though it conveys the heated volatile products of combustion. In the pipe *i*, between the furnace and the valve-chest, is an auxiliary furnace or chamber, *k*, which may be supplied with means for consuming therein, with a flame, gas, oil, petroleum, or other suitable combustible substance.

Part of the fuel in the large furnace is changed by the heat therein to volatile gases which do not burn when they are generated, but which will burn if, while they are hot, they are brought directly into contact with flame. To supply such a flame, through which all the volatile products of combustion from the large furnace must pass, the small furnace *k* is supplied as stated, and the results which follow its application are found in practice to be highly beneficial.

In hot-air engines it is of special importance that the exhaust-valve should fit its seat perfectly, for if at the time the induction-valve is open the eduction-valve leaks there is nothing to prevent the gaseous contents of the cylinder and furnace from escaping past the leak; hence it is important that special provision should be made for examining the condition of the joint made by the exhaust-valve with its seat, and for repairing any deterioration therein as soon as it becomes sensible. By reference to Fig. 9, the exhaust-valve *l* will be seen as closed upon its seat. This is formed on the end of a tube or thimble, *m*, which is provided with a flange, so that when *m* is inserted into the valve-chest *j* the flange on *m* makes the joint with the valve-chest, and the exhaust-pipe can be connected with that end of *m* which is outside of the valve-chest. It will be seen that this piece *m* can readily be removed from the valve-chest, can be faced anew in the lathe very readily where the valve rests upon it, so that it is a matter of but small moment to keep this valve-seat so constructed and arranged in constant working order.

The arrangement of the air-pump so that a vertical plane passing through its axis shall intersect the axis of the main shaft so places the pump that it affords the best and cheapest stand possible for the support of the main-shaft boxes *n* and simplifies and cheapens the construction of the engine. The valves of the air-pump, which are of the flexible-disk variety, are peculiar in that they have no hinge and are not guided of a central rod. By reference to Fig. 8, Sheet 4, it will be seen that the eduction-valve *o* rests freely on a flat seat, being prevented by a grating from being forced through the aperture which it closes. The valve is guided at its periphery by pins or rods standing up vertically around the valve-seat and in contact, or nearly so, with the edge of the valve, which, in its rising and falling, is thereby kept in place. These guides might be formed as wings or ridges, extending from the cap *p* inward toward the valve. This cap is is arranged eccentrically over and with respect to the valve, which gives room for the crescent-shaped eduction-pipe seen in Figs. 6 and 7, which is formed beyond the valve and between it and the inner boundary of the cap or chamber *p*. The arrows seen on the various figures indicate the directions of the various currents in the operation of the engine

I claim—

1. Guiding a flexible-disk valve, substantially as described.

2. Also, the employment of a secondary furnace in combination with the primary furnace and the cylinder of a hot-air engine when located so that the products of combustion from the primary furnace go through the secondary furnace on their passage into the cylinder, substantially as and for the purpose set forth.

3. The arrangement in the furnace, in connection with a suitable opening or openings through the wall thereof into the air-conduit pipe, of a perforated movable air-passage ring, so as to be interchangeable with the movable lining-rings.

In witness whereof I have hereunto set my hand this 18th day of October, A. D. 1864.

CYRUS W. BALDWIN.

Witnesses:

J. B. CROSBY,

ALBERT F. HALL.