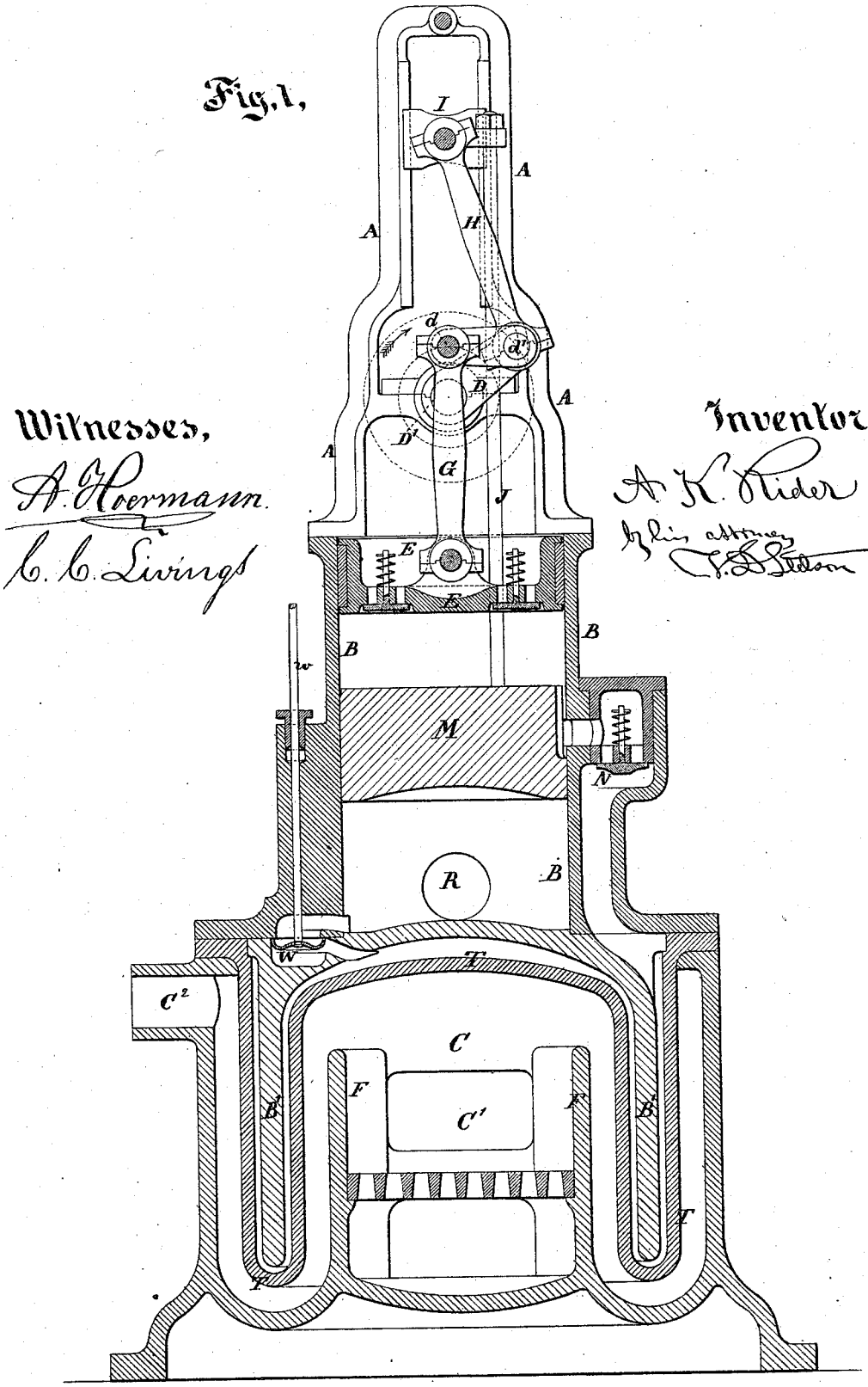
2 Sheets—Sheet 1.

A. K. RIDER.

AIR ENGINE.

No. 111,088, Patented Jan. 17, 1871.

Fig. 1.



Witnesses,

A. Hoermann.

C. C. Livings

Inventor,

A. K. Rider

by his attorney

T. D. Stetson

2 Sheets—Sheet 2.

A. K. RIDER.

AIR ENGINE.

No. 111,088. Patented Jan. 17, 1871.

Fig. 3,

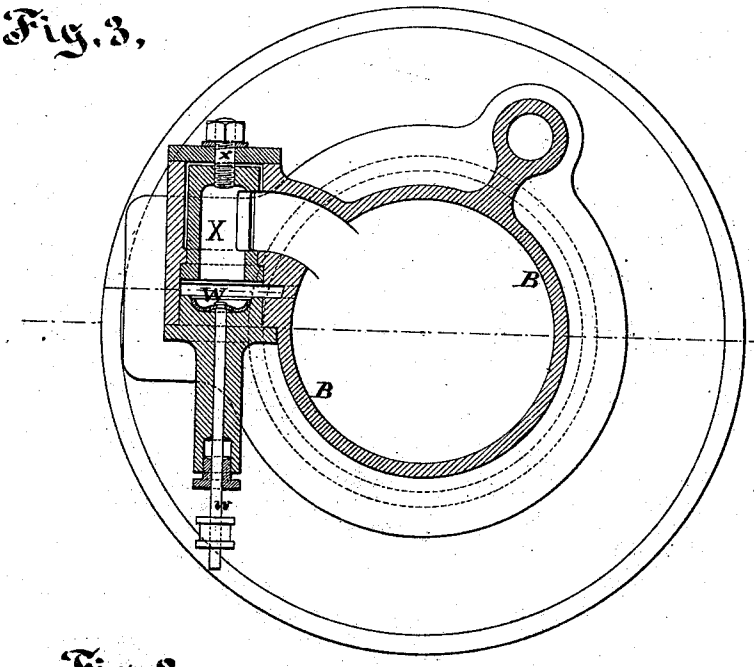
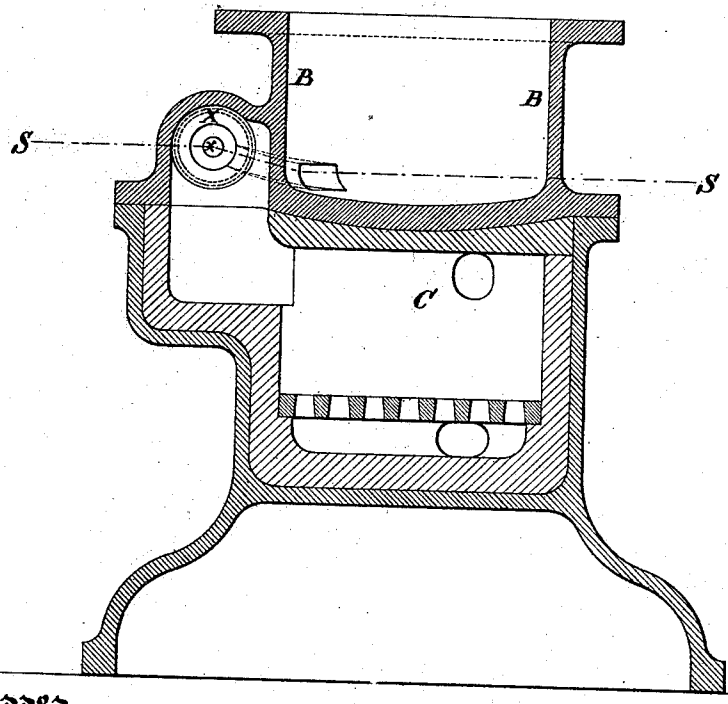


Fig. 2,



Witnesses,
A. Hoermann.
C. C. Livings

Inventor,
A. K. Rider
by his attys T. G. Stetson

United States Patent Office.

ALEXANDER K. RIDER, OF NEW YORK, N. Y., ASSIGNOR TO HIMSELF, CORNELIUS H. DELAMATER, AND GEORGE H. REYNOLDS, OF SAME PLACE.

Letters Patent No. 111,088, dated January 17, 1871.

IMPROVEMENT IN AIR-ENGINES.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, ALEXANDER K. RIDER, of the city and county of New York, in the State of New York, have invented certain new and useful Improvements in Air-Engines; and I do hereby declare that the following is a full and exact description thereof.

My invention employs a changing piston, by the aid of which, in connection with a suitable working-piston, and valves, and passages, the cold air is received and compressed in the same cylinder which is employed to work off the heated and expanded air.

This mode of operation has been long known, and involves marked advantages, among which is the reduction of the cost of the engine from that required when two cylinders, one serving as a pump and the other as a working-cylinder, are employed, and an increased degree of coolness, and durability, and facility for lubrication of the parts.

A portion of my invention relates to certain novel means of producing a proper motion of the changing-piston or shifter. Another portion relates to the construction of the furnace and of the adjacent parts where the air is heated by a fire maintained outside of the cylinder and its connected passages. Another portion relates to devices for increasing the power by the aid of a cut-off valve, peculiarly arranged and operated to directly and immediately control the admission of the heated air into the cylinder.

The accompanying drawing form a part of this specification.

Figure 1 is a central vertical section through the entire engine, showing clearly the novel part, with so much of the ordinary part as is necessary to indicate their relations thereto.

Figure 2 is a corresponding vertical section through the furnace and adjacent parts, with a modified construction, containing only a portion of the invention.

Figure 3 is a horizontal section on the line S S in fig. 2.

Similar letters of reference indicate like parts in all the figures.

B is the cylinder, and

A, a framing fixed thereon; while

D is the crank upon a main-shaft, D', to which the power is communicated.

E is a piston, which I term, for convenience, the working-piston;

G, the connecting-rod leading from the working-piston E to the main crank-pin *d*;

M is a piston, which, to avoid confusion, I term the shifter or changing-piston; and

J, two small parallel rods, which serve as piston-rods to the shifter, and connect it to a cross-head, I, traversing in ways or guides in the framing A.

H is a connection, through which the proper motion is communicated to the cross-head I, and thus to the changing-piston or shifter M, from a crank-pin, *d'*, which is formed in the solid forging, or is otherwise mounted in the position represented, relatively to the other part, it being understood that the upper piston should be packed, and that the lower piston or shifter should be fitted to work with tolerable tightness without packing; that the lower piston may be hollow and filled with charcoal, or analogous non-conductor; and that the most highly heated parts may be defended by a coating of fire-brick or the like; and that other ordinary and suitable devices may be employed at various points to promote the end sought.

The valve N opens downward automatically, to allow the air to be shifted from its cool position above the shifter to the heated space below the shifter.

The lower edge of the cylinder B is provided with a deep lip or hanging curtain, B', of a little greater diameter than itself, and a casting, T, formed as represented, encloses this curtain B', both on the outside and inside. These parts are both permanently fixed at uniform distances apart, so as to provide a space both outside and inside of the curtain B', through which the cool air received from above shall be compelled to traverse at each stroke, and thus be presented for a relatively long period to the heating action of the several surfaces.

The furnace C is fed through a door, C', at one side, which, it will be understood, opens out through a suitable aperture provided and properly inclosed in the independent castings B' and T.

The hot gases from the furnace, after expending a portion of their heat against the furnace-crown, where it is very directly applied to the heating of the air above, descend around walls F, and pass under the rounded lower edge of the casting T; thence ascending in an annular space outside, they impart heat to the exterior face of said casting, and ultimately escape through the flue C^2 leading to a chimney not represented.

R is an exhaust-valve passage, controlled by an exhaust-valve not represented, worked by eccentrics, or suitable cams, or the like, not represented. Its function, as also those of other parts, not here explained fully, correspond with those of similar parts in the air-engine patented by John Ericsson in 1855 and 1858.

W is a valve, which performs an important function in controlling the supply of air from the hot-spaces around and in contact with the casting T to the base of the working-cylinder or cylinder proper

This valve W is worked by a rod, *w*, passing out through a stuffing-box, and actuated by a cam or other suitable part upon the engine not represented. Its function is to hold back the supply of air to the base of the cylinder, and thus render it practicable to accumulate a considerable pressure of air in the heating-chambers while the exhaust-passage R is open.

A little before the changing-piston has descended to its lowest depression, the valve W is lifted or moved from its seat, and the hot air under high pressure is allowed to enter and heat the changing-piston in the last portion of its descent. It continues to flow into the cylinder and force up the changing-piston M and its associated working-piston E, and gives motion actively to the engine.

I make the valve W in a dishing-form, by forging it or working it with dies from thin boiler-iron, or analogous material, which will yield, by its elasticity, to adapt itself to any slight warping or change of position of the parts. It is operated by a rod, *w*, so as to move it back into a cavity, as represented, when not in use. This withdrawal of the valve W takes it out of the current of heated air, and keeps it at a much lower temperature than it would otherwise attain. Its seat is formed in a casting separate from the main cylinder, (see figs. 2 and 3.) It may be accurately turned and faced to adapt it to the correspondingly-finished face or rim of the valve W.

The removable seat is indicated by X, and a screw-bolt, which retains it in place, is marked *x*.

The valve W may be worked horizontally or vertically, or in various inclined and intermediate positions, as convenience may dictate.

The current of intensely-hot gases from the heating-chamber or furnace is led to the cut-off valve through a narrow aperture, as shown, and not only is the valve arranged to be drawn back out of the direct impact of this hot current, but the seat X is also, to some extent, similarly protected. The hot gas is not allowed to strike it directly; its position partially protects it from the heat.

Some of the novel features of my invention may be employed without the others. Thus, for example, a certain distinctly appreciable advantage accrues from my arrangement for giving motion to the shifter, which may be realized either with the improvements in other parts of the engine or without them.

The connecting-rod G, reaching from the crank-pin downward to the main piston, compels a lingering of the main piston on the upper center, or at the top of its stroke, to give a long time, in which cool air may be drawn through its valves, while the connection H, reaching upward from the crank-pin *d'* to the cross-head I connected to the shifter, compels a lingering of the latter on the lower center. This gives a very desirable relation of the motions and distances apart of the two pistons throughout the active revolution, while all the motions are smooth crank motions. This noiseless and very nearly absolutely correct motion obtained in this simple manner is equally available with an outside furnace, as represented, or with a closed furnace, in which the fire should be maintained under pressure, or with various other modifications.

I claim—

1. The connection H, extending upward or away from the cylinder, arranged as represented relatively to the operating parts *d d'*, and to the several connections of the working-piston E and shifter M, for the purposes set forth.

2. The cut-off valve W and seat X, protected from the action of the current of heated gas, and arranged and operating relatively to the furnace or correspondingly heated portion of the engine, and to the cylinder B and pistons E and M, and their connections, as set forth.

3. The casting B' and casing T, constructed and arranged as represented, relatively to the furnace C, cylinder B, pistons E M, and their connections and passages, for the purposes herein set forth.

In testimony whereof I have hereunto set my name in presence of two subscribing witnesses.

A. K. RIDER.

Witnesses:

THOMAS D. STETSON,

C. C. LIVINGS.