2 Sheets--Sheet 1.

A. K. RIDER.

Air-Engine.

No. 167,568. Patented Sept. 7, 1875.

Fig. 1.

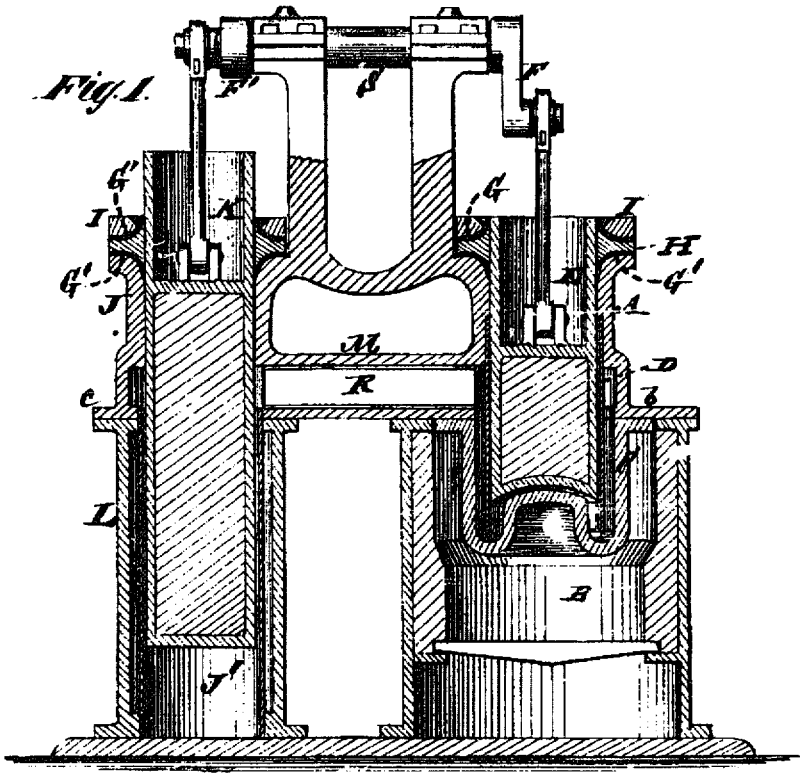
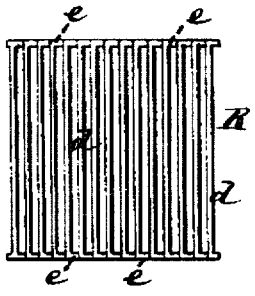


Fig. 2.



Witnesses
Geken Becker
Fred Haynes

A. K. Rider
by his Attorneys
Brown & Allen

2 Sheets--Sheet 2.

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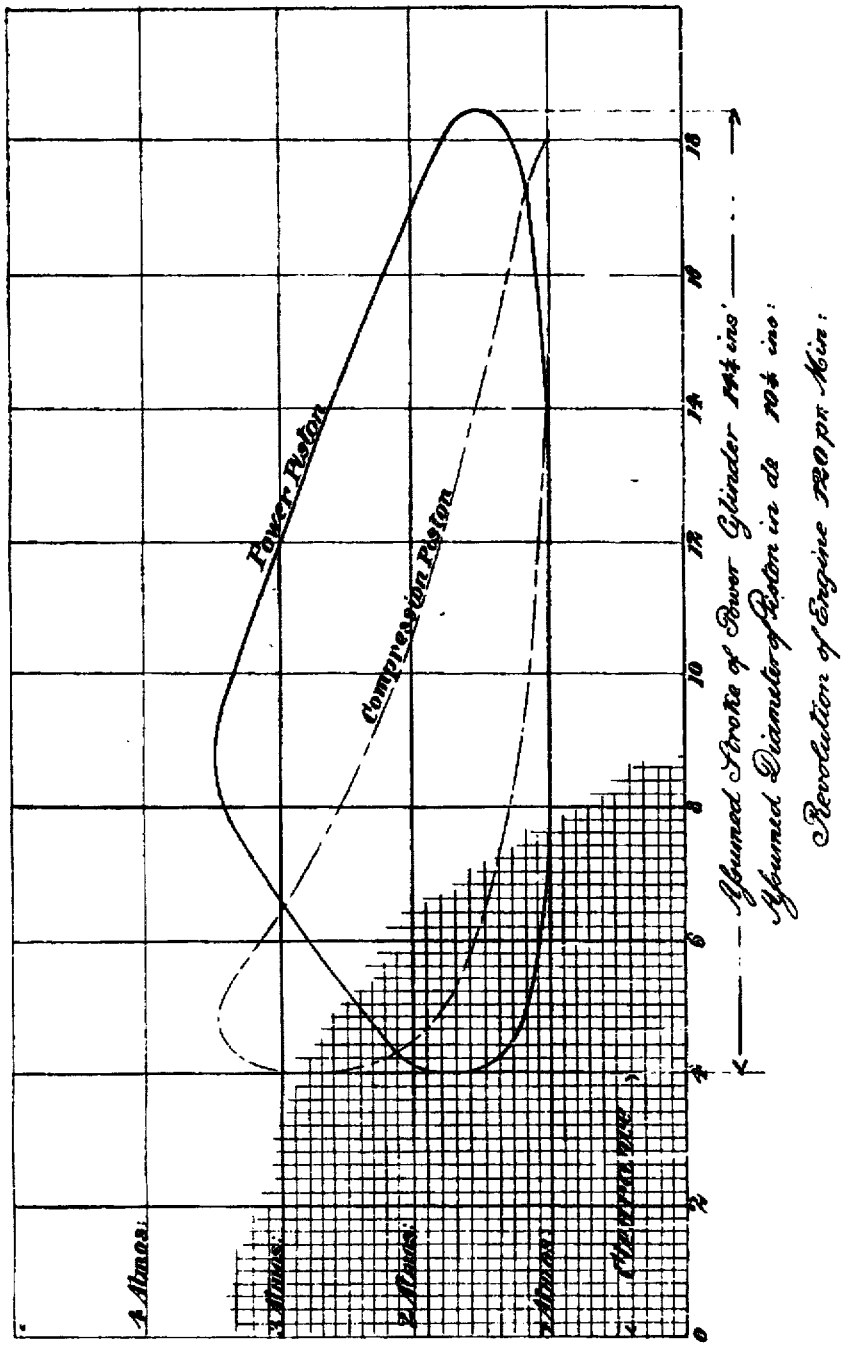

Witnesses
John Becker
Fred Haynes

A. K. Rider
by his Attorneys
Brown & Allen

UNITED STATES PATENT OFFICE.

ALEXANDER K. RIDER, OF WALDEN, NEW YORK, ASSIGNOR TO RIDER, WOOSTER & CO., OF SAME PLACE.

IMPROVEMENT IN AIR-ENGINES.

Specification forming part of Letters Patent No. **167,568**, dated September 7, 1875; application filed August 2, 1875.

To all whom it may concern:

Be it known that I, ALEXANDER K. RIDER, of Walden, in the county of Orange and 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, clear, and exact description of the same, reference being had to the accompanying drawing, which forms part of this specification.

This invention relates to engines which are designed to be operated by the successive compression, heating, expansion, and cooling of atmospheric air or other gaseous fluid or vapor, applied either at its normal density, or at a higher or lower pressure, as desired, such air, gaseous fluid, or vapor being used continuously, and merely passing from one portion of the engine to another part thereof alternately, and requiring no renewal besides what may be necessary to supply deficiencies consequent on leakage. The engine comprises a power or working cylinder, and a compression-cylinder, with their respective pistons, packings, connections, and main or fly-wheel shaft, together with a heater, regenerator, and cooler, and connecting openings or passages, which devices, under different constructions, combinations, and arrangements, are used in other engines of the description my invention relates to.

The invention consists in certain novel constructions and combinations or arrangements of various parts of the engine, including a disposition of the compression-chamber and its cooler below the air-passage connecting said chamber with the heater of the power-cylinder; also including a regenerator arranged within the connecting air-passage; likewise a regenerator of improved construction; and a novel means of packing the cylinders or their pistons, whereby numerous specific advantages are obtained, and an air-engine combining increased durability with efficiency is produced.

Figure 1 represents an air-engine constructed in accordance with my invention, and Fig. 2 an end view, upon a larger scale, of the regenerator.

A is the power-cylinder situated directly over the fire-chamber B, and having attached to its lower flange *b* the heater C, which may be similar to that described in Letters Patent issued to me July 16, 1872, and reissued March 25, 1873. Fitted to and inserted in the lower interior portion of the power-cylinder A is a shield or tube, D, the use of which is to deflect and distribute the inflowing air in a thin sheet over the interior surface of the heater C, and thereby serve to produce a most efficient heating of the charge of air. E is the power-piston, the preferable construction of which, as here shown, is that known as the trunk; but any other kind may be used. Said piston is extended downward into the heater, as usual, and its lower portion is filled with non-conducting material to prevent the undue heating of the cylinder and packings. It is shown connected direct to the crank F on the engine-shaft S, but may be connected by beam or lever, if preferred. G G′ are the piston-packings, which may be of leather. These packings are in duplicate for each cylinder. The lower one of these packings has its lap downward to resist the escape of the air below the piston, while the upper packing has its lap upward to prevent the lubricating material from entering too freely into the cylinder, and also to prevent the ingress of air when the interior pressure is less than that on the exterior of the piston, which will occur under certain conditions. Between these two packings G G′ is a relief-ring, H. This ring is of peculiar construction, being much broader or thicker on its inner surface than its outer one, which latter unites with the former, by easy upper and lower curves, which give to it a flat outer disk-shape, and inner upright cylindrical form, and so that it meets the surface of the piston as a fillet on a flange meets its corresponding cylinder or groove. The inner edges of said ring are made as sharp and thin as practicable.

The object and use of this relief-ring are important. As leather packings are usually made they have a tendency to jam and produce great friction when the direction of motion under pressure is such as to condense the lap, the combined action of pressure and

motion forcing the leather into a sharp corner, and against the cylinder in internal packings, or against the piston in trunk-pistons, where the packing is external. The relief-ring, constructed as described, entirely obviates this difficulty, by allowing the packing to slide onto the curvilinear surface, and effectually relieves the friction by the insinuation of the sharp edges of the ring between the piston and packing at the point of greatest resistance. The packing has thus a vertically-changing motion in the direction of the piston's travel, the acting surface being reduced when the piston's motion is toward the packing, and increasing when the motion is reversed. The relief-ring is, in this case, made double-acting—that is, it has a relieving edge on both sides. It may, however, be made single-acting when only one packing is used under pressure, and in that case only one side of the ring will require the relieving-edge. Said relief-ring and packings are held in position by the cap-ring I, which is dished out on its upper side to give a convenient reservoir for the lubricant, and it is secured by bolts passing through it, through the cap-ring and an upper flange on the cylinder.

When such relief-ring is used with interior packings, as in the ordinary construction of piston, the same arrangement of parts will be made, excepting that the plano-cylindric form will be on the exterior edge of the relief-ring in place of the interior, as described.

J is the compression-cylinder, having about the same piston development or area as the power-cylinder. It is also fitted with a trunk-piston, K, and has packings G G′, and interposed relief-ring H, as hereinbefore described, with reference to the power-cylinder A and its piston E. Said cylinder J rests on and is secured by its lower flange *c* to the cooler L, and is connected to the power-cylinder by the passage M. The cooler L is situated immediately under the compression-cylinder J, and on its position and proper construction greatly depends the efficiency of the engine. It is made double, to permit a constant current of cold water to surround the compression-chamber J′, and keep it cool. The compression-chamber J′ extends downward from the lower portion of the compression-cylinder J to the base of the engine, and the piston K of the compression-cylinder is made to fit it loosely, and to extend to the bottom of the compression-chamber at the lowest part of the stroke. This position of the compression-chamber J′—namely, wholly below the air-passage M—causes the oil used in lubricating to flow downward and collect in the bottom of the compression-chamber, from whence it can be readily blown out. This prevents the clogging up of the passage M or other parts, which would otherwise occur.

The compression-piston K nearly fills up the interior of the compression-chamber, and thereby causes the air on its return from the heater to be presented in a very thin sheet to the cold surface of the compression-chamber J′, and gives the highest efficiency in cooling the air previous to its compression.

R is the regenerator. It is situated in the passage M, between the power and compression cylinders, and is traversed each way by the air passing from one cylinder to the other. It is constructed of thin plates *d*, made, preferably, of cast-iron. The edges *e* of these plates are thickened so as to give a uniform space between each plate of about one thirty-second of an inch, more or less. Said plates are disposed lengthwise of the passage, and give an uninterrupted airway with the least resistance through and between them. The plates are set on edge to afford the greatest possible facility for their removal through a bonneted opening, in case they require cleaning. F′ is the crank on the shaft S, to which the compression-piston K is attached. The cranks F F′ are arranged from eighty-five to ninety-eight degrees apart—that is, the one in advance of the other. Their exact position is dependent on the amount of clearance or waste spaces around the pistons and in the passage-ways. The cranks being farthest apart when the clearance is at a minimum, the direction of revolution is such that the power-crank is in advance of the compression-crank.

When the engine is designed for pumping, the pump is bolted to the cooler and discharges into it, and the pump may be worked by an arm extending from an ear on the compression-piston, the cooler forming simply a part of the water-pipe.

The operation of the engine is briefly as follows: The compression-piston K first compresses the cold air in the compression-chamber J′ into about one-third its normal volume, more or less, when, by the advancing or upward motion of the power-piston E and the completion of the down-stroke of the compression-piston K, the air is transferred from the compression-chamber J′ through the regenerator R, and into the heater C, without appreciable change of volume. The result is a great increase of pressure corresponding to the increase of temperature, and this impels the power-piston E up to the end of its stroke. The pressure still remaining in the power-cylinder, and reacting on the compression-piston K, forces the latter upward till it reaches nearly to the top of its stroke, when, by the cooling of the charge of air, the pressure falls to its minimum, the power-piston descends, and the compression again begins. In the mean time the heated air, in passing through the regenerator, has left the greater portion of its heat in the regenerator-plates, to be picked up and utilized on the return of the air toward the heater, as in other hot-air engines.

I claim—

1. The compression-chamber J′, with its cooler L, arranged below the air-passage M,

which connects said chamber with the heater C of the engine, whereby the lubricating material is restrained from clogging the passage M and other parts connected therewith, and is collected in the bottom of said chamber, substantially as specified.

2. In combination with the power and compression cylinders A and J, and heater C, the regenerator R, composed of plates *d*, arranged horizontally in the passage M, between said cylinders, and communicating therewith at its ends, substantially as described, whereby the air passing from one cylinder to the other traverses said regenerator, and the air is heated and cooled, as and for the purpose described.

3. The relief-rings H, having their inner and outer surfaces of different breadths, united by one or more curves, and leaving a sharp edge at their junction with the piston or wearing surface, in combination with the packings G G′, substantially as specified.

4. The combination of the power-cylinder A, the piston E, the shield or tube D, the heater C, the passage M, and regenerator R, the compression-chamber J′, and its cooler L, and the compression-cylinder J, and its piston K, the whole being arranged essentially as herein set forth.

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Witnesses:
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