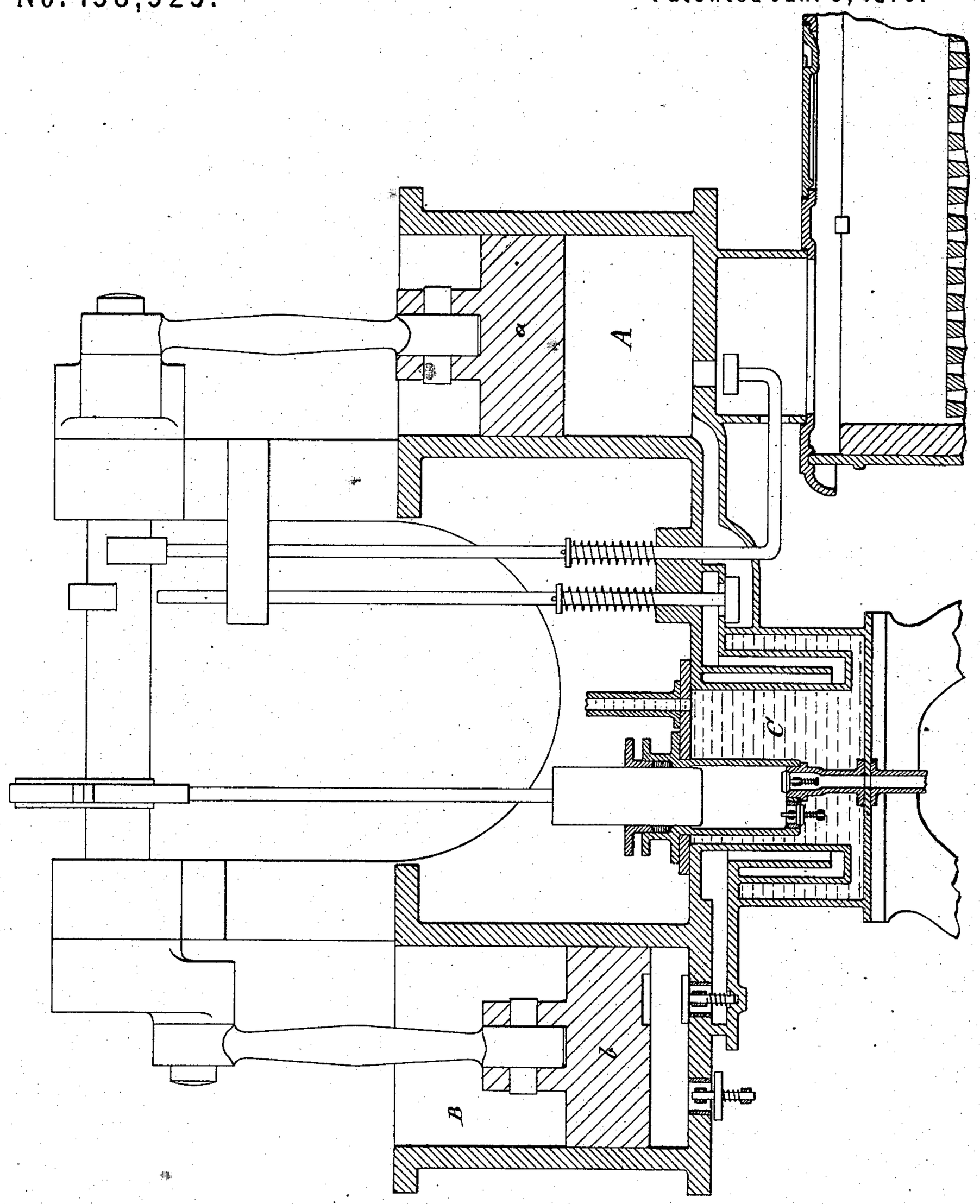
2 Sheets--Sheet 1.

A. K. RIDER.

Air-Vacuum Engines.

No. 158,525. Patented Jan. 5, 1875.



Witnesses:

Arnold Hörmann.

W. C. Dey

Inventor:

A. K. Rider

by his attorney T. A. Stetson.

New York Lith.

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2 Sheets--Sheet 2.

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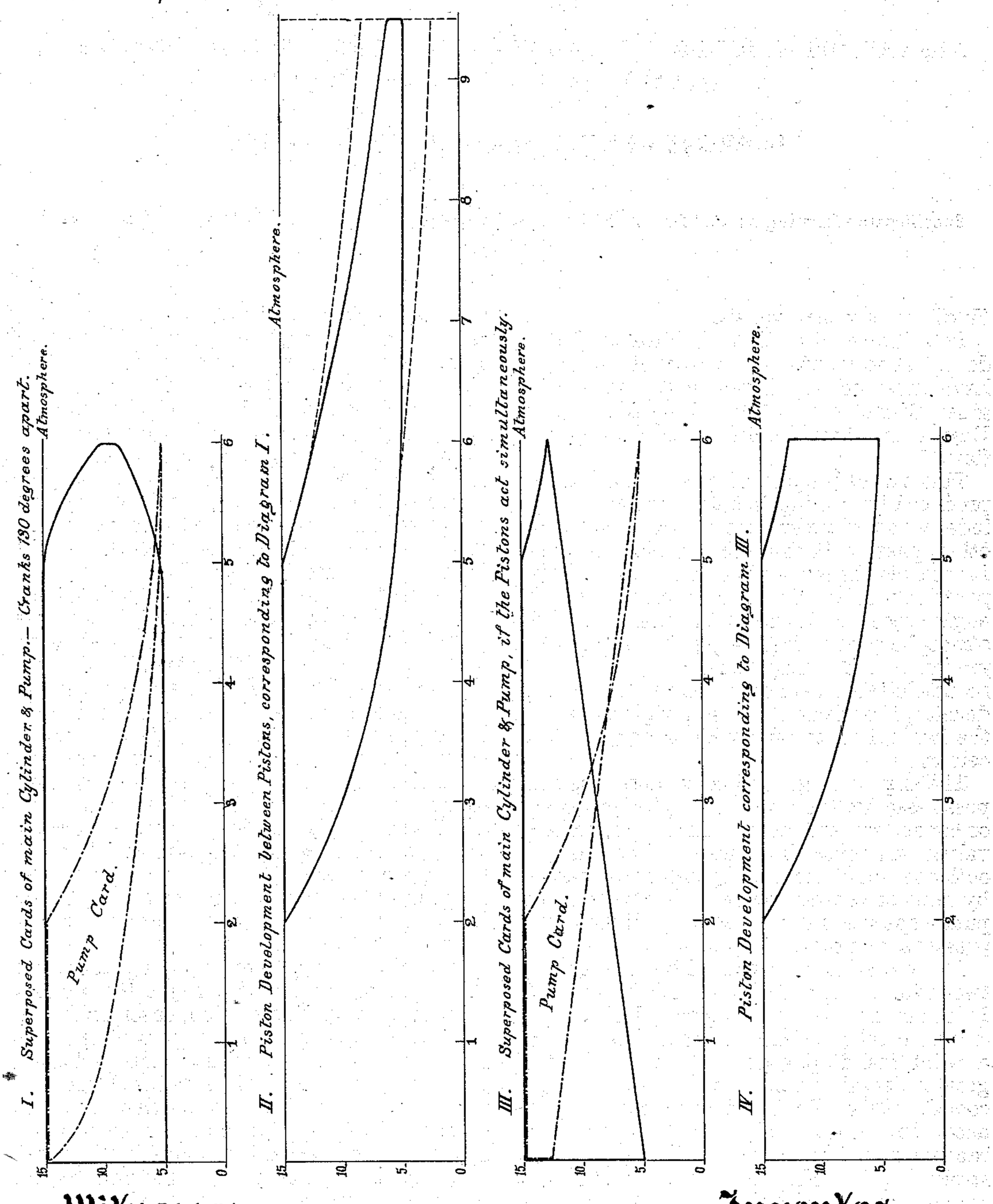

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UNITED STATES PATENT OFFICE.

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

IMPROVEMENT IN AIR-VACUUM ENGINES.

Specification forming part of Letters Patent No. **158,525**, dated January 5, 1875; application filed May 20, 1874.

To all whom it may concern:

Be it known that I, A. K. RIDER, of Walden, Orange county, in the State of New York, have invented an Improvement in Air-Engines, which may be termed an Air-Vacuum Engine, of which the following is a specification:

This engine is operated by a partial vacuum produced by cooling hot air. It has two cylinders, and transfers the air from one to the other, passing it through a cooler in transit. It receives the air hot and discharges it comparatively cold. As usually constructed, the engine receives the air at the pressure of the atmosphere and discharges it at the same pressure; but it may be made to work under an artificial atmosphere of more than normal density, if preferred, by using tight covers on the two cylinders and exhausting into a receiver.

The engine, in general construction, is composed essentially of a working-cylinder, a cooler or condenser, and an air-pump, with suitable valves and controlling means. The inlet and outlet valves of the main cylinder are operated by cams or eccentrics; but the valves of the pump operate automatically by difference of pressure, as usual.

The cooler or condenser C is arranged between the main cylinder A and the pump B. It is shown in the drawing as a double cylindrical vessel immersed in water, and having a cylindrical diaphragm in the interior to give greater length of current to the air being cooled. Other forms of condenser may be used, but not as well. The cranks are arranged in such a manner that the pump upstroke begins before the piston of the main cylinder has completed its upstroke by about one-sixth of the stroke. The cranks are set about one hundred and thirty degrees apart. The main cylinder A takes its supply of heated air direct from the furnace or other source of heat, and the inlet-valve of the main cylinder closes considerably before the completion of the upstroke, thus expanding the inclosed hot air in the main cylinder to any desirable point, and the expansion is subsequently carried still farther by the pump commencing to draw soon after the closure of the inlet-valve, which permits the work of exhaustion in the pump to be performed, in a great measure, before any considerable portion of the air is cooled. The stroke of the pump is, therefore, accomplished with much less power than would be required if the strokes of main piston and pump were simultaneous and opposite each other; or, in other terms, the expansion of the heated air is carried out much farther with corresponding gain. The character and amount of this gain are shown by diagrams on Sheet 2 of the drawings, marked 1, 2, 3, and 4.

The power is derived from the unbalanced pressure of the atmosphere acting first on the piston *a* of the main cylinder A, and afterward on the piston *b* of the pump B. The inlet and outlet valves of the main cylinder are so operated by cams on the main shaft that one is closed before the other opens. The inlet-valve should be open at the moment the main piston begins its upstroke, and may shut at any point in the stroke less than five-eighths of the whole stroke upward, according to the required degree of expansion. The outlet-valve of main cylinder should open at the commencement of the upstroke of the pump. The inlet-valve opens outward and the outlet inward.

In engines designed for pumping, the water being pumped is carried through the cooling-chamber surrounding the condenser, said cooling-chamber being simply a part of the suction or discharge pipe of the pump. This engine may take the hot air from the chimney of any ordinary fire or range, as when used for a household pumping-engine. In that case a special fire to operate the engine is dispensed with; or it may be run with gas-burners, arranged in a proper combustion-chamber; or it may have the air heated in a heater specially constructed, similar to that in my air-engine patented July 16, 1872; reissued March 25, 1873.

Other constructions of cylinder and pump will serve, with some success, the purpose intended by this arrangement, provided that the main piston begins its upstroke before the former has completed its upstroke, whether it is by cross-connection or separate motion, or by beams or levers.

Sheet 2 represents diagrams as produced by the well-known instrument termed "the indicator." Diagram 1 represents cards from the main cylinder A and from the pump B, superposed. The cranks are arranged, as herein described, one hundred and thirty degrees apart. The effective mean pressure in the cylinder, allowing nothing for leakage or friction, is six and one-half pounds per square inch. Diagram 3 shows the theoretical cards superposed, which would be taken from the main cylinder and pump if the cranks were in the same plane, so that the main piston and the pump-piston rose and sank exactly simultaneously. The effective mean pressure so arranged, allowing nothing for leakage or friction, would be only four and three-tenths pounds per square inch.

I claim as my invention—

The exhaustive pump B, combined with the main cylinder A and cooler or condenser C, so as to work with a partial vacuum, substantially as set forth.

In testimony whereof I have hereunto set my hand this 18th day of May, 1874, in the presence of two subscribing witnesses.

ALEX. K. RIDER.

Witnesses:

WM. E. NICHOLS,

JAMES GOWDY.