No. 883,316. PATENTED MAR. 31, 1908.

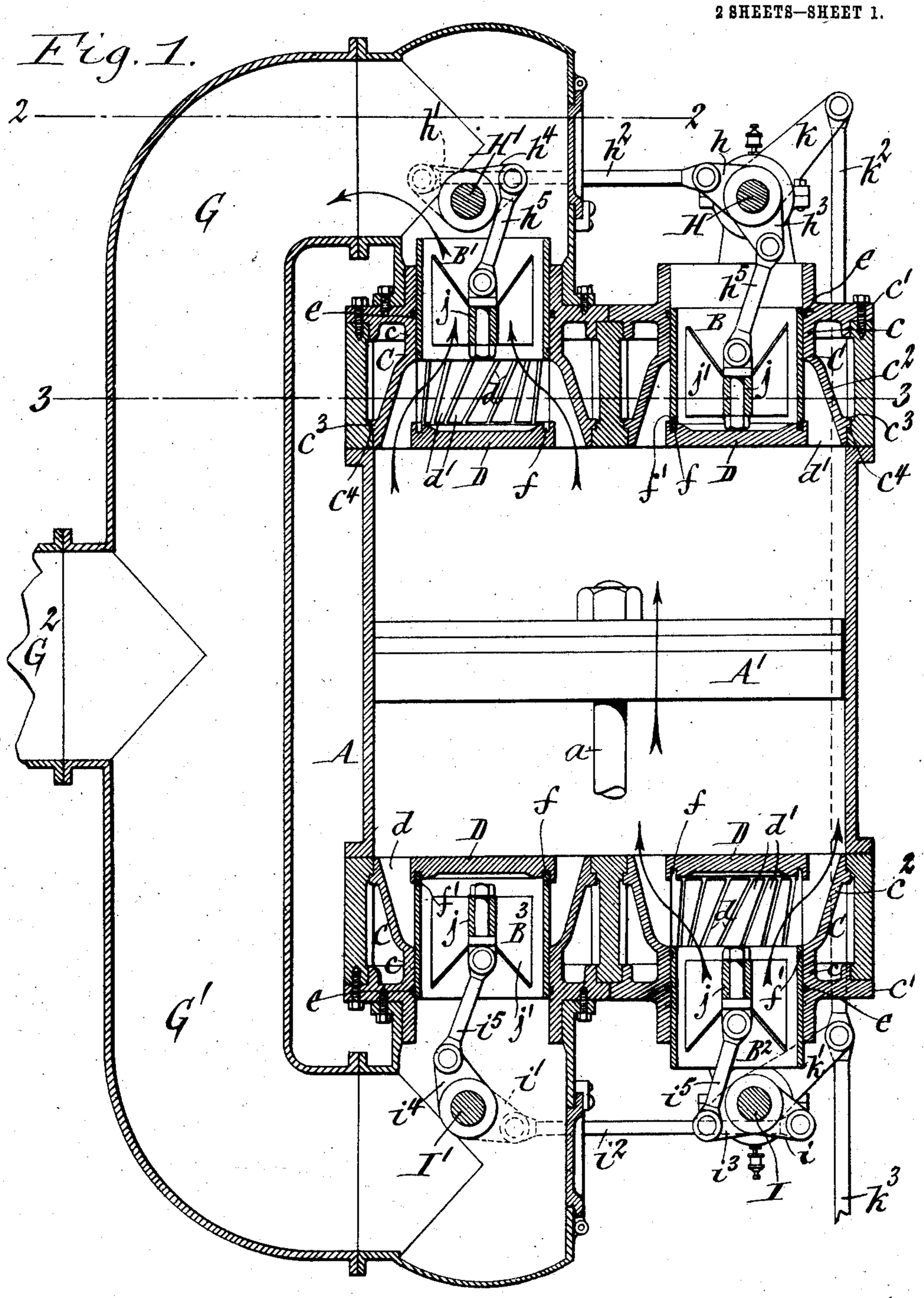
P. H. KANE.

BLOWING ENGINE.

APPLICATION FILED FEB. 14, 1907.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

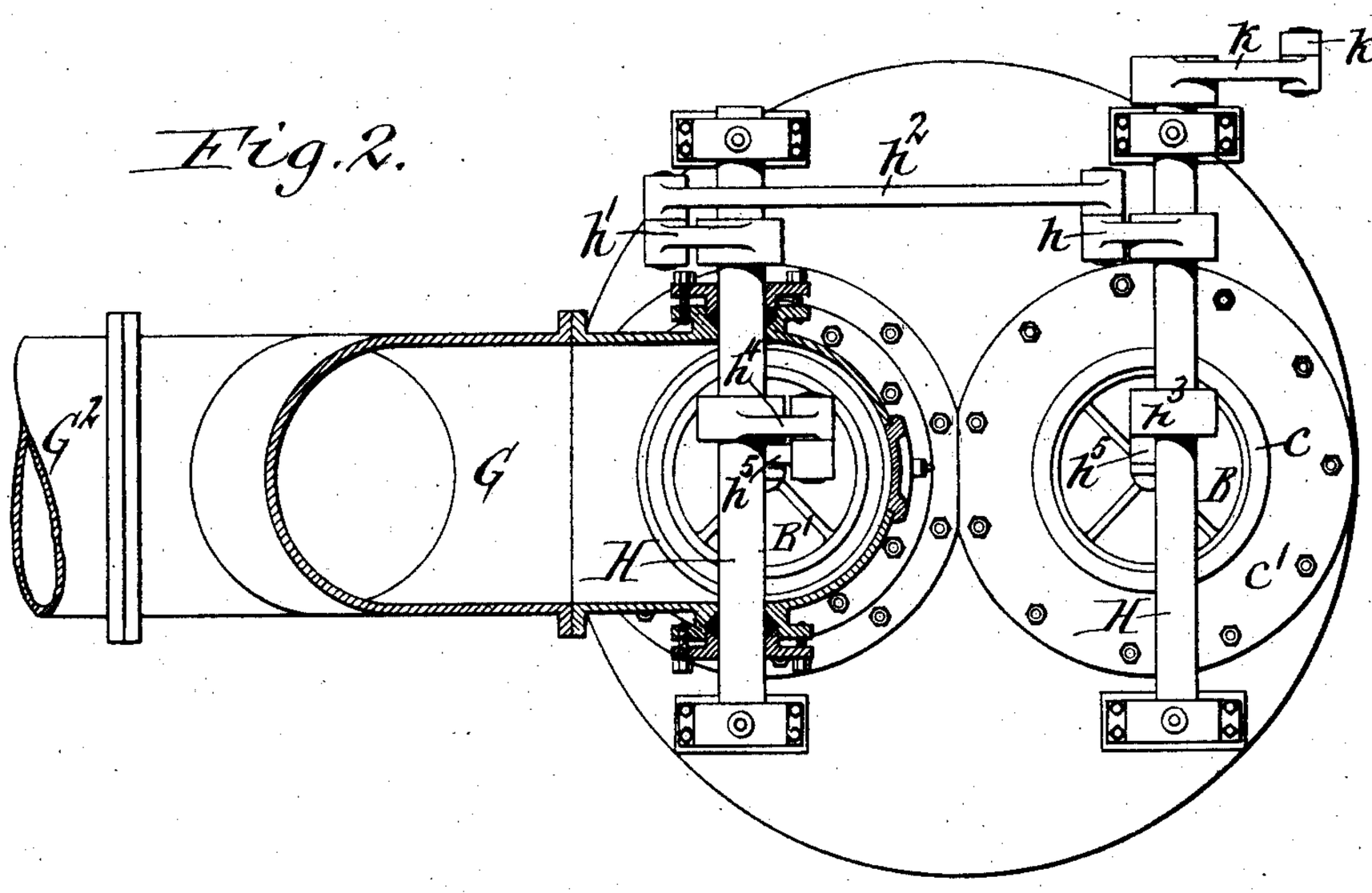
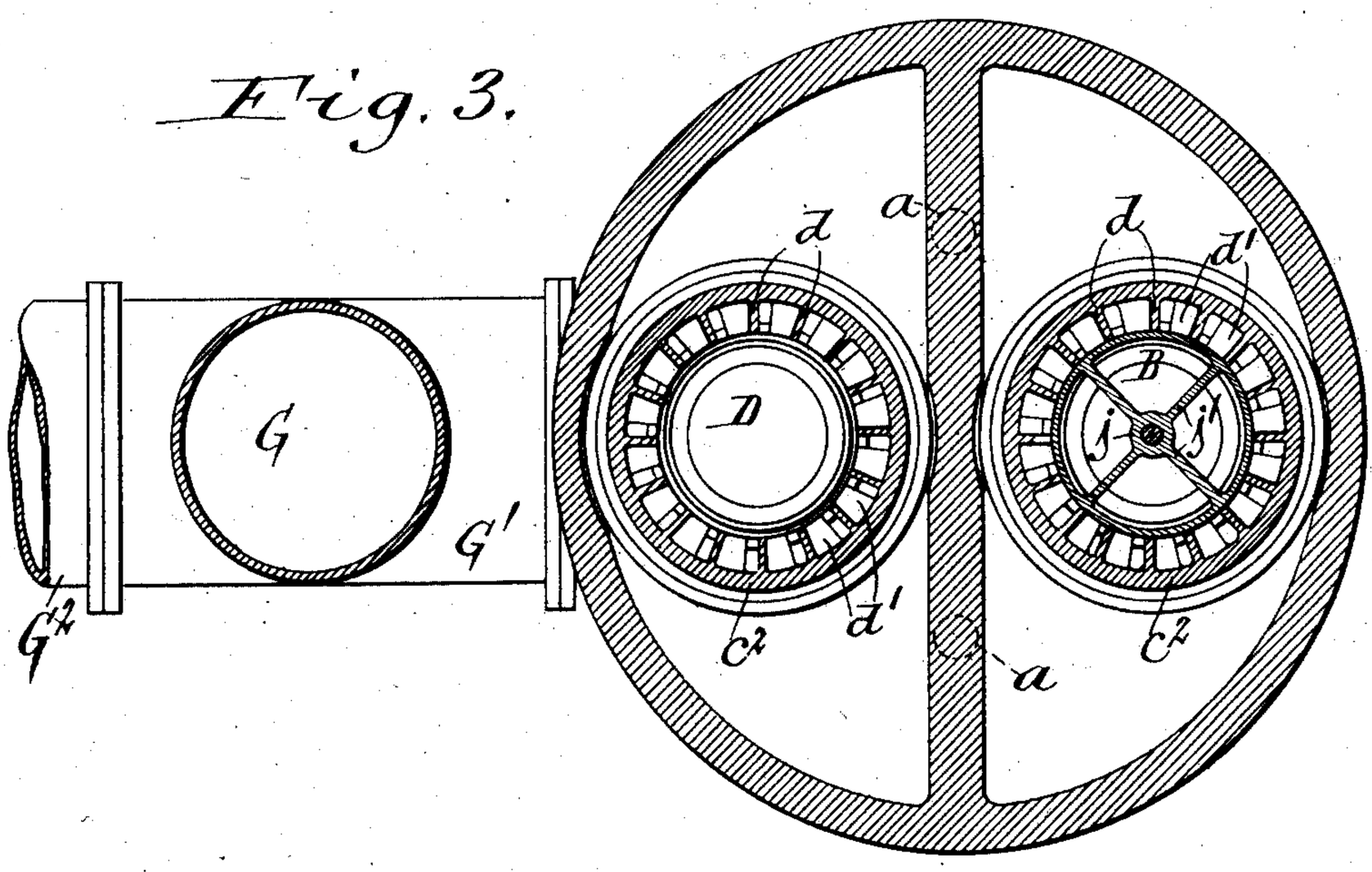


Fig. 3.



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BLOWING-ENGINE.

No. 883,316. Specification of Letters Patent. Patented March 31, 1908.

Application filed February 14, 1907. Serial No. 357,293.

To all whom it may concern:

Be it known that I, PATRICK H. KANE, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented a new and useful Improvement in Blowing-Engines, of which the following is a specification.

This invention relates to an improved valve and valve gear designed more especially for blowing engines or air compressors such as are used in connection with blast furnaces, and more particularly to engines of this type in which reciprocating tubular valves are employed.

The object of my invention is the provision of a simple and efficient actuating mechanism for the valves.

In the accompanying drawings consisting of 2 sheets: Figure 1 is a vertical longitudinal section of a blowing engine embodying the invention. Fig. 2 is a sectional top plan view thereof, the plane of the sectional part being in line 2—2, Fig. 1. Fig. 3 is a horizontal section in line 3—3, Fig. 1.

Similar letters of reference indicate corresponding parts throughout the several views.

A indicates the cylinder of the engine containing the piston A^1. The piston rods a are located on opposite sides of the center of the piston, as shown by dotted lines in Fig. 3, and are actuated by a steam engine or other suitable motor not shown.

In the upper head is arranged an inlet valve B and an outlet valve B^1, and the lower head contains corresponding inlet and outlet valves B^2, B^3. The inlet valves are preferably arranged in line with each other and on one side of the axis of the cylinder, while the outlet valves are arranged in similar opposing relation on the opposite side of said axis, as shown. These four valves are identical in construction and a description of one, say the valve B, will therefore apply to all. The valve is open at both ends and snugly fitted in the contracted cylindrical outer portion c of a valve case or chamber C open at both ends and suitably secured in an opening of the adjacent cylinder-head. In the preferred construction shown in the drawings, the contracted portion of the valve case has a projecting flange c^1 which is bolted to the outer side of the cylinder head, while the enlarged inner portion c^2 of the valve case is preferably conical and provided with a projecting flange c^3 which bears against a shoulder c^4 in the opening of the cylinder head. Projecting inwardly from this enlarged portion is an annular series of equidistant radial ribs d extending lengthwise of the case and having their inner edges arranged flush with the bore of the contracted portion c of the case, so that the ribs and said contracted portion together form a guide or cage for the valve. These ribs extend to the inner end of the valve case where they are joined to an imperforate head D preferably cast integral therewith and made of considerably smaller diameter than the inner end of the valve case to leave a space between said parts for the passage of the air. When the valve is in its open position, as shown in connection with the lower inlet valve B^2, it wholly uncovers the ports or passages d^1 between the radial ribs d, permitting the outer air to enter the cylinder through the hollow valve and said ports. When said inlet valve is in its lowest, or innermost position, as shown in connection with the upper inlet valve B, its inner end is closed by the head D, thus covering the ports d^1 and preventing the entrance of the outer air into the cylinder through said valve.

To form a tight joint between the valve case and the valve, the former may be provided in the bore of its contracted portion with an annular groove containing a suitable packing e, and in order to form a similar joint between the valve and the head D, the latter is provided with an annular groove f which receives the inner end of the valve, and the valve is provided in its outer side with a circumferential groove containing a packing f^1.

G, G^1 are the discharge conduits or branches connecting the cases C of the outlet valves B^1, B^3 with the main conduit G^2 which leads to the reservoir, not shown.

The several valves may be operated by any suitable valve mechanism but I prefer to employ the improved valve gear shown in the drawing, which is constructed as follows: Above the upper valves B, B^1, respectively, are arranged a pair of transverse rock shafts H, H^1 journaled in bearings carried by the upper cylinder-head, while below the lower valves B^2, B^3 are arranged a pair of similar shafts I, I^1 supported in bearings carried by the lower cylinder-head. The two upper shafts

are caused to rock in unison by rock arms h, h^1 secured thereto and connected by a rod h^2, and the two lower shafts I, I^1 are likewise connected by rock arms i, i^1 and a rod i^2. The upper valves B, B^1 are reciprocated from the corresponding rock shafts H, H^1 by rock arms h^3, h^4 and links h^5, while the lower valves are likewise actuated from the lower shafts I, I^1 by rock arms i^3, i^4 and links i^5. In the construction shown in the drawings, the links h^5 and i^5 are pivoted to hubs j arranged centrally in the tubular valves and connected with the latter by webs j^1. The upper and lower shafts H, I are actuated from the main shaft of the steam engine or motor by any suitable means, the mechanism shown in the drawings consisting of rock arms k, k^1 secured to said shafts and connected by a link k^2 and a rod k^3 which connects the lower arm k^1 with an actuating member on the engine shaft, not shown.

The operation of the blowing engine is as follows: When the piston is in its middle position, as indicated by the arrow in Fig. 1, the upper inlet valve and the lower outlet valve are fully closed, and the upper outlet valve and the lower inlet valve are fully open. As the piston moves upward from this position, it forces air through the open ports d^1 of the upper outlet valve-case and the corresponding valve B^1 into the reservoir. At the same time, it draws air into the cylinder on its lower side through the lower inlet valve B^2 and the ports d^1 of the corresponding valve case. As the piston approaches the upper end of its stroke, the upper outlet valve gradually closes and by the time the piston reaches the upper end of its stroke, said outlet valve has been fully closed, and during this same movement of the piston, the lower inlet valve has also been fully closed. On the return or downward stroke of the piston, the upper inlet valve begins to open to admit air above the piston and the lower outlet valve begins to open to discharge the air below the piston, the upper inlet valve and the lower outlet valve being wide open by the time the piston reaches its mid-position. As the piston approaches the end of its downward stroke, the upper inlet valve and the lower outlet valve are gradually closed and by the time the piston reaches the end of said stroke, both of said valves are fully closed.

In order to obtain the proper action of the valves, each inlet valve must open quickly just as the piston recedes from it, to obtain an ample air supply, and when said valve is closed during the opposite stroke of the piston, it should remain closed until the piston fully completes that stroke, in order to compress the air to the necessary degree. Each outlet valve must move inwardly or toward its closed position rapidly enough to be fully closed by the time the piston reaches the end of its stroke in moving toward said valve, and must remain closed during the entire opposite or receding stroke of the piston. To effect this action of the valves, the actuating rock arm h^3 of the upper inlet valve B, for example, is arranged to assume a position on the underside of the shaft H when said valve is closed, as shown in Fig. 1, so that in this position of the valve said rock arm moves across the dead center. The inlet valve is by this arrangement slightly reciprocated while in its closed position but not enough to open it, the groove f in the head D which receives the inner end of the inlet valve being of sufficient depth to permit of this idle motion of the valve without opening it. The actuating arm h^4 of the upper outlet valve B^1 at the same end of the cylinder is nearly horizontal in the wide-open position of said valve, the arm thus being in the most favorable position for effectively and rapidly moving said valve downwardly to its closed position at the same time that the rock arm h^3 of the companion inlet valve B is moving idly across the dead center. When the shafts H, H^1 are rocked in the opposite direction, the arm h^3 moves through the effective part of its arc or stroke while the arm h^4 moves through the idle part of its stroke, opening the upper inlet valve rapidly and keeping the upper outlet valve closed during the entire downward stroke of the piston. The same actions take place with reference to the lower inlet and outlet valves B^2, B^3.

As shown in Figs. 1 and 2, the rock shafts H, H^1 I, I^1 are offset or arranged out of alinement with the axes or pivots of the corresponding inlet and outlet valves. By this arrangement, the valve rods or links i^5 and h^5 exert a nearly straight thrust and pull upon the valves and side thrust or strain upon the valves is reduced to a minimum, thus producing a smoother action of the valves than would be obtained if said shafts were arranged in line with the valve pivots.

It will be observed that the valves and their guides or cases do not extend into the body of the cylinder but terminate at or near the inner edges of the cylinder heads, so that they are seated wholly within these heads. This construction while facilitating the construction and assemblage of the parts, avoids obstructing the interior of the air cylinder and reducing its capacity, which is the case when the valves or their guides, or both, are extended into the body of the cylinder through the piston.

I claim as my invention:—

In a blowing engine, the combination of a cylinder, an inlet valve and an outlet valve arranged in each head of the cylinder, rock shafts arranged opposite the respective valves and each having an actuating arm connected with the corresponding valve,

and means for operatively connecting the two shafts at the same end of the cylinder, the actuating arms of the valves at the same end of the cylinder being arranged to close one of said valves when the other is opened and the arm of each valve being arranged to move across the dead center in the closed position thereof, substantially as set forth.

Witness my hand this 9th day of February, 1907.

PATRICK H. KANE.

Witnesses:
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