P. H. KANE.

BLOWING ENGINE.

APPLICATION FILED MAY 6, 1907.

960,556.

Patented June 7, 1910.

4 SHEETS—SHEET 1.

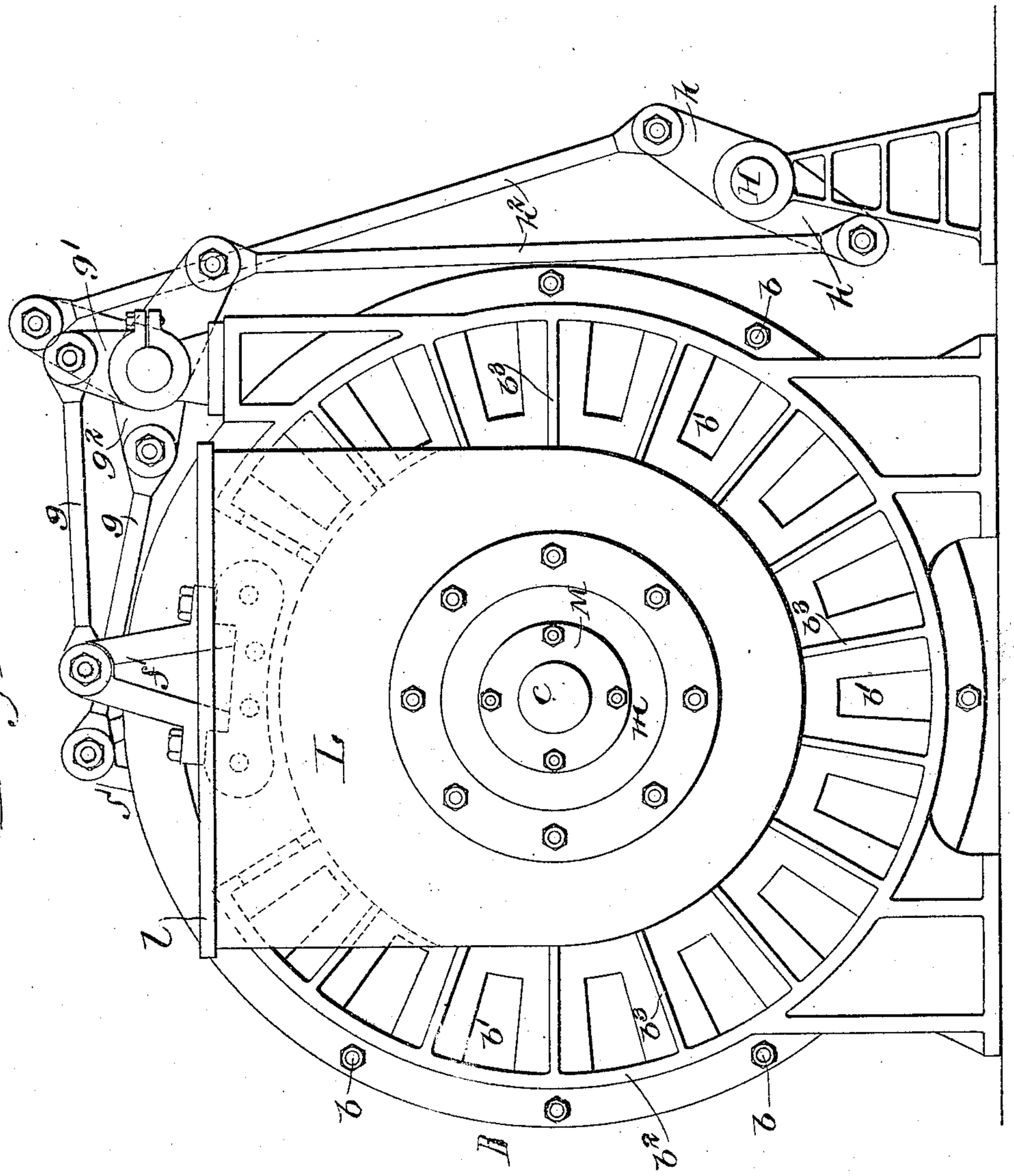

Fig. 1.

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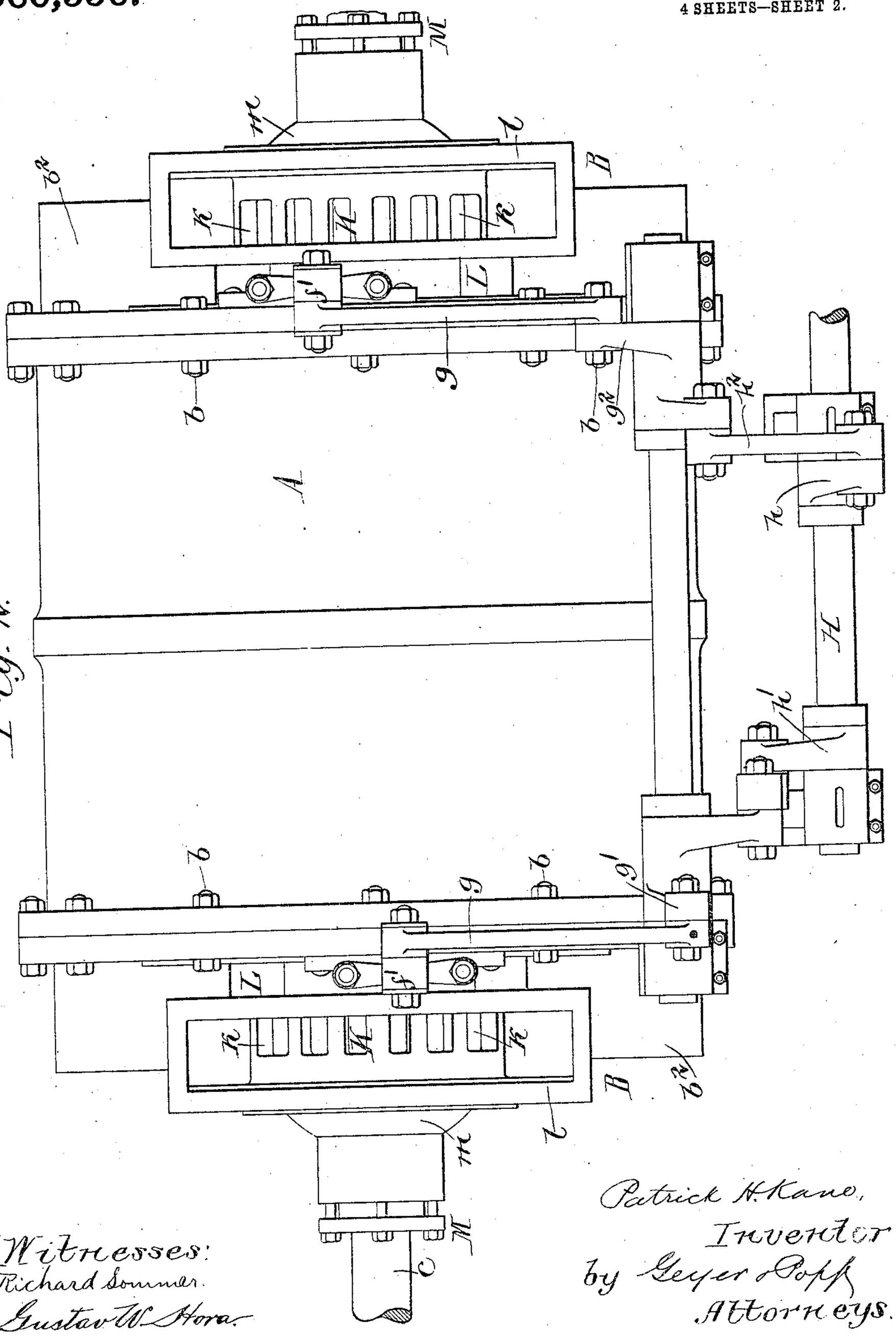

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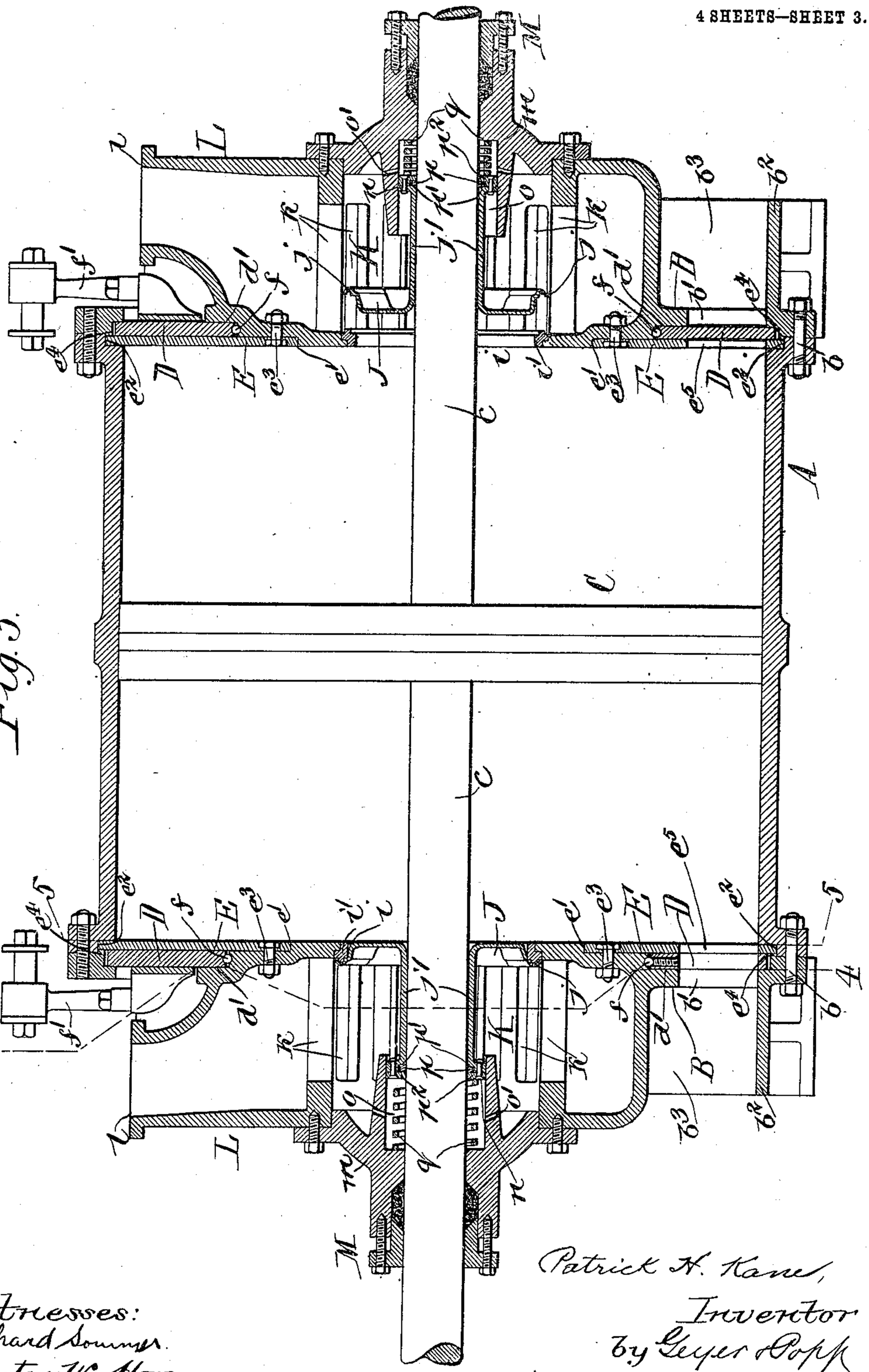
4 SHEETS—SHEET 3.

Fig. 3.



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4 SHEETS—SHEET 4.

Fig. 5.

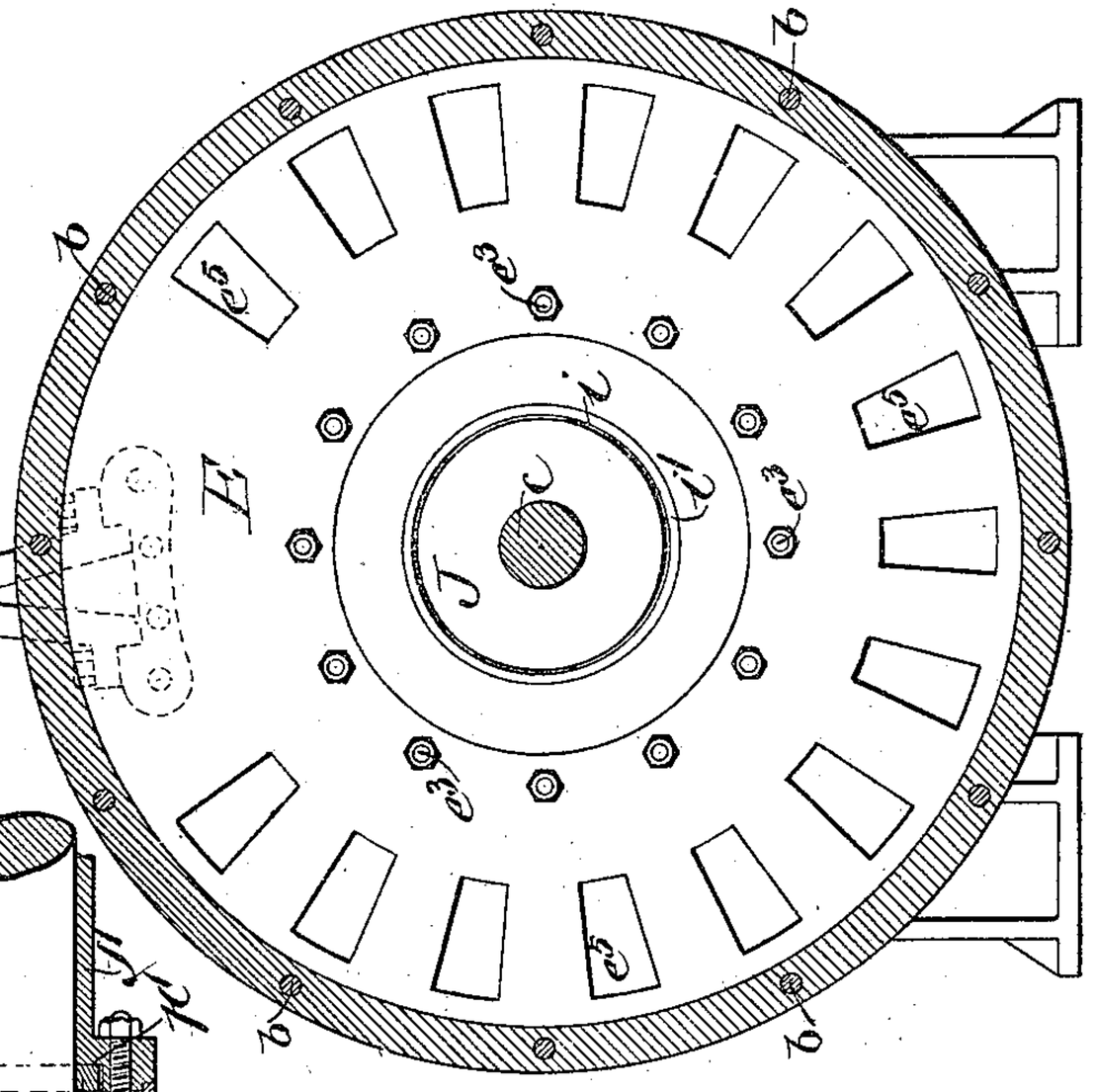


Fig. 6.

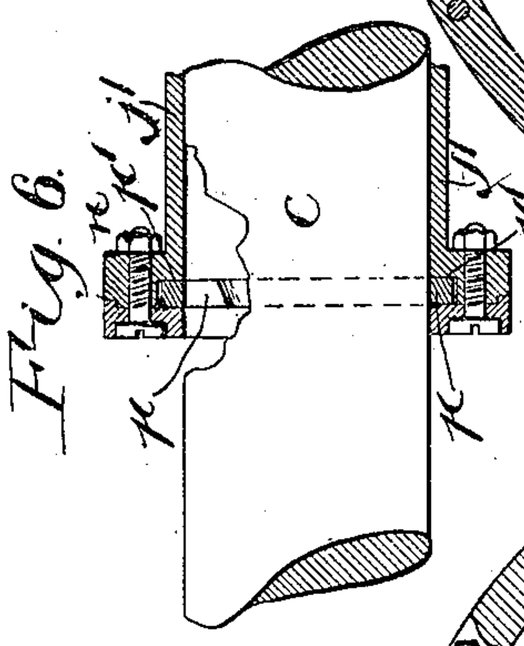
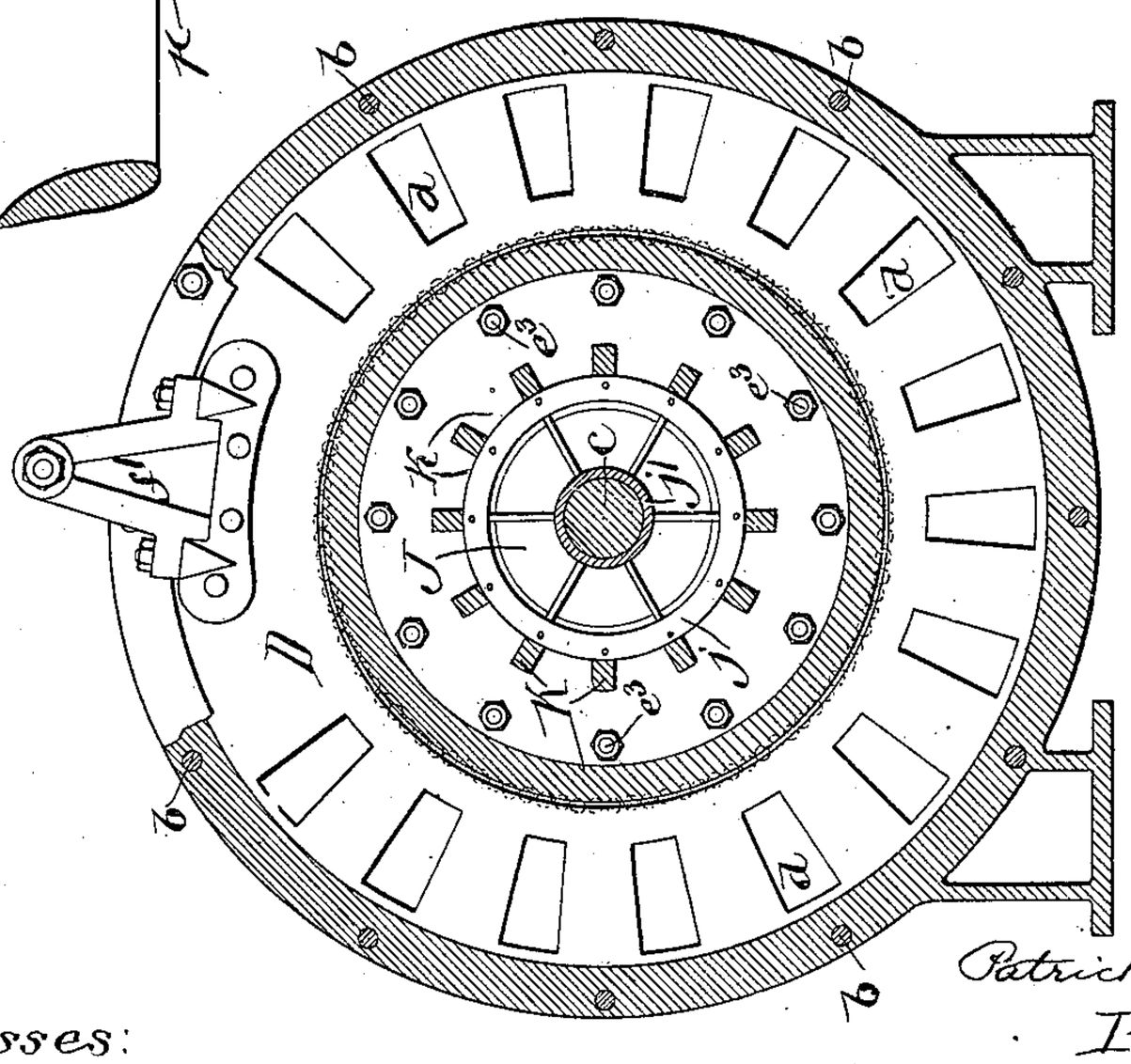


Fig. 4.



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UNITED STATES PATENT OFFICE.

PATRICK H. KANE, OF BUFFALO, NEW YORK.

BLOWING-ENGINE.

960,556. Specification of Letters Patent. Patented June 7, 1910.

Application filed May 6, 1907. Serial No. 372,112.

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 the class of blowing engines employed for supplying compressed air to blast furnaces, and more especially to engines of this type having outlet valves which open automatically when the pressure in the cylinder exceeds the pressure in the air reservoir.

The leading object of my invention is to improve the construction of the engine with a view of providing air inlets of large aggregate area in proportion to the size of the cylinder, thus permitting a free and ample ingress of the air, guarding against undue heating of the same and obtaining the maximum efficiency of the engine.

Further objects are to simplify the construction of the valve mechanism and reduce the cost of the same, and to improve the engine in other respects.

In the accompanying drawings consisting of 4 sheets: Figure 1 is an end view of the engine. Fig. 2 is a top plan view thereof. Fig. 3 is a horizontal section of the same. Figs. 4 and 5 are transverse sections in lines 4—4 and 5—5, Fig. 3. Fig. 6 is a fragmentary longitudinal section of the outlet valve and piston rod, on an enlarged scale.

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

A indicates the body of the engine-cylinder, B its heads secured thereto by bolts *b*; C the piston and *c* the piston rod preferably arranged axially in the cylinder and passing through both its heads.

Each head B is provided near its periphery with an annular row of air inlet ports b^1, and in order to render the head strong and yet comparatively light, it is provided with an outwardly-extending stiffening rim b^2 arranged concentric with the piston rod, and radial stiffening webs or ribs b^3 extending inwardly from said rim and arranged midway between adjacent air inlet ports b^1. The inlet ports of each head are controlled by a rotary or oscillating valve D consisting of a ring applied to the inner side of the head and having an annular row of air inlet ports *d* spaced like the corresponding inlet ports b^1 of the head and adapted to register or break register therewith for permitting or preventing admission of the external air to the cylinder. In the preferred construction shown in the drawings, these valve-rings are seated in annular grooves d^1 formed in the cylinder heads and confined therein by fixed retaining-plates E which are seated in recesses e^1, e^2 formed respectively in the inner sides of the heads and the ends of the cylinder-body A.

The central portion of each retaining plate is secured to the contiguous cylinder head by bolts or other fastenings e^3, while the margin of the plate is clamped between the bottom of the recess e^1 and the cylinder head, the latter being provided at its inner edge with an annular flange e^4 which extends into said recess and bears against the retaining plate, as shown in Fig. 3. These retaining plates have air-inlet ports e^5 which coincide with the ports b^1 of the cylinder-heads. The plates E while confining the valve-rings in their seats also serve to relieve them largely from the pressure in the cylinder permitting them to operate more freely. These valve-rings are fitted between the cylinder heads and the retaining plates E with sufficient looseness to turn freely, and in order to minimize friction, balls or rollers *f* may be interposed between the inner edges of the rings and the opposing walls of the grooves d^1, as shown.

The inlet valves are oscillated in opposite directions by any suitable mechanism. In the construction shown in the drawings, the valves are provided on their outer sides near their upper edges with actuating arms f^1 which are connected by rods *g* with elbow levers g^1, g^2 which are alternately rocked in opposite directions by oppositely-disposed arms *h*, h^1 secured to a horizontal rock shaft H, the last-named arms being connected with said elbow levers by rods h^2. The shaft H is rocked from the main engine-shaft, not shown, by any suitable or well-known means.

Centrally in each cylinder head is located an air outlet port or passage *i* which is preferably concentric, with the piston rod and provided with a bushing i^1 forming a seat for an outlet valve J. This valve is arranged on the outer side of the adjacent cylinder-head and preferably of the dished form shown. It is provided with a marginal rim or flange *j* adapted to seat against the bushing i^1, and a hollow stem j^1 extend-

ing outwardly from the valve and surrounding the piston rod *c*, so as to be guided thereon. The outlet valves are arranged to reciprocate in cylindrical cages K extending outwardly from the cylinder heads and inclosed by outlet hoods or casings L having connections *l* for the usual discharge pipes, not shown, which lead to the customary reservoir. The hoods L and valve cages K are preferably cast integral with the cylinder-heads, as shown. These cages are provided in their cylinder walls with air outlet passages *k* through which the compressed air passes from the interior of the cages into the hoods L. The latter are provided with suitable stuffing boxes M through which the piston rod *c* passes. As shown in Fig. 3, the hoods are provided in their outer walls with openings of the same size as the internal diameter of the valve-cages, which openings are closed by caps or covers *m* bolted to the hoods and carrying the stuffing boxes. Upon removing these covers, the outlet valves can be readily inserted or removed.

Each outlet valve is preferably provided at the outer end of its stem with an enlargement or piston *n* which is fitted in a barrel or cylinder *o* extending inwardly from the cap *m*, the barrel being closed at its outer end and provided in its wall with air escape openings o^1. In the use of the engine, the air in the hoods L and the barrels *o* is under pressure, and to prevent leakage of such air between the valve-stem *j* and the piston rod into the engine cylinder, each of said stems is provided with a suitable packing consisting preferably of a split elastic ring *p* of metal embracing the piston rod and seated in a recess p^1 in the flanged front end of the valve-stem, the ring being confined in this recess by a cap p^2. This elastic ring is sprung upon the piston rod so that it constantly tends to contract producing a reliable air tight joint between the valve-stem and the piston rod.

As shown by dotted lines in Fig. 1, the rims b^2 and webs b^3 are interrupted or omitted at the top of the cylinder heads to permit of the necessary play of the valve-actuating arms f^1.

q indicates springs applied to the piston rod between the flanged outer ends of the valve-stems *j* and the closed ends of the barrels *o* and tending to close the outlet valves.

The operation of the engine is as follows, assuming the reservoir to contain a certain quantity of compressed air:—When the piston is at the left hand end of its stroke and begins to move in the opposite direction, the left hand inlet valve D begins to open and the right hand inlet valve and the right and left hand outlet valves J are fully closed, the outlet valves being held in that position by the springs *q* and the reservoir-pressure against their rear sides. As the piston moves toward the right, it compresses the air in front of it until the pressure in the cylinder exceeds the pressure in the reservoir, when the right hand outlet valve is opened to the position shown in Fig. 3 and the compressed air delivered into the reservoir. At the same time the piston has drawn air into the cylinder on its opposite side through the left hand inlet valve which has meanwhile been opened. As the piston approaches the end of the last-named stroke, the right hand outlet valve is moved toward its left by its spring *q* and is fully closed by the time the piston reaches the end of said stroke. During this same right hand stroke of the piston, the left hand inlet valve has been fully closed. On the return or left hand stroke of the piston, the right hand inlet valve begins to open to admit air behind the piston and the air on the left side of the latter is compressed until it exceeds the reservoir-pressure against the back of the closed left hand outlet valve, when this valve is opened and the compressed air delivered into the reservoir, as before. As the piston approaches the end of said left hand stroke, the right hand inlet valve closes and the left hand outlet valve is moved toward its seat, and by the time the piston completes that stroke both of the last-mentioned valves are fully closed.

To obtain the proper action of the engine, each inlet valve must open quickly just as the piston recedes from it, in order to insure 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 required degree. To effect this action of the inlet valves, the inner short arms of the elbow levers g^1, g^2 are arranged to assume a substantially horizontal position and pass the dead center when the valves are closed, as shown in connection with the lever g^2 in Fig. 1. The inlet valves are by this arrangement slightly oscillated while in their closed position but not sufficiently to open them. When the inner arm of one or the other of the levers g^1, g^2 is rocked upwardly, after passing above the dead center, it moves through the effective part of its arc or stroke, rapidly opening the corresponding inlet valve and admitting a full supply of air to the cylinder.

By controlling the air inlet ports in each end of the cylinder by a single rotary or oscillatory valve arranged concentrically with the piston rod or the cylinder-axis, the construction of the engine is materially simplified and reduced in cost, and a free and ample inlet for the air is at the same time insured, this construction and arrangement affording a very large aggregate area

of the inlet ports without unduly increasing the diameter and length of the cylinder and without encroaching on or reducing the capacity of the cylinder.

Another important feature of the invention consists in arranging the outlet valves J centrally in the cylinder heads and mounting them to slide on the piston rod. This construction, while permitting the use of comparatively large outlet ports, dispenses with separate guides for the outlet valves, thus further simplifying the construction and lessening the cost of the engine.

While the invention is herein shown and described in connection with a horizontal blowing engine, it is equally applicable to vertical engines.

I claim as my invention:

1. In a blowing engine, the combination of a cylinder having a head provided centrally with an air outlet port and around said port with a row of air inlet ports, a valve controlling said outlet port, an oscillatory inlet valve controlling said inlet-ports, and means for actuating said inlet valve, substantially as set forth.

2. In a blowing engine, the combination of a cylinder having a head provided centrally with an air-outlet port and around said port with a circular row of air-inlet ports, a valve controlling said outlet port, an oscillatory annular inlet-valve surrounding said outlet-port and having a circular row of ports adapted to register with said inlet-ports, and means for actuating said inlet valve.

3. In a blowing engine, the combination of a cylinder having a head provided with a row of air inlet ports arranged concentrically with the cylinder, a ported oscillatory valve-ring coöperating with said air inlet ports and applied to the inner side of said head, and a protecting plate covering the inner side of said valve-ring and having air passages, substantially as set forth.

4. In a blowing engine, the combination of a cylinder having a head having an annular recess in its inner side and air inlet ports arranged in the recessed portion of the head, a ported oscillatory valve-ring seated in said recess, a protecting plate covering said valve-ring and having air passages, and means for actuating the valve-ring, substantially as set forth.

5. In a blowing engine, the combination of a cylinder provided in its end with a recess, a head secured to the end of the cylinder and provided in its inner side with an annular groove or recess arranged concentrically with the cylinder and air-inlet ports arranged in the recessed portion of the head, a ported valve-ring seated in the recess of the head, and a protecting plate covering said valve-ring and seated in the recess of the cylinder, substantially as set forth.

6. In a blowing engine, the combination of a cylinder having each of its heads provided with an annular row of air inlet ports, a ported valve-ring applied to the inner side of each head and controlling its ports, and a protecting plate covering said valve-ring, and having its marginal portion clamped between the end of the cylinder and said head, and means for securing the inner portion of the protecting plate to the cylinder head, substantially as set forth.

7. In a blowing engine, the combination of a cylinder having a head provided centrally with an air-outlet port, and around said outlet port with a row of air inlet-ports, valves controlling said inlet and outlet ports, a discharge-hood or connection applied to the outer side of said cylinder head and communicating with said outlet port, said head having a stiffening rim extending outwardly therefrom and stiffening webs extending from said rim to said hood, substantially as set forth.

8. In a blowing engine, the combination of a cylinder having a head provided centrally with an air outlet port and around said port with a row of air inlet-ports, a piston in the cylinder having a rod passing through said outlet port, a reciprocating valve controlling said outlet port and guided on the piston-rod, and an oscillatory inlet-valve controlling said inlet ports, substantially as set forth.

9. In a blowing engine, the combination of a cylinder having a head provided with an air outlet port, a piston having a rod passing through said port, a valve controlling said port and guided on the piston-rod, a discharge hood or connection arranged on the outer side of said head and communicating with said port, said hood being provided opposite said valve with an opening of sufficient size to admit the same, and a cover applied to said opening, substantially as set forth.

10. In a blowing engine, the combination of a cylinder having a head provided with an air-outlet port, a piston having a rod passing through said port, a discharge hood or connection carried by the head and provided opposite said port with a barrel having an air-escape opening, a reciprocating outlet valve controlling said port and surrounding the piston rod, said valve having a hollow stem guided on the piston rod and fitted in said barrel, and a contractible packing ring interposed between said valve stem and the piston-rod, substantially as set forth.

Witness my hand this 3d day of May, 1907.

PATRICK H. KANE.

Witnesses:
C. F. GEYER,
E. M. GRAHAM.