No. 754,162. PATENTED MAR. 8, 1904.

E. REYNOLDS.

BLOWING ENGINE.

APPLICATION FILED SEPT. 19, 1898.

NO MODEL. 3 SHEETS—SHEET 1.

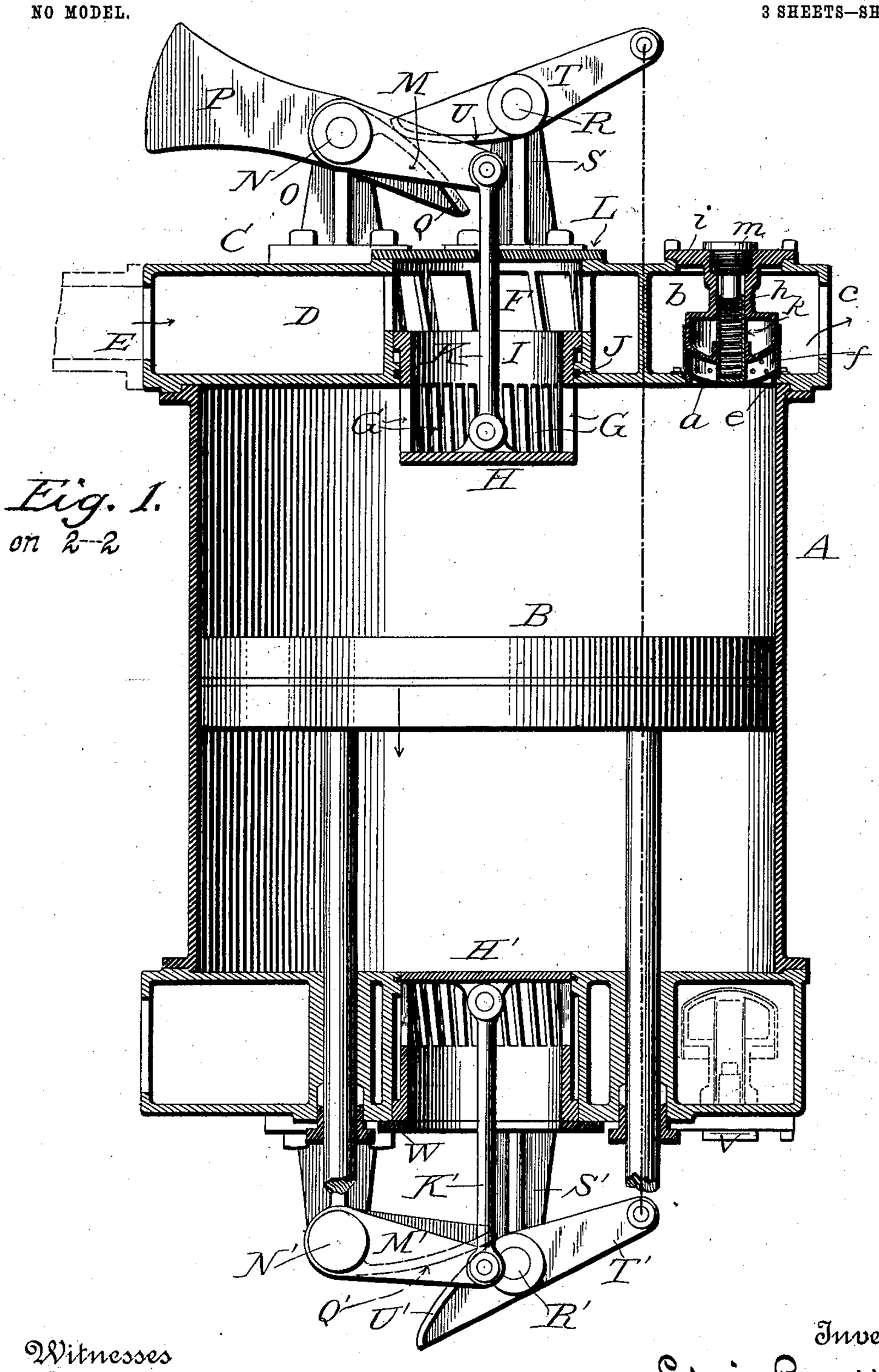

Fig. 1.
on 2--2

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NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2.

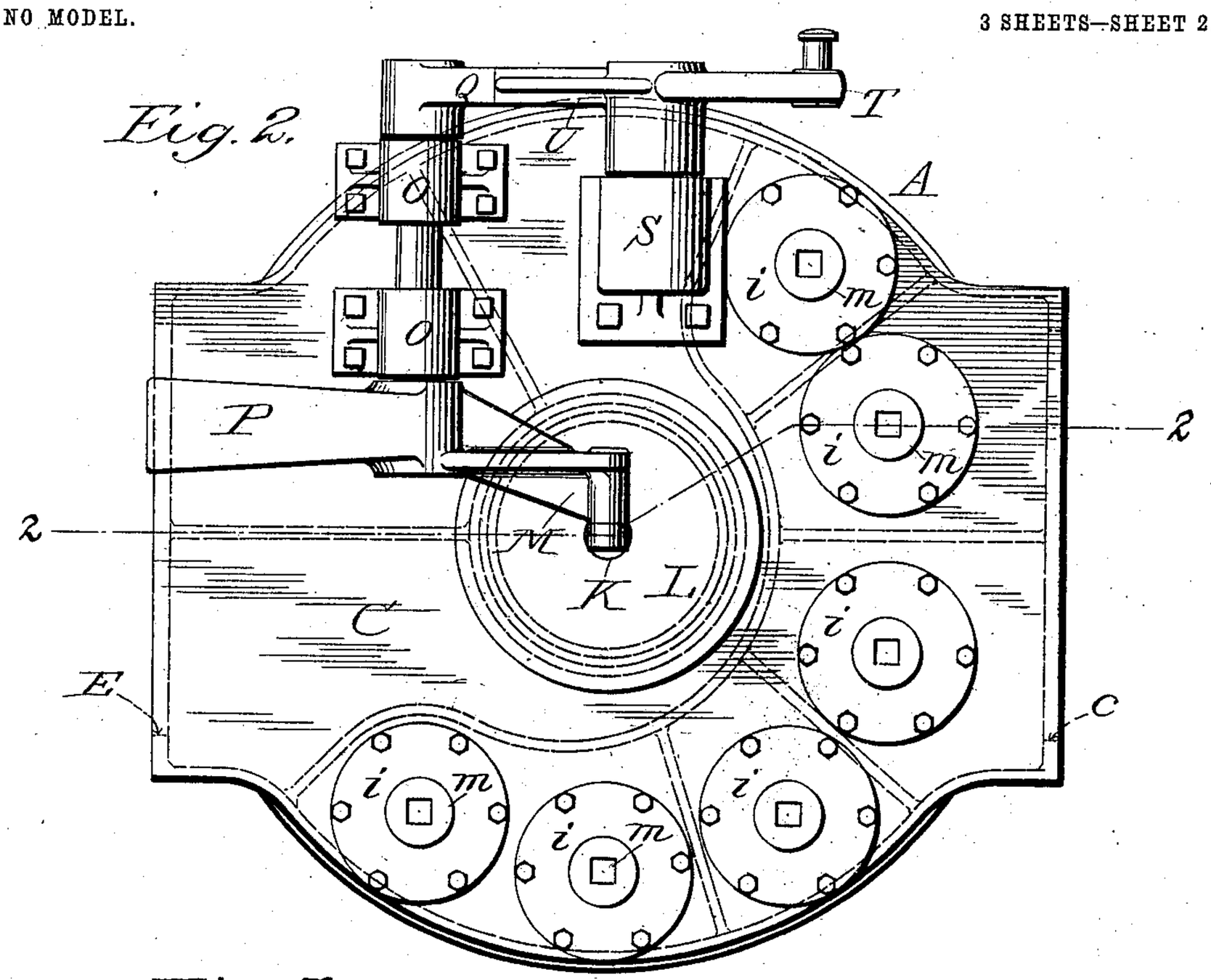
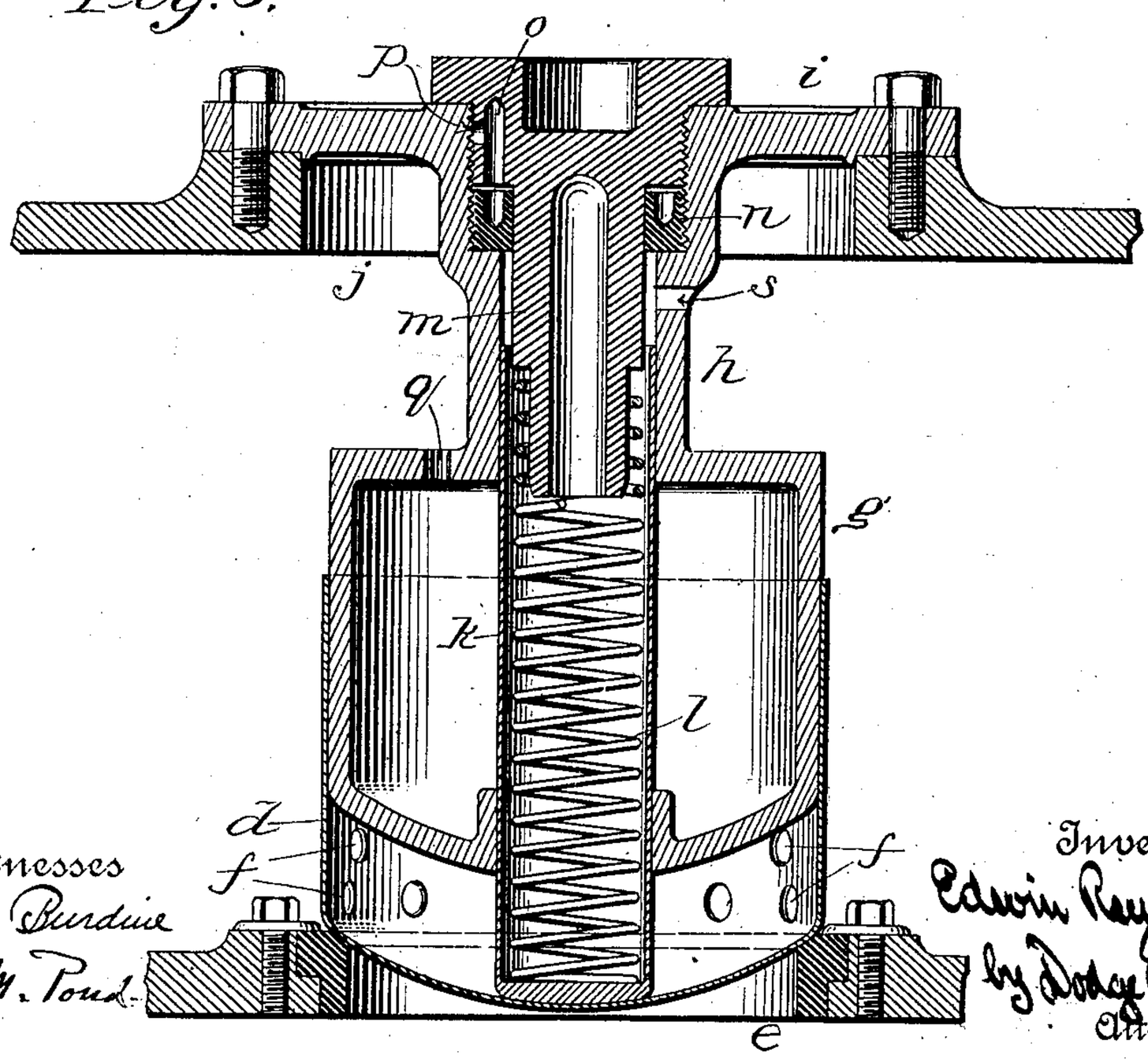


Fig. 3.



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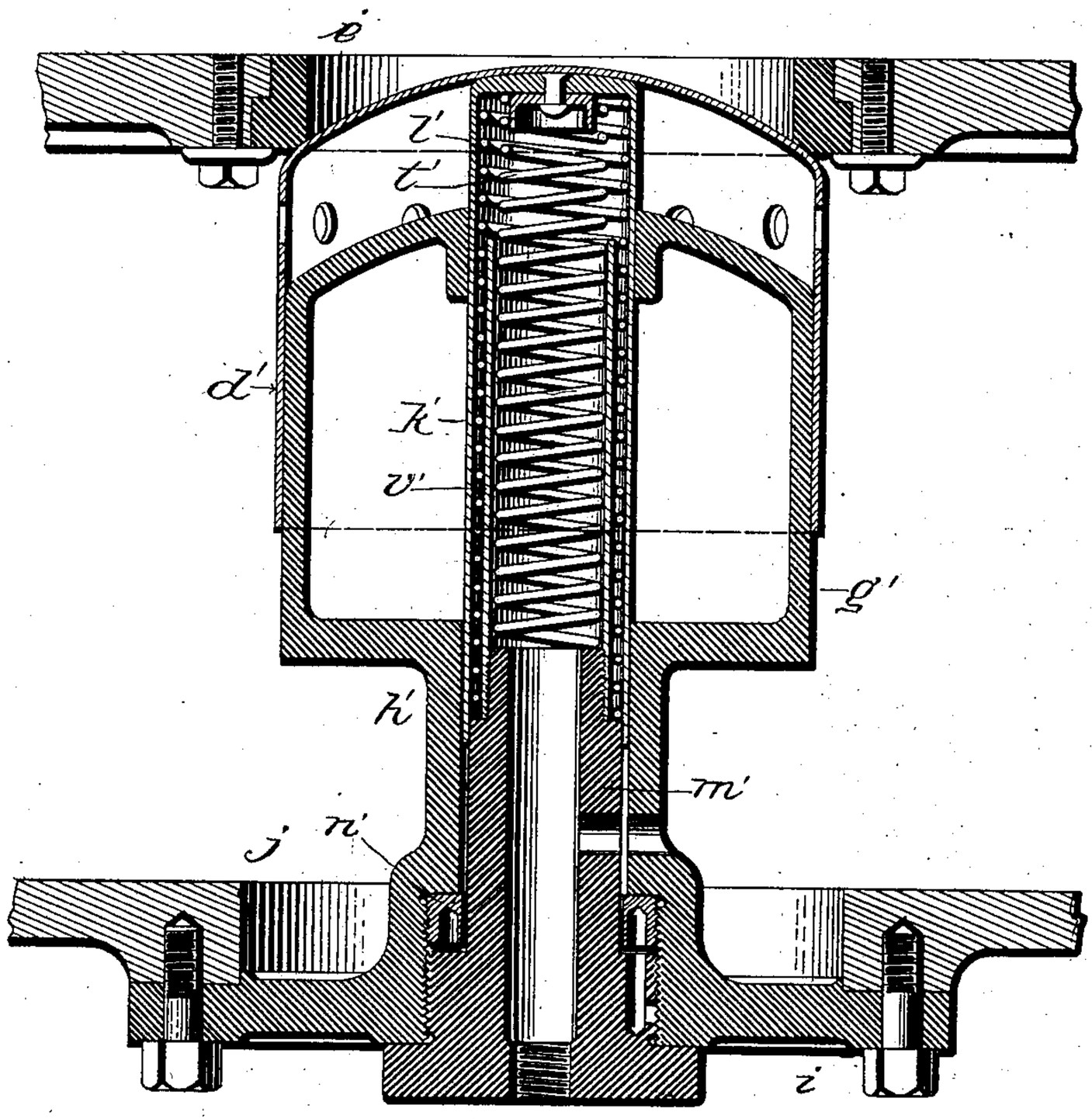
APPLICATION FILED SEPT. 19, 1898.

NO MODEL. 3 SHEETS—SHEET 3.

Fig. 4.



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No. 754,162. Patented March 8, 1904.

UNITED STATES PATENT OFFICE.

EDWIN REYNOLDS, OF MILWAUKEE, WISCONSIN.

BLOWING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 754,162, dated March 8, 1904.

Application filed September 19, 1898. Serial No. 691,364. (No model.)

To all whom it may concern:

Be it known that I, EDWIN REYNOLDS, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Blowing-Engines, of which the following is a specification.

My present invention pertains to improvements in blowing-engines, compressors, or pumps, and relates more particularly to the valves employed therein, all of which will be hereinafter set forth, reference being had to the accompanying drawings, in which—

Figure 1 is a longitudinal sectional view of one of the cylinders with its piston-head and valve mechanism. Fig. 2 is a plan view of the cylinder; Fig. 3, an enlarged detail view of one form of the exhaust-valves, and Fig. 4 a similar view showing a slightly-modified construction.

The invention has for its object to provide an inlet-valve in which all clearance, necessary with many other types of induction-valves, is done away with; to secure perfect balance of the valve when in operation, enabling the valve to be operated without any other strain on the valve mechanism than that due to the weight and friction of the valve parts, and ability to take up lost motion, necessary with all forms of valves which are required to make a complete stroke while the main piston is making half a stroke, and this without the use of wrist-plates, telescoping rods, springs, dash-pots, and the like.

Other objects of the invention are to provide a discharge-valve having a graduated air-cushion between its standing piston and the movable portion of the valve, to form a cushion between the removable plug of the valve and the tube containing the spring for actuating the valve, to provide a construction in which the spring is readily accessible by simply removing one plug or cap, and the centralization of the cup-shaped valve over its seat by means of the standing piston.

Referring to the drawings, A denotes the cylinder proper, and B the piston working therein.

C designates the upper cylinder-head provided with a chamber D, which is preferably in communication with the atmosphere outside of the building through an opening E and suitable pipes connected therewith. Said chamber D communicates with the ports formed in the valve-seat or guide F of the upper induction-valve. Said valve, as will be seen upon reference to Fig. 1, is circular in form and has a series of openings or ports G formed intermediate its solid head H and the upper cylindrical portion I. A suitable packing-ring or gland J is placed in the cylinder-head and bears against the outer face of the valve, so that when said valve is closed the head H will form a tight fit or junction with the cylinder-head and prevent any escape of air therefrom.

Pivotally connected to the head H of the valve is a link K, which extends up through an opening in the plate L, mounted upon the cylinder-head over the valve-opening or way, the upper end of the link K being pivoted to the outer end of an arm or lever M, secured upon a shaft N, journaled in suitable bearings O upon the cylinder-head. Formed integral with said lever M is a weighted arm P, the said arm being situated upon the opposite side of shaft N from the arm M, as indicated in Figs. 1 and 2, the tendency of the weight being to elevate the valve or keep it in its closed position. It is manifest that instead of employing the weighted arm P springs may be used to draw the valves to their seats. Secured upon the opposite end of said shaft N is a cam-seat Q, and secured upon a shaft R, mounted in a suitable standard S, is a lever T, having a cam or cam-toe U, designed to act upon the cam-seat Q. The outer end of the lever T is connected by a rod to a similar lever T′, secured upon a shaft R′, journaled in a suitable standard S′, mounted upon the lower head V of the cylinder. Said lever T′ is provided with a cam or cam-toe U′, which acts upon a cam-seat Q′, mounted upon one end of a shaft N′. Said shaft has secured to it an arm M′, which in turn is connected to a link K′, said link being connected to the head H′ of the lower induction-valve.

The lower induction-valve is of the same form or type as the upper valve; but instead of employing a plate L to entirely close the

opening in the head I simply provide a ring W to prevent the withdrawal of the valve from its seat or the blowing out of the valve. By thus leaving the interior of the valve open to the atmosphere the air which is drawn in through said valve will be taken from the room or building in which the engine is located, while, as above stated, the air entered through the upper valve will come from outdoors. This construction, however, is not essential, but optional. The air may be admitted to the lower valve in the same manner as the upper one, and vice versa, without affecting the operation of the same.

The lever T′ is connected to an eccentric or other suitable device and transmits the motion to the upper and lower valves through the cams and rod, as above described.

In Fig. 1 the piston is shown at its mid-stroke, with the upper induction-valve having a full port, being carried to this position by the cam U and lever M, the lower induction-valve being closed and held in position by the pressure of the air and its own weight, the cam U′ traveling away from the cam-seat, the lever M′ remaining stationary, and thus losing the motion of half of the stroke. Upon the upward movement of the piston-head B the operation will be reversed, the lower induction-valve opening when the piston-head commences its upward movement, and the proportion of the cams is made so that the speed of the valve travel gives practically the same ratio of port opening to piston displacement during the entire stroke. The upper induction-valve will meanwhile have been closed through the agency of the weighted arm P′. The closure of the upper induction-valve takes place as the piston-head B begins the last portion of its downward stroke, so that when the piston-head begins its upstroke said upper induction-valve will be entirely closed and any escape of air from above the piston-head must be through the eduction or exhaust valves, which will now be described.

A series of ports or openings *a* are provided in each of the cylinder-heads and communicate with a chamber or recess *b*, having a common exit *c*. Within the chamber *b* and over each of the ports *a* is mounted a discharge-valve, preferably of the form shown in detail in Fig. 3.

The valve proper comprises a cup-shaped shell *d*, provided with a rounded head which fits or bears upon the valve-seat *e*, as shown in Fig. 3. Said shell is provided with a series of openings *f*, formed near its lower end, the body of the shell being of such interior diameter as to make a mechanical fit upon the fixed standing piston or head *g*. Said head or piston is hollow, and extending from its upper face is a stem *h*, terminating in a plate *i*, which fits over and closes an opening *j*, formed in the outer face of the cylinder-head. Said opening *j* is of such diameter as to permit the insertion of the head *g*, the valve *d*, and the seat *e* therethrough. The stem *h* is made hollow, and an opening is formed in the curved or rounded lower end of the head *g*, and mounted in said stem and extending through said opening is a tube *k*. The lower end of the tube *k* is closed and bears against the inner face of the head of the shell *d*, and to hold said tube against the head I employ a spring *l*, the upper end of which surrounds the reduced lower end of a plug *m*. This plug is screwed into an opening formed in the plate *i*, while beneath it is secured a collar or ring *n*. The plug *m* is provided with an opening *o*, into which from the outside of the plug extends a lateral opening *p*. The object of these openings is to provide means for relieving the pressure on the under side of the plug when the stem is being removed for the purpose of making repairs to the valve.

It will be seen that should the spring break, necessitating its replacement, all that it will be necessary to do will be to remove the plug *m*, whereupon tube *k* will be forced up against the lower face of the ring *n* by the receiver-pressure, thereby practically closing any exit that the air might have through the valve to the atmosphere.

Upon reference to Fig. 3 it will be seen that normally the tube *k* in the position shown is balanced against the pressure by the air entering the port *s* and the opening *f*. However, when the plug *m* is loosened, so as to release the pressure of the spring, the next piston-stroke will, through the cylinder-pressure, force the valve and the tube *k* up until the opening *s* is covered. Thereupon if the spring-pressure be removed the tube *k* will remain in its elevated position, closing the aperture *s* and being held in such position by the receiver-pressure.

By having the valves so arranged that repairs can be made to the parts without permitting the air to escape it will not be necessary to stop the engine.

The standing piston or head *g* is provided on its upper face with an opening *q* for the purpose of admitting air under receiver-pressure to the interior thereof, thereby insuring like pressure upon the tube *k* throughout its length. An opening *s* in the stem *h* is provided, so that the interior of the tube *k* is in direct communication with the receiver-pressure.

In the operation of the eduction-valve the spring tends to hold the valve to its seat until the pressure formed in the cylinder in advance of the piston-head slightly exceeds that contained in the receiver, when the compressed air in the cylinder will force the valve-cup *d* off its seat, compressing the spring. The air contained within the shell beneath the head *q* will also be compressed, the air escaping through the openings *f* until the valve is nearly raised to its highest posi-

tion. It will of course be seen that after a certain degree of pressure is obtained in the receiver the springs in the upper valves could be dispensed with, they being necessary only when there is little or no pressure in the receiver to properly return the valves to their seats.

In the lower cylinder-head I use discharge-valves constructed as shown in Fig 4. The cup-valve b', the standing piston g', the tube k', and the ring n' are made in all respects and for the same purpose as the corresponding parts in the upper valve as described; but for reasons given below I prefer to use two springs l' and t' and two tubes k' and v' in the lower valves. The tube k' is mounted in the stem h' and extends through the lower end of head g', bearing against the inner face of the head of the shell or cup d'. The spring l' holds the said tube against the face of the head or shell d', and its other end has its bearing against the plug m'. The lower end of plug m' is turned down and the tube v' screwed or fastened thereon. The tube v' extends downward within the tube k' to form a casing for the spring t', the length of said tube being governed by the travel of the valve d'. Within the tube v' I place the spring t', one end of which bears against the inner face of the head of tube k' and the other end against the end of plug m'.

The strength of the springs l' and t' are equal and each is equal to the strength of the spring l', Fig. 3. In operation we have the following working conditions: Tending to close the upper valve is the combined weight of the valve d, the shell k, and the spring l. Should the spring l break, the valve would still continue to operate in a satisfactory manner, as the weight would act in closing it.

Tending to close the lower valve we have the combined strength of the two springs l' and t'; tending to prevent its closing we have the weight of the parts. In case of one of the springs l' and t' breaking the valve would continue to operate in a satisfactory manner, as the remaining spring has sufficient strength to raise the valve and parts so that the former will seat. In case only one spring is employed and same breaks the valve would remain open and the compressed air would escape back to the cylinder, and hence through the induction-valve, necessitating shutting down the engine at once, whereas with my invention the engine can continue running until such time as it is convenient to replace the broken spring.

It will be understood that the induction-valve may be used in conjunction with any other form of exhaust or eduction valve and that likewise the particular types of exhaust or eduction valves may be used with any other form of induction-valve, and I do not, therefore, desire to limit myself to the conjunction of these two particular types.

While I have shown the invention as applied to a vertical engine, still it is manifest that by changing the position of the weights or springs for closing the valves and applying the same to the induction-valves at both ends of the cylinder the invention could be used upon an engine of a horizontal type.

Having thus described my invention, what I claim is—

1. In combination with a chambered cylinder-head, a valve-seat formed thereon; a fixed stem extending down toward said seat; a valve mounted and movable upon said stem toward and from the seat; a tube mounted within the stem and bearing upon the inner face of the valve at one end; a plug fitting within the upper end of the stem; and a spring interposed between the lower closed end of the tube and the lower end of the plug.

2. In combination with a chambered cylinder-head, a valve-seat formed thereon; a fixed stem extending down toward said seat; a valve mounted and movable upon said stem toward and from said seat; a tube fitting within the stem and bearing at its lower end upon the inner face of the valve; a plug fitting within the upper end of the stem; a spring interposed between the lower closed end of the tube and the lower end of the plug; and a ring or collar n, also mounted within the stem and projecting out in line with the upper end of the tube.

3. In combination with a chambered cylinder-head, a valve-seat formed thereon; a fixed stem extending down toward said seat and provided with an enlarged head; a valve d movably mounted upon said head and provided with a series of openings f; a tube k fitting within said head and extending through and bearing upon the inner face of the valve; a plug m fitting within the upper end of the stem; a ring or collar n also fitting within the stem and extending out in line with the upper end of the tube; a spring bearing against the lower end of the plug and tending to force the tube down; and a vent formed in the plug, substantially as and for the purpose described.

4. In combination with a chambered cylinder-head, a valve-seat formed in one wall thereof; a fixed support extending from the opposite wall toward the valve-seat; a valve mounted upon said support; means located in the interior of said support for forcing the valve down to its seat; means for affording access to said forcing means; and means for closing the opening formed by the removal of the parts in securing said access, against escape of air from the chambered cylinder-head.

5. In combination with a chambered cylinder-head, a valve-seat formed in one wall thereof; a fixed support, comprising the hollow cylindrical head g, stem h and plate i; a cup-shaped valve d mounted upon said head g; a tube k extending through the lower end of the head and bearing upon the inner face of

the valve, the upper end of the tube extending into the hollow portion *h;* a plug *m* secured in the plate *i* and extending down into the tube *k;* a spring bearing against the lower end of the plug and the lower closed end of the tube; a collar or ring *n* fitting within the tubular portion *h* and extending out in line with the upper end of the tube *k;* and an opening *q* formed in the enlarged head *g*.

6. An exhaust-valve for air-compressors, comprising an annular head; a cup-shaped valve mounted thereon provided with openings *f;* a hollow tube mounted within the annular head and bearing at its closed end upon the inner face of the valve; a closure for the upper end of said tube when it is elevated; and a spring for forcing said tube down.

7. In a blowing-engine or compressor system, the combination of the cylinder; a moving piston; induction-valves having ports in their sides, and their inner ends closed; positive means for opening said valves; weighted arms or levers for closing said valves; means for arresting the valves when the closed ends are in the same plane as the inner face of the cylinder-head; and means for taking the thrust of the valves off the operating mechanism while the valves are in a state of rest, substantially as described.

8. In combination with a cylinder-head, a valve-seat formed thereon; a fixed stem extending toward said seat; a valve mounted and movable upon said stem toward and from the seat; a tube mounted within the stem and bearing upon the inner face of the valve at one end; a plug fitting within the outer end of the stem; a shell or tube secured to the lower end of the plug and extending within the outer tube; a spring interposed between the closed end of the outer tube and the inner end of the plug; and a second spring fitting within the inner tube and bearing at one end against the closed end of the outer tube.

In witness whereof I hereunto set my hand in the presence of two witnesses.

EDWIN REYNOLDS.

Witnesses:
CYRUS ROBINSON,
W. E. DODGE.