No. 713,687. Patented Nov. 18, 1902.

C. ROBINSON.

BLOWING ENGINE.

(Application filed Oct. 19, 1899.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

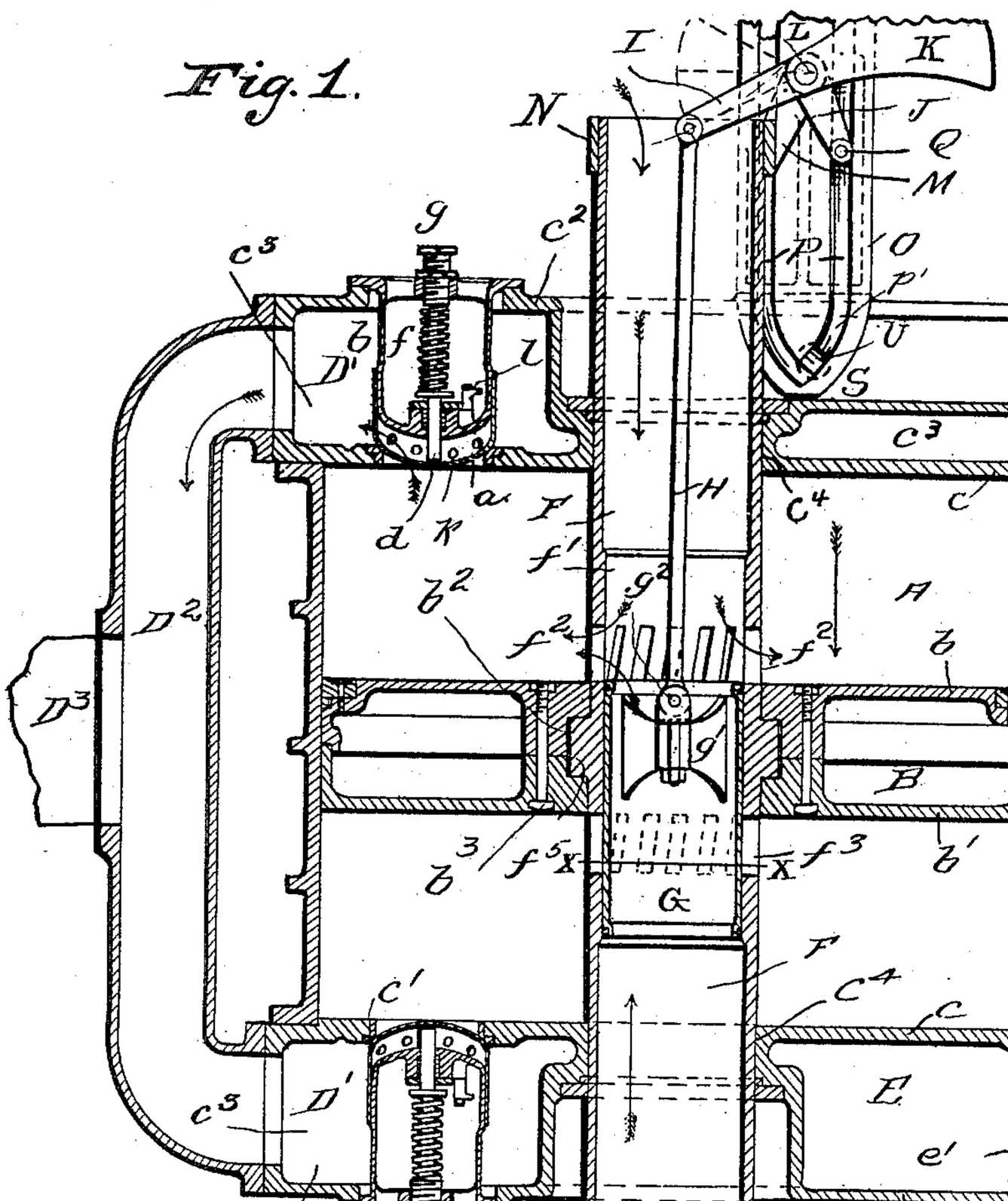

Fig. 10

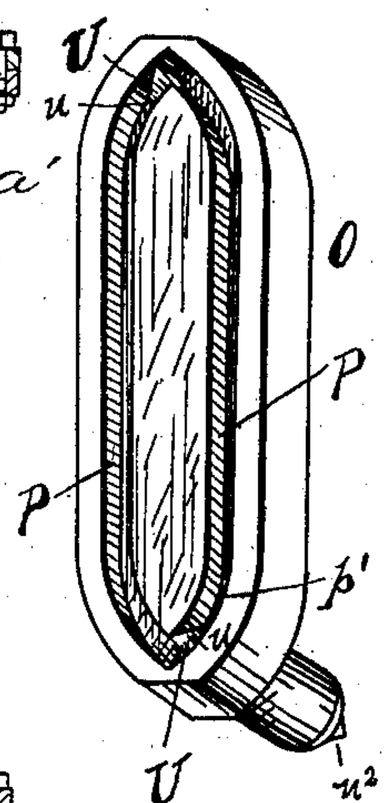

Fig. 7.

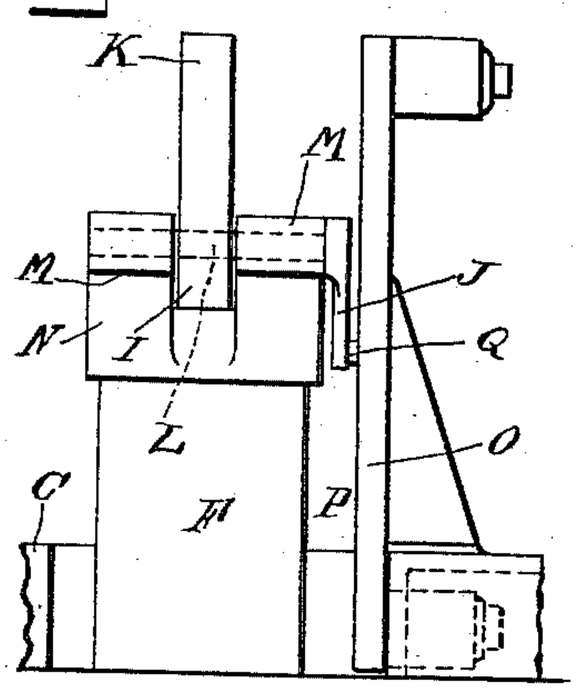

Fig. 6.

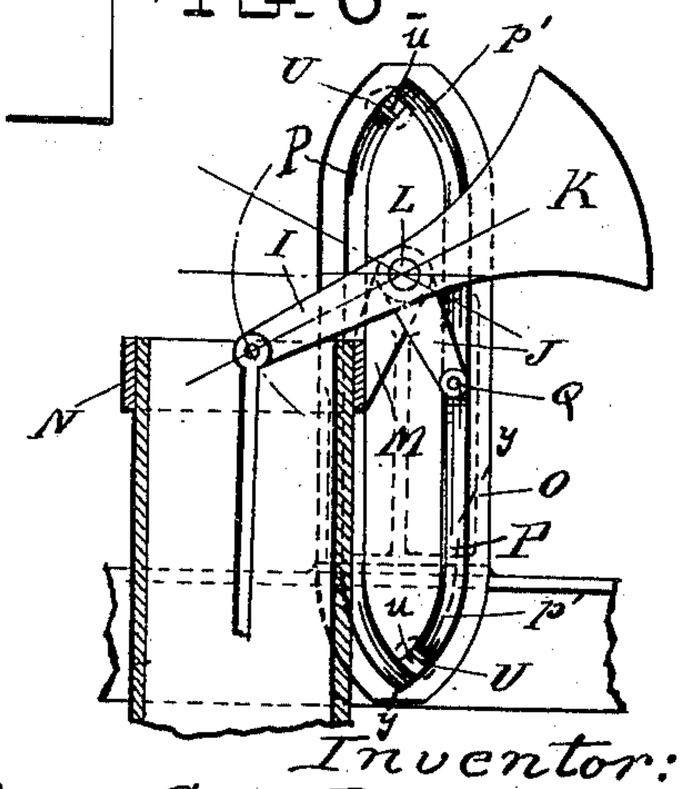

Fig. 11

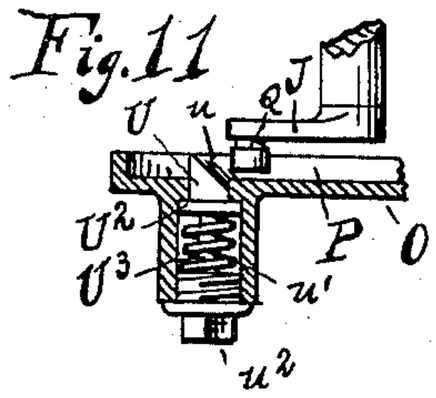

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Fig. 2.

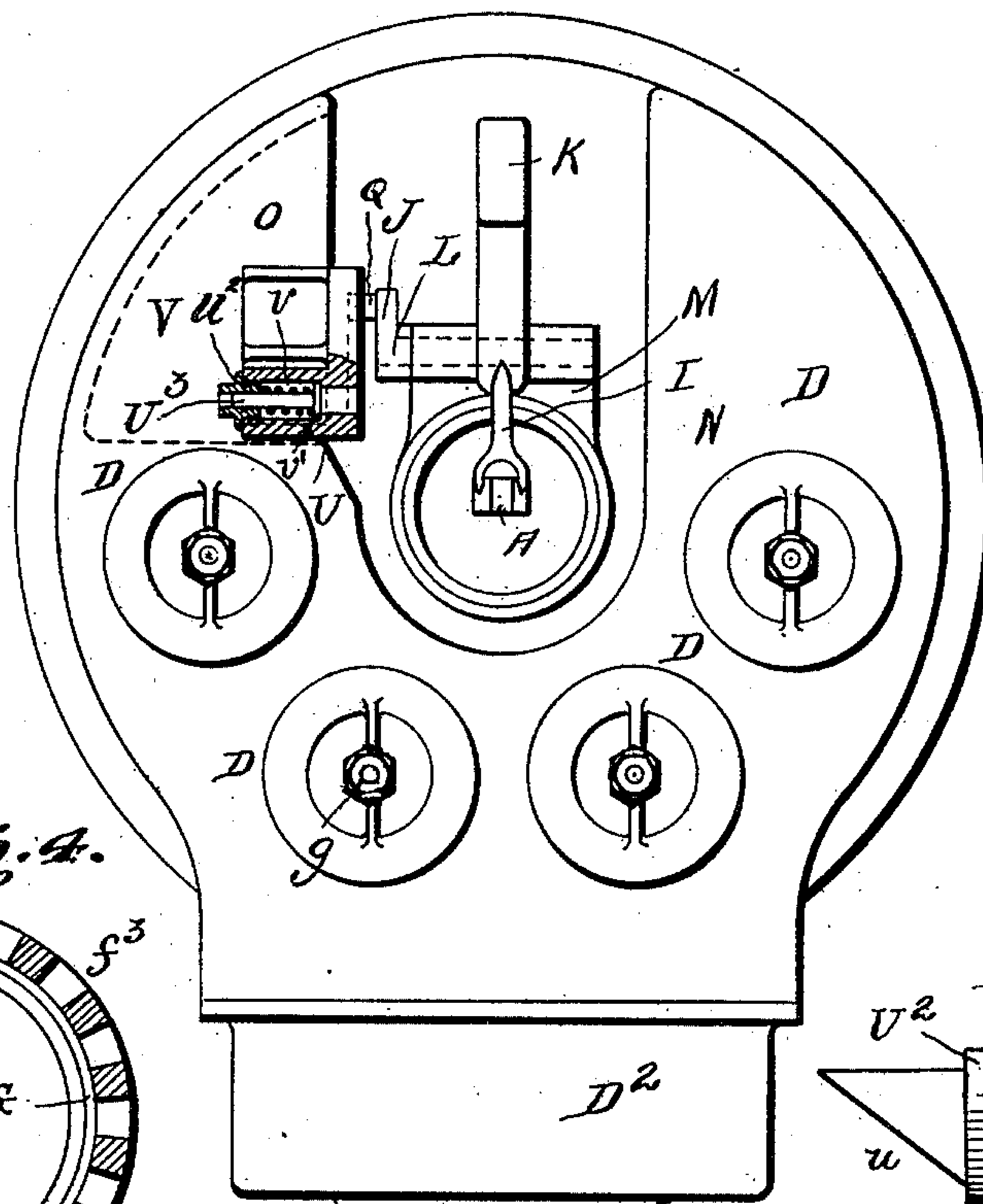


Fig. 4.

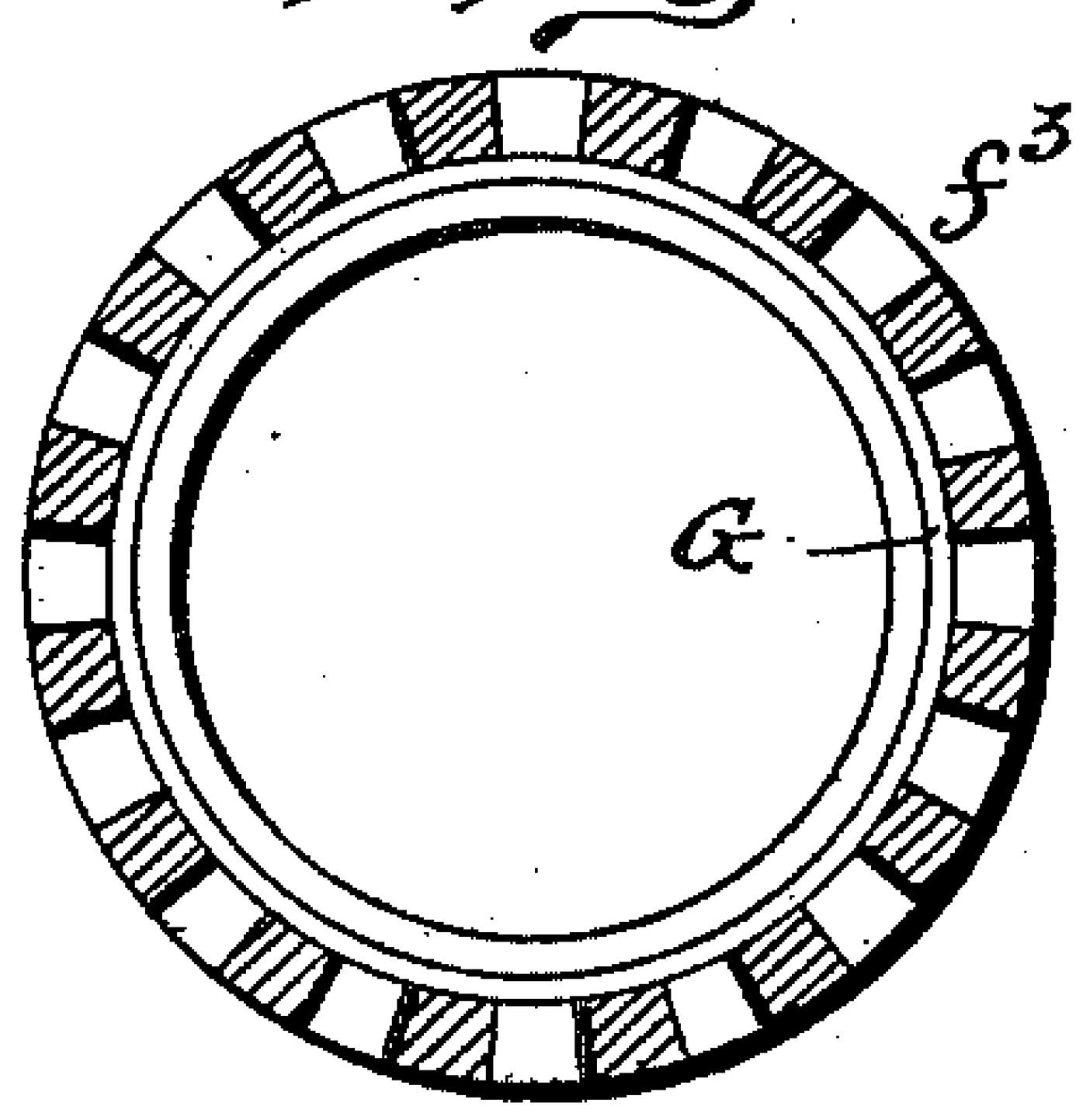


Fig. 5

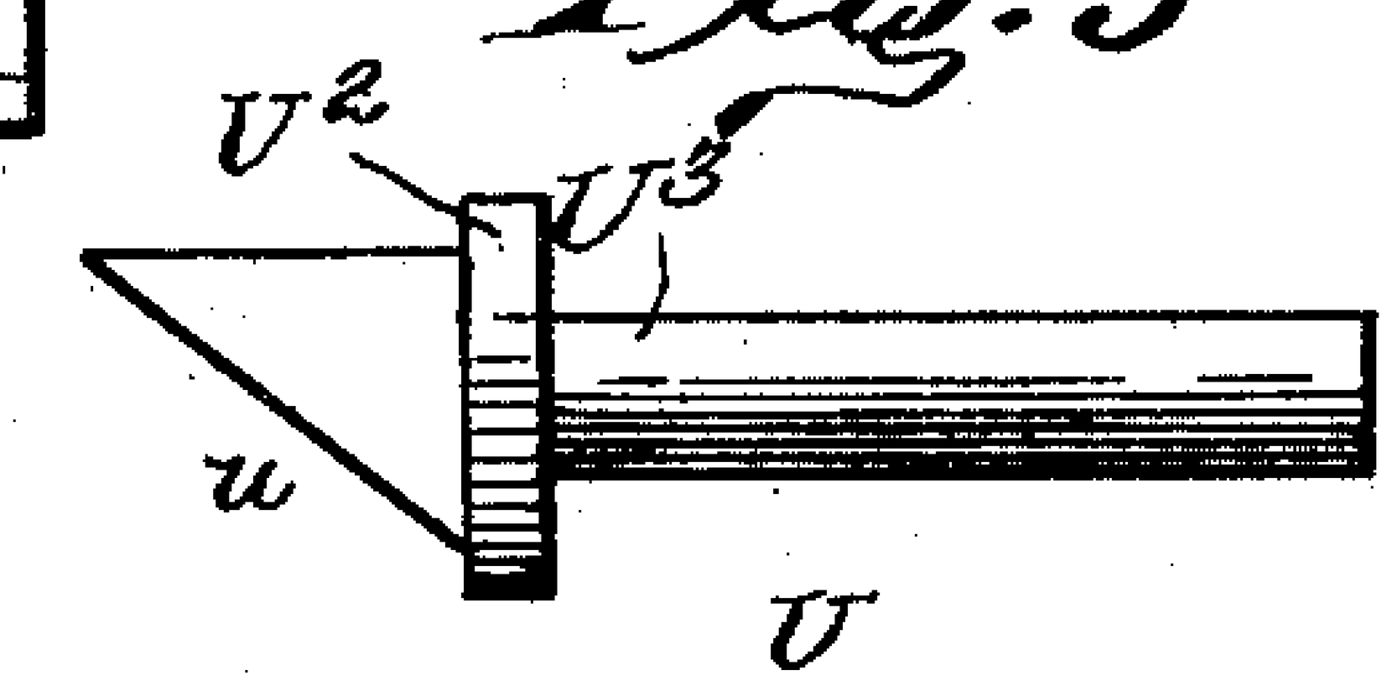
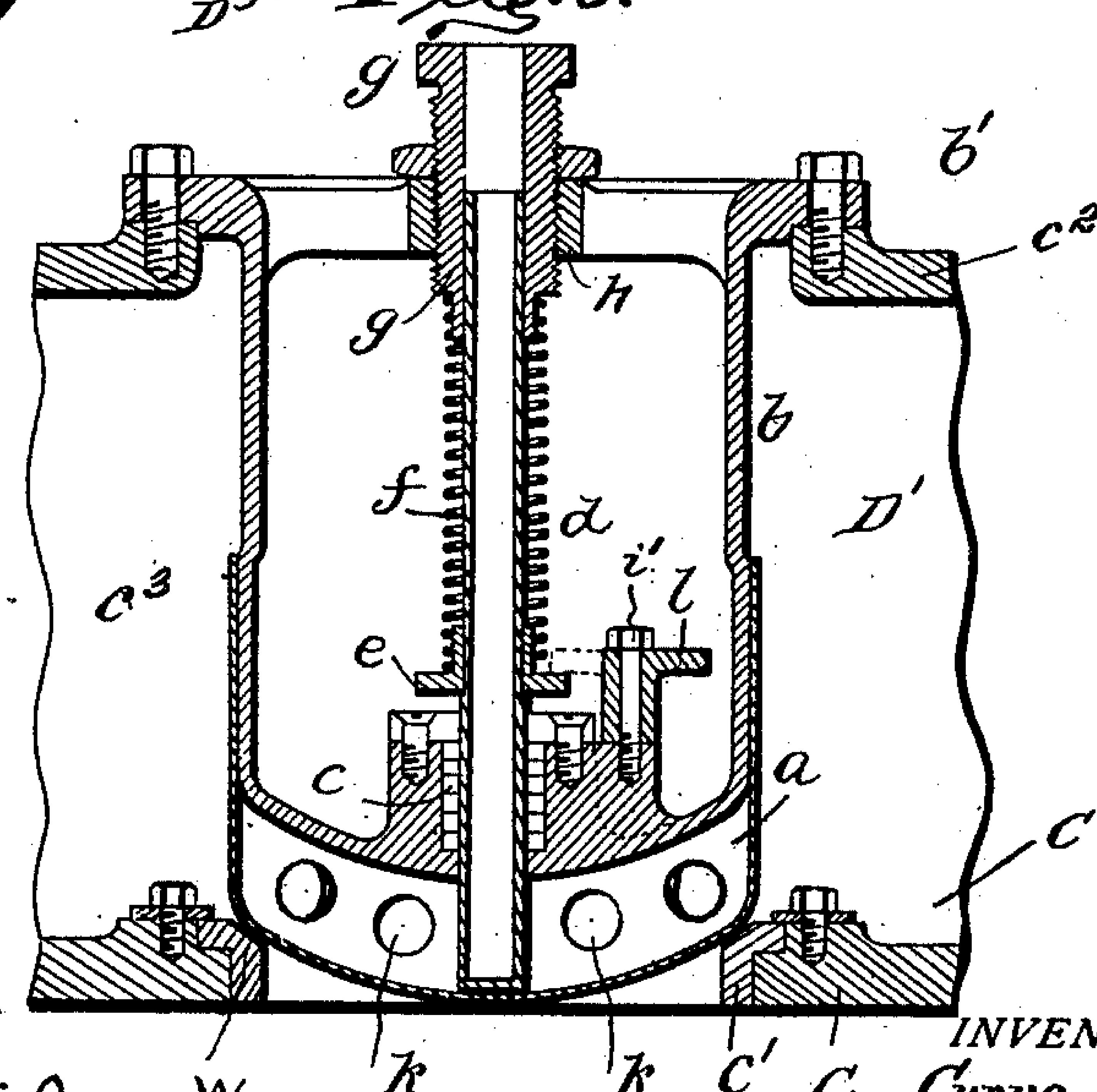


Fig. 3.



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(No Model.) 3 Sheets—Sheet 3.

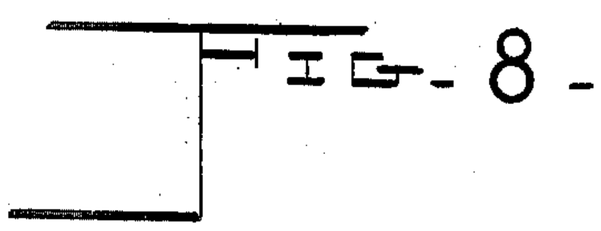

FIG. 8.

FIG. 9.

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UNITED STATES PATENT OFFICE.

CYRUS ROBINSON, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO THE WESTINGHOUSE MACHINE COMPANY, OF PITTSBURG, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

BLOWING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 713,687, dated November 18, 1902.

Application filed October 19, 1899. Serial No. 734,114. (No model.)

To all whom it may concern:

Be it known that I, CYRUS ROBINSON, a subject of the Queen of Great Britain, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Blowing-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

My present invention has for its principal objects to improve the construction and operation of the outlet-valves of blowing-engines and to render more accurate and effective the means for operating the inlet-valve within the hollow reciprocating piston-rod.

In order to make the invention more clearly understood, I have shown in the accompanying drawings means for carrying the same into practical effect without limiting my improvements in their useful applications to the particular constructions which for the sake of illustration I have delineated.

In said drawings, Figure 1 is a central section of a mechanism embodying my invention, the parts shown including the cylinder and piston-valve and piston-rod and the inlet and discharge valve mechanism. Fig. 2 is an end view of the parts in Fig. 1. Fig. 3 is a section, on a larger scale, of one of the discharge-valves. Fig. 4 is a cross-section on the line $x\,x$ of Fig. 1. Fig. 5 is a side view of one of the movable parts of the guide that controls the piston-valve. Fig. 6 is a sectional view showing the guide and the parts fitted therein which control the positions of the piston. Fig. 7 is a view of the parts in Fig. 6, shown at right angles thereto. Fig. 8 is a view, partly in side elevation and partly in section, illustrating a modification of the valve-guiding mechanism. Fig. 9 shows the parts in Fig. 8 when looked at from another direction. Fig. 10 is a perspective view of the cam detached. Fig. 11 is a cross-section on the line $y\,y$ of Fig. 6.

In the drawings, A indicates the cylinder, which may be of any usual or preferred sort as concerns its details. Within the cylinder there is a piston B, which also may be constructed in any preferred way, although I prefer to have it substantially as shown—that is to say, to have it formed in two parts b and b', which constitute halves separable about centrally on a plane transverse to the axis of the cylinder, shaped to have annular grooves or recesses b^2 at their centers, which when the two parts $b\ b'$ are put together provide a groove or annular recess, in which can be fitted a flange f^5 on the piston-rod. At the periphery the piston can, if required, be provided with a packing of any suitable sort. The two halves are joined together by bolts b^3. The upper or lower heads of the cylinder are respectively indicated by C and E. These also in many respects may be similar to those that are well known or can be constructed in any preferred way so long as they are adapted to meet the requirements of my construction. As shown, each has a wall c at the end of the cylinder-chamber, perforated to receive the valve-seats c', and an outer wall c^2, there being preferably between the walls c and c^2 a space or chamber c^3.

F indicates the part which serves the purpose of a piston-rod and also of a valve-chamber. It is hollow and fitted to the heads C and E, the latter having central apertures at c^4, provided with packings or glands, if required. At f^5 this hollow piston-rod has an outwardly-extending annular flange fitted in the aforesaid groove or recess b^2 in the two-part piston. At points immediately adjacent to the piston, both above and below it, there are ports, as at $f^2\,f^3$, of any suitable number, preferably a relatively large number, preferably formed as inclined slots through the hollow rod.

I will herein refer more particularly to a compressor or compressor-engine, and the parts already referred to may be considered as constituting parts of such a mechanism. When the piston and cylinder above set forth are to be used for compressing air, for instance, the piston can be connected to the piston-rod of an engine by a suitable connection, such as shown at I'.

Within the hollow piston-rod F there is fitted the valve G, which is also tubular and of a suitable length, such as that shown. This can have a motion longitudinally of and independently of the piston-rod. With these

parts are combined others, such that when the piston B and the hollow rod F are moving in either direction the ports f^2 or f^3 in front of the piston are closed and those in the rear thereof are opened. Such closing and opening of the ports is effected by the proper movement of the valve G. The movements of the valve are accomplished as follows:

H is a rod pivotally connected at g^2 to the valve G. At its upper end the rod is connected to a lever I, which in turn is connected to a lever J, pivoted by means of a shaft L, mounted in bearing-ears M M, secured to the upper end of the hollow piston-rod F. The lever I extends to points beyond the axis at L and is weighted, preferably by having cast integral with it a weight K, which serves to counterbalance the lever I, the rod H, and the valve G. If preferred, the lugs or ears M M can be formed integral with a sleeve or collar N, which can be secured to the hollow piston-rod.

The lever J carries a laterally-projecting crank or pin at Q, preferably provided with an antifriction-roller. This is fitted and travels in a way or groove P in the cam O, this cam and its groove being such as to impart to the levers J and I and the valve G, connected thereto, the movements that are required for the latter. As the piston descends in the direction of the arrows in Fig. 1 the roller Q approaches the part p' of the cam-groove and travels through this part until it impinges on the stop-pin U. The latter is formed with a head U^2 having a beveled or inclined edge u, and with a stem or shank U^3. It is arranged in such manner that it can move longitudinally transverse to the cam-groove. The head part u^2 is somewhat larger than the shank or stem U^3, and a spring u' is placed around the latter, said spring bearing in one direction against the head U^2 and in the other direction against a stop-nut u^2, through which the stem or shank can fit. When the roller Q strikes the beveled face u, as aforesaid, it forces the stop U outward against the tension of the spring u'. When the roller reaches the end of the cam-groove P, the stop U is forced inward immediately behind the roller and the latter is prevented from returning along that part of the cam-groove through which it has just moved and is compelled to move along the opposite part. For instance, when the roller reaches the bottom of the cam-groove (moving in the direction of the arrows shown in Fig. 1) the stop U after the roller has passed it prevents the latter from moving backward through the same part of the groove and compels it to move upward through the opposite part. In doing so the roller takes a pathway differently related to the axis of the shaft L, and consequently the lever I is thrown in the opposite direction from that illustrated in Fig. 1, and as a result the rod H and the valve G are caused to occupy different positions as to the ports f^2 and f^3. When the roller Q reaches the upper part of its path, it impinges upon the upper stop U, constructed and arranged similarly to that above described, and after passing it is compelled to follow the right-hand part of its path when descending.

It will be seen that when the piston is descending the valve G is in such position that the ports f^2 above the piston are opened, while those below it are closed, and vice versa, and consequently the lower part of the cylinder below the piston is a closed chamber, wherein the air is compressed and driven past the valve D', the ports above the piston being at the same time opened, so that air can enter the upper part of the cylinder; but as soon as the stroke of the driving-engine is reversed the position of the valve G is also reversed through the action of the roller Q and its cam-guideway—that is to say, the upper part of the cylinder becomes a closed chamber when the piston is moving outward, while the lower part is opened for the reception of air.

The valves by means of which the passage of the air from the cylinder is controlled are herein shown as being constructed as follows: a is a cup formed preferably of steel and fitted to and guided on a tubular guide b. The latter is hollow and formed with a boss or thickened portion at the inner end, which is perforated and provided with a metallic packing c. Through the latter passes a tubular rod or guide-bar d, which is arranged to bear against the inner face of the end of the valve proper, a. This guide d is at its outer end fitted into a guide-plug g, and around it there is placed a coiled spring f, which at its outer end bears against the plug g and at its inner end bears against a flange or stop-collar e, rigidly secured to the guide d. The plug g is of the nature of a hollow nut, which can be adjusted in or out to regulate the tension of the spring f.

When the pressure of the air within the cylinder A exceeds the pressure in the receiver, (with which communicate the chambers c^3 and the ducts D^2 and D^3,) the valve a is forced from its seat and the air discharged from the cylinder, and as the valve moves outward it presses the guide d also outward against the tension of spring f, and when the pressure falls again said spring, bearing against the collar e, again compels the guide d to force the valve a tightly against its seat.

Apertures k k are formed in the valve a at a suitable distance from the lower end of the latter, which apertures can be moved out to points beyond the ends of the tubular guide b, and as soon as they do pass beyond said end the escape of air from the interior of the valve is shut off; but a quantity thereof remains, which serves as a cushion for the valve and prevents the latter from striking against the end of the guide b.

It is sometimes necessary to throw a valve out of operation while the compressor is at work, and heretofore it has been necessary

to shut down the whole compressor in order to accomplish this whenever it is desired to renew the spring *f* or to make other similar changes. I have obviated this stoppage of the mechanism as follows: I employ a stop *l*, which can engage with the valve or with some of the parts connected thereto and prevent the valve being opened, although allowing the rest of the mechanism to continue in operation. The stop *l*, as shown, consists of an adjustable arm held by a pivot at *i'*, it being adapted to be turned into such position as to engage with the abutment-collar *e* on the guide rod or tube *d*. In Fig. 3 this adjustable stop is shown in full lines in its inactive position, while in dotted lines it is shown as engaging with and lying immediately outside of the stop-collar *e*. When it is in the latter position, it will be seen that the guide rod or tube *d* cannot move outward and that therefore the valve is held against opening. When the stops are in such position, the plug-nut *g* can be withdrawn entirely or as far as desired, and, if required, the spring *f* can be withdrawn and another put in place thereof, and while these steps are being taken the engine and compressor can continue in operation, for, as will be seen upon examining Fig. 2, there are several such valves at each end of the cylinder.

With respect to the inlet-valve G the following characteristic matters will be noted: First, I provide a valve which is perfectly balanced and so disposed as to require only such an amount of power as will overcome friction and inertia; second, I provide one which requires only a minimum clearance—to wit, a clearance of not more than one-half of one per cent. in cylinders of seven feet in diameter; third, I do away with the necessity of two piston-rods, which are commonly used with many types of valves in such mechanisms, and I centralize the strains directly with relation to the rod of the steam-engine piston, my construction as a result being much lighter and safer, and, still further, I obviate the necessity of eccentrics or similar devices for transmitting motion from the engine-shaft to the valve, such as are generally used for actuating positively-actuated inlet-valves.

Various means may be employed to actuate or shift the valve G. In place of the mechanism for this purpose shown in Fig. 1 I may employ that illustrated in Figs. 8 and 9, in which the valve-actuating lever I and shaft L are connected by an arm 1 with a wheel or crank 2. Said arm is keyed on the shaft L, so as to be capable of oscillating it, and is jointed at its other end with the wheel 2 by a wrist-pin 3. The wheel is mounted so as to rotate on a shaft or stud 4, fixed or mounted on the body of the engine-cylinder or cylinder-head, and when it is necessary it is driven or is given a tendency to turn in the proper direction by a wire rope 5 or other suitable device from the engine-shaft. The wheel 2 is so designed and arranged as to make one revolution for each complete throw of the piston-rod H, and preferably the radius of the pin 3 from the center shaft 4 is equal to that of the engine-crank. The actuation of the arm 1 by the piston-rod F will turn the wheel or crank 2; but the action of the connection 5 insures that the wheel shall turn past the lines on which the arm 1 will not be effective and shall continuously rotate in the same direction. It will be understood from the above description that as the piston-rod F reciprocates the parts I, L, and 1 travel with it, but the simultaneous rotation of the wheel 2 controls the position of the arm 1 and of the valve G, causing the latter to open the upper ports f^2 and close the lower ports f^3 as the piston moves downward and vice versa as it moves upward.

What I claim is—

1. In an air-compressor, the combination of a stationary cylinder, outlet-valves for controlling the escape of compressed air and adapted to yield to the air, springs for holding said valves closed against the pressure of the air, a piston adapted to reciprocate in said stationary cylinder, a piston-rod connected to said piston, power mechanism connected to the said piston-rod to drive it, said rod being provided with an air-duct, a valve in said air-duct, a lever for moving the said valve carried by and movable with the piston-rod, and means for moving said lever independently of the movement of the piston-rod, substantially as set forth.

2. In a blowing engine or compressor, the combination of a stationary cylinder, a reciprocating piston therein, valve-seats in the cylinder-wall, one or more on each side of the piston, spring-held valves in said seats, a piston-rod having an air-duct and having ports above and below the reciprocating piston, a driving-engine connected to the said piston-rod, a valve in the air-duct in the piston-rod, a lever connected to the valve, and pivotally connected to the piston-rod, and stationary devices for moving the lever around its fulcrum and moving the valve opposite to the movement of the piston, substantially as set forth.

3. In an air-compressor, the combination of the stationary cylinder, the spring-held outlet-valves in the wall of the cylinder, the reciprocating piston in the cylinder, the piston-rod connected to the piston and provided with an air-duct, and having ports above the piston and ports below it, a hollow balanced valve alternately closing and opening the upper and lower ports, a lever connected to the said valve and moving bodily with the piston, and devices held against longitudinal movement and engaging with the lever and causing the valve to reciprocate longitudinally of the piston-rod, substantially as set forth.

4. The combination of the stationary cylinder, the piston reciprocating in the cylinder, the piston-rod having an air-duct, and ports

above the cylinder and ports below it, a valve in the said air-duct for controlling said ports, an engine connected to the piston for driving it for compressing the air, a lever connected to the valve, and a stationary guide for the lever having a substantially rectilinear guideway, and two curved guideways at the ends of the rectilinear guideway, substantially as set forth.

5. In a compressing-engine, the combination with the cylinder having a valve-seat in its walls, of an outlet-valve engaging with the valve-seat at one end and having a hollow body portion extending backward from said end, the tubular guide fitted inside of the valve, the central guide-rod *d* bearing against the end of the valve, the collar *e* secured to the central guide-rod, and the spring bearing against said collar and against a stationary abutment, substantially as set forth.

6. The combination, with the cylinder, having a valve-port and valve-seat, of the valve mechanism comprising a hollow cup movable toward and from the valve-seat, a spring for holding the valve against the seat, and a positive lock for locking the valve against the seat, substantially as set forth.

7. The combination, with the cylinder, having a valve-port and a valve-seat, of the valve adapted to rest upon said seat, a spring arranged to normally tend to hold the valve against the seat, a removable holder for the spring, and means for positively locking the valve against the seat, when the spring is removed, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

CYRUS ROBINSON.

Witnesses:
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E. E. ARNOLD.