(No Model.) 3 Sheets—Sheet 1.

J. H. REYNOLDS.

AIR COMPRESSOR.

No. 572,372. Patented Dec. 1, 1896.

Fig. 1.

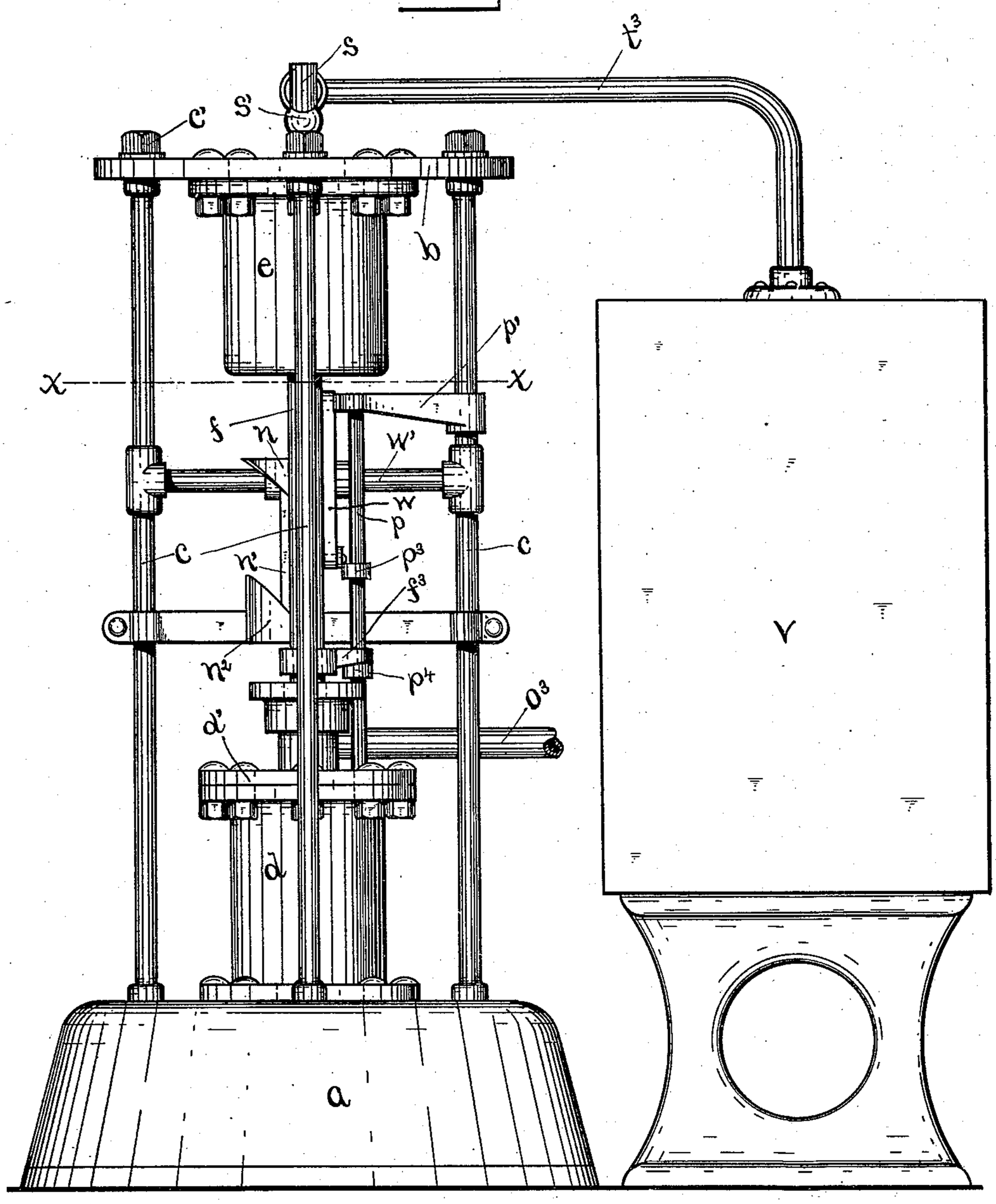

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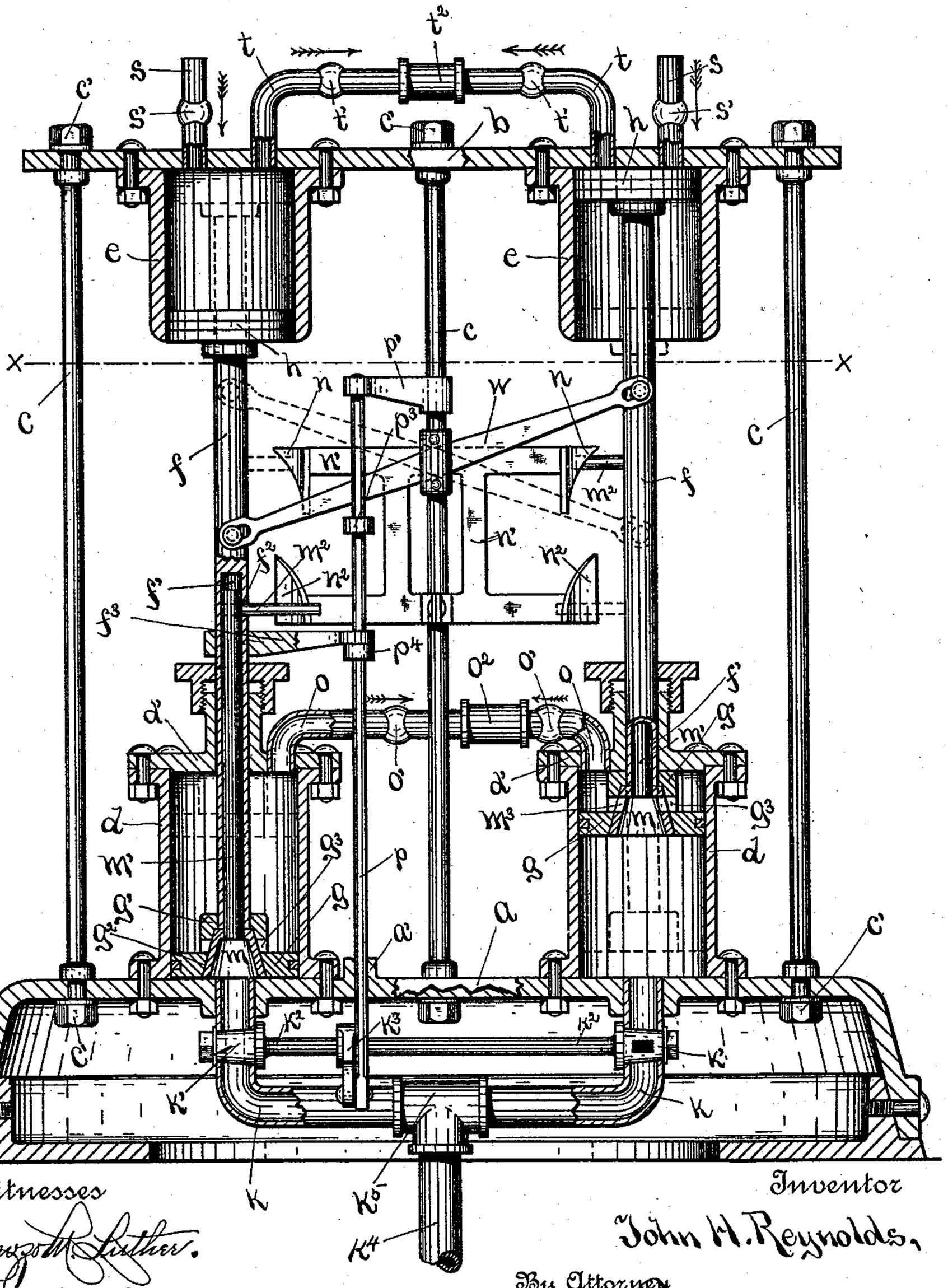
Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

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AIR COMPRESSOR.

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Fig. 3.

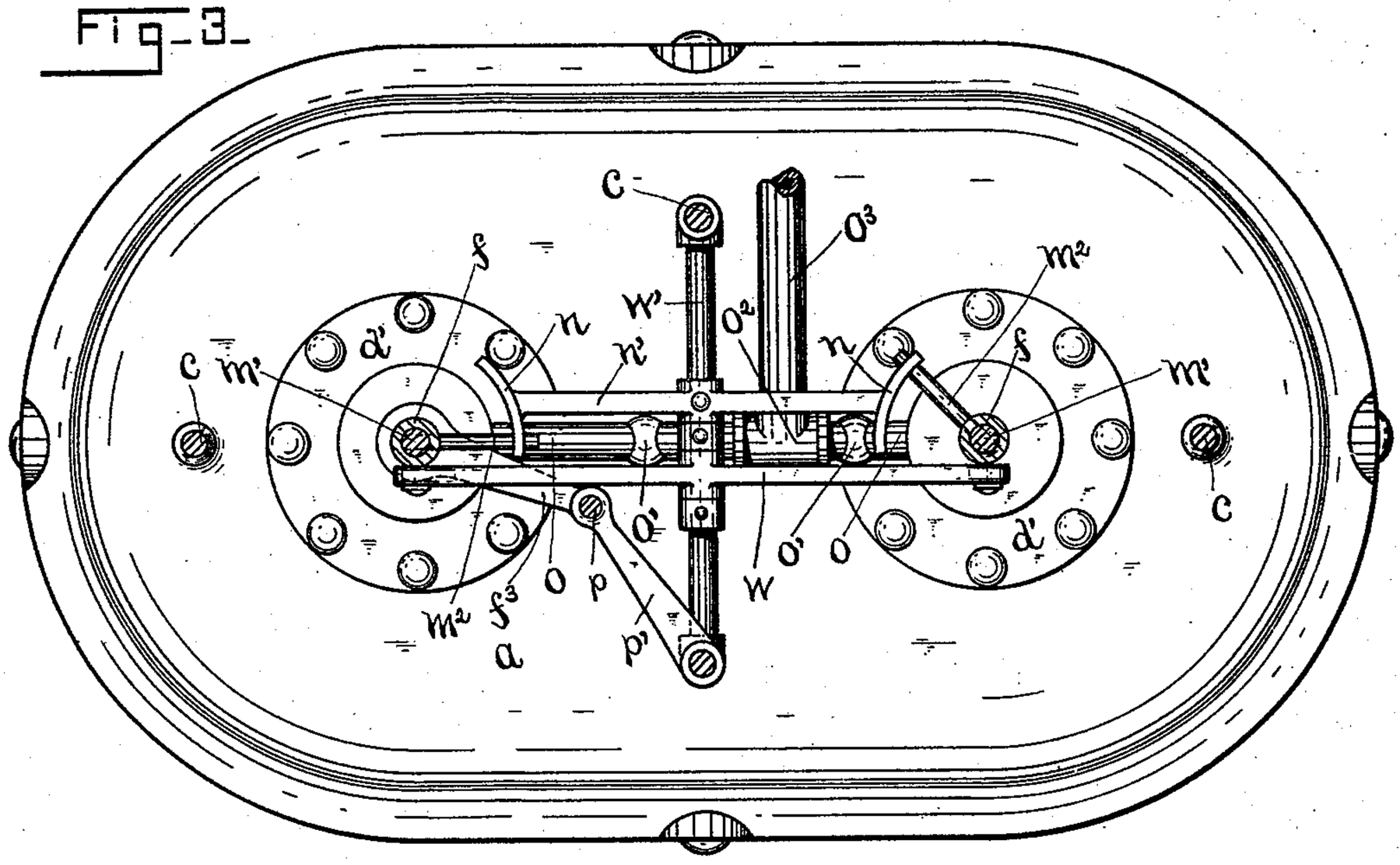


Fig. 4.

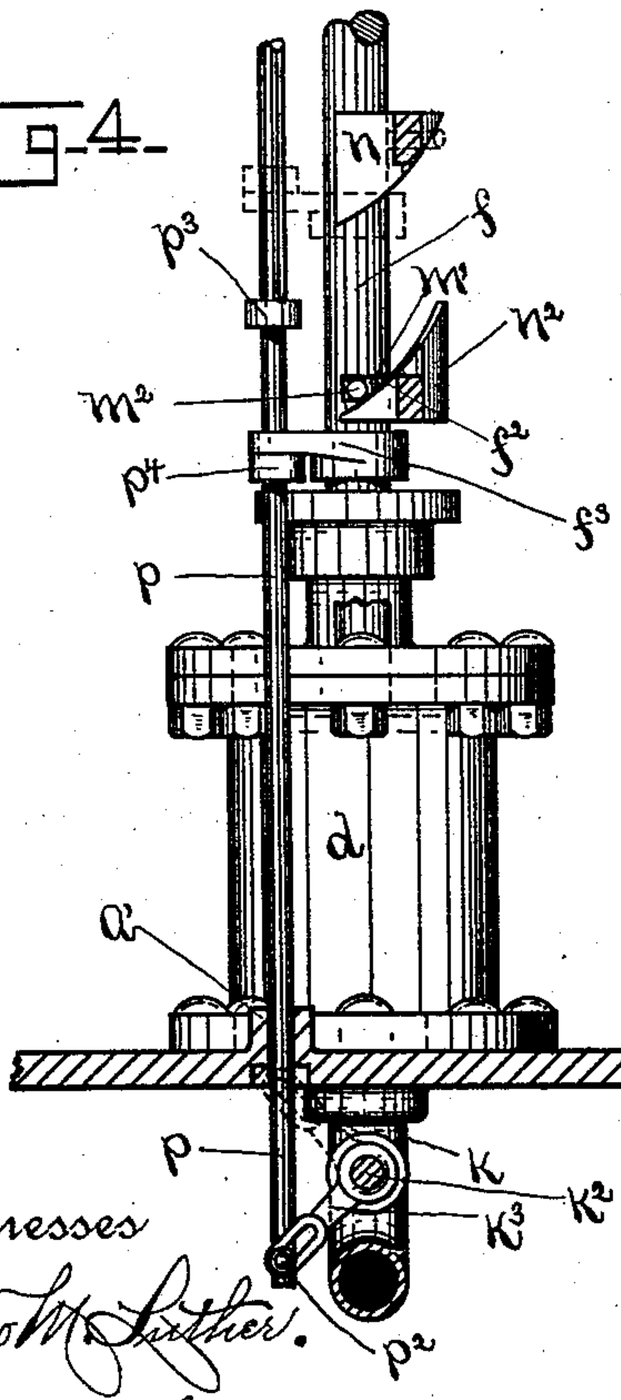


Fig. 5.

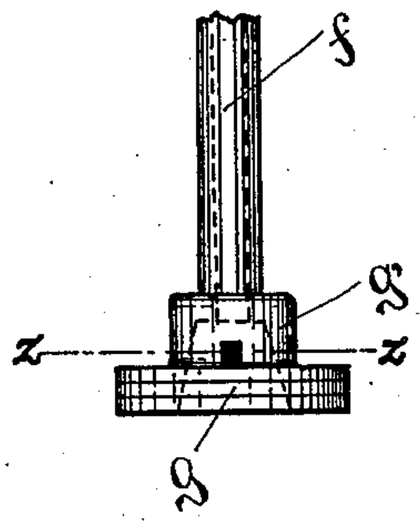


Fig. 6.

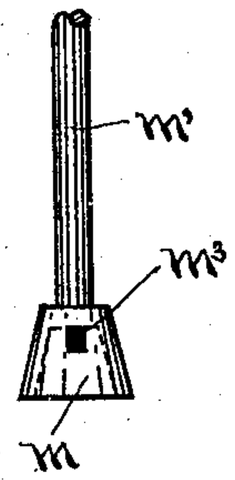


Fig. 7.

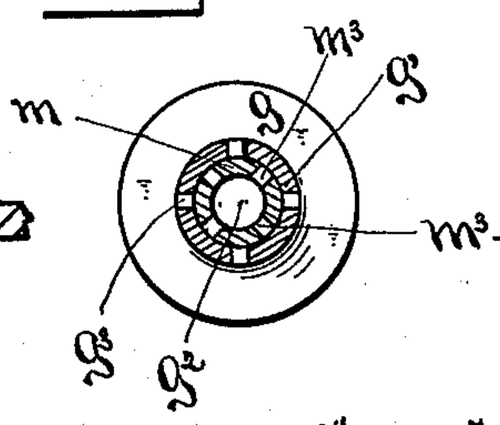
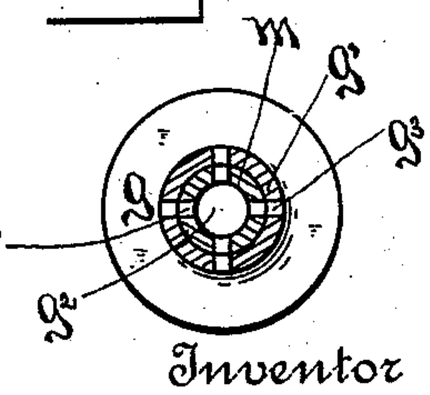


Fig. 8.



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UNITED STATES PATENT OFFICE.

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AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 572,372, dated December 1, 1896.

Application filed April 28, 1896. Serial No. 589,474. (No model.)

To all whom it may concern:

Be it known that I, JOHN H. REYNOLDS, a citizen of the United States, residing in the city and county of New London, and State of Connecticut, have invented certain new and useful Improvements in Air-Compressors, which improvements are fully set forth and described in the following specification, reference being had to the accompanying three sheets of drawings.

The immediate object of this invention is the production of a peculiar form of air-compressor, by means of which the force and flow of water, as distributed under high pressure in ordinary service-pipes, may be utilized, thus making it possible to accumulate and hold in reserve for power or refrigerating purposes a vast amount of energy that is now wasted.

My said apparatus is intended to be placed in a line of water-pipe in such manner that whenever a faucet or valve is opened at the delivery end of the pipe the flow of water therethrough will serve automatically to start said appartus into action, causing it to compress a certain quantity of air and force the same into a receiver, from which it may be used as needed.

To aid in explaining my newly-invented apparatus, I have provided the annexed drawings, in which—

Figure 1 is a side elevation of said apparatus, and Fig. 2 shows, principally in vertical section, the air-compressing mechanism. Fig. 3 is a plan view of those parts located below line $x\,x$ of Fig. 2. Fig. 4 is an elevation of one of the water-cylinders and its piston-rod, showing particularly the mechanism for controlling the valve through which the water enters said cylinders. Figs. 5, 6, 7, and 8 are detail views of a rotary valve through which the water in the cylinder escapes after having performed its work.

I have illustrated my invention as including two systems of water and air compressing cylinders, as by such an arrangement a more constant or continuous outflow of water may be maintained, for the reason that when one system stops the other system starts into action and the outflow of water is thus interrupted, but inasmuch as the two systems are substantially alike I shall give a detailed description of only one.

Referring to the drawings, the letter *a* denotes the base upon which my device is mounted, and *b* a top plate supported somewhat above said base by means of vertically-extending rods or bolts *c*, the opposite ends of which are securely clamped to the base *a* and plate *b*, respectively, by means of nuts *c'*, said base *a*, plate *b*, and rods *c* thus forming a rigid framework inclosing and supporting the operative portions of my device.

To accomplish the compression of air by means of my device, one or more sets of cylinders are provided, (preferably two,) each set composed of what I term a "water-cylinder" *d* and an "air-compression cylinder" *e*.

Cylinders *d* and *e* are in vertical alinement with each other, the former being mounted, as shown, upon base *a* and the latter depending from the under side of plate *b*. A piston-rod *f* is provided common to both cylinders *d* and *e*, said rod bearing upon one end a piston *g* of pecular construction to coact with the water-cylinder *d* and upon its opposite end a piston *h* of the ordinary type to coact with the air-compression cylinder.

By the introduction of water under pressure into cylinder *d* a reciprocating motion of piston *g* within said cylinder is attained, and through rod *f* similar motion is imparted to piston *h*, the movement of which latter within its cylinder *e* serves to compress air therein and to drive such compressed air into a receiver, as is fully explained hereinafter.

It has already been stated that my device is placed in the line of water-pipe, and it is the pressure of water caused to flow therethrough by the opening of a faucet or valve at the delivery end of such line of pipe that I have utilized to operate the system of pistons just described.

Referring now to the manner in which said flow of water serves to operate the pistons and to the construction of the cylinders and other elements of my device immediately connected with the controlling of said flow of water, Fig. 2, the letter *k* denotes a pipe by means of which water is introduced directly into the cylinder *d*, said pipe *k* leading into the lower end thereof. Piston *g* has centrally located

on one face a boss g', and extending through said piston and into said boss from the opposite face is a cone-shaped chamber g^2, from the smaller end of which a number of openings g^3 lead outward through boss g'. Boss g' serves also to receive that end of piston-rod f that is coincident with piston g.

Reference-letter m denotes a conical shell which when my device is assembled is seated in and snugly fits the cone-shaped chamber g^2, but is free to be revolved therein.

Piston-rod f is tubular throughout a portion of its length, as at f', and such tubular portion is adapted to receive a stem or rod m', extending from the smaller end of the conical shell m, Fig. 2. Rod m' is provided near its free end with an arm m^2, projecting at right angles thereto, said arm passing outward through an opening or slot f^2 in the tubular rod f. The conical shell m is provided with openings m^3, similar to the openings g^3 of boss g'.

It will now be readily understood by reference to Figs. 2, 7, and 8 of the drawings that shell m may be so revolved in its seat as to carry its openings m^3 either into or out of alinement with openings g^3, thus providing means of communication through piston g to the opposite end of cylinder d. When piston g is in its lowest position, with its conical shell m so located as to close the passage through openings m^3 and g^3, as shown in the left-hand cylinder of Fig. 2 and also in Fig. 7, the introduction of water through pipe k into said cylinder serves to drive the piston g upward within the cylinder, this upward movement also carrying upward rod f and the inner rod m' until piston g has nearly reached the opposite end of the cylinder d, when the arm m^2, projecting from rod m' through the opening f^2 of rod f, comes in contact with a fixed cam n, supported upon a framework n', mounted on posts c. Further upward movement of the said traveling parts now causes the end of said arm m^2, engaging cam n, to follow the outline of said cam, which engagement effects the partial revolution of rod m' within rod f, and when piston g has reached its highest point in the cylinder d (the position shown in dotted lines in the left-hand cylinder d) said rod m' and its connected shell m will have revolved sufficiently to bring into coincidence the openings m^3 and the openings g^3, as shown in the right-hand cylinder of Fig. 2 and in Fig. 8, when the water will be allowed to pass freely from the lower portion of cylinder d through the piston and thence through a pipe o, leading from the cylinder-head d' to a faucet at the delivery end of said pipe.

To guard against any possibility of the return or backward flow of water through pipe O into cylinder d after the flow of water from pipe k is shut off, a valve O' is located in pipe O, the construction of which is such that water can pass therethrough only in the direction of the arrow adjacent thereto. It will therefore be readily understood that the flow of water from cylinder d will force open said valve O' and allow the water to pass out, but any attempt of the water to return to cylinder p will result in the closing of the valve. So soon as the flow of water is shut off piston g at once commences to descend by gravity, (or by aid of the companion piston g when a double-cylinder system is employed, as hereinafter described,) the arm m^2 in such downward movement engaging a suitable cam n^2 when the piston g has nearly reached the lower end of the cylinder, such cam serving to swing the arm in the direction opposite to that when engaging cam n, and thus revolving rod m' and its shell m in the proper direction to again close the passage through openings m^3 and g^3, and this last-named result is accomplished just as the piston reaches the bottom end of cylinder p. The piston is then again ready to travel upward so soon as the flow of water is turned on.

To control the flow of water from pipe k into cylinder d, so that such flow may be shut off when the highest point in cylinder d has been reached by the piston g, and in order that the piston may be allowed to return to its lowest position to be again acted upon by the inflow of water, the following-described automatically-acting mechanism has been provided:

Reference-letter p denotes a vertically-extending rod supported at its upper end in the free end of an arm p', secured to one of the posts c, and near its lower end having a bearing a' in the base a, which rod p is capable of a vertically-reciprocating movement in its said bearings. Located in the pipe k is a valve k', on the stem k^2 of which is located an arm k^3, the free end of which is slotted to receive either the end of rod p or a pin p^2, projecting therefrom, and on said rod p are collars p^3 p^4. Fixedly secured to rod f and projecting at right angles therefrom is an arm f^3, the free end of which lies in the path of said collars p^3 p^4. When valve k' is open and the flow of water from pipe k is forcing the piston g and its rod upward, such movement of rod f correspondingly raises the arm f^3, the free end of which latter engages collar p^3 just before the piston g has reached its highest point in cylinder d or approximately at the time that the conical shell m begins to revolve to allow the passage of water through piston g, said arm f^3 and collar p^3 being so located on rods f and p, respectively, that such engagement of the parts is accomplished at the time stated. Continued upward movement of rod f now acts through arm f^3, engaging collar p^3 to correspondingly draw upward the said arm p and to raise the free end of the arm k^3, secured to the lower end of said rod p until rod f has reached its highest position, as shown in dotted lines, Fig. 4, when rod p will have been raised sufficiently to rock arm k^3 from the position shown in full lines to that shown in dotted lines, and will

thus have resulted in rocking the valve-shaft k^2 sufficiently to close valve k' and bring it into the position of the right-hand valve of Fig. 2. As the piston moves downward again the rod p will be left in its highest position until arm f^3 engages the collar p^4, which it does just before piston g has reached the bottom of the cylinder, when rod p is forced downward, rocking arm k^3 into the position shown in full lines, Fig. 4, thus again opening valve k' just as the piston g has reached its lowest point, after which the various operations described again take place and are repeated so long as there is a flow of water through pipe k.

The manner in which the flow of water is utilized to impart a reciprocating movement to piston g and connected parts being now understood, an explanation will be given of the manner in which such reciprocating movement accomplishes the compression and storage of compressed air.

Cylinder e is provided with inlet and outlet passages, (shown in the drawings as pipes s and t,) each of which is provided with valves s' and t', said valves being of such construction as to allow the passage of air therethrough in the direction indicated by the arrows adjacent to each, the tendency of air to pass in the opposite directions resulting in the automatic closing of said valves and preventing such passage. When piston h moves downward in cylinder e, it tends to create a vacuum in said cylinder, and to overcome such vacuum air rushes thereinto through inlet s, forcing open and passing freely by valves s', piston g being now in the position shown in the left-hand section of Fig. 2. So soon, however, as the return movement of said cylinder commences it begins to drive before it and compress within cylinder e the air just admitted. The air now seeks an outlet through pipes s and t, but is prevented from passing out through pipes s by the automatically closing of valves s', as described. The forcing of air into passage t, however, opens valve t', thereby allowing the current of air to pass through pipe t to a suitable receiver v. The air thus forced into the receiver is prevented from returning to the cylinder e by the check-valve t'. It will now be readily understood that air can enter cylinder e only through pipe s and leave only through pipe t.

While I have thus far described a single system of water and air compression cylinders, I have shown in the drawings a double system of such cylinders. The latter form is preferable and when thus constructed the operating portions of one system alternate in position and motion with those of the companion system, and when two systems are employed I preferably connect rods f by means of a walking-beam w, hinged centrally on a horizontal rod w', supported by posts c. By means of walking-beam w the upward travel of the rod f and connected parts of one system forces downward the rod f and connected parts of the companion system, which return movement is thus more satisfactorily accomplished than when dependent upon gravity.

When the double system is employed, the valve stem or shaft k^2 is preferably made sufficiently long to engage pipe k of each system and thus to support upon each end a valve k'. These valves are set at a quarter-turn to each other, so that they may admit and shut off the flow of water alternately to their respective cylinders g. When valves k^2 are arranged in the manner just described, only a single rod p and connected parts for controlling valves k' is required, but it will be readily seen that, if desired, each valve k' may have its own controlling mechanism.

In the accompanying drawings the pipes k are shown as leading from a common pipe k^4, to which they are joined by means of a T k^5. This feature is also carried out in the case of outlet-pipes o, leading from cylinders d, and with the pipes t, leading from cylinders e. In the former case the pipes are connected by a T o^2, from which a pipe o^3 leads to the outlet or faucet, and in the latter case pipes t lead to a T t^2, from which a pipe t^3 leads to a receiver v.

Assuming now that a device of my described construction is provided, the opening of a faucet at the delivery end of pipe o^3 causes water to flow from pipe k^4, through pipes k, into and through cylinders d, setting in motion the operative parts of my device in the manner described and passing thence from said cylinders through pipes o and o^3 and through the said faucet. The movement of pistons h within the cylinders e results in the compression of air and the storing of it in receptacle v, from which it may be drawn for desired uses.

My device as a whole is very simple in its construction, is not expensive to build, and utilizes to good advantage the otherwise lost power present in all ordinary water-service pipes.

Having thus described my invention, I claim—

1. In an air-compressor, in combination, two superimposed cylinders, a piston for each of said cylinders mounted upon a single piston-rod as set forth, a rotary valve mounted on a stem within the said piston-rod, and means substantially as described for rocking said stem to open and close the said valve, for the purpose specified.

2. In combination, two end-to-end cylinders, pistons for said cylinders mounted upon a single piston-rod, a water-pipe leading into one of said cylinders having a valve as set forth, means for opening and closing said valve, a rotary valve in the piston of said water-cylinder, and means for rotating said piston-valve to open and close the same.

3. In combination, in and with a line of water-pipe a water-cylinder having a piston

and piston-rod as set forth, a valve located in the piston, means for automatically shutting off the inflow of water at the end of the stroke and means for simultaneously opening said piston-valve to pass the water to the opposite side of the piston, an air-compression cylinder and a piston for the same mounted upon the piston-rod of the said water-cylinder.

4. In combination, two pairs of end-to-end cylinders each provided with a piston-rod and pistons as set forth, a lever-arm *w* whose opposite ends are connected with said piston-rods, means for automatically introducing water into one of the cylinders of each pair, and means consisting of rotary valves within said pistons and mechanism for operating the same whereby the water in said cylinders may pass the pistons and be discharged, substantially as and for the purpose specified.

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