(No Model.) 3 Sheets—Sheet 1.

G. J. KEENAN.

AUTOMATIC HYDRAULIC AIR PUMP.

No. 533,817. Patented Feb. 5, 1895.

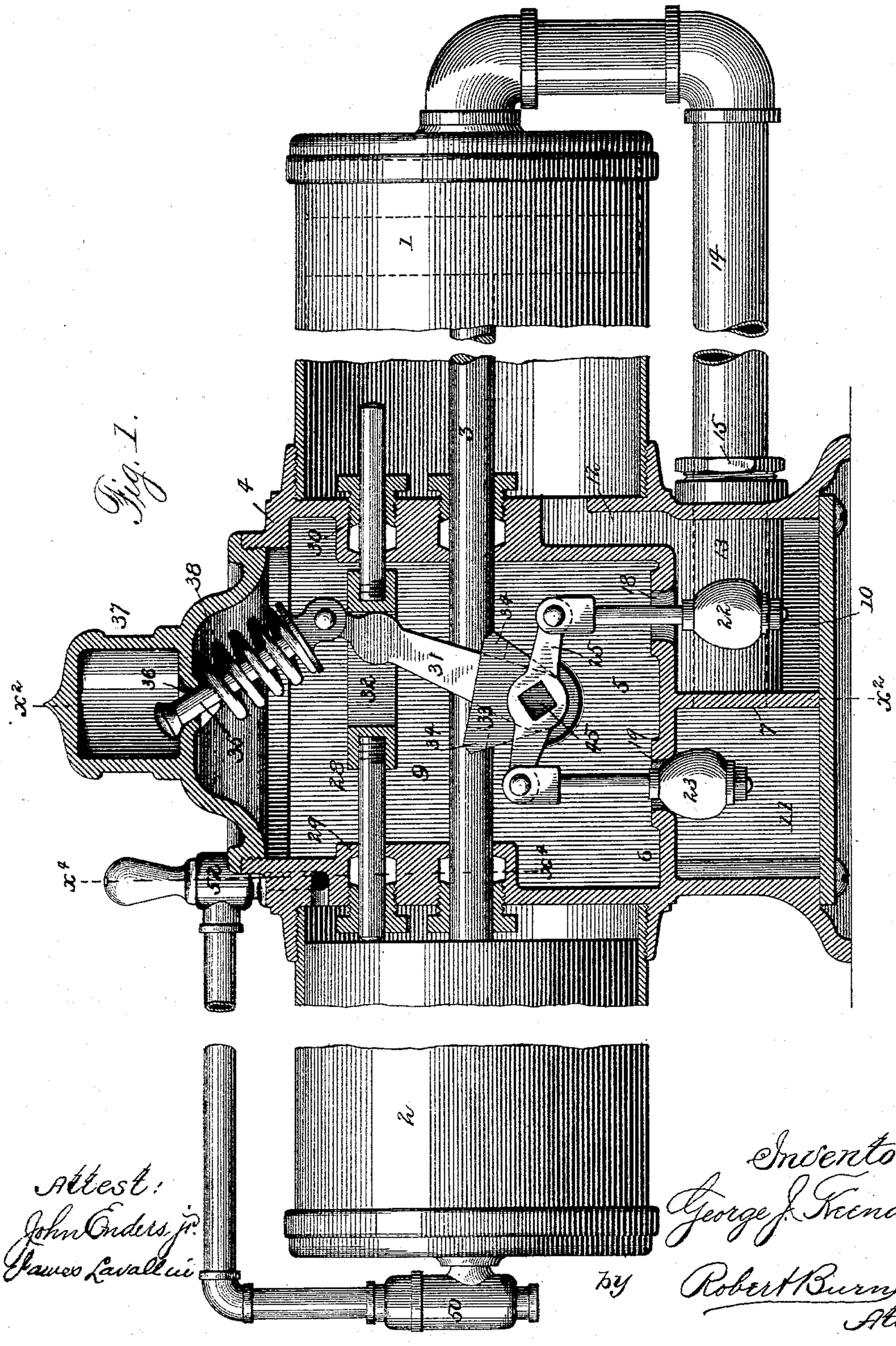

Fig. 1.

Attest:
John Enders jr.
Frances Lavallee

Inventor
George J. Keenan,
by Robert Burns
Atty.

(No Model.) 3 Sheets—Sheet 2.

G. J. KEENAN.

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Fig. 2.

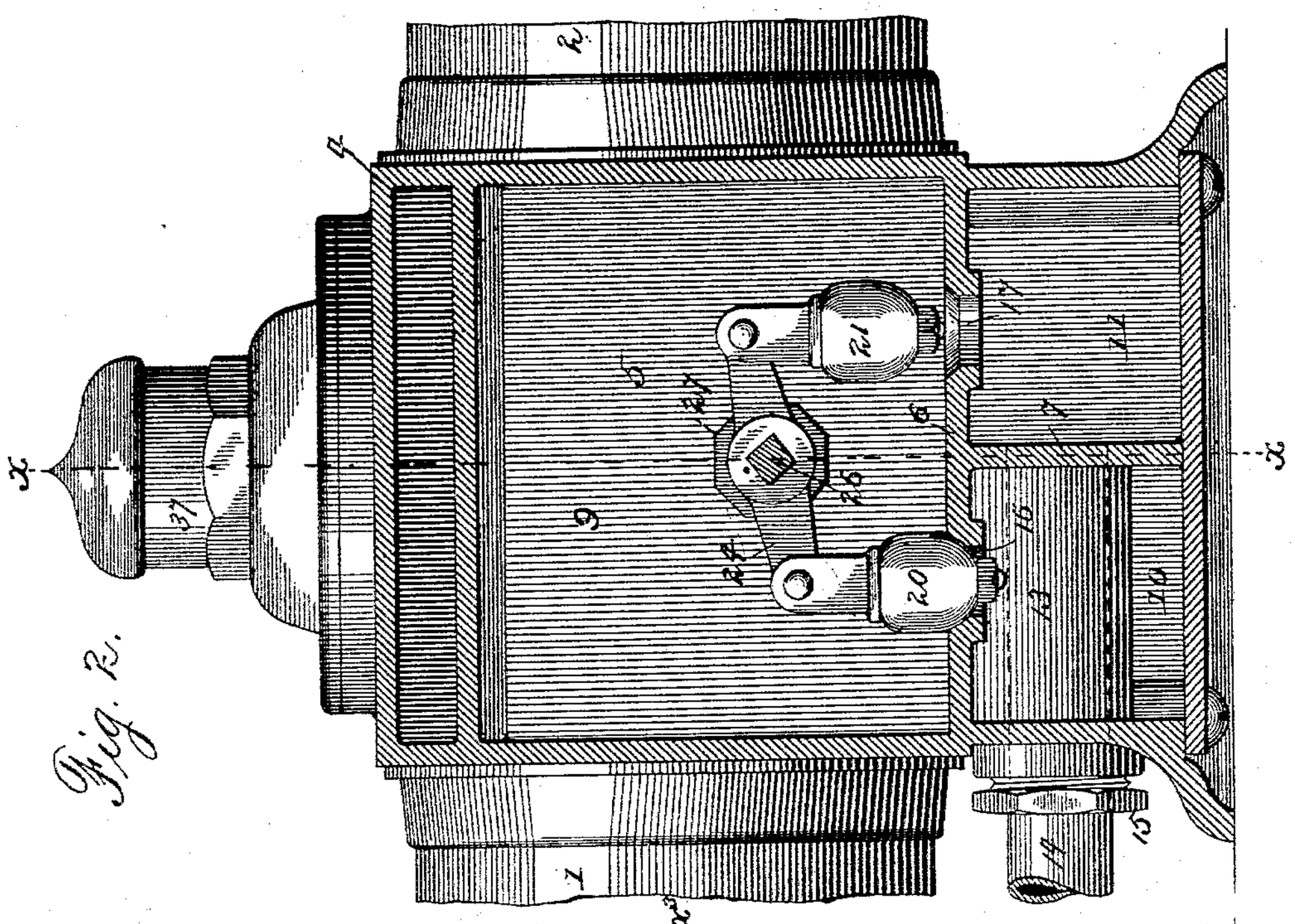
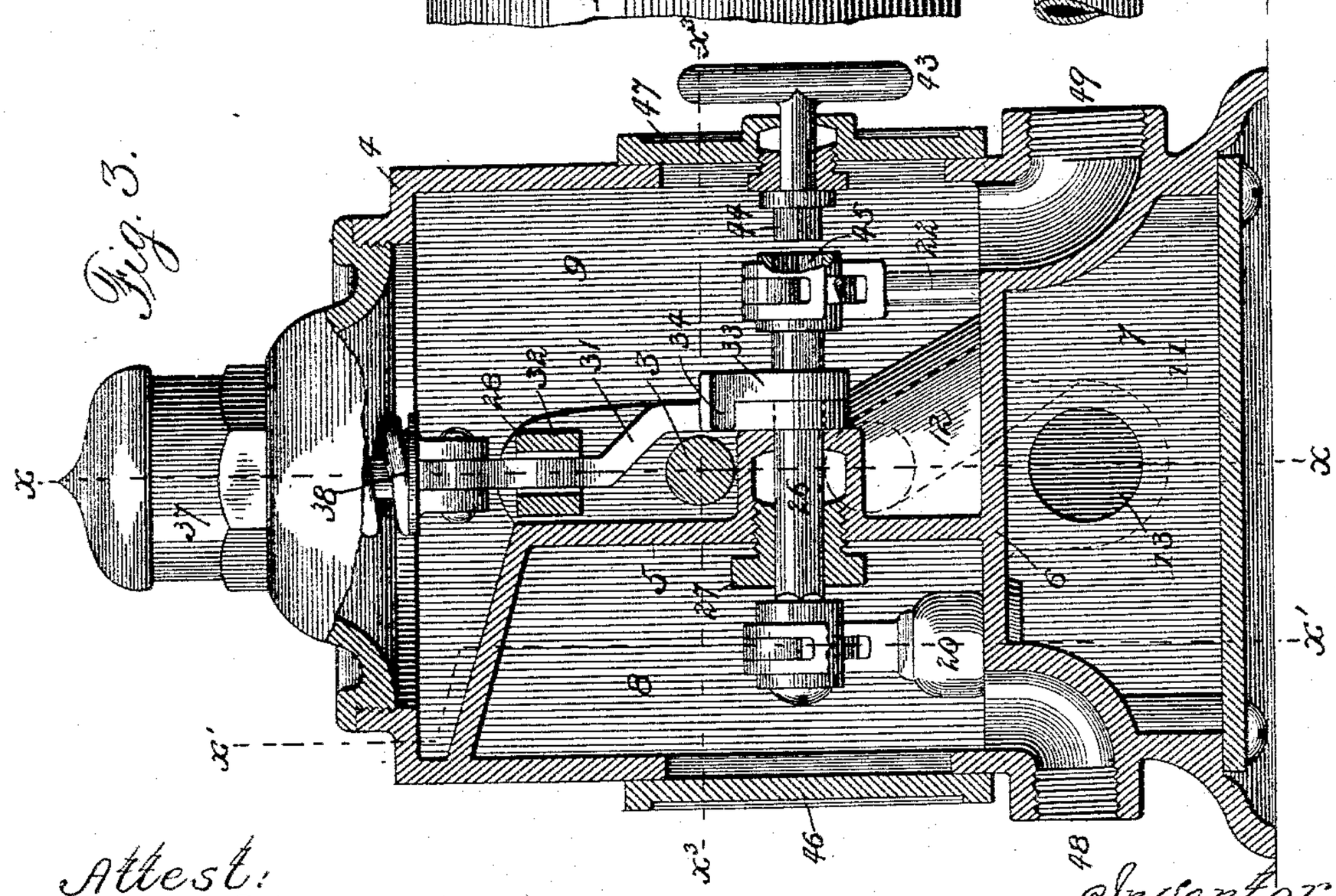


Fig. 3.



Attest:
John Enders jr.
James Lavallee

Inventor
George J. Keenan
by Robert Burns Att'y.

(No Model.) 3 Sheets—Sheet 3.

G. J. KEENAN.

AUTOMATIC HYDRAULIC AIR PUMP.

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Fig. 1.

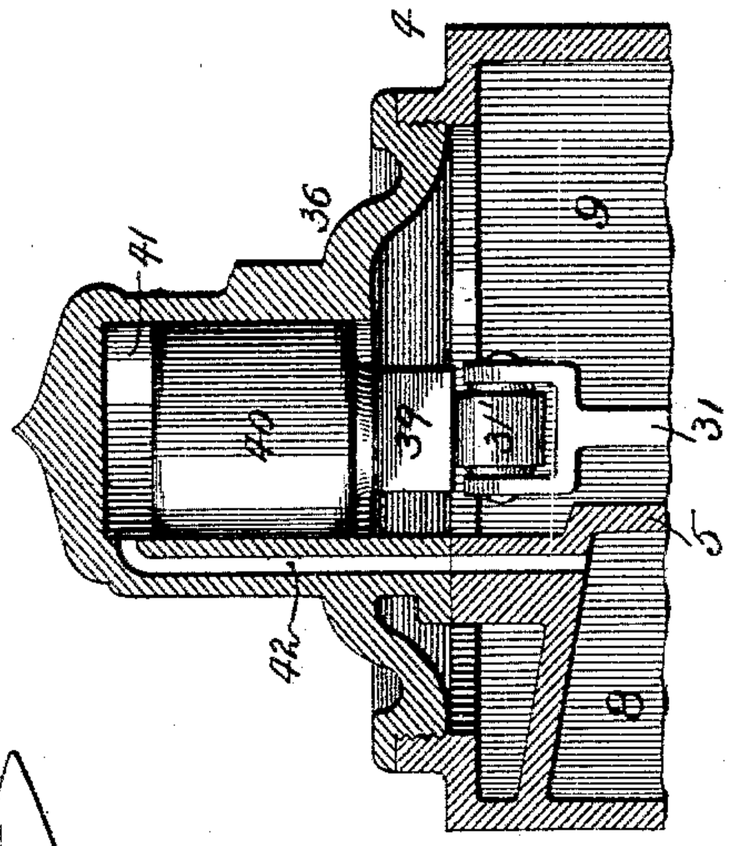


Fig. 5.

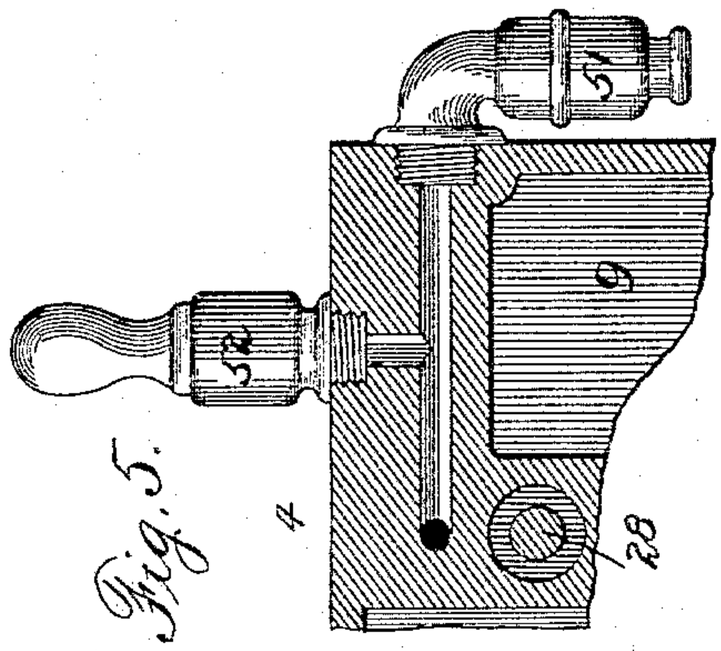


Fig. 6.

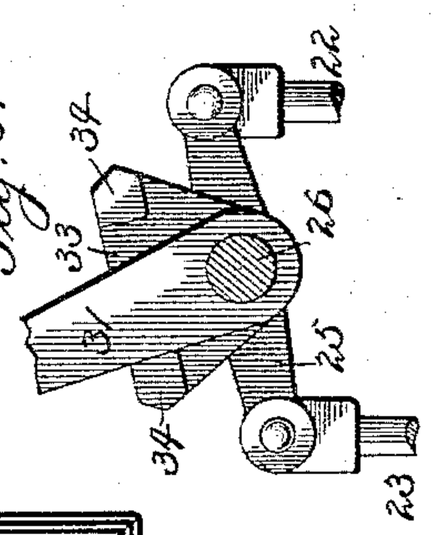


Fig. 8.

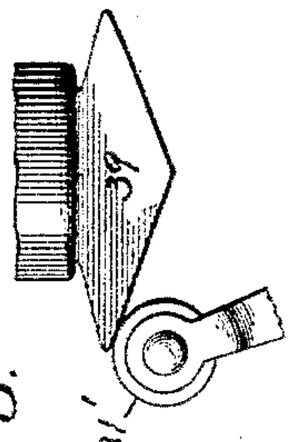
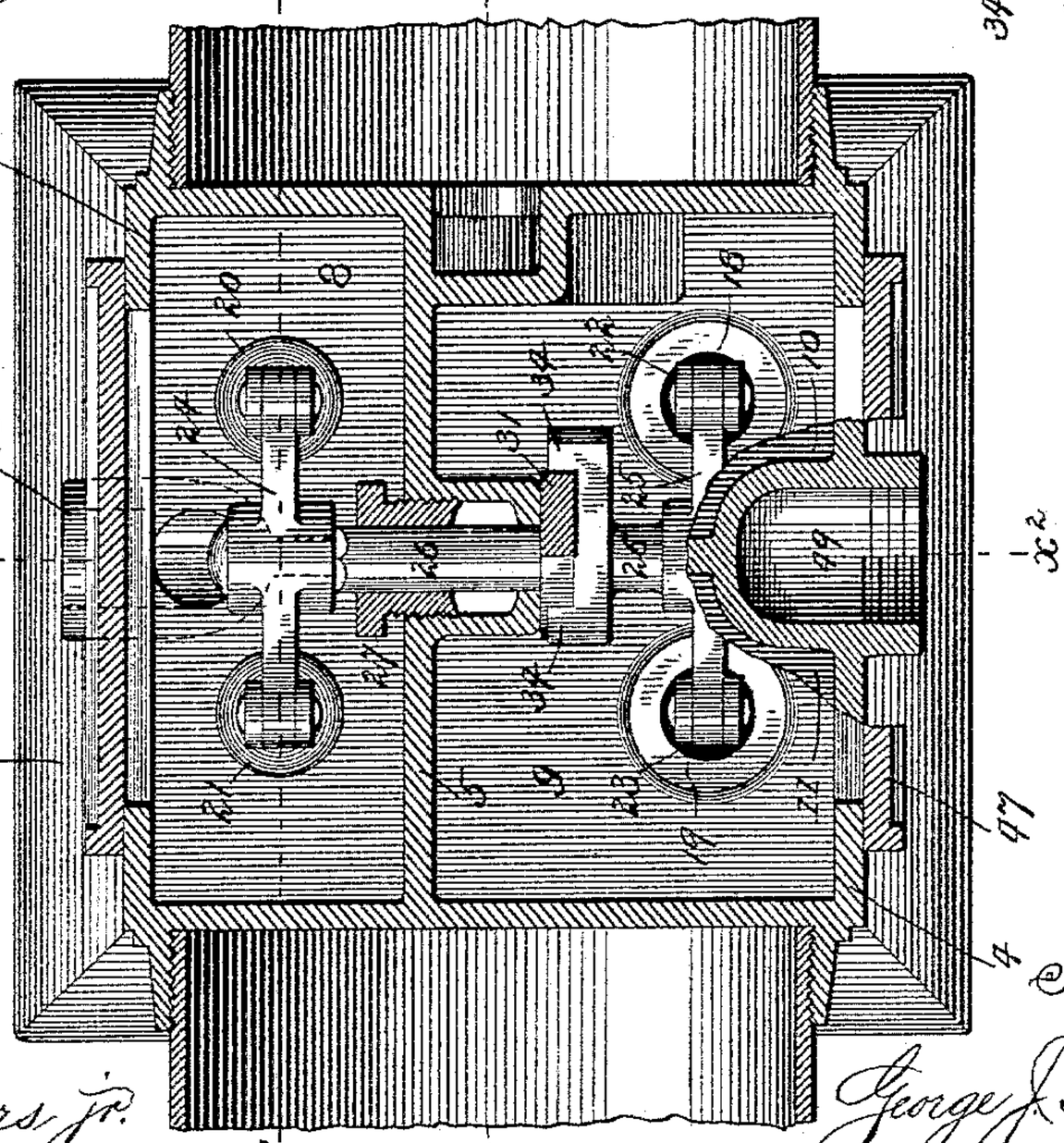


Fig. 4.



Attest:
John Enders jr.
Hamer Cavallini

Inventor
George J. Keenan,
by
Robert Burns.
Atty.

UNITED STATES PATENT OFFICE.

GEORGE J. KEENAN, OF CHICAGO, ILLINOIS.

AUTOMATIC HYDRAULIC AIR-PUMP.

SPECIFICATION forming part of Letters Patent No. 533,817, dated February 5, 1895.

Application filed September 22, 1894. Serial No. 523,821. (No model.)

To all whom it may concern:

Be it known that I, GEORGE J. KEENAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Automatic Hydraulic Air-Pumps; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification.

This invention relates to that class of hydraulic air compressors, in which a reciprocating water engine is employed to operate a reciprocating air pump to afford a constant supply of compressed air, and in which the cylinders are placed in line, with the piston of each connected to a piston rod common to both pistons; and the present improvement has for its object, mainly, to provide a simple, effective and durable means for alternately reversing in an automatic and positive manner, the communication between the pressure and waste chambers of the valve chest, and the pair of induction-eduction chambers or passages in said valve chest, that are in constant communication with the respective ends of the water engine cylinder; which arrangement in its more perfected nature involves the following features: separate valve heads for each water inlet and outlet opening; such valve heads made of elastic material, and connected to a common operating mechanism so as to operate in unison; and the valve chest forming a connection between the water and air cylinders, with its waste chamber arranged to inclose the valve operating mechanism, the piston rod, &c., and adapted to collect the waste or escape from the packing glands at the adjacent ends of such pump cylinders, as will hereinafter more fully appear and be more particularly pointed out in the claims. I attain such object by the construction and arrangement of parts illustrated in the accompanying drawings, in which—

Figure 1, is a longitudinal sectional elevation, principally on line x—x, Figs. 3 and 4, of a hydraulic air pump, constructed in accordance with the present invention, and illustrating the outlet or waste valves of the water cylinder; Fig. 2, a detail longitudinal sectional elevation at line x'—x', Figs. 3 and 4, and in a direction opposite to Fig. 1, illustrating the pressure supply valves of the aforesaid water cylinder; Fig. 3, a transverse sectional elevation, at line x^2—x^2, Figs. 1 and 4; Fig. 4, a horizontal section at line x^3—x^3, Fig. 3, with a portion of the floor of the waste chamber broken away; Fig. 5, a detail transverse section at line x^4—x^4, Fig. 1, illustrating the air ports of the inner end of the air cylinder; Fig. 6, a detail sectional elevation of the valve mechanism in a direction opposite to that shown in Fig. 1; Fig. 7, a detail transverse section illustrating a modification; Fig. 8, a detail side elevation of the same.

Similar numerals of reference indicate like parts in the several views.

Referring to the drawings 1, represents the water cylinder, and 2, the air cylinder, arranged in line, with their pistons connected together by a piston rod 3, common to both; and in the present invention the two cylinders are connected together by the valve chest or box 4, having at opposite sides suitable necks for the attachment of the cylinders 1 and 2.

In my preferred construction as illustrated in the drawings, the valve chest 4, is of a cubical form having a suitable base that forms the support for the pump. Such valve chest is divided by a longitudinally extending vertical partition 5, a horizontally arranged partition 6, and a transversely extending vertical partition 7, into the longitudinally extending water pressure or inlet chamber 8, and waste water or outlet chamber 9, and a pair of transversely extending induction-eduction chambers or passages 10 and 11, the one being in connection with the near end of the water cylinder 1, by the port or passage 12, and the other with the far end of such cylinder by means of the longitudinally extending port or passage 13, and the connecting pipe 14, that is connected at one end to the outer head of the cylinder 1, and at the other end to the port or passage 13, in a readily removable manner by means of a packing gland 15, as shown in Fig. 1, so as to admit of a ready detachment of parts in taking the pump apart for repairs, &c.

The horizontal partition 6, forms a dividing floor between the pressure and waste

chambers 8 and 9, and the induction-eduction chambers 10 and 11, and in this partition are formed four valve openings 16, 17, 18 and 19, to constitute valve seats for the four valve heads 20, 21, 22 and 23.

The valve openings 16 and 17, and valve heads 20 and 21, connect and control communication between the water pressure or inlet chamber 8, and the induction-eduction chambers 10 and 11, while the valve openings 18 and 19 and valve heads 22 and 23, connect and control communication between the water outlet or waste chamber, 9, and the said induction-eduction chambers 10 and 11.

In the present improvement the inlet valves 20 and 21, open upward, and the outlet valves 22 and 23 open downward, so that they will tend to close, and be held closed by the water pressure within the respective pressure and waste chambers of the valve chest; and each pair of valves will have their stems pivotally attached to the opposite ends of a pair of rocking beams 24 and 25, which in turn are secured to an operating rock shaft 26, that is arranged transversely in the respective chambers 8 and 9; its passage through the vertical partition 5, between said pressure and waste chambers being made in a water tight manner by means of a packing gland 27, so as to prevent any leakage from such pressure chamber into the waste chamber.

It is material to the present invention that the valve heads 20, 21, 22 and 23, be made of an elastic material such as rubber, so that they will yield to a certain degree, and admit of the perfect closing of the other valves, regardless of which valve has reached its seat. This is especially the case in the present construction where the whole series of valves work in unison through intermediate connecting mechanism.

In order to operate the rock shaft 26, so as to reverse the position of the valves at each stroke of the pump, the following automatic mechanism is provided:

28 is a longitudinally arranged slide, the respective ends of which pass in through suitable glands 29 and 30, in the adjacent heads of the water and air cylinders, so as to be in the path of the pistons of the same, and receive a limited alternating reciprocating movement from such pistons as they near the end of their inward stroke.

31, is a lever loosely pivoted on the rock shaft 26, with its free end arranged in the path of the slide 28, so as to receive motion therefrom. In my preferred construction the connection between this lever and the slide 28, is by means of a slotted yoke 32, but any other equivalent means of connection may be employed instead, that will admit of a limited independent movement of the slide 28, with relation to said lever. 33, is an arm fixed to the rock shaft 26, and loosely connected to the lever 31, preferably by projections 34 in the path of said lever, and arranged in such a manner as to permit of a limited independent movement of the lever with relation to the arm 33. Such limited independent movement of the slide 28, and of the lever 31, is requisite to the proper action of the reversing mechanism of the valves, in effecting a perfect reversal of the valves immediately subsequent to the end of the stroke of the pump pistons, as hereinafter set forth.

35, is a toggle link, pivoted at one end to the upper end of the lever 31, with its upper end engaged in a central guide orifice 36, in the cap portion 37, of the valve chest, so as to be capable of a sliding movement in the operation of the parts.

38, is a spring surrounding the link 35, and having bearing at its lower end upon a collar fixed on said link, and at its upper end against the cap portion 37 of the valve chest as shown. In the above construction, the lever 31, in reaching a vertical position compresses the spring 38, after which the spring reacts, to impart an independent movement to the lever 31, to cause a reversal of the valve mechanism.

In the modification shown in Figs. 7 and 8 of the drawings, the free end of the lever 31, is provided with a friction reducing roller 31′, that bears against the centrally arranged wedge shaped block 39, upon the under side of a single acting piston 40, the cylinder 41, of which is formed in the cap 36 of the valve chest as shown, such piston being under constant pressure in a downward direction, so as to constitute an elastic cushion, by a pressure of water introduced from the main water pressure chamber 8, into the upper end of the cylinder 41, through the connecting port 42.

In order to render the valve mechanism capable of manipulation by hand from the outside of the apparatus, I make use of the following mechanism:

43, is a turn key the shank of which passes through a suitable gland at the side of the waste chamber 9, and adapted to have a limited endwise movement, so that its inner squared end 44, may be engaged in a square recess 45, in the end of the rock shaft 26. With this construction when it is desired to manipulate the valve mechanism by hand, on the accidental stoppage of the pump, the turnkey 43, will be pushed into engagement with the said rock shaft, to effect a connection therewith. At other times such turnkey will be withdrawn from such engagement, leaving the valve mechanism free to operate in an automatic manner.

The water inlet or pressure chamber 8, as well as the water outlet or waste chamber 9, will be provided with side openings, and closing caps 46, 47, therefor, for convenient access to the interior of such chambers and the valve mechanism contained therein. Water is introduced into the pressure chamber 8, through the lateral inlet neck 48; and the waste water from the waste chamber 9, passes away through the lateral outlet neck 49, at the opposite side of the valve chest.

The air cylinder 2, will be provided with

the usual air inlet and outlet valves at each end. In the drawings I illustrate a compound inlet-outlet valve 50, at the outer end of the cylinder 2, and an independent inlet valve 51, and an independent outlet valve 52, for the inner end of such air cylinder, as shown in Figs. 1 and 6. No claim, however, is made to such features in the present application.

In the present improved construction as illustrated in the drawings, the glandular openings through which the piston rod, and the valve slide pass into the interior of the cylinders, are arranged within the closed waste chamber 9, so that any leakage through such glands will be caught by such chamber. An additional and very important advantage of this construction, is that under no conditions can water be forced into the air cylinder.

The operation of my improved pump is as follows: The valves being in the position illustrated in the drawings, to wit: the inlet valve 20 and outlet valve 23 closed, and the inlet valve 21 and outlet valve 22 open, the water pressure from the chamber 8, flows through the opened valve passage 17, chamber 11, passage 13 and pipe connection 14, to the outer end of the water cylinder 1, forcing the piston thereof inward, and discharging the waste water from the inner end thereof, through the port 12, chamber 10 and opened valve passage 18, into the waste water chamber 9. Such piston as it reaches the inward limit of its stroke, actuates the slide 28, to move the lever 31 to a vertical position, or a little past the same, compressing the spring 35. Up to this point the movement of the lever 31, owing to its limited independent motion with relation to the arm 33 of the valve operating rock shaft 26, has no effect upon the valves. As the lever 31, however, attains such position, the spring 35 reacts to impart further movement to such lever independent of the slide 28; and it is this independent movement that actuates the rock shaft 26, to cause a reversal of the valves, by contact of such lever with a projection 34, of the arm 33, that is in the path of the lever 31, in its aforesaid movement. With this improved arrangement of valve reversing mechanism, an adjustment of the parts is admissible, so that the positive movement of the slide 28, can be employed to effect the heavy initial opening of the valves, the spring 35 acting in this case, in an auxiliary manner, to further and fully open the valves. In the reversal of the valves as above mentioned, the pressure inlet valve 20, opens, and the pressure inlet valve 21 closes, while the waste valve 23 opens and the waste valve 22 closes. Water pressure then enters the inner end of the water cylinder 1, through the opened valve passage 16, chamber 10, and port 12, while the waste from the outer end of the water cylinder flows through the pipe 14, passage 13, chamber 11, and opened valved passage 19 into the waste chamber 9; which action continues until the pump pistons near the completion of their stroke, when the slide 28 is again operated to move the valve lever 31, in a direction opposite to that already described, to effect another reversal of the valves back into the position first described.

Having thus fully described my said invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a hydraulic air pump, the combination of a water cylinder, an air cylinder, pistons, piston rod, packing glands therefor in the cylinder heads, and a valve chest connecting the two cylinders, the piston rod and packing glands therefor being arranged and inclosed within the waste chamber of such valve chest, substantially as set forth.

2. In a hydraulic air pump, the combination of a water cylinder, an air cylinder, pistons, piston rod, packing glands therefor in the cylinder heads, a valve operating slide, packing glands therefor in the cylinder heads, and a valve chest connecting the two cylinders, the piston rod, the valve operating slide and the packing glands therefor being arranged and inclosed within the waste chamber of such valve chest, substantially as set forth.

3. In a hydraulic air pump, the combination of a water cylinder and an air cylinder, the pistons of which are connected to a common piston rod, a valve chest connecting said cylinders together, and formed with pressure and waste chambers, and a pair of induction-eduction chambers, that are arranged at right angles to the pressure and waste chambers, and have communication therewith, and a series of independent valves operating in unison, to control communication between such chambers, substantially as set forth.

4. In a hydraulic air pump, the combination of a water cylinder, an air cylinder, a valve chest, formed with pressure and waste chambers and induction-eduction chambers, water inlet and outlet valves the operating mechanism of the outlet valves arranged in the waste chamber, and connected to the operating mechanism of the inlet valves by a rock shaft passing through a packing gland in the partition between the pressure and waste chambers, substantially as set forth.

5. In a hydraulic air pump, the combination of a water cylinder, an air cylinder, a valve chest, formed with pressure and waste chambers and induction-eduction chambers, water inlet and outlet valves the operating mechanism of the outlet valves, arranged in the waste chamber, and consisting of a pair of valve heads 22, 23, at the opposite end of a rocking beam 25, an operating lever 31, and an operating slide 28, passing through the adjacent heads of the cylinders and actuated by the pistons thereof, the operating mechanism of the inlet valves consisting of the pair of valve heads 20, 21, at the opposite ends of a rocking beam 24, and an operating rock shaft 26, common to both rocking beams, and adapted

to pass through a packing gland in the partition between the pressure and waste chambers, substantially as set forth.

6. In a hydraulic air pump, the combination of a water cylinder, an air cylinder, a valve chest formed with chambers 8, 9, 10 and 11, connected together by valve openings 16, 17, 18 and 19, the series of valves 20, 21, 22, and 23, the rocking beams 24 and 25, the rock shaft 26, and arm 33, the operating lever 31, connected to said arm so as to have limited independent movement, and the slide 28, passing through the adjacent heads of the cylinders and actuated by the pistons thereof, substantially as set forth.

7. In a hydraulic air pump, the combination of a water cylinder, an air cylinder, a valve chest formed with chambers 8, 9, 10 and 11, connected together by valve openings 16, 17, 18 and 19, the series of valves 20, 21, 22 and 23, the rocking beams 24 and 25, the rock shaft 26, and arm 33, the operating lever 31, connected to said arm so as to have limited independent movement, an elastic cushion such as 38, engaging the free end of the lever 31, and the operating slide 28, passing through the adjacent heads of the cylinders, and actuated by the pistons thereof, substantially as set forth.

8. In a hydraulic air pump, the combination of a water cylinder, an air cylinder, a valve chest formed with chambers 8, 9, 10 and 11, connected together by valve openings 16, 17, 18 and 19, the series of valves 20, 21, 22 and 23, the rocking beams 24 and 25, the rock shaft 26, arm 33, the operating lever 31, connected to said arm so as to have limited independent movement, an elastic cushion such as 38, engaging the free end of the lever 31, through a toggle link 35, and the operating slide 28, passing through the adjacent heads of the cylinders and actuated by the pistons thereof, substantially as set forth.

9. In a hydraulic air pump, the combination of a water cylinder, an air cylinder, a valve chest, pairs of inlet and outlet valves arranged independently upon rocking beams and a common rock shaft, and located within the valve chest, and a turnkey 43, extending in through the wall of the valve chest, and adapted to engage the rock shaft, to actuate the valves, substantially as set forth.

In testimony of said invention witness my hand this 18th day of September, 1894.

GEORGE J. KEENAN.

In presence of—

ROBERT BURNS,

JAMES LAVALLIN.