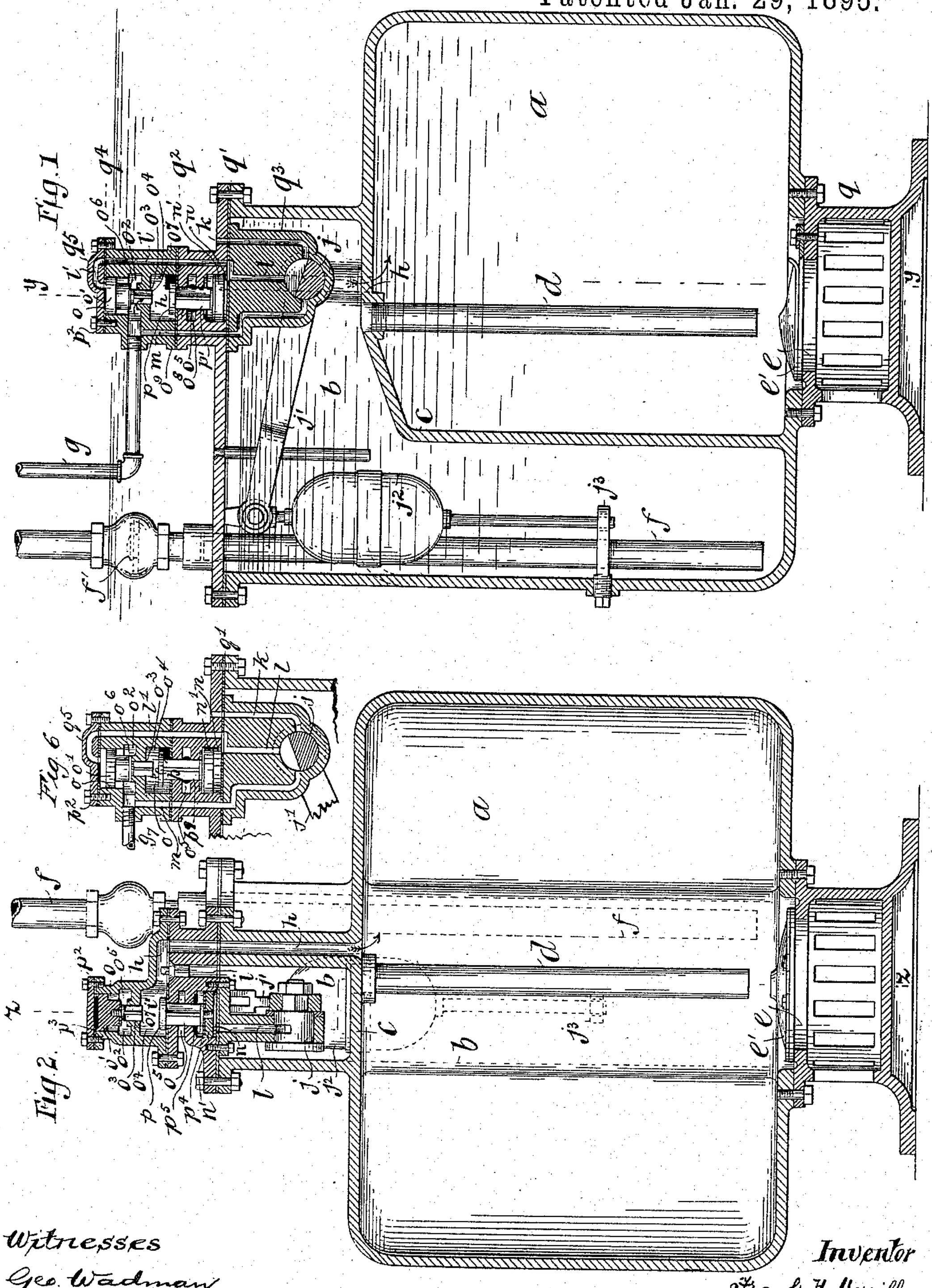
(No Model.) 2 Sheets—Sheet 1.

F. H. MERRILL.

LIQUID RAISING APPARATUS.

No. 533,229. Patented Jan. 29, 1895.



Witnesses
Geo. Wadman
Fred. Kemper.

Inventor
Frank H. Merrill
By his attorneys
Gifford & Law.

(No Model.)

2 Sheets—Sheet 2.

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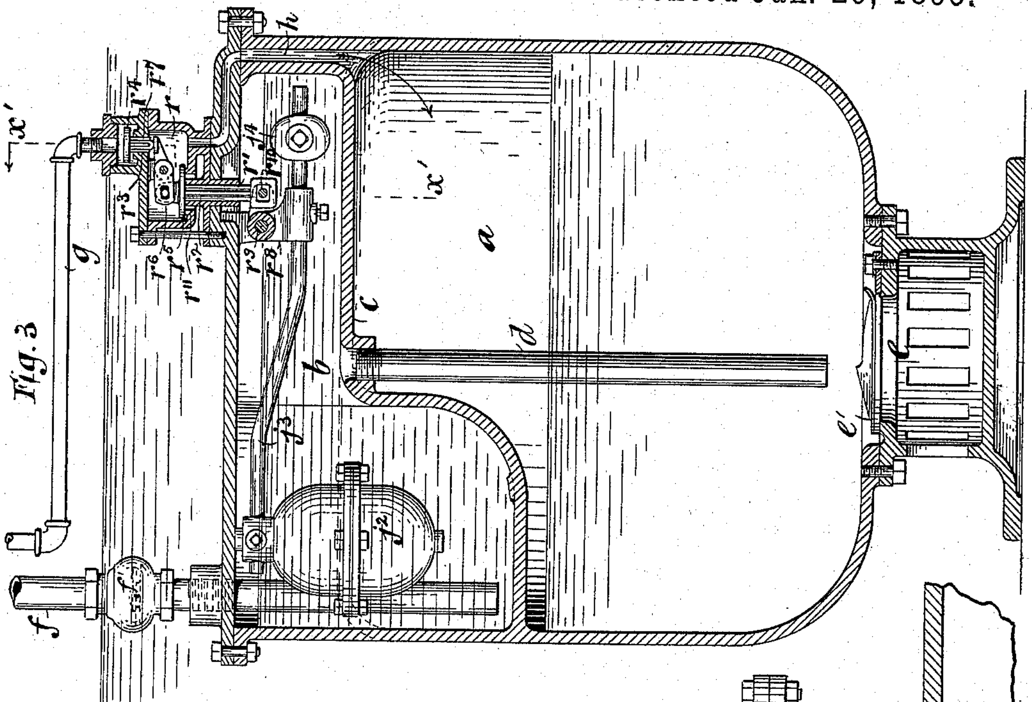

Fig. 3

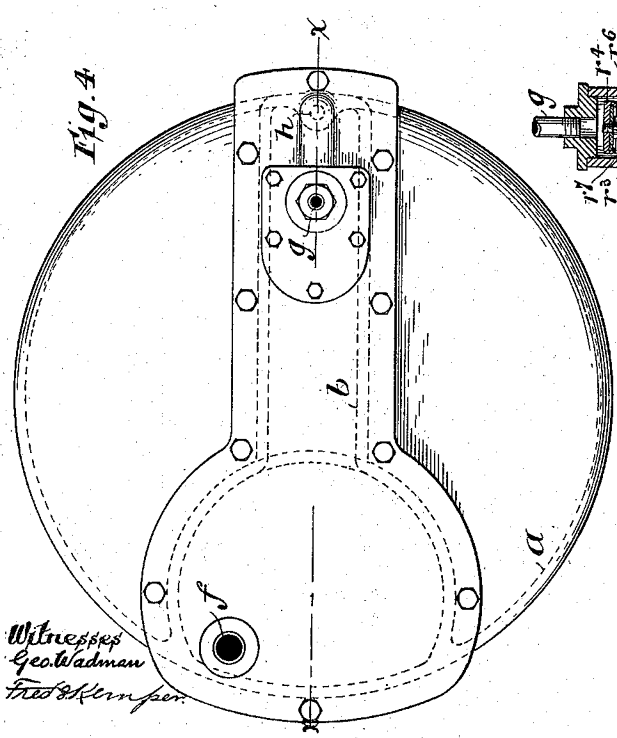

Fig. 4

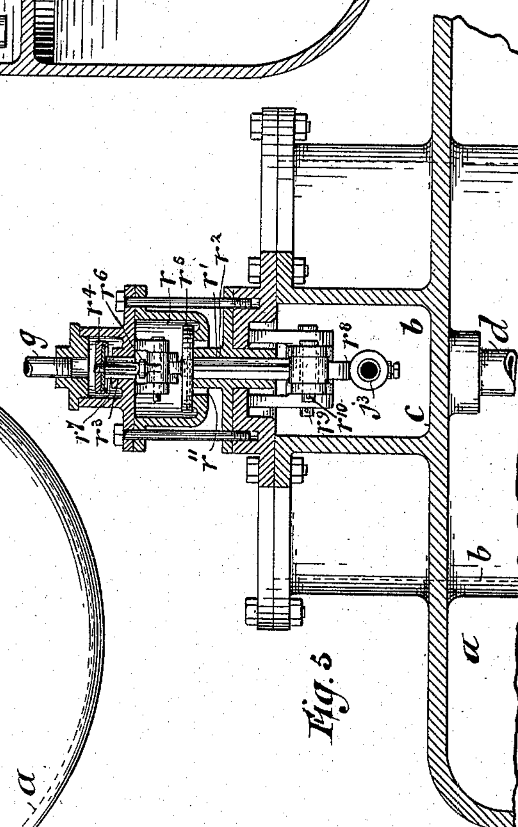

Fig. 5

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UNITED STATES PATENT OFFICE.

FRANK H. MERRILL, OF BOUND BROOK, NEW JERSEY, ASSIGNOR TO THE MERRILL MANUFACTURING COMPANY, OF NEW JERSEY.

LIQUID-RAISING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 533,229, dated January 29, 1895.

Application filed June 21, 1892. Renewed July 20, 1894. Serial No. 518,155. (No model.)

To all whom it may concern:

Be it known that I, FRANK H. MERRILL, of Bound Brook, in the State of New Jersey, have invented a new and useful Improvement in Liquid-Raising Apparatus, of which the following is a specification.

This invention is peculiarly adapted for use in the construction of a single acting pump although it may also be used in the construction of a double acting pump.

In single acting pumps as heretofore constructed, the shifting of the valve controlling the connection of the water compartment with the pressure and exhaust respectively, was determined either by the following of the compressed air up the water delivery pipe until the pressure was reduced by the reduced column of water, in which case the economy of the apparatus was sacrificed; or by the employment of a float in the water compartment to operate as a detector to determine by the changing level of the water when the valve should be shifted, in which case it has been practicable to only partially fill the water compartment.

By my invention I am enabled to overcome both of the above difficulties, as will be apparent from the following description.

In the accompanying drawings, I have shown two constructions of my invention.

Figure 1 is a vertical section of the first construction through line *z z* of Fig. 2. Fig. 2 is a vertical section of the same through the line *y y* of Fig. 1. Fig. 6 is a detail corresponding with a portion of Fig. 1 excepting that the parts are in a different position. Fig. 3 is a vertical section of a second construction through line *x x* of Fig. 4. Fig. 4 is a plan view of the same. Fig. 5 is a vertical section of the upper portion through line *x'*, *x'* of Fig. 3.

I will first describe the first construction and its mode of operation which is best adapted for high pressure.

a is the water compartment.

b is the supplemental water compartment both of which are included within the same shell and are separated from each other by a partition *c;* the compartment *b* forming an L around the top and one side of the compartment *a*.

d is a water passage pipe leading from near the bottom of the compartment *a* into the bottom of that portion of the compartment *b* which lies above the compartment *a* so that when the compartments are filling with water through the valve opening *e* at the bottom of the compartment *a*, the compartment *a* will be entirely filled with water before the water commences to enter the compartment *b* to which it has access through the pipe *d*.

e' is an upwardly opening valve by which the water entrance passage *e* is closed.

f is the water delivery pipe which leads from the bottom of the compartment *b*.

f' is a check valve in the water delivery pipe.

g is the compressed air supply pipe.

h is a passage connecting in certain conditions of the apparatus, the air supply pipe *g* with the top of the compartment *a* and in other conditions of the apparatus, connecting the top of the compartment *a* with the exhaust.

i is a passage connecting the top of the compartment *b* with the passage *h;* the entrance of *i* into *h* being closed by an outwardly opening check valve *i'* adapted to be held closed when *h* is connected with the compressed air supply pipe but to be open by the pressure of the air in compartment *b* as soon as *h* is connected with the exhaust.

j is a rotating valve operated by the arm *j'* to which arm is connected a float j^2 within the chamber *b*.

j^3 is a guide by which the motions of the float j^2 are confined to a vertical direction. The valve *j* in one position shown in Fig. 1, connects the exhaust passage *k* with the passage *l*, and in the other position, shown in Fig. 6, connects with the passage *l* the passage *m* leading from the compressed air supply pipe *g*. The passage *l* in turn connects with the interior of the cylinder *n* and also with the passage *l'* which in turn connects with the interior of the cylinder *o*. Within the cylinder *n* is located a vertically reciprocating piston *n'* and within the cylinder *o* is located a vertically reciprocating piston *o'*. The cylinder *o* opens at its lower end into a chamber o^2 communicating with the compressed air supply pipe *g* and this chamber communicates through the opening o^3 with a chamber o^4 from which leads the passage *h*. Upon the bottom of the piston o' is mounted a valve o^6 adapted to close the opening o^3 when the piston o' is in its lowermost position, shown in Fig. 6, and the star o^7 assists in guiding this valve and the piston o' vertically.

o^5 is an exhaust passage leading from the chamber o^8 and this chamber o^8 communicates above through the opening o^9 with the chamber o^4, and below with the cylinder n above the piston n'.

p is a valve adapted to close from above the opening o^9 and mounted upon the star p' by which it is fixed to the piston n' so that when that piston is in its lowermost position, as shown in Fig. 1, the opening o^9 will be closed and when in its uppermost position as shown in Fig. 6, the opening o^9 will be open.

The operation of the first form of apparatus is as follows: Suppose the compartments a and b to be full of water, as shown in Fig. 1, and the valves and pistons to be in the position therein shown. The compressed air from the pipe g will now communicate as indicated by the arrow, through the chamber o^2, the passage o^3, the chamber o^4 and the passage h with the compartment a forming a pressure within the compartment a which will close the valve e' and proceed to force the water from the compartment a through the pipe d into the compartment b and thence into the delivery pipe f. When the water has been forced from the compartment a to below the level of the opening into the pipe d, the air will follow up through the pipe d into the compartment b and occupy the upper portion of the compartment b until the water therein has been forced low enough to drop the float j^2 from the position shown in Fig. 1, into the position shown in Fig. 6. This produces a corresponding movement of the arm j' and valve j. Now, the passage l instead of being, as before, connected with the exhaust passage k is connected by the movement of the valve j with the pressure passage m and consequently compressed air is supplied to the cylinder o above the piston o', and to the cylinder n below the piston n'. The pressure above the piston o' will be aided by the weight of the piston and by the suction of the compressed air passing downward through the passage o^3 to force the piston o' and the valve o^6 connected therewith, downward so as to close the passage o^3. At the same time, the pressure below piston n' will, by reason of the greater area of surface presented thereto, overcome the downward pressure in opposition thereto on the top of the valve p and will force the piston n' and the valve p upward so as to open the passage o^9 and connect the chamber o^4 and therefore the passage h with the exhaust passage o^5, as shown in Fig. 6. The pressure from the passage h being thus released, the back pressure in the chamber b will open the check valve i'. Thus, both the chamber a and the chamber b will be cut off from the pressure passage g and communicated with the exhaust and thereupon the gravity of the water surrounding the compartments a and b will open the valve e' and fill both of those compartments. As soon however, as the filling of the compartment b has proceeded far enough to raise the float therein, the valve j will be rotated back to its first position and the passage l being thereby cut off from the pressure and connected with the exhaust, the downward pressure upon the piston o will be relieved and the upward pressure upon it in the chamber o^2 will cause it to raise and permit the compressed air to communicate with the compartment o^4 and therefore with the passage h. At the same time, the pressure being relieved from below the piston n' the weight of that piston and the parts connected therewith will cause it to fall and seat the valve p which will thereafter be held securely seated so long as the pressure is in communication with the chamber o^4.

The packing in the joint between the cylinder head p^2 and the cylinder o is extended so as to overhang the outward edges of the piston o' and an upwardly extending flange or rim p^3 is provided on the outer edge of o' adapted to embed itself into said packing when the piston is in its uppermost position so as to insure a tight contact.

p^4 is a packing laid upon the upper side of the piston n' and a downwardly extending rim, bead or flange p^5 is provided around the upper end of the cylinder n, which bead embeds itself in the packing p^4 when the piston n' is in its uppermost position and secures tightness of contact.

As will be seen by reference to the drawings, the apparatus shown is cast in the following parts: first, a stand q upon which the whole structure is supported from below; second, a casting extending from the top of the stand to the line q' containing the compartments a and b; third, a casting extending to the line q^2 containing the cylinder n and the parts surrounding it; fourth, a casting q^3 bolted to the bottom of the casting last referred to and hanging within the chamber b containing the chamber for the valve j and the head of the cylinder n and a portion of the passages l, h and m; fifth, a casting extending above the line q^2 to the line q^4 containing the chambers o^4, o^2, the cylinder o and the passages surrounding the same; sixth, a casting q^5 constituting the head for the cylinder o and containing a portion of the passage l'.

The second construction is best adapted for low pressure. I will next describe so much of it as differs substantially from the first.

r is a chamber which will be alternately connected with the pressure in the pipe g and with the exhaust and with which chamber the pipe h is connected and which chamber is also connected with the compartment b by means of a passage r' through which extends the star r^2. In addition to the passage r' connected with the chamber r is the passage r^3 by which it communicates with the pressure passage g. The passage r^3 is closed by the upwardly opening valve r^4 and the passage r^2 is closed by the upwardly opening valve r^5 mounted upon the top of the star r^3 and connected with the valve r^4 by means of a train of mechanism consisting, in the construction shown, of a lever r^6 and the star r^7 extending through the passage r^3.

j^2 is a float within the water compartment b which is mounted upon an arm j^3 carrying at its opposite end the counterpoise j^4. This arm is secured to a bell crank lever r^8 fulcrumed at r^9 and pivoted by pivot r^{10} to the lower extremity of the star r^2. The opening through which the pivot r^{10} extends in the extremity of the star is larger than the pivot both longitudinally (to provide for the circular motion of lever r^8) and vertically (to permit of slight vibrations of the float without moving the valve).

The operation of the second form of apparatus is as follows: Suppose the parts of the apparatus to be in the position shown in Fig. 3. Now, the valve r^4 is open and the valve r^5 is closed connecting the pressure pipe g with the top of the compartment a through the passage h. The pressure of air in the top of the compartment a will close the valve e' and force the water out of the compartment a through the pipe d into the compartment b and thence into the water delivery pipe f. As soon as the water has descended in the compartment a below the bottom of the pipe d, the air under pressure will follow it up through the pipe d into the compartment b. When the water in the compartment b has descended so as to drop the float j^2, the train of mechanism connecting this float with the valve r^5 will raise that valve and open communication between the compartment b and the chamber r. The valve r^5 closes not merely the passage r' but also a series of perforations r^{11} surrounding the passage r' and forming an exhaust so that when the point in the operation already described is reached, the compartment b will be connected with the exhaust. At the same time that the valve r^5 opens, it moves the lever r^6 so as to remove the support of the valve r^4 and consequently the pressure upon the top of that valve will drop by its own weight combined with the suction of the draft of air through the opening beneath it cutting the chamber r off from the pressure passage g.

The communication of the passage r with the exhaust as above described, of course creates a communication of the compartment a with the exhaust through the passage h and the chamber r. Now, the compartments a and b being both communicated with the exhaust the gravity of the water surrounding them will open the valve e' and fill both of the compartments, filling the compartment a first, and lastly the compartment b; so that both compartments will be practically full when the buoyancy of the water in the compartment b raises the float j^2 and closes the valve r^5 and opens the valve r^4 by the train of mechanism connecting the float with those two valves.

The pressure on top of the valve r^4 when it closes, is such that the valve will retain its seat against the force generated by the float until that force has increased to a considerable extent, and as soon as that force has increased sufficiently to unseat the valve and permit the compressed air to get beneath it, the opening of it to its fullest extent will be instantaneous. The same character of operation in the reverse direction will take place when the valve o^5 is closed and the valve o^4 is opened.

It will be observed that in both the modifications above described, the closing of the valve is independent of the column of water being raised and that the compartments are cut off from the pressure supply before any loss of the compressed air commences through the delivery pipe; also that when the water acts upon the float to turn on the pressure, it has already filled all that part of the water compartment which is of extensive horizontal area and lacks only the filling of the upward extension or supplementary part of the water compartment which may be of such trifling horizontal area as that the water lacks only a small amount of the total capacity of the whole water compartment; because the float at the instant it acts to turn on the pressure occupies the horizontally small extension or supplement of the main water compartment, which horizontally small extension or supplement of the main compartment, in the particular form of construction which I have shown for the purpose of illustrating my invention, the float occupies at all times being in this particular form cut off by the partition c from the horizontally extended portion of the water compartment.

I claim—

1. In a liquid raising apparatus operated by compressed gas in combination, a liquid compartment a, a connecting supplementary compartment b of relatively small horizontal area, a float located in said supplementary compartment, an inlet and outlet liquid passage, an inlet gas passage, a valve controlling the gas inlet and means whereby the upward motion of the float as the liquid accumulates in the supplementary compartment opens said valve and the downward motion of the float closes the same; both of said compartments being below the liquid level, substantially as described.

2. In a liquid raising apparatus in combination, a primary liquid compartment provided with inlet water and gas passages, a supplementary liquid compartment, a pipe leading thereinto from near the bottom of the primary liquid compartment, a liquid delivery pipe leading from said supplementary compartment, a float in said supplementary compartment, a valve controlling said gas inlet passage and means whereby the rising and falling of said float are communicated to

cause the opening and closing of said valve; both of said compartments being below the liquid level, substantially as described.

3. In a liquid raising apparatus in combination, primary and secondary liquid compartments located below the liquid level, gas and liquid inlet passages to said primary compartment, gas and liquid outlet passages from said secondary compartment, a passage leading from near the bottom of the primary to the secondary compartment, valves controlling said inlet and outlet gas passages, a float located in the secondary compartment and means whereby the motions of said float are caused to alternately open and close said valves, substantially as described.

4. In a liquid raising apparatus in combination, primary and secondary liquid compartments located below the liquid level, inlet liquid and gas passages connecting with the primary compartment, a passage leading from near the bottom of the primary compartment to the secondary compartment, a liquid delivery pipe leading from near the bottom of the secondary compartment, a gas exit passage from the secondary compartment, valve mechanism controlling said gas inlet and exit passages, a float in said secondary compartment, means whereby the motions of said float are communicated to said valve mechanism, substantially as described.

5. In a liquid raising apparatus a vessel divided by the partition c into the primary liquid compartment a and secondary liquid compartment b, gas and liquid entrance openings into the compartment a, a passage leading from near the bottom of the compartment a to compartment b, a liquid delivery pipe leading from near the bottom of compartment b, a gas exit passage leading from compartment b, a float in compartment b and valve mechanism connected with said float whereby said gas entrance and exit passages are opened alternately as the water rises or falls in the compartment b, substantially as described.

6. In a liquid raising apparatus in combination a pressure chamber provided with liquid inlet and outlet passages, a gas inlet passage and the following mechanism whereby said inlet gas passage is controlled, viz: a chamber o^4 provided with openings into pressure and exhaust passages, valves o^6 and p controlling said openings, pistons o' and n' connected with said valves, a valve j, a pressure passage m leading to said valve, an exhaust passage k leading from said valve and a passage $l\ l'$ leading from said valve to the cylinders of said pistons, substantially as described.

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