No. 644,618. Patented Mar. 6, 1900.

D. H. MAURY, JR.

PUMPING MACHINERY.

(Application filed Mar. 28, 1898.)

(No Model.) 4 Sheets—Sheet 1.

FIG. 1

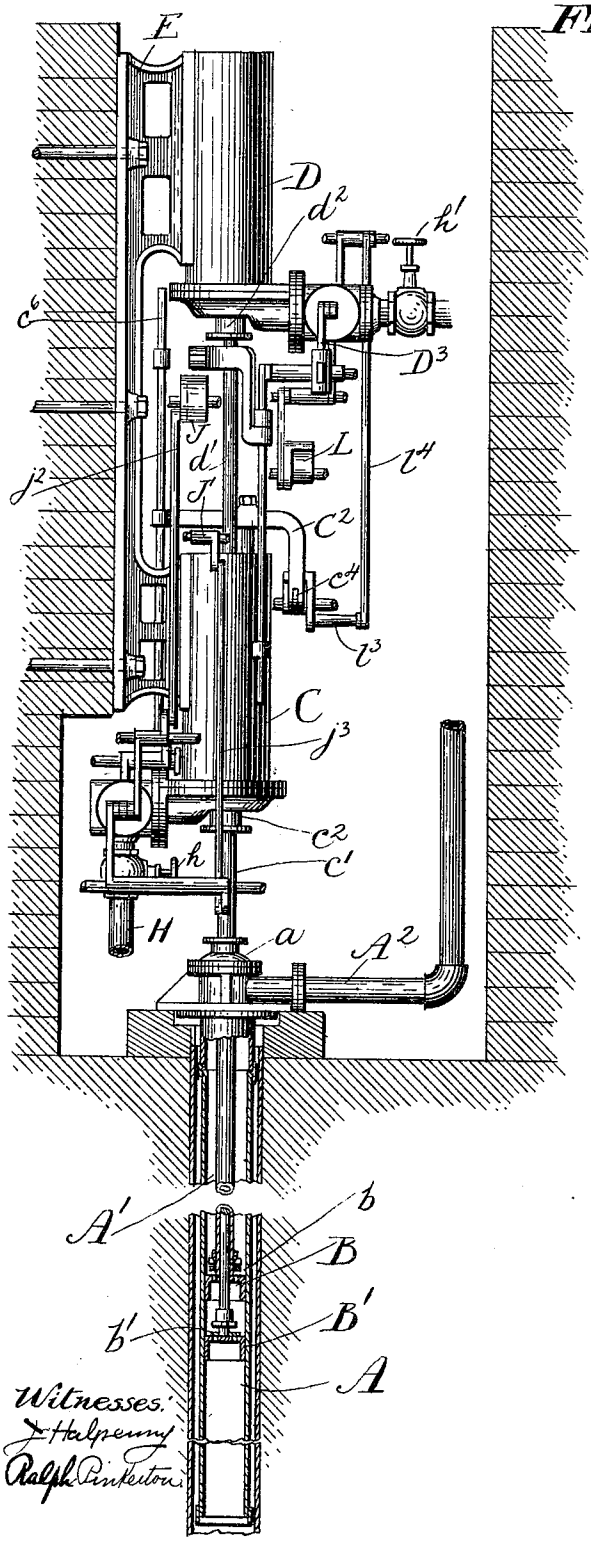
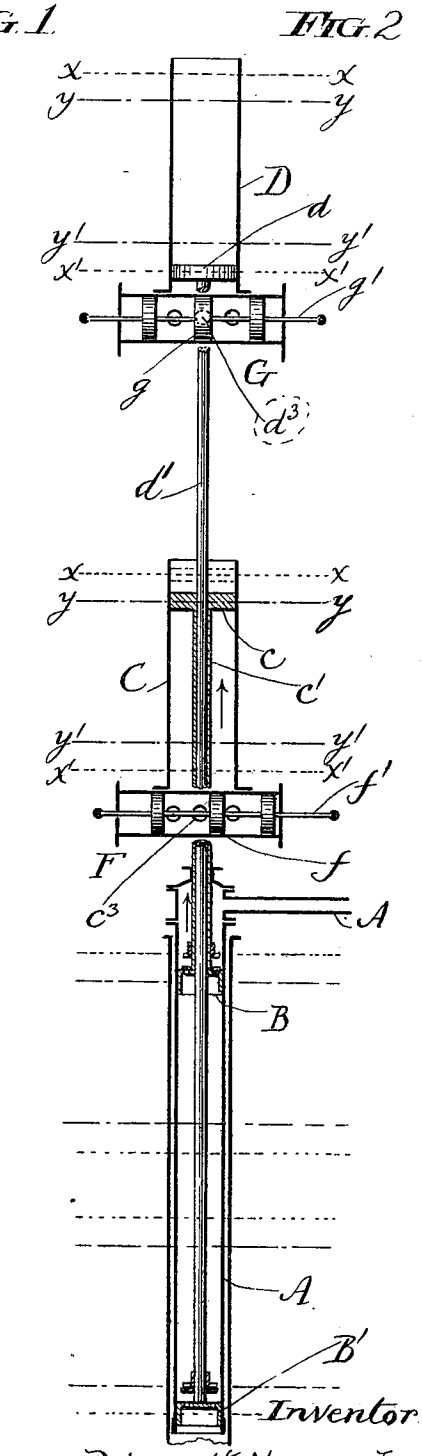


FIG. 2



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FIG. 3

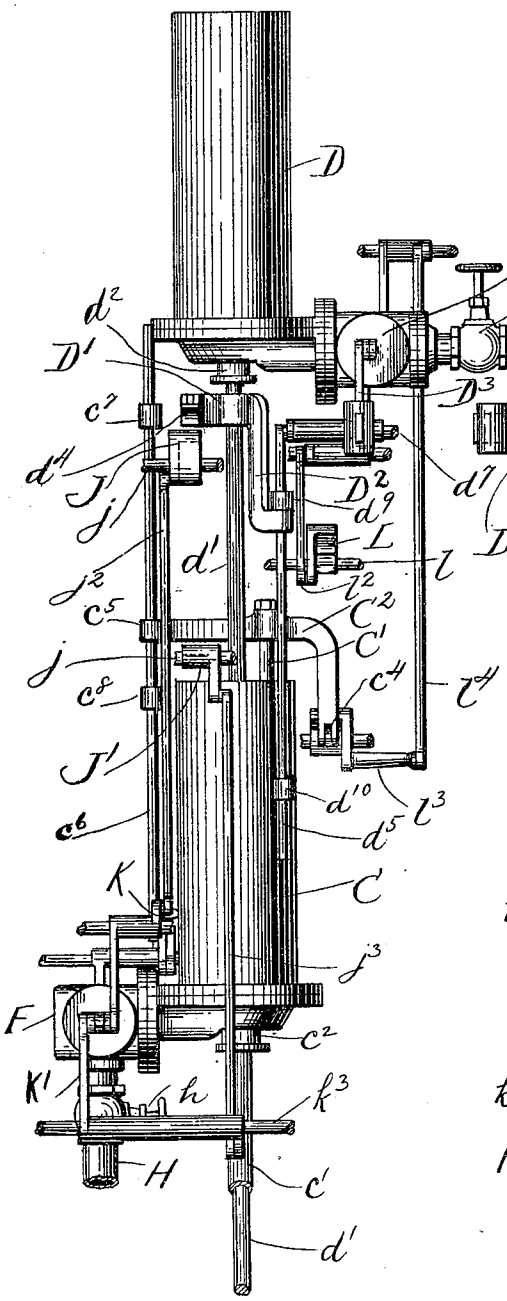
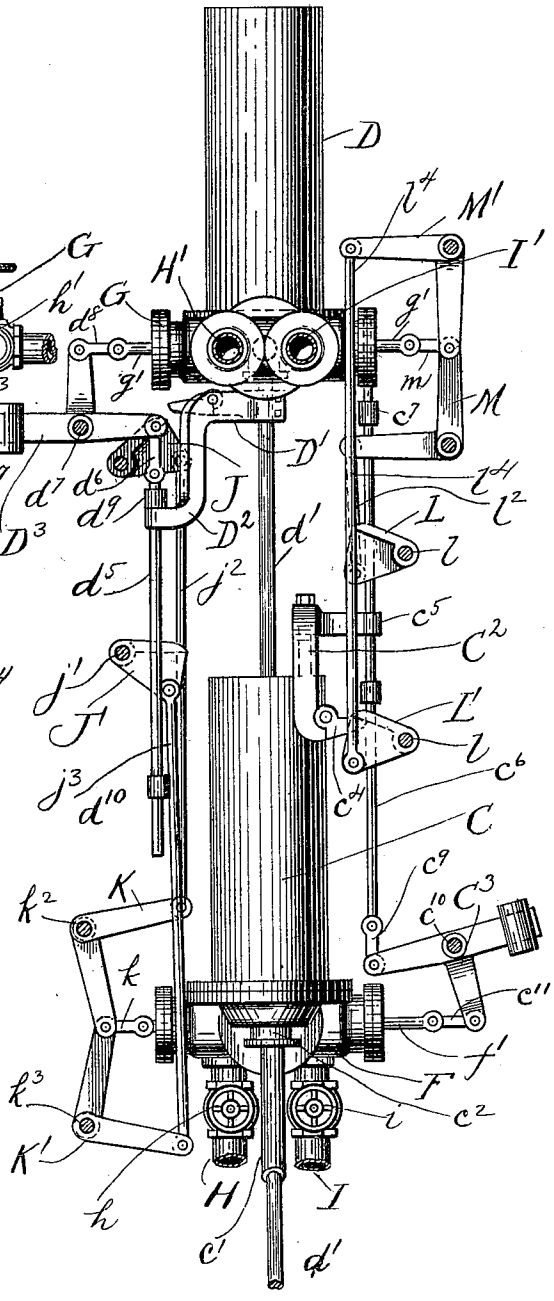


FIG. 4



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FIG. 5.

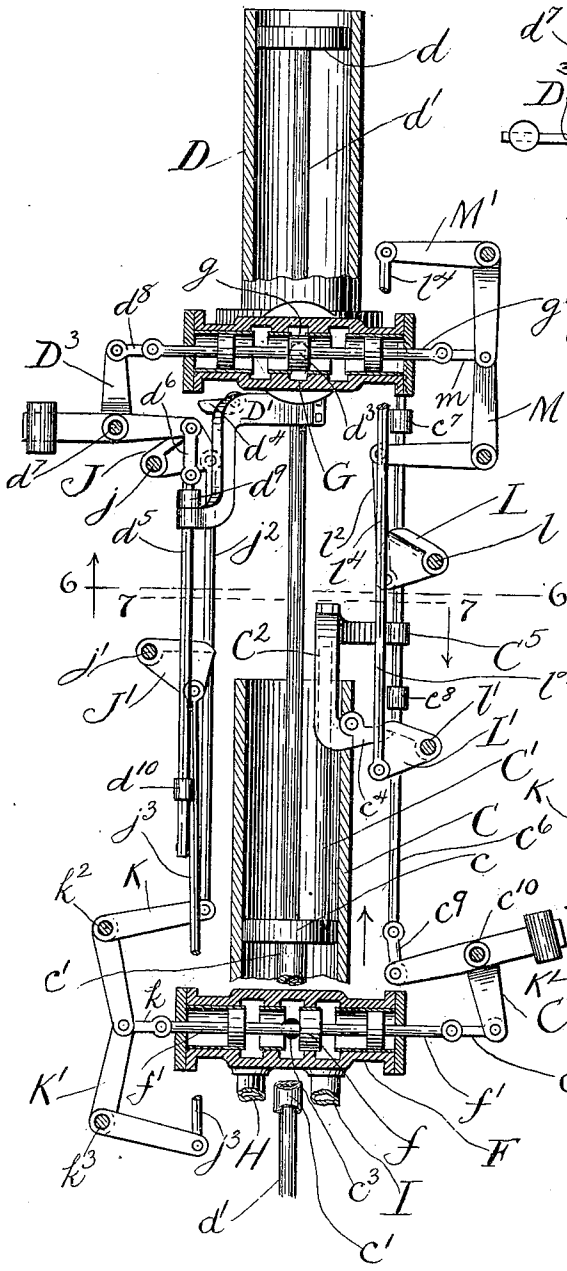


FIG. 6.

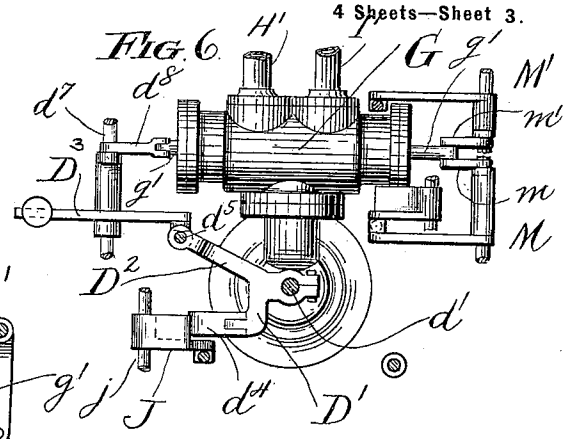


FIG. 8.

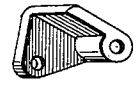
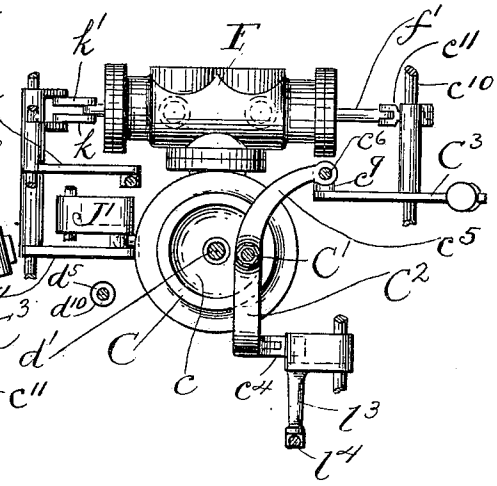


FIG. 7.



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No. 644,618. Patented Mar. 6, 1900.

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PUMPING MACHINERY.

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(No Model.) 4 Sheets—Sheet 4.

FIG. 9.

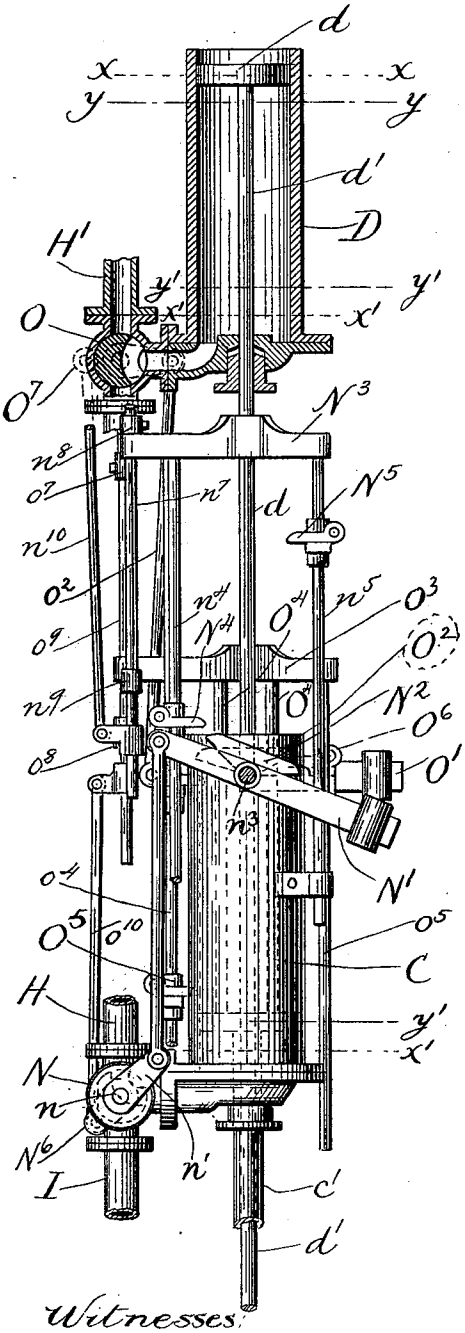
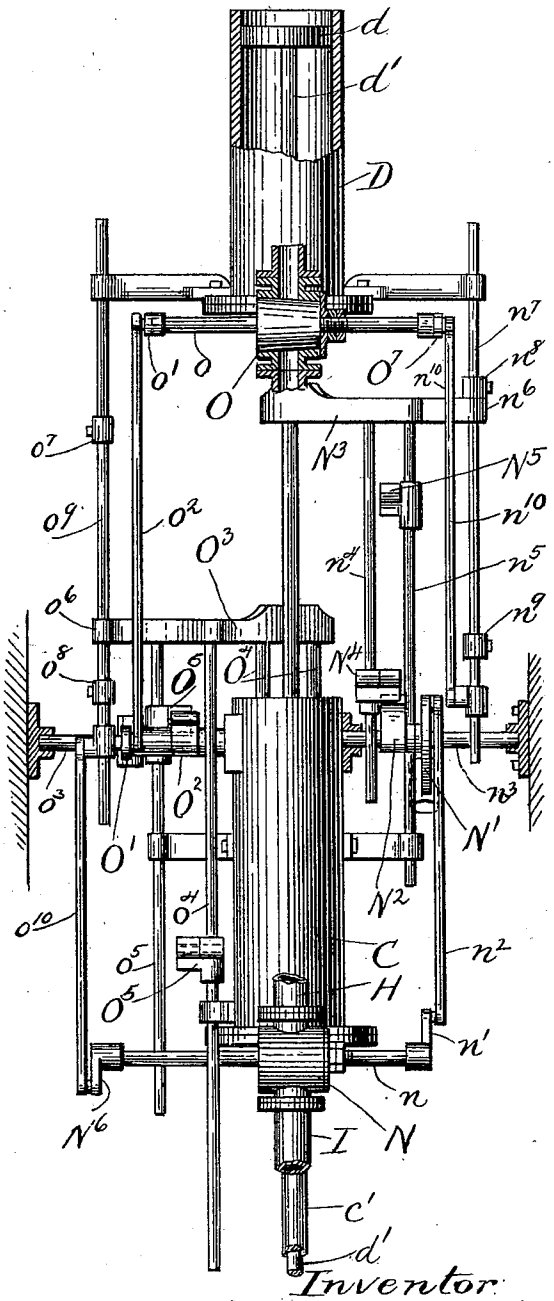


FIG. 10.



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UNITED STATES PATENT OFFICE.

DABNEY H. MAURY, JR., OF PEORIA, ILLINOIS.

PUMPING MACHINERY.

SPECIFICATION forming part of Letters Patent No. 644,618, dated March 6, 1900.

Application filed March 28, 1898. Serial No. 675,372. (No model.)

To all whom it may concern:

Be it known that I, DABNEY HERNDON MAURY, Jr., of Peoria, in the county of Peoria and State of Illinois, have invented certain new and useful Improvements in Pumping Machinery, of which the following is a specification.

This invention relates to pumping machinery of that class in which the flow of the discharge-column is maintained continuous and in large degree constant by means of two single-acting plungers operating in alternation with a relatively-slow working stroke and quick return, after the manner set forth, for example, in the patent of Edward E. Johnson, No. 595,175, granted December 7, 1897.

The object of the present invention is to provide a fluid-actuated power-head for effecting a plunger movement of the character referred to; and it consists in the matters herein set forth, and particularly pointed out in the appended claims.

A pump-head embodying my invention is provided with two single-acting pistons, each of which is designed to be connected with one of the single-acting plungers of the pump. Fluid-pressure is admitted to the cylinder of each piston to effect the working stroke of that piston by a valve which is opened by the movement of the other piston just previous to the close of the working stroke of the latter. This working stroke of the second piston is determined in turn by the closing of the admission-port of its cylinder as soon as the first piston is well started. The exhaust-port of this second cylinder is then opened for the return stroke of the second piston, and the exhaust is so regulated that by the time the first piston reaches the point near the end of its working stroke, at which it will open the admission-valve of the second cylinder, said return stroke of the second piston will have been completed, ready for its next working stroke to begin when the admission-valve of its cylinder is thus opened. In this manner the working strokes of the pistons, and consequently of the plungers, are made to overlap, and the discharge-column is therefore never free from the impelling action of the one or the other of the plungers. The two pistons travel in the same direction for a brief interval at the beginning and end of the working stroke of each, but never travel simultaneously in the opposite or return direction, the return stroke of each piston being entirely accomplished while the working stroke of the other piston is still in progress.

Pumping machinery of the type under consideration is especially adapted for pumping from deep wells of small diameter in which the pump-plungers are placed one above the other within a single cylinder and operated by plunger-rods, of which one is tubular, while the other reciprocates through it. A convenient and satisfactory arrangement of the power-head in this case is to place its cylinders "tandem" and in line with the pump-cylinder and let the hollow plunger-rod connect with the lower piston, while the inner plunger-rod extends up through the lower piston and connects with the upper piston. The head may be actuated by steam, air, water, or other fluid pressure, as found convenient in each situation, and the precise construction of its valves will depend largely upon the nature of the particular fluid used, although the general operation of the valve movement must obviously be substantially the same in each case.

In the accompanying drawings, Figure 1 is a general view, in sectional elevation, of a deep-well pump and actuating-head constructed in accordance with my invention in one form. Fig. 2 is a diagrammatic view showing the relative positions of the pistons, plungers, and valves at a different point in the stroke. Fig. 3 is an enlarged side elevation of the power-head alone. Fig. 4 is a front eleavtion thereof. Fig. 5 is a sectional elevation thereof. Fig. 6 is a bottom plan section taken on line 6 6 of Fig. 5. Fig. 7 is a top plan section taken on line 7 7 of Fig. 5. Fig. 8 is a perspective detail of one of the pivoted tappet-blocks. Figs. 9 and 10 show side and front elevations of a fluid-actuated power-head constructed in accordance with my invention, but provided with a valve mechanism of a form somewhat modified from that previously shown.

In said drawings, A designates the pump-cylinder, and B B′ valved plungers arranged one above the other within said cylinder and having valves, such as *b b′*, which open upwardly and permit the current to flow freely

upward through the plungers, but close instantly against any return or downward movement thereof. The cylinder A is, in effect, simply a lower section of a continuous vertical pipe A′, from the upper end of which a discharge-pipe A^2 leads off to any connection or outlet desired—as, for example, to the service-pipes or reservoir of a waterworks system. The upper plunger B is attached to the lower end of a tubular plunger-rod, while the lower plunger B′ is similarly attached to a smaller plunger-rod, which extends upwardly through the tubular plunger-rod of the upper plunger and reciprocates freely therein. Both of said rods extend upwardly the full length of the pipe A′ and pass out of the latter through any suitable packing-box *a*. The parts thus described may be of any suitable construction, as they constitute in themselves no part of my present invention, except as considered broadly in connection with the actuating-head, which imparts movement to the plungers and which is in this instance constructed as follows:

C D designate, respectively, two single-acting cylinders arranged tandem or one above the other upon a vertical axis coincident with the axis of the pump-cylinder and plungers. Said cylinders may be held in this arrangement by any suitable supporting-framework, and in the construction shown in Fig. 1 are conveniently bolted to a rigid base-plate E, which is shown as anchored to the masonry walls of the pump-pit. A piston *c* within the lower cylinder is attached to a tubular piston-rod *c′*, which extends downwardly out of the cylinder through a packing-box c^2 and is connected with a tubular plunger-rod of the upper plunger B of the pump. In the same manner a piston *d* in the upper cylinder is attached to a smaller piston-rod *d′*, which extends downwardly out of the cylinder through a packing-box d^2 and thence through an aperture in the lower piston *c*, into the tubular rod *c′* of the latter, where it connects with the plunger-rod of the lower plunger B′ of the pump. In other words, the upper plunger and lower piston are each attached to the same tubular rod, while the lower plunger and upper piston are each attached to the smaller rod, which extends freely through the tubular rod and can reciprocate therein.

The valve mechanism of the pump-head is such that the admission and exhaust of the actuating fluid in the upper cylinder will be controlled by the movement of the lower piston and in the lower cylinder by the movement of the upper piston, so that while the piston and plunger movements are mechanically independent, as above stated, their alternation in the manner desired is nevertheless maintained. The actuating-head illustrated in this instance is designed more particularly for hydraulic power, and its valves are shown as consisting of two balanced piston-valves F G, which respectively control the admission and exhaust of the water-pressure to and from said cylinders C and D. A port C^3 leads from the cylinder C centrally into the valve F and will be placed in communication either with an inlet-pipe H or an outlet-pipe I or will be cut off from communication with either, according to the position of a controlling-piston *f*. A valve-stem *f′* is attached to the valve-piston *f* and connects it with the valve-actuating mechanism. In the same manner a valve-piston *g* on the valve-stem *g′* of the valve G controls communication between a port d^3, which leads into the cylinder D, and supply and exhaust pipes H′ and I′.

The operation of the valves will be generally as follows: As the upper piston approaches the end of its working stroke it moves the valve-piston *f* to admit pressure beneath the lower piston *c* and starts the latter on its working stroke. As soon as this piston is well under way it moves the valve-piston *g* to close the admission-port of the upper cylinder D and brings the upper piston *d* to rest. The position of the parts at this instant is shown in Figs. 1, 3, 4, and 5 of the drawings. The continued upward movement of the lower piston, however, moves the valve-piston *g* still farther and opens the exhaust of the cylinder D, permitting the piston *d* to descend, and such exhaust will be made relatively free, so that the descent will be accomplished considerably in advance of the completion of the upward or working stroke of the lower piston *c*. The exhaust from the upper cylinder is then closed and pressure again admitted to said cylinder by the movement of the lower piston as the latter approaches the upper limit of its working stroke, the relative positions of the parts at this point in the movement being shown somewhat diagrammatically in Fig. 2. The next working stroke of the upper piston *d* is thus started and almost immediately terminates the working stroke of the lower piston by moving the valve-piston *f* to close the admission-port of the lower cylinder. In its continued upward movement the upper piston then opens the exhaust-port of the lower cylinder to permit the descent of the piston *c* and later closes the exhaust and opens the inlet port again to start the next working stroke of the lower piston.

Various mechanical movements may obviously be devised for controlling the valves in the manner described. As herein shown, the mechanism furnished for this purpose is constructed as follows:

D′ designates an arm rigidly clamped to the upper piston-rod *d′* and carrying a pivoted tappet-pawl d^4. Said pawl is designed to engage and operate in succession on its upward stroke two pivoted tappet-blocks J and J′, but on its downward stroke is designed to pass freely by said blocks without moving them, and to this end said pawl is pivoted in such manner as to swing upward freely, while held against downward movement beyond an ap-

proximately horizontal position. The tappet-blocks J and J′ swing upon pivots j and j', which are supported in the framework of the machine in any suitable manner, not herein illustrated. The upper tappet-block J is connected by a link j^2 with one end of a bell-crank lever K, the other end of which is connected by a link k with one end of the stem f' of the valve F, which controls the flow of the actuating fluid to and from the lower cylinder. The lower tappet-block J′ is similarly connected by a link j^3 with a bell-crank lever K′, which in turn is connected by a link k' with said valve-stem f. The lever K oscillates about a suitable stationary supporting-pivot k^2, located above the valve, and the lever K′ oscillates upon a similar pivot k^3, located below the valve. This results in a reverse arrangement of the bell-cranks which results in reverse movements of the valve-stem as the tappet-blocks are swung in succession by the tappet-pawl. Thus as said pawl first begins its upward movement it strikes the tappet-block J′ and moves the valve-stem f' to close the inlet and open the exhaust of the lower cylinder, and thereby terminate the upward stroke of the lower piston and start its downward or return stroke. Then as said lower piston reaches the lower end of its cylinder the pawl strikes the upper tappet-block J and moves the valve-stem back to close the exhaust and open the inlet of the lower cylinder, thereby terminating the downward stroke of the piston c and starting it upon its working stroke again. In substantially the same manner the valve G is controlled by the movement of said lower piston. A rigid rod C′ projects upward from the piston c and carries at its upper end an arm C^2, to which a tappet-pawl c^4 is pivoted in such manner as to be capable of swinging freely upward, while held against downward movement beyond a substantially horizontal position. Tappet-blocks L and L′ are mounted upon suitably-supported pivots l and l' in the path of this pawl and are adapted to be oscillated in succession by the latter. The upper tappet-block L is connected by a link l^2 with a bell-crank lever M, which in turn is connected by a link m with the stem g' of the valve G, and the lower tappet-block L′ has a rigid laterally-extending lug l^3, through which it is connected by a link l^4 with a bell-crank lever M′, arranged reversely to the bell-crank M and also connected with the valve-stem g' by a link m'. In the first part of its upward movement the pawl c^4 oscillates the lower tappet-block L′ and moves the valve-stem g' to close the inlet and open the exhaust of the upper cylinder, and thereby terminate the working stroke of the other piston and start its downward stroke. Then as said upper piston reaches the lower end of the upper cylinder the pawl c^4 strikes the upper tappet-block L and moves the valve-stem g back to close the exhaust and open the inlet of the upper cylinder, thereby starting the piston d upward on its working stroke again. In Figs. 1, 3, 4, and 5 the parts are shown in the positions occupied as the lower piston reaches that point just after beginning its upward movement, at which the inlet of the upper cylinder is closed to terminate the upward stroke of the piston d and just before the exhaust of said upper cylinder is opened to start said piston d on its return stroke. It will be noted that the contact of both pawls with their tappet-blocks not only operates the valves, as described, but also serves in each case to bring the other tappet-block into position to be moved by the pawl in turn, and the operation of the mechanism is thus continuously maintained. The return or working stroke of the pistons and plungers is designed to be accomplished in the construction thus shown by the weight of the parts; but it will be obvious that fluid-pressure may also be applied upon the upper surfaces of the pistons to accelerate the action, if found desirable. In any case, moreover, it will usually be found desirable to provide means for adjustably regulating the inlet and exhaust to meet the varying conditions of service, and to this end I have shown ordinary globe-valves h and i in the inlet and exhaust pipes H and I of the valve F and similar valves h' and i' in the inlet and exhaust pipes H′ and I′ of the valve G. By the adjustment of these valves, and particularly of the valves in the exhaust-pipes, the velocity of the downward stroke of each piston may easily be so regulated that the full return will be completed in the exact interval which elapses between the opening and closing of the exhaust by the movement of the other piston, and I am thus enabled to guard, on the one hand, against an unnecessary shortening of the downstroke, due to a too-early closing of the exhaust, and, on the other hand, against the possibility of contact between the piston and cylinder-head, due to a too-late closing of the exhaust.

To further guard against the possibility of accident due to a failure of the valve mechanism to terminate the stroke of either piston in either direction, safety devices are herein shown as provided for the purpose of causing each piston to operate its own valve to terminate its movement in case of a failure of the regular valve mechanism to operate said valve in time, these devices being in this instance constructed as follows:

D^2 designates a stop-arm projecting from the arm D′, which carries the pawl d^4 or otherwise rigidly secured to the piston-rod d' or other part which moves with the piston d. The end of the arm D^2 is apertured to embrace loosely a rod d^5, which is connected by a link d^6 with a bell-crank lever D^3. The latter is mounted to oscillate upon a suitable supporting-pivot d^7 and is connected by a link d^8 with the valve-stem g'. Stops d^9 and d^{10} are provided on the rod d^5 above and below the stop-arm D^2 and are so located that before the piston d reaches the proper limit of its

movement in either direction said stop-arm will come in contact with one or the other of the stops, and thus operate the valve-stem g' to close the port d^3 of the cylinder D in case at any time said valve-stem has not been already moved to accomplish this result by the contact of the pawl c^4 with one or the other of the tappet-blocks L or L'. In a similar manner an arm c^5, rigidly secured to the piston c to move therewith and herein shown as projecting from the arm C^2, which carries the pawl c^4, is apertured to loosely embrace a rod c^6, having stops c^7 and c^8, with which the arm c^5 may contact at opposite ends of the piston movement. Said rod is connected by a link c^9 with a bell-crank lever C^3, which is mounted to oscillate about a supporting-pivot c^{10} and is connected by a link c^{11} with the valve-stem f'. The stops c^7 and c^8 are so located on the rod c^6 that the action of the stop-arm c^5 against them will be relatively the same as that of the stop-arm D^2 on the stops d^9 and d^{10} of the rod d^5—that is to say, before the piston c reaches the proper limit of its movement in either direction the contact of the arm c^5 with one or the other of the stops will operate the valve-stem f' and close the port c^3 of the cylinder C in case said valve-stem has not been already moved in this manner by the contact of the pawl d^4 with one or the other of the tappet-blocks J or J'.

From a consideration of the operation of the devices last described it will appear that a complete valve mechanism for controlling a fluid-actuated head to effect a plunger-movement of the peculiar character which this invention contemplates might be designed in which the stroke of each piston in one or both directions would be terminated by the movement of that piston instead of by the movement of the other piston, and such a construction would be within the scope of my invention, although for certainty of action and for other practical reasons it is considered preferable to control the entire valve-movement of each cylinder by the movement of the piston in the other cylinder after the manner hereinbefore described.

In Figs. 9 and 10 I have shown a valve mechanism differing in its specific construction from that previously illustrated, but involving the same general principles of operation. In these figures the inlet and exhaust of the cylinders C and D are controlled by oscillatory plug-valves N and O, respectively. The stem n of the valve N is provided with a rigid radial arm n', which is connected by a link n^2 with an oscillatory lever N'. This lever is pivotally mounted upon a supporting-shaft n^3 and has rigidly attached to it to oscillate therewith a double-ended tappet-arm N^2. A cross-head N^3 is rigidly secured to the piston-rod d' and carries two depending bars n^4 n^5, upon which tappet-pawls N^4 N^5 are pivotally mounted in such manner as to be capable of swinging freely upward while held against downward movement beyond their normal horizontal position. The pawl N^4 is considerably below the pawl N^5, and its location relatively to the adjacent end of the tappet-arm N^2 is such that it will oscillate said arm and work through the connections described to shift the valve N, so as to cut off communication between the cylinder C and the exhaust-pipe I and open communication between the said cylinder and the inlet-pipe H just before the upper piston d reaches the upper limit of its movement. In the downward movement of the piston d both of said pawls will slip freely past the tappet-arm by reason of their pivotal mounting; but as said piston begins to rise again on its next working stroke the pawl N^5 will oscillate the arm N^2 in a reverse direction and shift the valve N again to close the inlet and open the exhaust of the cylinder C. In this manner the movement of the lower piston c will obviously be controlled by the working movement of the upper piston d in accordance with the principles hereinbefore stated. In like manner also the working movement of the lower piston controls the movement of the upper piston through similar connections. The valve O is provided with a stem o, having at one end a rigid radial arm o', which is connected by a link o^2 with an oscillatory lever O' similar to the lever N^2 and herein shown as located diametrically opposite to the latter near the upper end of the lower cylinder. The lever O' is pivotally supported upon a shaft o^3 and has rigidly attached to it to oscillate therewith a rocking tappet-arm O^2. A cross-head O^3, carried by bars O^4, that are rigidly connected with the lower piston c, has depending from it two bars o^4 and o^5, upon which tappet-pawls O^5 and O^6 are pivotally mounted in the same manner as the pawls N^4 and N^5. The location of these pawls with respect to the tappet-arm O^2 is the same as that of said pawls N^4 and N^5 with respect to the tappet-arm N^2, and the movement of the lower piston will therefore operate through these connections to open and close the inlet and exhaust of the upper cylinder precisely as the movement of the upper piston is described as opening and closing the inlet and exhaust of the lower cylinder. Safety devices to insure against failure of the valves to close at proper times in each piston movement are also provided in this construction substantially as before. A stop-arm n^6 projects from the cross-head end N^3 and loosely embraces the vertical rod n^7, upon which stops n^8 and n^9 are fixed in such relation that the stop-arm n^6 may come in contact with them at opposite ends of the piston movement. A link n^{10} connects the rod n^7 with a rigid radial arm O^7 on the stem of the valve O, and if it should happen that for any reason the movement of the lower piston should fail to operate the valve O when the upper piston reaches the proper limit of its movement said upper

piston would by this means itself close the valve O at the right moment. In the same way a stop-arm o^6 on the cross-head O^3 reciprocates between stops o^7 and o^8 on a vertically-movable rod o^9. Said rod is connected by a link o^{10} with a rigid radial arm N^6 on the stem of the valve N, so that the movement of the lower piston may operate to close said valve in case the movement of the upper piston should fail to do so in time.

The lines $x\,x$ and $x'\,x'$ shown in Figs. 2 and 9 indicate the positions of the pistons at the extremities of their movements, and the lines $y\,y$ and $y'\,y'$ shown on said figures indicate the points near the extremities of the stroke at which each rising piston shifts the valve of the other cylinder. Obviously with the mechanism herein illustrated such shifting of the valves will not take place instantly; but said lines $y\,y$ and $y'\,y'$ may be understood to indicate the approximate point in the piston movement at which the shifting occurs. The exact distance of said lines from the lines $x\,x$ and $x'\,x'$ is not material and may vary widely without interfering with the satisfactory working of the machine, the prime desideratum being that each piston shall have attained approximately its normal velocity before the velocity of the piston which is just completing its working stroke is noticeably reduced, and if this condition is maintained the desired constant flow of the discharge-column is effected no matter at what precise point the load is shifted from one piston to the other. It will also be understood that various changes, both in the general design and structural details of the head described, may be made without departing from the spirit of the broad invention.

I claim as my invention—

1. An actuating mechanism for double-plunger pumps, comprising a single-acting actuating-cylinder and piston for each plunger, an independent exhaust and admission valve for each cylinder, and means for closing and opening the valve of each cylinder during each working stroke of the other piston by the movement of the latter.

2. An actuating mechanism for double-plunger pumps, comprising an actuating cylinder and piston for each plunger, an exhaust and admission valve for each cylinder, means for closing and opening the valve of each cylinder during each working stroke of the other piston by the movement of the latter, and means for closing the valve of each cylinder by the movement of its own piston.

3. An actuating mechanism for double-plunger pumps, comprising an actuating cylinder and piston for each plunger, and valve mechanism for admitting and exhausting fluid-pressure to effect a slow working stroke and quick return of each piston, comprising a tappet-pawl moving with each piston and two tappet-arms arranged in the path of each pawl and connected with the valve of the other cylinder and movable in succession by the pawl during the working stroke of the piston.

4. An actuating mechanism for double-plunger pumps, comprising an actuating cylinder and piston for each plunger and valve mechanism for admitting and exhausting fluid-pressure to effect a slow working stroke and quick return of each piston, comprising a tappet-pawl moving with each piston, two tappet-arms arranged in the path of each pawl and movable in succession by the latter during the working stroke of its piston, and reversely-arranged lever connections between each pair of tappet-arms and the valve which controls the movement of the other piston to that which actuates said pair of tappet-arms.

In testimony that I claim the foregoing as my invention I affix my signature hereto, in the presence of two subscribing witnesses, this 18th day of March, 1898.

DABNEY H. MAURY, JR.

Witnesses:
SAML. D. WEAD,
MATILDA SCHNEIDER.