(No Model.) 2 Sheets—Sheet 1.

G. WESTINGHOUSE, Jr.

FLUID PRESSURE MOTOR.

No. 359,303. Patented Mar. 15, 1887.

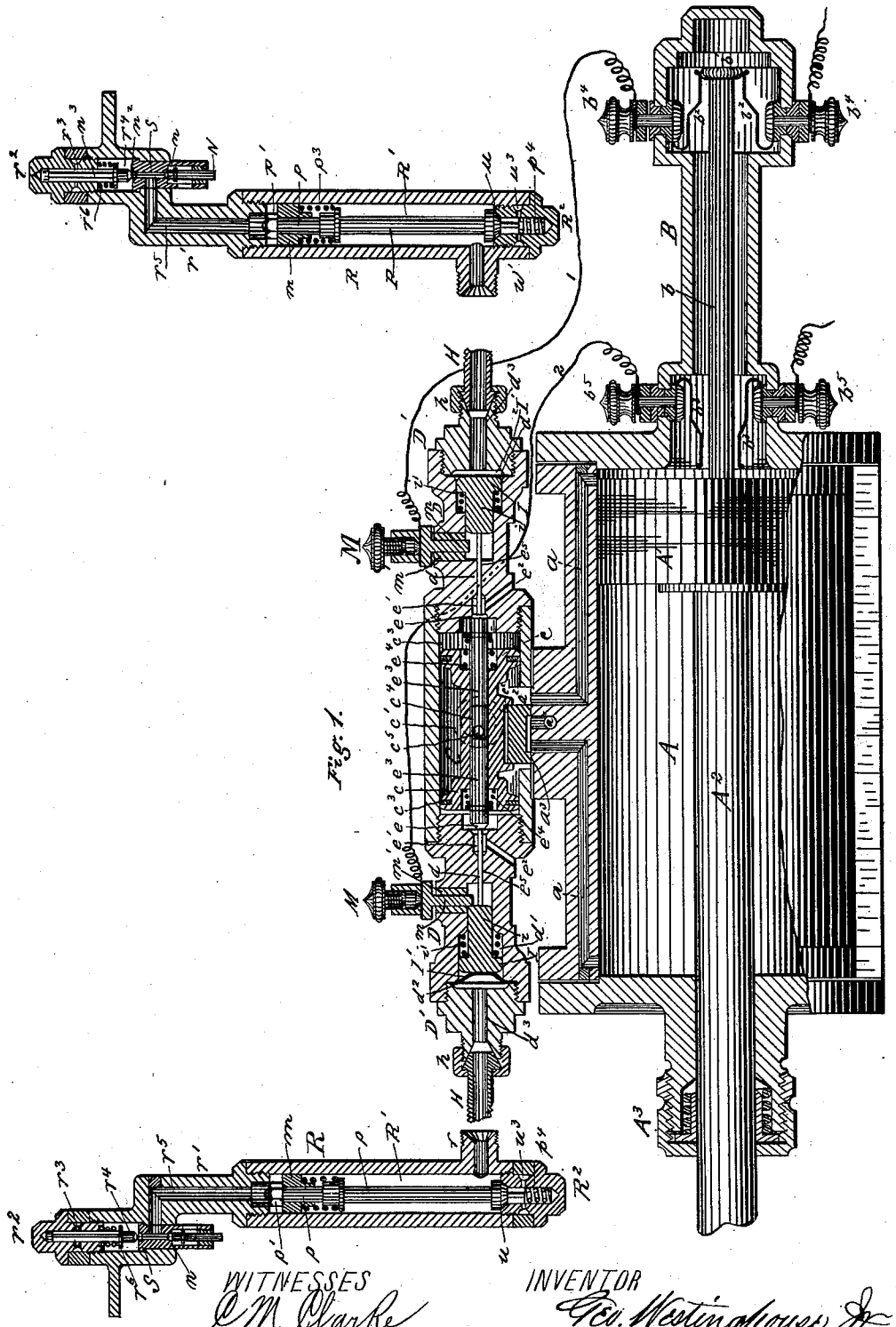

Fig. 1.

WITNESSES
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(No Model.) 2 Sheets—Sheet 2.

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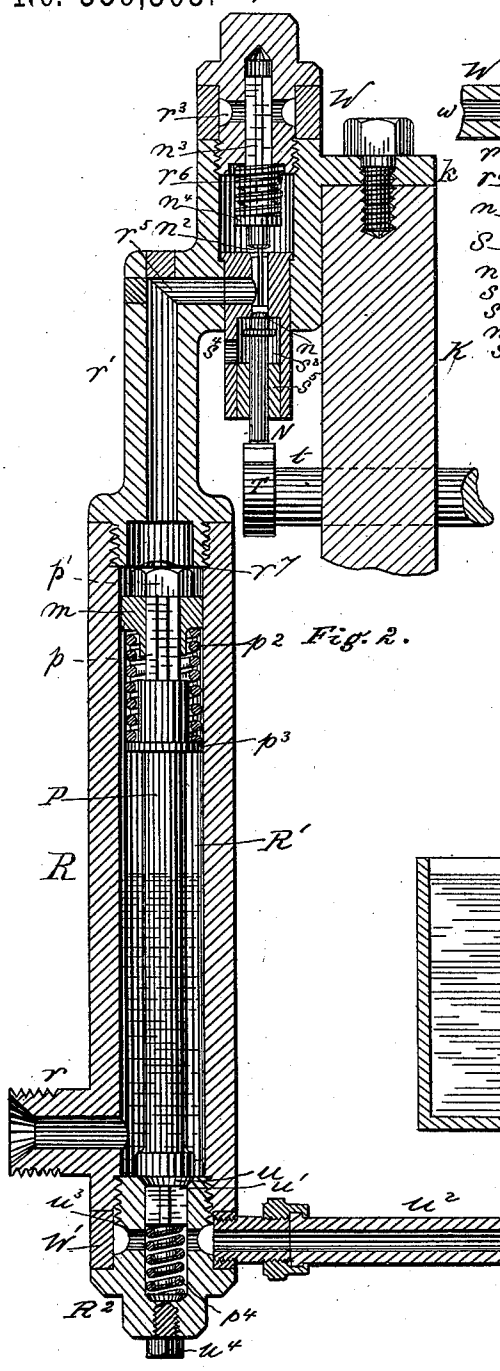

Fig. 2.

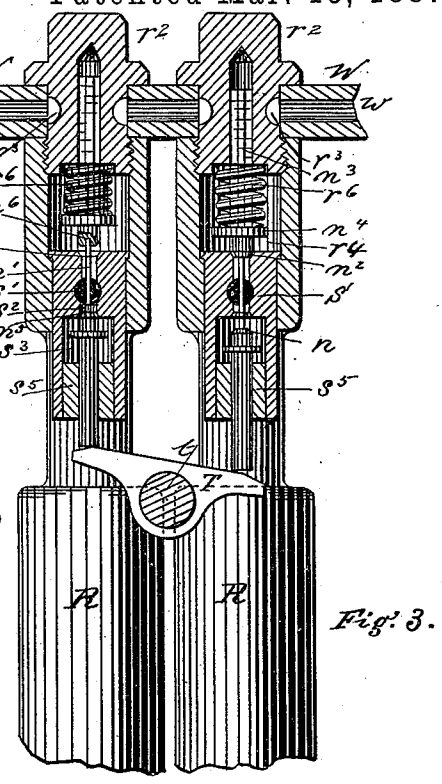

Fig. 3.

WITNESSES

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UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., OF PITTSBURG, PENNSYLVANIA.

FLUID-PRESSURE MOTOR.

SPECIFICATION forming part of Letters Patent No. 359,303, dated March 15, 1887.

Application filed August 30, 1886. Serial No. 212,177. (No model.)

To all whom it may concern:

Be it known that I, GEORGE WESTINGHOUSE, Jr., residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, a citizen of the United States, have invented or discovered a certain new and useful Improvement in Fluid-Pressure Motors, of which improvement the following is a specification.

In the accompanying drawings, which make part of this specification, Figure 1, Sheet 1, is a vertical sectional view of my improved fluid-pressure motor, showing the valve mechanism shifted to admit fluid-pressure to one side of the piston, also showing the valve mechanism by which impulse or movement is imparted from a distant station to operate the motor-valves, the pipe connecting the two being broken away, except at its ends. Fig. 2, Sheet 2, is a vertical sectional view, to an enlarged scale, of the operator's or distant station valve mechanism; and Fig. 3 is a view in sectional elevation of the upper portion of a pair of such valves connected as in use for operating the motor in opposite directions, the plane of section in this figure being at right angles to that shown in Fig. 2.

My present invention relates to certain improvements in the valve-actuating mechanism of fluid-pressure engines or motors.

In an application for patent filed by me August 30, 1886, Serial No. 212,180, I have described and claimed a fluid-pressure engine or motor having a power-piston, a distributing-valve, two small pistons inclosed within the valve-chamber, connected with and operating the distributing-valve, valve-governed escape-ports for moving the valve-controlling pistons by difference of fluid-pressure thereon, and electrically-controlled mechanism for opening the escape-valves at the pleasure of the operator.

My present invention consists of certain combinations of an engine or motor having pistons, valves, and ports, substantially as shown and described in said prior application, with mechanism for operating the escape-valves by force applied through a fluid, preferably a liquid column inclosed within pipe-connections, as hereinafter more fully described and claimed.

In the drawings, A represents a cylinder inclosing a packed piston, A'. A stem, A^2, extends from this piston through a suitable stuffing-box, A^3, and may make connection, directly or indirectly, with the apparatus or mechanism to be actuated thereby.

Fluid-pressure is admitted to either side of the piston from valve-chamber C by passages *a a*, and is exhausted to the outer air by intermediate passage, *a'*. A slide-valve, a^2, moving on the seat a^3, controls supply and exhaust of fluid-pressure. Movement is given to the valve by two pistons, *c c*, fixed upon a common tubular stem, *c'*, such stem having a one-sided enlargement at or near its center, with recess or socket c^2 therein to receive the upper part of the valves. The valve-governing pistons *c c* may either fit loosely within the cylindrical valve-chamber C; or by preference small channels or passages c^3 are made along the chamber-wall in the path of the pistons, or through the body of the pistons, thereby providing for passage of fluid in small quantities from the inner to the outer sides of the pistons. Fluid, by preference air under pressure, is supplied to the valve-chamber between its inclosed pistons by any suitable pipe-connections leading from a reservoir, compressing apparatus, or other source of supply. If fluid be permitted to escape from either end of the valve-chamber outside one of the valve-pistons *c*, an excess of fluid-pressure will be exerted on the pistons in the direction of such escape, thereby moving them and the distributing-valve a^2 in that direction. When such escape is closed, the leakage or limited flow past the piston will soon restore equilibrium of pressure.

In order to make provision for such escape and to control opening and closing the same, ports e' are made in the chamber ends or heads, leading by passages e^2 to the exterior air. These ports are opened and closed by valves *e*, which abut or rest against stems e^3, extending inward within the tubular passage c^4 of stem *c'*. Springs e^4 hold the valves to their seats with a definite degree of pressure, assisted somewhat by fluid-pressure upon the inner ends of stems e^3, admitted within the stem *c'* through central port, c^5.

In order to unseat the valves and permit escape, rods or stems e^3 are extended from the valve outward through the ports e' and through an axial passage, *d*, into a piston-chamber, *d'*,

formed in the cases or shells D, which latter—one at either end—screw into the ends of and, in effect, form heads for the piston-chamber C.

Pistons I are fitted to move in the chambers d', such pistons having stems i, extending inward to or nearly to the ends of valve-rods e^5. The pistons are packed to prevent leakage past them, and yet afford freedom of movement, by means of diaphragms I′, bound at their peripheries between the abutting shoulders d^2 of the shells D and plugs D′, which latter screw into and close the ends of the piston or diaphragm chambers, except in the central pipe-like passages, d^3, leading to such chambers through the plugs.

The pistons I are held against the diaphragms I′ by springs i', having some predetermined degree of tension or resistance to compression—say twenty-five pounds, (more or less.) If fluid, by preference liquid, filling the passages d^3 and the space on the outer sides of the diaphragms be subjected to a compressing force greater than the resisting power of the springs, the diaphragms I′ will be bent or deflected inward, as represented on the left, Fig. 1, thereby pressing the piston I and stem i inward against valve-rod e^5, and forcing the valve from its seat. Such unseating of the valve permits escape of fluid-pressure through port c', and causes the pistons c and valve a^2 to move to the left, as shown, in position to admit fluid-pressure to the right of the main piston and open the passage on the left to the exhaust.

In Fig. 1 the valve a^2 is shown shifted to the left, as above described; but the piston is on the right, not having yet moved in response to fluid-pressure, which might enter through right-hand port a. When fluid or liquid pressure in passage d^3 is released or falls below the power of spring i', the latter forces the piston outward, thereby permitting the compressed spring e^4, assisted by fluid-pressure on stem e^5, to seat valve e and close the escape. This being done, the leakage or limited passage of fluid-pressure past the piston c will soon restore equilibrium of fluid-pressure on the valve-pistons.

Provision is also made in this motor for making and breaking electric circuits, both by movements of the valve-operating mechanism and by the piston at the ends of its stroke. This feature of construction is not claimed herein, however, but is included in the subject-matter of a separate application filed by me of even date herewith.

Make and break by the valve mechanism is secured by connecting the metal parts of the engine in circuit, and also binding-posts M M, which latter are secured to but electrically insulated from the plugs or shells D D by hard-rubber or equivalent sleeves m'. The inner ends, m, of these posts are in position to make contact with the inner ends of piston-stems i, when the latter are moved inward to open the escape-valves. Consequently the circuits connected to the posts and the pistons will be made and broken by making and breaking contact between the parts m and i.

The piston make and break is secured by means of a stem, b, carrying a button, b', which makes contact at the two ends of piston-stroke with springs b^2 b^3, secured to posts b^4 b^5, which latter are secured to but electrically insulated from the shell B, cast on the head of the main cylinder. Circuits connected to the posts b^4 b^4 or b^5 b^5 will be made and broken by the movement of the piston. The circuits thus made dependent upon the movements of the engine may be employed for various purposes, as described in the separate application referred to, and among others they may, if desired, be made to actuate some signal by which it may be known whether some desired movement of the engine has been effected.

In apparatus of this class employed to operate switches, signals, locks, and other parts or appliances connected with a railway-track, it is ordinarily required to control the operation of the same from some central or common station more or less distant. To this end a pipe or tube, H, is connected to each plug D′ by coupling h. These pipes are extended in length from each end of the valve mechanism of the motor to the cabin or stand of the operator, where each makes connection by suitable coupling with the pipe end r of an operator's valve mechanism R. As before stated, I prefer to use liquid in this pipe-connection H, and of the various liquids which may be used therein to communicate pressure or impulse I prefer one like alcohol, or petroleum, or other equivalent liquid not liable to congeal or be frozen. Such liquid or other fluid medium is forced into the connecting-pipe under such pressure as practically to exclude air or other compressible gas or vapor and to secure a column or body of uniform density. In practice the liquid composing such column may be confined wholly within pipe H, or it may enter and partially fill the chamber in shell R of the valve mechanism, which may be made of sufficient length for this purpose, as hereinafter described. If the liquid is contained wholly within pipe H, open communication is afforded to it from chamber R′, by passage r. Pressure to be communicated through the column or pipe is imparted by fluid, by preference air, under pressure of sufficient degree. This is done as follows:

To the upper end of shell R is screwed an elbow-shaped upper shell or case, r', closed at its upper end by screw-plug or other equivalent stopper, r^2, having therein an annular port, r^3, for admission of air under pressure. Air thus supplied passes downward between the wings of upper valve-stem, n^3, filling the chamber r^4 below. At the angle of the elbow, and extending downward therefrom, is a valve plug or bushing, S, having therein ports s s', leading from supply-chamber r^4 downward and laterally to the tubular or pipe-like passage r^5, through the elbow-piece r'; also, a port, s^2, in line with and below port s, opens

into a valve-chamber, s^3, and thence by port s^4 to open air. The bushing s^5, in the lower end of this valve-chamber, affords a guide for valve-stem N, on the upper end of which is formed the escape-valve n, seating upward against and closing the port s^2. This valve has a pin-extension, n^5, thereon, adapted to enter and fill or practically close the passage s^2, like a piston, and thus prevent escape in case the conical portion n of the valve is not properly seated by reason of insufficient lift on the stem N. A reduced stem, n', extends from pin n^5 upward through ports s^2 and s, and abuts against or enters a socket-passage, n^6, in the supply-valve n^2, which latter is formed on the lower end of winged stem n^3, and seating downward closes port s from above. A light spring, r^6, seated between the collar n^4 on stem n^3 and the inner end of plug r^2 above, presses valve n^2 upon an escape-valve, n, away from the respective seats or ports. Upward lift of sufficient force upon the stem N will seat escape-valve n and open supply-valve n^2, thereby permitting air-supply under pressure to pass through ports s s' to passage r^5, and thence to the upper side of collar or valve-ring m. This ring or collar moves loosely on the upper winged end, p, of stem P, and it is held in place thereon between a nut, p', secured on the upper end of the stem, and a spring, p^2, below, seated upon a collar, p^3, on the stem.

Pressure of inflowing fluid upon the upper face of valve or ring m, if in excess of the resistance of spring p^2, will depress such valve, permitting the fluid supply to pass downward through the wing-passages p to the chamber R′ below. This pressure will be operative upon the liquid or other equivalent medium, whether the same is contained within pipe H or whether it enters and partially fills chamber R′, and being communicated through such medium will be effective in moving the diaphragm L′ and opening the escape-valve e of the engine, as before described. When upward lift on stem N is released, the spring r^6 will seat valve n^2, closing the supply and opening the escape-valve n. The escape thus afforded will reduce fluid-pressure in passage r^5, so that fluid-pressure below the ring-valve m, plus the pressure of spring p^2, will lift the valve and seat it upon the under face of nut p', thereby preventing fluid escape past the same. As the passage r^5 is open to the external air by ports s^2 s^4 there will be practically atmospheric pressure only to oppose the pressure confined below the ring-valve m. Consequently the stem P will be raised toward or against the stop r^7 by such pressure, assisted somewhat by spring p^4 below, thereby unseating the valve u, formed on the lower end of the stem, and opening an escape-port, u', formed in the bottom plug, R^2, of the shell or case. If the liquid column is confined to pipe H, this escape may open directly to the exterior air, either by side port, w^3, or by an open port in the end made by removing the screw-plug w^4, such escape taking place when valve u is raised. If, on the other hand, the liquid column terminates in chamber R′, I prefer to make pipe-connection u^2 from port w^3 to a small tank or reservoir, U, fixed at sufficient height above the pipe H to insure sufficient liquid in the case R at all times to fill pipe H. As the valve u is raised the pressure upon the liquid will be relieved by forcing a portion of the liquid, in case liquid is contained in chamber R′, into the tank, thereby in either case providing for quick release or cessation of the force or impulse exerted upon the liquid column. Slow leakage past the valve m—such as is incident to valve-piston mechanism of this character—will permit the liquid in tank U and chamber R′ to return to a common level. The valve u may be seated or returned to normal position either by the weight of the stem P and valve m or by pressure of inflowing fluid thereon, so as to impart to the liquid the desired impulse. The operation of valve m, stem P, and valve u, both in admitting fluid-supply, imparting impulse to the liquid column, and in relieving pressure below the valve m, is automatic, prompt, and efficient, and is substantially the same, whether liquid is present in the chamber R′ or not; but if present the tank U performs an important function, not only in affording convenient means for maintaining liquid-supply without introducing air into the pipes, but also in providing relief from pressure or impulse without waste of liquid; also, to this same end the shell R may be made of considerable length—say six inches, more or less—in order that valve m may be clearly above the level of liquid, and thereby prevent discharge of liquid upward.

The stems N for supply and exhaust fluid may be lifted in any convenient and suitable manner, either by hand or by means of suitable mechanical contrivance. In Fig. 3 two of the valve mechanisms are shown connected together, each being connected by separate pipes H to its appropriate end D′ of the mechanism, for shifting the distributing-valve a^2 of the engine, as before described.

Fluid-supply is by a passage, w, in upper connecting-bar, W, and the relief or escape may be either directly to the exterior air or by separate pipe-connections to tank U. The two valves are secured by flanges k to any suitable support, K, and their stems N are lifted by a rocking bar, T, upon the ends of which the stems rest, and the stems are raised alternately by rocking the pivot t, which carries the bar. This may be done either by hand or by mechanical contrivance, and I reserve for a separate application suitable interlocking apparatus for effecting these movements in predetermined order with reference to other operations to be performed on or about a track. Either fluid-supply valve n^2 will be opened, as desired, according to the movement of the rocking bar T in one or the other direction, and when said bar is moved into its middle or horizontal position both the fluid-supply valves will be

automatically seated and both fluid-exhaust valves opened by the springs r^6.

Pressure communicated to the liquid column, as above described, will be transmitted almost instantaneously to and be effective on the diaphragm I', and while I prefer to use air as a medium of communicating such pressure to the liquid, yet other fluid medium, or even a liquid medium, may be emyloyed; also, instead of subjecting the liquid column to direct contact with the air or equivalent fluid, the two may be separated by a diaphragm or by movable piston or other equivalent yielding device by which pressure may be communicated from one to the other. Such partitions are not essential, but are referred to as modifications, which may, if desired, be made in details of construction, which I consider as coming within my invention; also, for the purpose of imparting impulse to the liquid column other means than fluid-pressure may be employed—for example, a mechanically-actuated plunger; or fluid-pressure may be admitted to and turned from the liquid column by a three-way cock or other equivalent device. I prefer, however, to emplow for this purpose the valve mechanism herein shown and described, because best adapted to fill all the requirements of use.

I claim herein as my invention—

1. The method herein described of imparting movement from a distant station to the valve-shifting mechanism of a fluid-pressure engine or motor, consisting in connecting such mechanism with the distant station by a continuous inclosed column or body of liquid and giving movement or impulse to such column by subjecting the same to pressure at the distant station, substantially as set forth.

2. A fluid-pressure engine or motor having a main piston, a distributing-valve, pistons for moving the distributing-valve, and escape-valves for reducing fluid-pressure on one side of the valve-pistons, in combination with suitable mechanisms for unseating the escape-valves, and a fluid column for communicating impulse or movement to the valve mechanism from a distance, substantially as set forth.

3. The combination of distributing-valve a^2, pistons $c\,c$, escape-valves e, pistons I, and fluid-pressure diaphragms I', substantially as set forth.

4. In a fluid-pressure motor, the combination of a distributing-valve, pistons for shifting the valve, escape-valves for reducing fluid pressure on one side of the piston, flexible diaphragms exposed on one side to a fluid column, pistons abutting against the diaphragms and the escape-valves, and springs for holding such latter pistons against the diaphragms, substantially as set forth.

5. In combination with the valve-shifting mechanism of a fluid-pressure motor, an inclosed fluid column for transmitting impulse without expenditure of fluid, and a movable or flexible partition between the valve mechanism and the fluid column for transmitting the impulse of the fluid column to the valve mechanism, substantially as set forth.

6. In combination with the valve-shifting mechanism of a fluid-pressure motor, a column of liquid for communicating movement to the valve mechanism from a distance, and valve mechanism for directing fluid under pressure upon the liquid column at the distant station, substantially as set forth.

7. A valve mechanism having, in combination, a valve-governed supply and exhaust ports at its upper end, and a valve-governed exit at its lower end, the valve for the latter exit having an upwardly-extending stem with a valve movable thereon opening downward to permit fluid passage and seating upward against and lifting the stem by fluid-pressure on the under side, substantially as and for the purposes set forth.

8. In mechanism for subjecting a liquid column to fluid-pressure, the combination of a case receiving a portion of the liquid at its lower end, valve-governed ports in the case above the liquid for supply and exhaust of fluid-pressure, a valve within the case above the level of the liquid, such valve opening downward to admit fluid-pressure to the liquid and seating upward to close the passage, and a valve-governed exit below the level of liquid, the valve to such exit being opened by upward pressure upon the valve above the liquid, substantially as set forth.

9. In mechanism for subjecting a column of liquid to fluid-pressure, the combination of a case having open communication with the liquid, valve-governed ports above the level of liquid for supply and exhaust of fluid-pressure, a valve-governed exit below the level of liquid, and a liquid reservoir or receptacle communicating with the exit, substantially as set forth.

10. The combination of rock-shaft t, bar T, valve-stems N, resting upon the bar on either side of the shaft and lifted alternately by rocking movements thereof, fluid-supply valves n^2, and springs r^6, acting to automatically seat said valves when the rock-shaft is moved to central position, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEO. WESTINGHOUSE, JR.

Witnesses:
R. H. WHITTLESEY,
J. SNOWDEN BELL.