(No Model.)

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PUMP FOR THE PRODUCTION OF HIGH VACUUMS.

No. 338,552. Patented Mar. 23, 1886.

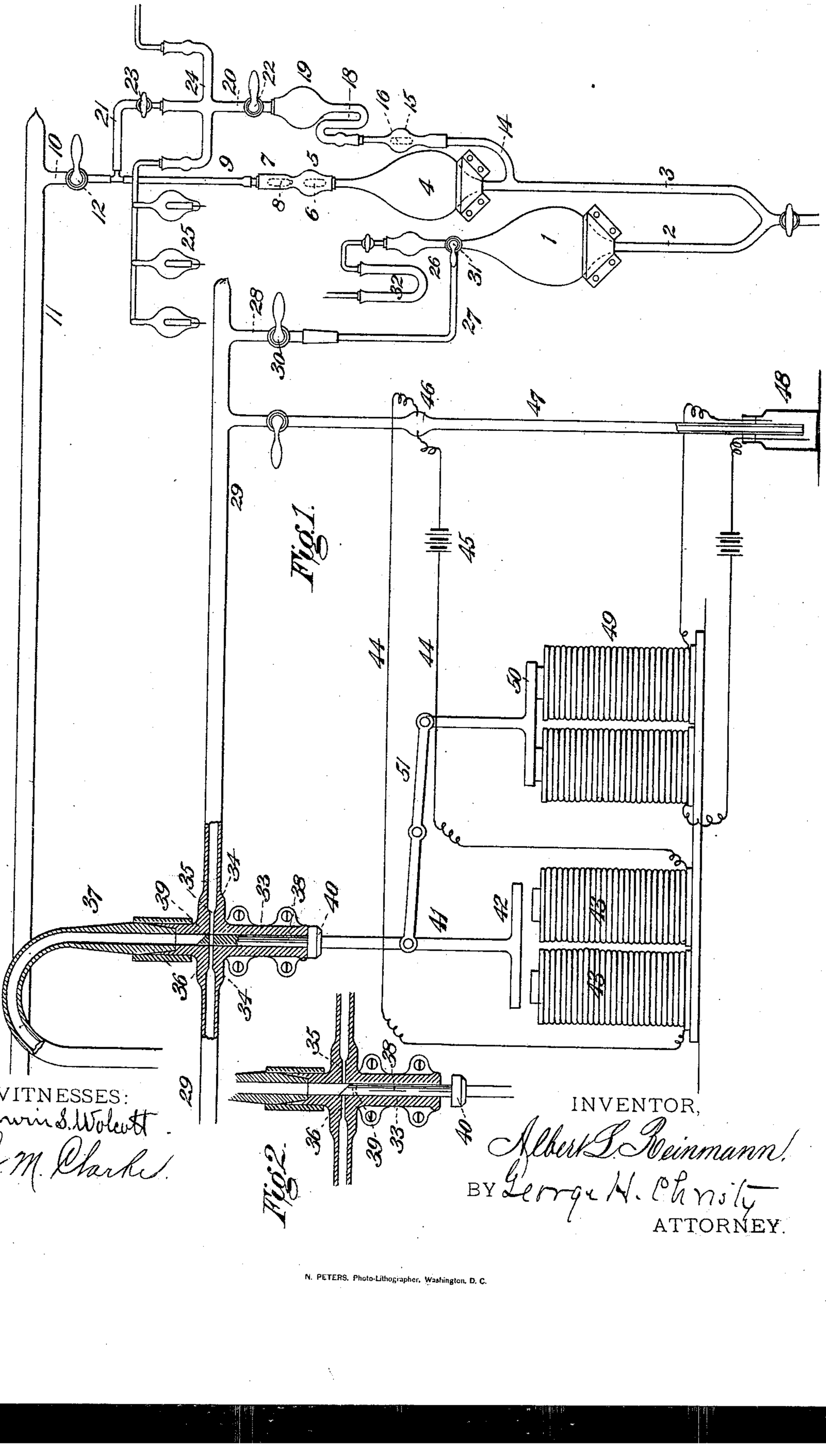

Fig. 1.

Fig. 2.

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PUMP FOR THE PRODUCTION OF HIGH VACUUMS.

SPECIFICATION forming part of Letters Patent No. 338,552, dated March 23, 1886.

Application filed November 21, 1885. Serial No. 183,463. (No model.)

To all whom it may concern:

Be it known that I, ALBERT L. REINMANN, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, a citizen of the United States, have invented or discovered certain new and useful Improvements in Pumps for the Production of High Vacuums, of which improvements the following is a specification.

In the accompanying drawings, which make part of this specification, Figure 1 is a view in side elevation of my improved pump, having incorporated therewith electro-magnetic mechanism whereby the operation of my improved pump is made continuous and automatic. Fig. 2 is a sectional elevation of the valve controlling the atmospheric pressure in the mercury-reservoir.

My invention relates to certain improvements in that class of pumps for the production of high vacuums, in which the movement of the mercury to and from the vacuum-chamber is effected or controlled by atmospheric pressure acting on the mercury in the reservoir, and the object of said invention is, by the addition of certain devices, to render the operation of such a pump automatic and continuous; and to these ends my invention consists in the construction and combination of parts, substantially as hereinafter described and claimed.

The reservoir 1, which is secured in the usual manner to a board or wall, is tapered off at its lower end into a tube, 2, of small diameter, the lower end of said tube being bent and connected to a vertical tube, 3, extending up above the reservoir 1 and terminating in the vacuum bulb or chamber 4. In the upper portion of the bulb 4 is formed the valve-chamber 5, in which is located the valve 6, said valve being constructed to permit exit of air from the bulb 4, but to prevent its return thereto; and above the valve-chamber 5 is formed another valve-chamber, 7, provided with a valve, 8, seating in the same manner as the valve 6. This valve-chamber 7 is connected by a small pipe, 9, to the branch pipe 11, leading to a suitable exhaust-pump, and in the branch pipe 10 is located the turn-cock 12, adapted to cut off connection between the exhaust-bulb 4 and the pipe 11.

In the vertical pipe 3, just below the vacuum-chamber 4, is formed a branch pipe, 14, extending up alongside of the chamber 4, and being provided with a valve-chamber, 15, in which is located the valve 16, constructed to permit of the flow of air down through said pipe 14, but to prevent mercury from passing up through the same. To the upper end of the valve-chamber 15 is connected one end of the trap 18, formed on the lower end of the drying-chamber 19. Into the mouth of this chamber is inserted one end of the pipe 20, the upper end of said pipe being connected by the small rubber tube 21 with the pipe 9, connecting the vacuum-chamber 4 and the pipe 11. The pipe 20 is provided near its ends with the turn-cocks 22 and 23, and between these cocks are formed two or more branches, 24, adapted for connection with bulbs or lamp-bowls 25.

From the neck 26 of the reservoir 1 extends the tube 27, connected at its opposite end with the branch 28 of the pipe 29, leading to a suitable exhaust-pump, said branch pipe 28 being provided with a turning-cock, 30, for the purpose of cutting off connection between the reservoir and the exhaust-pipe 29.

In the neck 26, at the point of junction with the tube 27, is located the three-way cock 31, adapted to permit communication between the reservoir and the tube 27, or the upper portion of the neck 26.

Through the stopper in the mouth of the neck 26 is inserted one end of a tube provided with a turn-cock, and having its opposite end inserted through a rubber stopper in the mouth of one arm of the U-tube 32, the opposite arm of said tube being also closed by a rubber stopper, through which projects one end of a small tube.

In the U-tube 32 is placed some suitable drier for removing moisture from any air which may be admitted therethrough.

The operation of the pump above described is not automatic nor continuous, and in order to obtain automatism and continuity of action I add thereto the devices hereinafter described.

In the pipe 29, between the branch 28 and the exhaust-pump, (not shown,) is placed the valve case or cylinder 33, provided with side sockets, 34, for the reception of adjacent ends of sections composing the pipe 29, said sockets being connected by the transverse passages 35 and 36, forming thereby a continuous pas-

sage to the exhaust-pump. To the upper end of the cylinder 33 is connected a bent pipe, 37, leading to a suitable vessel containing chloride of calcium, or any other suitable substance for drying the air admitted therethrough. Within the cylinder 33 is located the piston 38, of a length sufficient to extend from the lower end of said cylinder up to and beyond the transverse passages 35 and 36, a distance a little in excess of its length of stroke. Through the upper end of the piston is formed the transverse passage 39, said passage being so located as to be in register with the passages 35 and 36 in the cylinder when the piston is at the upper limit of its stroke, and that portion of the piston above the passage 39 is beveled off on the side toward the passage 35, leading to the mercurial pump, so that when the piston is at the lower limit of its stroke, the passage 35 and the upper portion of the cylinder above the piston will be in communication, but the passage 36 will be closed. On the piston outside of the cylinder is formed a collar, 40, adapted to abut against the end of the cylinder when the passages in the piston and cylinder are in line, as above stated.

On the lower end of the piston-stem 41 is formed or secured the armature 42 of the electro-magnet 43. The ends of the wires 44, forming the circuit of said magnets, are inserted into a bulb, 46, of the barometric tube 47, and have the battery 45 included in their circuit. The barometric tube 47 is connected at its upper end to the pipe 29 at some point between the branch 28, leading to the mercurial reservoir and the valve mechanism controlling the flow of air to and from the mercurial reservoir, and its lower end is arranged within a jar or receptacle, 48, containing a sufficient quantity of mercury to fill the tube 47 to a point a little above the bulb 46, as will be hereinafter described. Within this jar or receptacle are arranged the ends *a* and *b* of the wire forming the circuit of the electro-magnet 49, one of said ends, as *a*, extending into close proximity to the bottom of the jar and the other end, *b*, extending only sufficiently far as to be immersed in the mercury when the atmospheric pressure in the mercury in the tube and jar, which is open-mouthed or has an air-inlet, is the same—*i. e.*, when the mercury in the jar and tube stand at the same level. The armature 50 of the electro-magnets 49 is attached to one end of the lever 51, the opposite end of said lever being attached to the piston-stem 41.

The operation of my improved pump is as follows: The exhaust-pipes 11 and 29 being connected to any suitable continuously-operating mechanical exhaust pump or pumps, and the lamp-bulbs 25 having been connected to the branches or supports 24, the cocks 12 and 30 are turned so as to permit free communication between the pipes 11 and 29 and the mercurial pump, and the piston 38 is raised, so as to bring the transverse passages in the piston and cylinder 33 into register. This movement of the piston is effected by inserting the end *b* of the circuit of the magnet 49 into the mercury in the jar 48, thereby completing the circuit of the magnet 49, and causing it to draw down the armature 50. The piston 38 will remain in this position, thereby permitting the mechanical pumps to exhaust the air from the mercurial pump and from the tube 47 until a sufficiently-high vacuum has been obtained to permit the atmospheric pressure on the mercury in the jar to force said mercury up the tube 47 into the bulb 46 and into contact with the ends of the wires 44, thereby completing the circuit of the magnets 43, and causing them to draw down the armature 42, the circuit of the magnets 49 being previously broken by the forcing of the mercury from the jar into the tube. This downward movement of the armature and the piston 38, connected thereto, will permit air to flow into the pipe 29, and thence into the tube 47 and the mercurial reservoir 1. The mercury, as it leaves the mercury-reservoir, flows by the pipes 2 and 3, into the vacuum-chamber 4, and on up past the valves 6 and 8, filling the valve-chambers 5 and 7, and floating said valves from their seats. As the mercury rises in the branch pipe 14 the valve 16 is floated up until the upper end of the valve-chamber is closed by the valve, thus preventing any farther upward movement of the mercury in the pipe 14. The admission of air into the upper end of the tube 47 will force the mercury therefrom into the jar or receptacle 48, thus breaking the circuit of the magnets 43. By the time the mercury has reached the desired height above the vacuum-chamber 4, enough mercury will have been forced into the jar 48 to complete the circuit of the magnets 49, thus causing them to draw down the armature 50, and thereby raise the piston 38, to cut off the inward flow of air, and open communication between the mechanical exhaust-pump and the pipe 29. The mechanical pumps will exhaust the air from the tube 47 and the reservoir, thus permitting the mercury to return to said reservoir, and by creating a vacuum in the tube 47 will permit of the forcing of the mercury in the jar up into the tube until the circuit of the magnets 43 is again completed. The tube 47, between the bulb 46 and its lower end, is made approximately equal to the height of the mercurial column at the place where the pump is to be used. At the beginning of the operation the cock 22 is closed and the cock 23 is opened, so that the action of the mechanical exhaust-pumps will remove all moisture from the bulbs, thus preventing any defilement of the mercury. After the moisture and dust have been removed from the lamp-bulbs the cock 23 is closed and the cock 22 is opened. It will be seen from the above that as soon as the mercurial pumps have been put into operation that the back and forth circulation of the mercury will be continuous and uninterrupted for as long a time as desired. As soon as the desired vacuum has been

obtained in the bulbs 25, and the latter have been sealed, the stop-cock 22 is closed, when the bulbs 25 can be removed and others substituted therefor without stopping the working of the pumps, the closing of said cock, the cock 23 having been previously closed, effecting a cutting out or isolation of the branches 24, to which the bulbs are connected. In the bulb 19 is placed some suitable moisture absorbent or drier, which by preference is inclosed in a perforated paper shell, which can easily be removed when the drier needs renewal.

I claim herein as my invention—

1. In an air-pump of the kind described, a vacuum-chamber having a valved outlet for the escape of air, in combination with a mercury-reservoir, a tube connecting the reservoir and chamber, said reservoir being connected by suitable pipes to a continuously-operating exhaust-pump, a valve mechanism interposed between the mercury-reservoir and exhaust-pump, a reciprocating column of mercury operated by the varying atmospheric pressures in the mercurial reservoir and its connections, and means for communicating the movements of the mercurial column to the valve mechanism, substantially as set forth.

2. In an air-pump of the kind described, a vacuum-chamber having an uninterrupted connection with a mechanical exhaust-pump, in combination with a mercury-reservoir, a tube connecting the reservoir and chamber, a continuously-operating exhaust-pump connected to the reservoir, a valve mechanism interposed between the reservoir and exhaust-pump, a barometric column, and electro-magnets for so operating the valve mechanism as to connect the reservoir with the exhaust-pump and with the open air alternately, the circuits of said magnets being opened and closed by the movement of the barometric column, substantially as set forth.

3. In a pump of the kind described, the vacuum-chamber 4, connected by a suitable tube to the exhaust-pipe 11, in combination with automatically-acting valves interposed between the vacuum-chamber and the exhaust-pipe, whereby the return of air to the vacuum-chamber is prevented, substantially as set forth.

4. In a pump of the kind described, the pipe 20, connected at both ends to exhaust-pipes or chambers and provided with branches 24 or other suitable means for connecting the bulbs to be exhausted therewith, in combination with cocks 22 and 23, for cutting off said pipes or branches 24 from communication with the exhaust pipes or chambers, substantially as set forth.

In testimony whereof I have hereunto set my hand.

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Witnesses:

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