No. 693,813. Patented Feb. 18, 1902.

D. P. BURDON.

LIQUID ELEVATING SYSTEM.

(Application filed Mar. 8, 1900.)

(No Model.) 2 Sheets—Sheet 1.

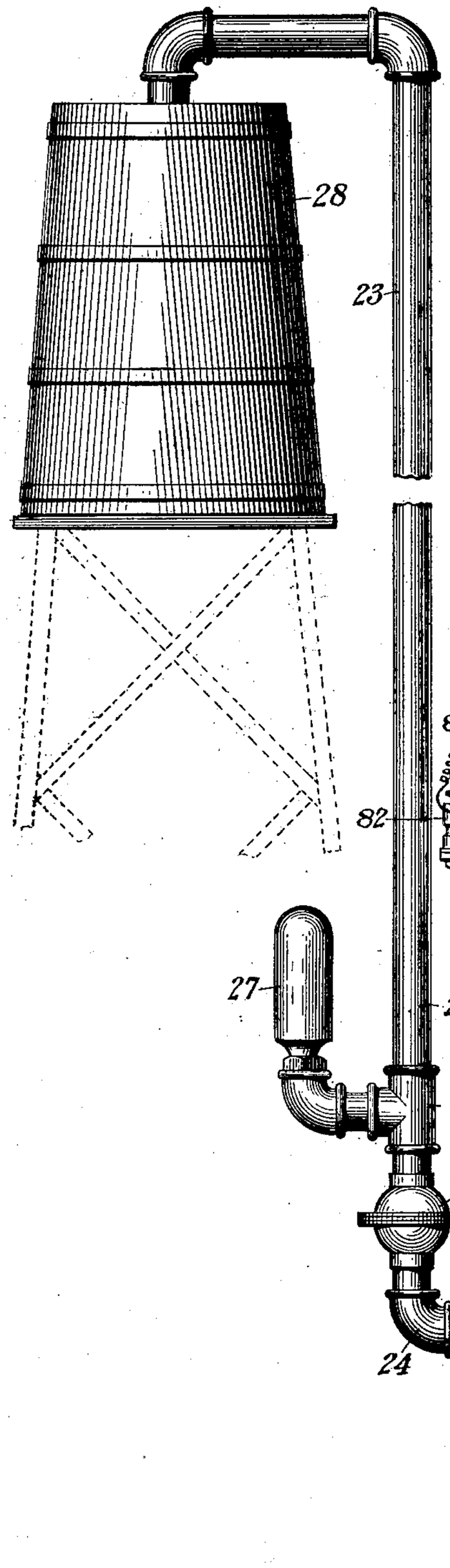

Fig. 1.

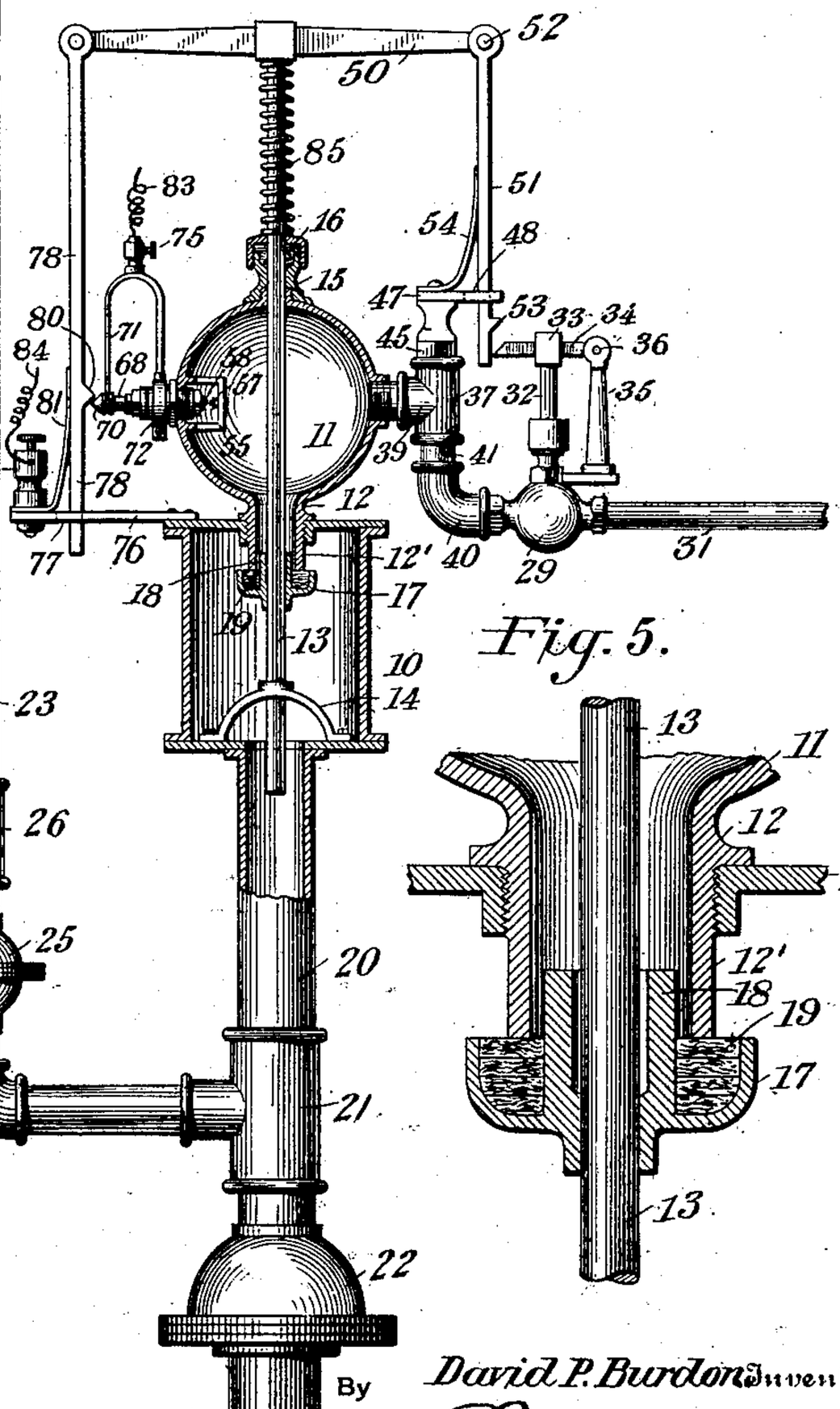

Fig. 5.

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

Fig. 2.

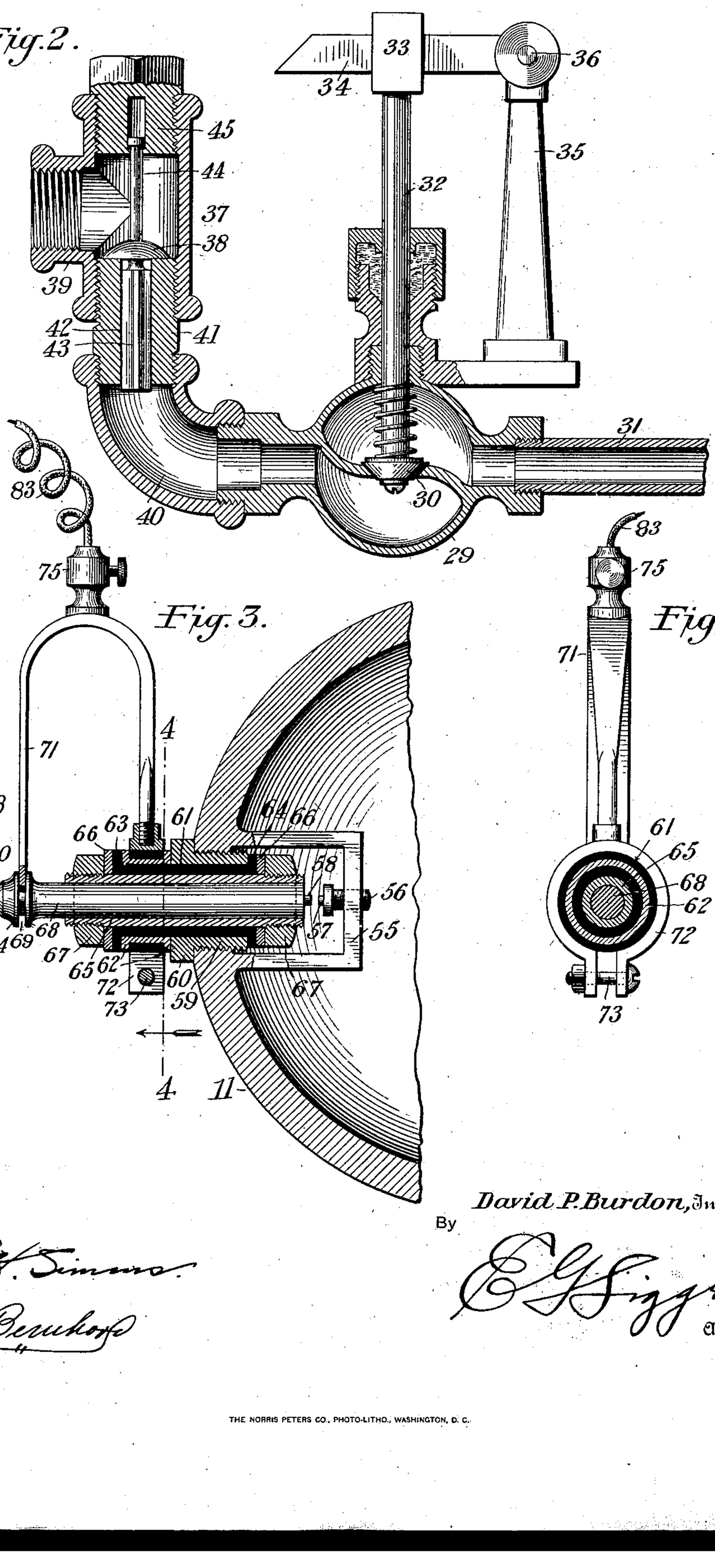

Fig. 3.

Fig. 4.

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UNITED STATES PATENT OFFICE.

DAVID PATTON BURDON, OF JACKSONVILLE, FLORIDA, ASSIGNOR OF ONE-HALF TO WILLIAM CLARKE AND WILLIAM F. CLARKE, OF JACKSONVILLE, FLORIDA.

LIQUID-ELEVATING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 693,813, dated February 18, 1902.

Application filed March 8, 1900. Serial No. 7,844. (No model.)

To all whom it may concern:

Be it known that I, DAVID PATTON BURDON, a citizen of the United States, residing at Jacksonville, in the county of Duval and State of Florida, have invented a new and useful Liquid-Elevating System, of which the following is a specification.

My invention relates to improvements in liquid-elevating systems especially designed to raise water from a source of supply to an elevated tank, such as a railway-tank; and its primary object is to provide a simple, efficient, and automatic means adapted to be operated wholly by the energy and vacuum erected by the combustion of an explosive charge or mixture of gas and air.

A further object is to provide means for controlling the supply of the explosive mixture to the explosion-chamber only at the proper interval and to thoroughly check the passage of the high-pressure gaseous fluid due to combustion of the charge of explosive mixture from having access to the mixture-supply means.

A further object is to provide an improved igniter peculiar to an apparatus of this character and controllable solely by the movement or play of the piston-valve, which is forced in one direction by the energy of the gaseous fluid, said igniter being operable at a period subsequent to the admission of the explosive charge or mixture to the explosion-chamber.

Further objects and advantages of the invention will appear in the course of the subjoined description, and the novelty in the combination of mechanisms and in the construction and arrangement of parts will be defined by the claims.

In the accompanying drawings I have represented a liquid-elevating system which embodies the several features of my invention in their preferred form, and to these drawings I shall now refer in order to explain more clearly the nature of the invention and the manner in which the same is or may be carried into effect.

Figure 1 is a sectional elevation of a liquid-lifting system embodying mechanism contemplated by this invention. Fig. 2 is an enlarged vertical section through the valved supply means for the explosive charge. Fig. 3 is a similar vertical section through the parts of the igniter. Fig. 4 is a cross-section in the plane of the dotted line 4 4 on Fig. 3. Fig. 5 is an enlarged detail view through the piston-valve and the parts associated therewith.

The same numerals of reference are used to indicate like and corresponding parts in each of the several figures of the drawings.

The vacuum-cylinder 10 is of any suitable construction, and it is surmounted by an explosion-chamber 11, the latter being formed by a vessel substantially globular in form. The vessel forming the explosion-chamber is provided at its lower side with an axial tubular foot-nipple 12, which is extended through and fastened in any suitable way to the upper head of the vacuum-cylinder, the lower part of this foot-nipple being extended into the chamber of the vacuum-cylinder and forming a seat 12′ for the piston-valve 17. This piston-valve is provided with an extended valve-rod 13, which is prolonged in opposite directions from the piston-valve, the upper part of this valve-rod passing through the explosion-chamber and through a stuffing-box, while the lower part of the rod extends through the vacuum-cylinder, so as to play in a yoke-shaped guide 14, the latter being fixed to the lower head of the cylinder and spanning the outlet at the upper extremity of the suction-pipe 20. The globular vessel forming the explosion-chamber is provided at its upper side with a stuffing-box 15, the same being disposed in line with the axis of the explosion-chamber and the subjacent vacuum-cylinder. Said stuffing-box is provided with an asbestos packing 16, which closely surrounds the upper portion of the valve-rod 13, said packing serving to prevent the escape of the high-pressure gaseous fluid generated in the explosion-chamber by the combustion of the explosive charge and the packing being also proof against deterioration under the action of the heat which is generated by explosion of the charge. The piston-valve 17 is made fast with the valve-rod at a point intermediate of its length, so as to remain in the vacuum-cylinder, and this valve in one embodi-

ment of the invention is cup-shaped in cross-section and provided with an extended guide-boss 18, the latter adapted to enter the lower part of the foot-nipple 12 in one position of the valve. Said piston-valve is provided with an asbestos packing 19, the latter being disposed within the cup of the valve, so as to be protected at its edges by the metallic portion of said valve. The packing and the valve exceed the diameter of the foot-nipple 12, and this packing is arranged for its upper layer to press against the seat 12′, formed by the lower part of the foot-nipple, the metallic side of the valve facing the water-inlet at the lower part of the vacuum-cylinder. In one position of the valve and its rod the foot-nipple is closed to cut off communication between the vacuum-cylinder in which the water is contained and the explosion-chamber adapted to receive the explosive charge which is adapted to be ignited in said chamber, thus wholly avoiding the admission of water to the explosion-chamber; but the explosion of the charge in said chamber generates the gaseous fluid adapted to displace the piston-valve and permit said fluid to pass into the vacuum-chamber for the purpose of expelling the water contained therein, whereby the water and the gaseous fluid are discharged from the vacuum-cylinder for the purpose of creating a partial vacuum in the explosion-chamber and the vacuum-cylinder, such partial vacuum insuring the supply of another explosive charge to the pressure-chamber and the inflow of liquid to the vacuum-cylinder. The asbestos packing in the piston-valve is proof against deterioration under the influence of heat generated by the combustion of the explosive charge.

The suction-pipe 20 has its lower portion immersed in any suitable source of liquid-supply, and the upper end of this suction-pipe is coupled in any suitable way to the lower head of the vacuum-cylinder, said suction-pipe being preferably arranged in coaxial relation to the vacuum-cylinder for the purpose of having the lower end of the valve-rod 13 enter the upper portion of the suction-pipe when the piston-valve is displaced from its seat. This suction-pipe is made in suitable lengths for the reception of a T-coupling 21 and the foot-valve 22, the latter being of any approved type. A liquid-eduction pipe 23 is provided at its lower portion with an elbow 24, that is united to the T-coupling 21 at a point above the foot-valve. This liquid-eduction pipe is provided between the elbow 24 and a T-coupling 26 with a check-valve 25, the latter arranged to open and close in an opposite direction to the foot-valve 22, so that on the flow of liquid through the suction-pipe to the vacuum-cylinder the foot-valve 22 is opened and the check-valve 25 is closed; but the expulsion of the liquid and the gaseous fluid from the vacuum-cylinder causes the foot-valve 22 to close and the check-valve 25 to open, thereby directing the liquid and the gaseous fluid through the eduction-pipe. The coupling 26 in the eduction-pipe has an air-chamber 27 united thereto in a manner to communicate with the eduction-pipe, and the air-cushion afforded by this chamber on the column of liquid forcibly expelled from the vacuum-chamber minimizes the shock on the apparatus due to the combustion and sudden expansion of the explosive charge. This eduction-pipe may extend any suitable distance above the working elements of the apparatus, and its upper extremity discharges into an elevated tank 28. This tank may be employed for any purpose, such as supplying water to railway-locomotives.

29 designates the shell of the controlling-valve 30, that regulates the admission of the explosive charge to the explosion-chamber. This explosive charge is in the nature of commingled gas and air, which is mixed in suitable proportions and is conveyed to the valve-shell 29 by a feed-pipe 31. The controlling-valve is provided with an upwardly-extending stem 32, the latter protruding beyond the valve-shell and furnished with an enlarged head 33. This head has a transverse slot or opening in which is loosely fitted a lever 34, one end of said lever being pivoted to a stand 35, as at 36. Between the controlling-valve and the explosion-chamber is disposed a back-pressure valve that is automatically closed by the pressure of the gaseous fluid generated within the chamber, said back-pressure valve serving to prevent the gaseous fluid from passing into the controlling-valve and interfering with the supply of the explosive mixture or charge to the explosion-chamber. This back-pressure valve has a chamber 37, in which said valve 38 is loosely confined, and this chamber 37 is provided at one end with a hollow connection 39, that is coupled to one side of the explosion-chamber. The other end of the chamber 37 has an elbow 40 united to the shell 29, and above this elbow is a vertical plug 41, the latter being provided with a vertical passage 42. The valve 38 has a depending recessed stem 43, slidably fitted in the passage of the vertical plug. The valve 38 is adapted in its closed position to be seated upon the upper end of the plug 41, and from this valve extends an upstanding stem 44, which is slidably fitted in an opening of the closure-plug 45, the same being secured in the upper part of the chamber 37, whereby the valve is limited by the stems 43 44 to reciprocably play in the chamber 37.

A guide-plate 47 is secured firmly to the shell of the chamber 37 in a position to extend laterally therefrom and above the valve-lever 34, said plate having a slot 48 for the accommodation of a valve-operating rod 51, that is slidably fitted in the slotted plate, so as to be guided thereby in a path adjacent to the valve-lever 34. The upper protruding end of the rod 13, forming a part of the piston-valve, carries a cross-arm 50, the same being disposed in a horizontal position at right

angles to the valve-rod and adapted to reciprocate with the valve. The valve-operating rod 51 is pivotally attached at 52 to one end of this cross-arm, and said rod is furthermore provided with a toe-piece 53, arranged on the upward movement of the cross-arm and the rod 51 to impinge the free end of the lever and open the controlling-valve 30. Said lever 34 is provided with a beveled free end, and the under side of the lifting-toe is also beveled to ride against said lever for the purpose of laterally deflecting the valve-rod 51 in the slot of the guide-plate 47 on the downward movement of said rod 51 with the cross-arm and the piston-valve, thus providing means for the toe to clear the lever; but a spring 54 is employed to hold the rod 51 in a position wherein the lifting-toe is in the vertical plane of the free end of the valve-lever, thus disposing the rod 51 normally in a position for the toe to engage with the valve-lever.

The back-pressure valve 30 is held closed upon its seat by the pressure of the gaseous fluid which is generated in the chamber 11 by the combustion of the explosive charge; but said valve is unseated automatically for the admission of a fresh explosive charge by the suction created in the explosion-chamber and the vacuum-cylinder due to the establishment of the partial vacuum therein by the expulsion of the liquid and the gaseous fluid.

I will now proceed to describe the igniter mechanism which I have invented for producing an electric spark at suitable intervals to effect the combustion of the explosive charge in the explosion-chamber 11, and this igniter mechanism is peculiar to an apparatus of my invention, because it is controlled by the movement of the piston-valve, which also actuates the charge-admission valve 30 in such a way that the igniter is operated automatically and subsequently to the admission of the explosive charge to the explosion-chamber. A yoke 55 is made fast to the shell forming the explosion-chamber, said yoke lying within the chamber and on the opposite side thereof to the connection 39, which unites the valved chamber 37 with the explosion-chamber. This yoke supports a screw 56, that carries a normally stationary contact 57, which is in opposition to a movable contact 58, the latter being carried by a slidable pin, presently described, both of said contacts being contained within the explosion-chamber and made of any suitable durable material—such, for example, as platinum. A screw-plug 59 has threaded engagement with the shell forming the explosion-chamber, said plug being hollow and disposed in alinement with the fixed contact 57. The outer end of the plug has an annular flange 60, that bears against the shell of the explosion-chamber, and said plug receives an insulating-bushing 61, of hard rubber, vulcanized fiber, or other material which is not affected by an electric current and which will withstand the action of heat. This insulated bushing extends through the threaded plug at both ends, and the front protruding end of the bushing has the spaced collars 62, for a purpose which will presently appear. Insulated packings 63 64 are fitted on the bushing, one of said packings being engaged with the threaded plug and the other packing resting against one of the collars 62. A metallic wear-sleeve 65 is contained within the insulated bushing, and metallic washers 66 are fitted on this insulated bushing against the packings 63 64, said washers and the packings being compressed by the nuts 67, which are screwed on threaded portions of the wear-sleeve for the purpose of making tight joints between the igniter devices and the shell of the explosion-chamber at the point where the slidable contact-pin 68 passes through the shell. This contact-pin is fitted loosely or slidably in the metallic wear-sleeve 65, so as to be insulated therewith by the bushing 61 from electrical contact with the chamber-shell, the inner end of said slidable pin carrying the movable contact 58. The outer exposed end of this contact-pin is formed with an annular groove 69 and with an exposed cam-head 70. A yoke-shaped spring 71 is provided at one end with a clip 72, having a clamping-screw 73, said yoke being fitted around the insulated bushing 61, between the spaced collars 62 thereof, in a position for the screw 73 to be tightened, in order to make the yoke fast with the insulated bushing, whereby said yoke-shaped spring is supported at one end in a fixed position on a part of the igniter device and is also insulated from electric contact with the explosion-chamber. The free end of this yoke-spring is forked at 74 and arranged to fit in the groove 69 of the slidable pin, thus disposing the spring in a position to impel the contact-pin normally in an outward direction, and thereby withdraw the movable contact 58 from the stationary contact 57. The yoke-spring carries a binding-post 75, to which is attached one of the circuit-conductors 83. A guide-plate 76 is fastened to a suitable part of the apparatus—as, for example, to the upper head of the vacuum-cylinder—said plate being firmly secured in electrical contact with the cylinder. This plate has a longitudinal slot 77, loosely receiving the lower part of a vertical rod 78, that is pivoted at its upper extremity to the end of the cross-arm 50, opposite the connection of the valve-operating rod 51 therewith. This rod 78 has a cam-knob 80, arranged to impinge the cam-head 70 of the slidable pin 68 on the upward movement of the rod 78 with the cross-arm and the piston-valve; but the rod 78 on the downward movement of the piston-valve is arranged to be deflected away from the cam-head of the slidable pin. A spring 81 is fastened to the plate 76, in position to act against the rod 78 to restore the cam-knob into operative relation to the slidable pin. This plate 76 has a binding-post 82, to which is attached the other

circuit-conductor 84, said binding-post being in electric connection with the fixed contact 57 through the plate 76, the cylinder, the nipple of the shell forming the explosion-chamber, and the yoke 55, although a wire may lead directly from the binding-post to the fixed contact 57, if desired.

In operation the spring 71 withdraws the slidable pin and the contact 58 away from the contact 57, thus opening the circuit, and the piston-valve is lifted by the energy of the spring 85, so as to occupy the seat 12′ and cut off communication between the explosion-chamber and the vacuum-cylinder, said spring 85 being preferably coiled around the upper protruding end of the valve-rod 13, so as to rest upon the stuffing-box 15 and the central part of the cross-arm 50. In this position of the parts the explosive charge has been previously admitted to the explosion-chamber and the water has been drawn into the vacuum-cylinder. Assuming that the piston-valve is moving in an upward direction after the expulsion of the liquid from the vacuum-cylinder and the gaseous fluid from the explosion-chamber and the vacuum-cylinder, so as to make their escape through the eduction-pipe, the partial vacuum created in the cylinder and the chamber serves in conjunction with the energy of the spring 85 to lift the piston-valve, which in turn raises the cross-arm and pulls upwardly on the rod 51 and the rod 78. As the rod 51 is lifted the toe-piece engages with the valve-lever to open the valve 30 and admit the explosive charge to the chamber 11. During this upward movement of the piston-valve the liquid flows through the eduction-pipe past the foot-valve and into the cylinder, the check-valve 25 being closed. Before the piston-valve and the rods 51 78 complete their upward movements the cam-knob 80 on the rod 78 engages with the cam-head of the slidable pin 68, thereby moving the latter inwardly to make the contact 58 engage the contact 57 and complete the electric circuit during the upward movement of the rod 78. Now as the rod completes its upward movement with the piston-valve and the rod 51 the knob 80 is withdrawn from engagement with the cam-head of the slidable pin, and the spring 71 thus becomes active to suddenly move the contact-pin in an outward direction, thereby quickly breaking the electric circuit and producing a spark within the explosion-chamber 11. This spark ignites the charge of explosive mixture and converts the same into a gaseous fluid at high pressure. This fluid displaces the piston-valve and acts upon the liquid contents of the cylinder to expel the same through a part of the suction-pipe and through the eduction-pipe, the foot-valve being closed in the eduction-pipe and the valve 38 being also closed by the pressure of the gaseous fluid. The rods 51 78 move downwardly with the cross-arm and the rod of the piston-valve, the springs 54 and 81 yielding for the toe-piece 53 and the cam-knob 80 to pass the valve-lever 34 and the head of the slidable pin 68. The suction created in the vacuum-cylinder and the explosion-chamber, together with the energy of the spring 85, again lifts the parts 17, 13, 51, and 78 to successively open the valve 30 and actuate the contact-pin 68 for exploding the mixture admitted to the chamber 11, the liquid in the meantime flowing into the vacuum-cylinder, and these operations are repeated over and over again for the purpose of elevating the water to the tank 28.

Changes within the scope of the appended claims may be made in the form and proportion of some of the parts, while their essential features are retained and the spirit of the invention is embodied. Hence I do not desire to be limited to the precise form of all the parts as shown, reserving the right to vary therefrom.

Having thus described the invention, what I claim is—

1. In a liquid-forcing system, the combination with a suction-pipe, and an eduction-pipe, of a vacuum-cylinder, an explosion-chamber in communication with said cylinder, a fluid-actuated valve adapted normally to close communication between the chamber and the cylinder and to be moved by the explosion to its open position, a valve mechanism operatively connected to the chamber and controllable by movement of the fluid-actuated valve to admit a charge to the explosion-chamber, and an igniting mechanism also controlled by said valve and arranged to explode a charge or mixture admitted to a chamber, as set forth.

2. In a liquid-forcing system, the combination of an explosion-chamber, a subjacent vacuum-cylinder, suction and eduction pipes in communication with the cylinder, means for admitting an explosive charge to the explosion-chamber, igniting mechanism, and a valve operatively related to the explosion-chamber for actuation by the explosion therein and having connection with the charge-admission mechanism and with the igniter to actuate the latter immediately subsequent to the feed of the charge to the explosion-chamber, as set forth.

3. In a liquid-forcing system, the combination of an explosion-chamber, a vacuum-cylinder in communication therewith, suction and eduction pipes in communication with said cylinder, a charge-controlling valve communicating with the explosion-chamber a back-pressure valve between the explosion-chamber and the charge-admission valve, an igniter mechanism, and a fluid-actuated valve controlling the communication between the cylinder and the chamber and having operative connections with the charge-admission valve and the igniter, whereby the movement of the first-mentioned valve serves to effect the admission of a new charge and its ignition in quick succession.

4. In a liquid-forcing system, the combina-

tion of an explosion-chamber, a vacuum-cylinder, suction and eduction pipes, a charge-admission valve connected with the explosion-chamber, a piston-valve controlling the communication between the chamber and the cylinder and exposed to the pressure of a gaseous fluid generated within said chamber for actuation thereby, operative connections between the piston-valve and the charge-admission valve, and an igniter mechanism, as set forth.

5. In a fluid-forcing system, the combination of an explosion-chamber, a vacuum-cylinder, suction and eduction pipes, a charge-admission valve connected with the explosion-chamber, a piston-valve controlling the communication between the chamber and cylinder exposed to fluid-pressure generated within the explosion-chamber or actuation by the explosion and having positive connections with the charge-admission valve, a back-pressure valve between the explosion-chamber and the charge-admission valve and operable by the pressure and suction within the explosion-chamber, and an igniter mechanism, as set forth.

6. In a fluid-forcing system, the combination of an explosion-chamber, a vacuum-cylinder, suction and eduction pipes, a piston-valve having a cross-arm, a charge-admission valve communicating with the explosion-chamber, a lever connected with the stem of the charge-admission valve, and the lifting-rod pivoted to the cross-arm and having a toe-piece in operative relation to said lever, as set forth.

7. In a fluid-forcing system, the combination of an explosion-chamber, a vacuum-cylinder, suction and eduction pipes, a piston-valve normally closing the communication between the chamber and cylinder, a charge-admission valve connected to the chamber, fixed and movable contacts within said explosion-chamber, a slidable element for actuating the movable contact, and connections between the slidable element and the piston-valve, as set forth.

8. In a liquid-forcing system, an explosion-chamber provided with an insulated bushing, a slidable element contained within the bushing and having a movable contact, a stationary contact, and a spring mounted on the bushing and coöperating with the slidable element to normally withdraw the movable contact from the stationary contact, in combination with a vacuum-cylinder, suction and eduction pipes, means for admitting an explosive charge to the chamber, a piston-valve disposed for actuation by the explosion, and a movable element connected with the piston-valve and arranged for engagement with the slidable contact element, as set forth.

9. In a liquid-forcing system, an explosion-chamber provided with an insulated bushing, a wear-sleeve within the bushing, means for making a tight joint between the bushing and sleeve and the shell of the explosion-chamber, a slidable pin having a cam-head and a contact, a stationary contact in the path of the slidable pin, and a yoke-spring fastened at one end and engaging at its other end with the slidable pin, combined with a vacuum-cylinder, a piston-rod having a piston-valve, an arm movable with said rod, another rod pivoted to the valve-arm and provided with a projection in operative relation to the cam-head of the slidable pin, means for admitting an explosive charge to the chamber, and suction and eduction pipes, as set forth.

10. In a liquid-forcing system, a vacuum-cylinder, an explosion-chamber surmounting said cylinder and provided at one end with a nipple and at its other end with a stuffing-box, and a valve-rod passing through the nipple and the stuffing-box and having a packed valve adapted to be seated against the nipple, combined with means for admitting an explosive charge to the chamber, an igniter mechanism, connections between the igniter, the charge-admission means, and the rod of the piston-valve, and suction and eduction pipes, as set forth.

11. In a liquid-forcing system, the combination of a vacuum-cylinder, a suction-pipe having a foot-valve, an eduction-pipe coupled to the suction-pipe and likewise provided with a check-valve, of an explosion-chamber coupled to the eduction-pipe, means for admitting an explosive charge to the explosion-chamber, an igniter mechanism, and a common operating means for the igniter mechanism, and a charge-admission mechanism, substantially as and for the purposes described.

12. In a liquid-forcing apparatus, the combination with an explosion-chamber, and induction and eduction pipes, of a valve controlling the communication between the explosion-chamber and said pipes and disposed for actuation by the explosion, and means operated by said valve for charging the explosion-chamber and for igniting the charge.

13. In a liquid-forcing apparatus, the combination with an explosion-chamber, and induction and eduction pipes, of a piston-valve normally closing the communication between the explosion-chamber and said pipes and designed to be operated in one direction by the explosion, means for effecting the retraction of the piston-valve immediately after the explosion, and means operated by said retractile movement of the valve for charging the explosion-chamber and for igniting the charge in quick succession.

14. In a liquid-forcing apparatus, the combination with an explosion-chamber, and a subjacent vacuum-cylinder, of an induction-pipe communicating with the vacuum-cylinder and provided with a check-valve, an eduction-pipe communicating with the induction-pipe at a point between the valve and the vacuum-cylinder, said eduction-pipe being provided with a check-valve seating in an opposite direction from the valve in the induction-pipe, a piston-valve normally closing the

communication between the explosion-chamber and the vacuum-cylinder and disposed to be opened by the force of the explosion, and charging and ignition devices in operative relation with the explosion-chamber and having operative relation to the piston-valve for successive actuation thereby.

15. In a liquid-forcing apparatus, the combination with an explosion-chamber, a vacuum-cylinder, an induction-pipe and an eduction-pipe, of a piston-valve normally closing the communication between the explosion-chamber and vacuum-cylinder and having its valve-stem extended above the explosion-chamber, reactive mechanism for retracting the piston-valve, a charge-admission valve disposed at one side of the explosion-chamber, an ignition device disposed at the opposite side thereof, a cross-head connected to the upper end of the valve-stem, and operating members connected to the opposite ends of the cross-head to effect the successive actuation of the charge-admission mechanism and the ignition device during the retraction of the piston-valve.

16. In a liquid-forcing apparatus, the combination with an explosion-chamber, and induction and eduction pipes provided with oppositely-opening valves, of a valve controlling the communication between the explosion-chamber and said pipes and disposed for actuation by the explosion, and means operated by said valve for charging the explosion-chamber and for igniting the charge, and an elevated receiving-reservoir in communication with the eduction-pipe.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

DAVID PATTON BURDON.

Witnesses:
SAML. W. FOX,
A. T. JONES.