(No Model.) 3 Sheets—Sheet 1.

J. STUMPF.

PUMP.

No. 578,950. Patented Mar. 16, 1897.

Fig. 1.

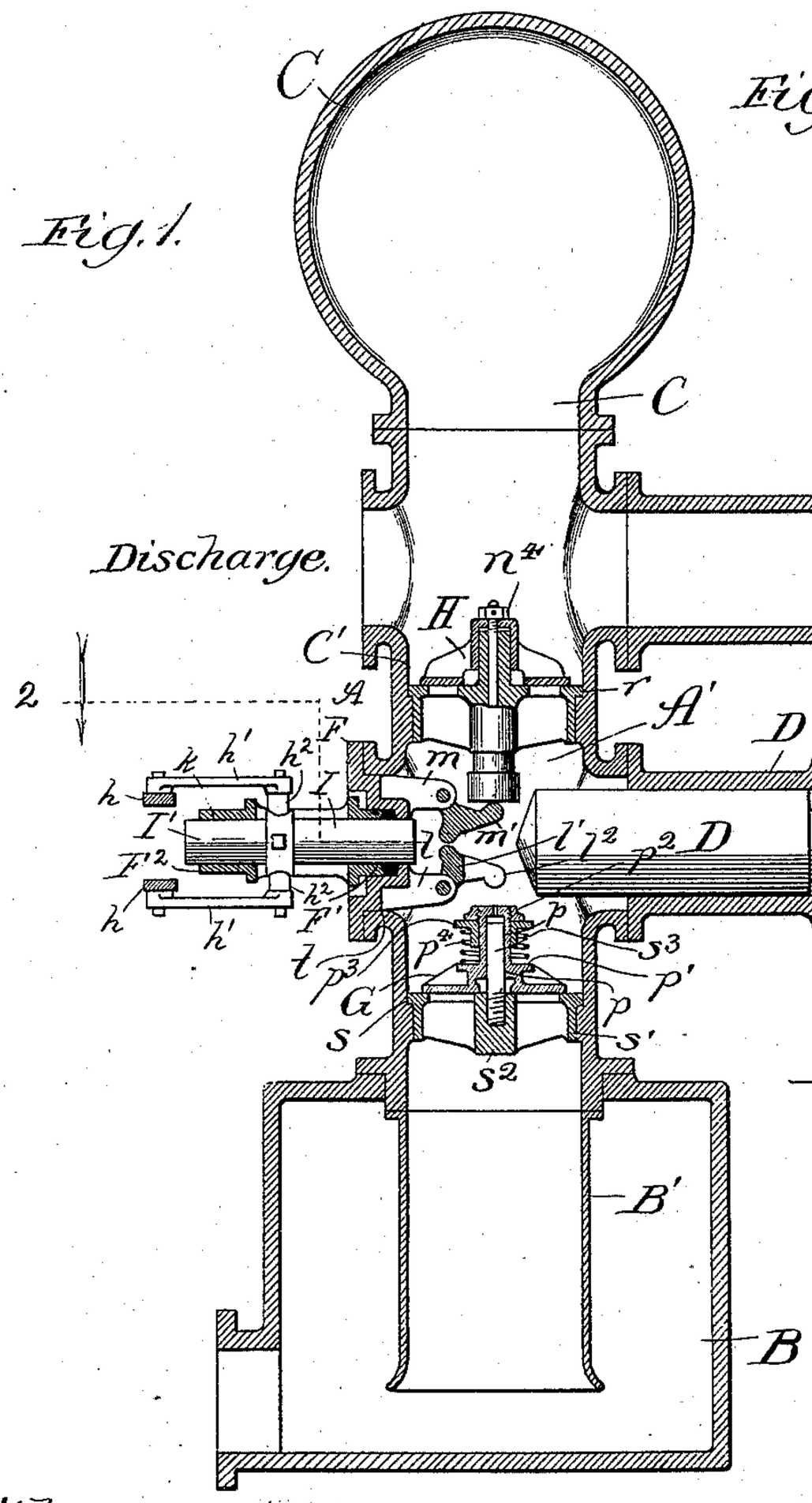
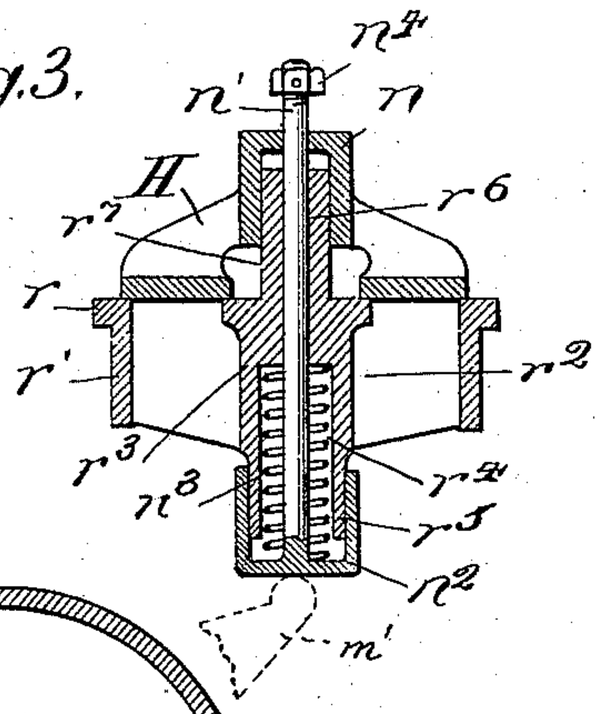


Fig. 3.



Witnesses:
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Lute J. Atlee.

Inventor:
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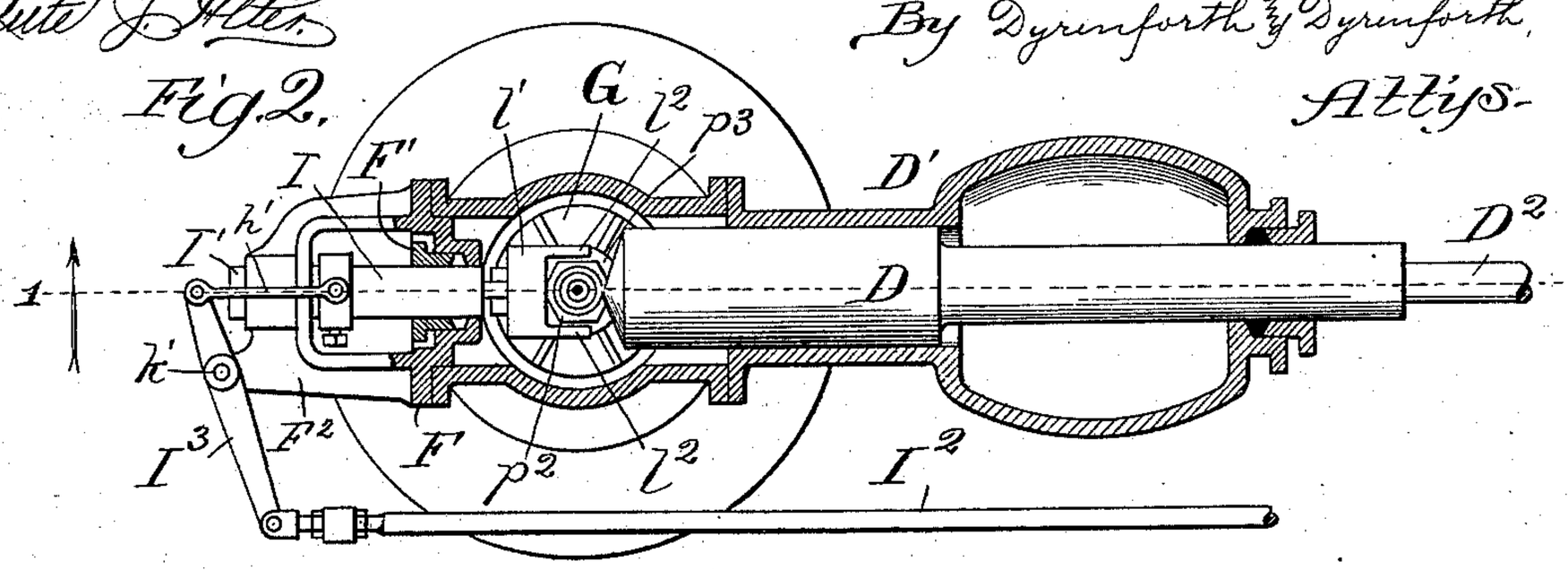
Fig. 2.



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J. STUMPF.

PUMP.

No. 578,950. Patented Mar. 16, 1897.

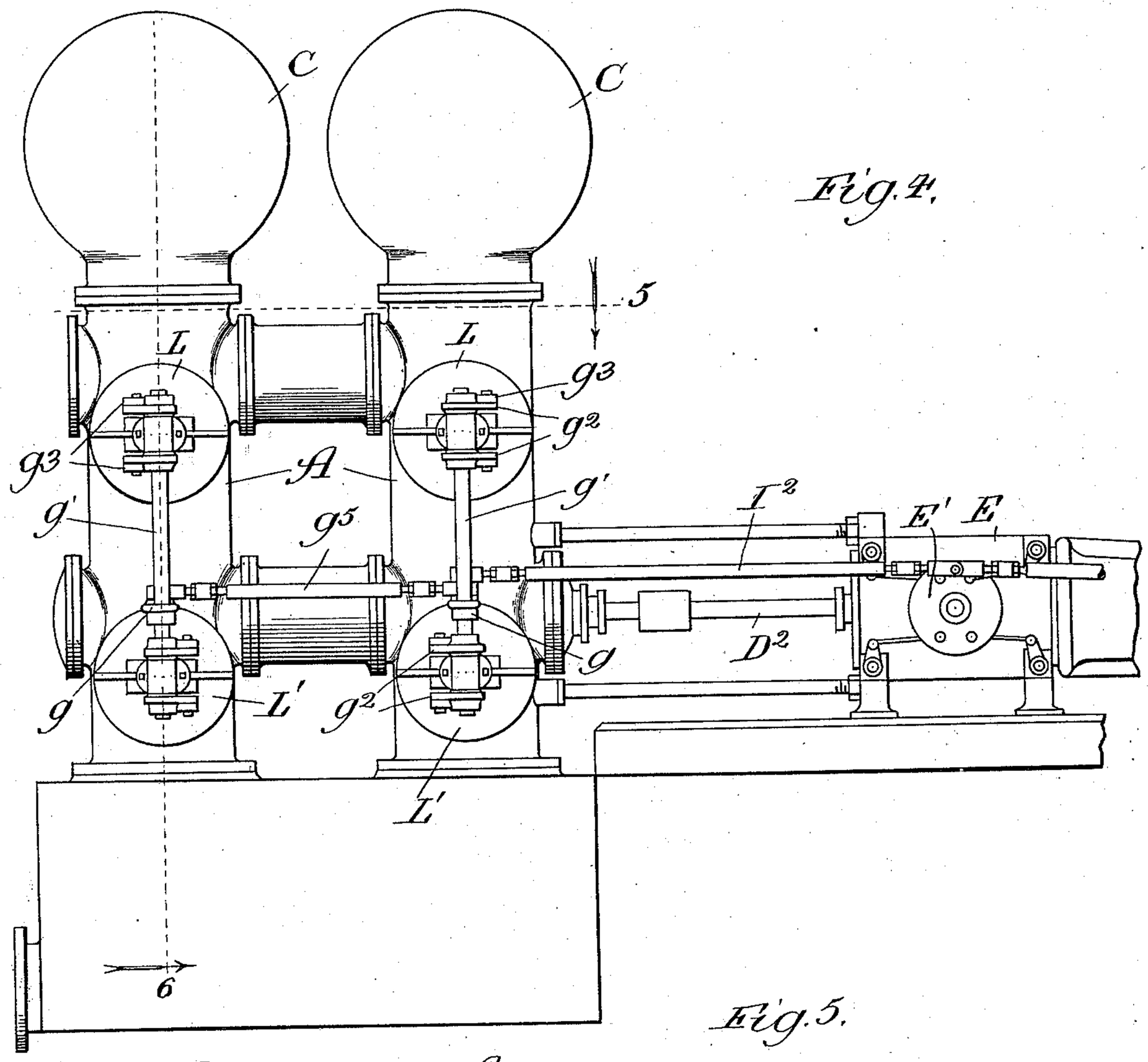

Fig. 4.

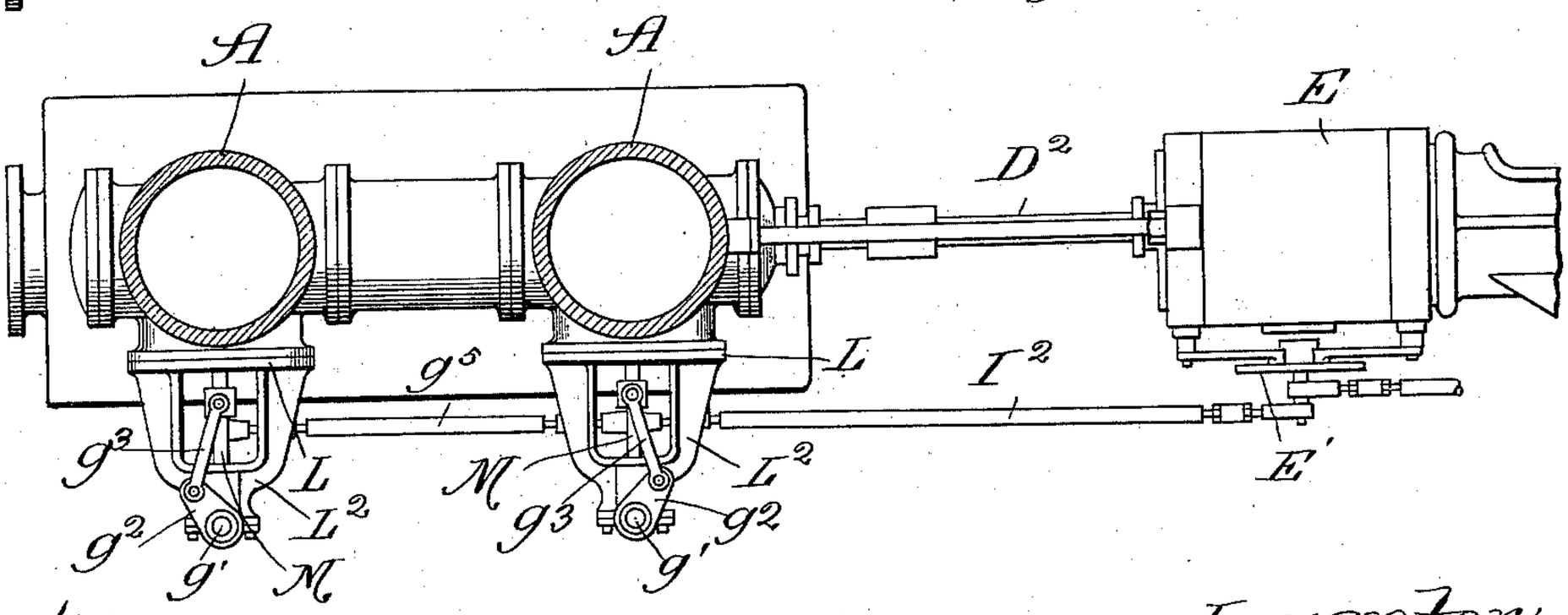

Fig. 5.

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(No Model.) 3 Sheets—Sheet 3.

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No. 578,950. Patented Mar. 16, 1897.

Fig. 6.

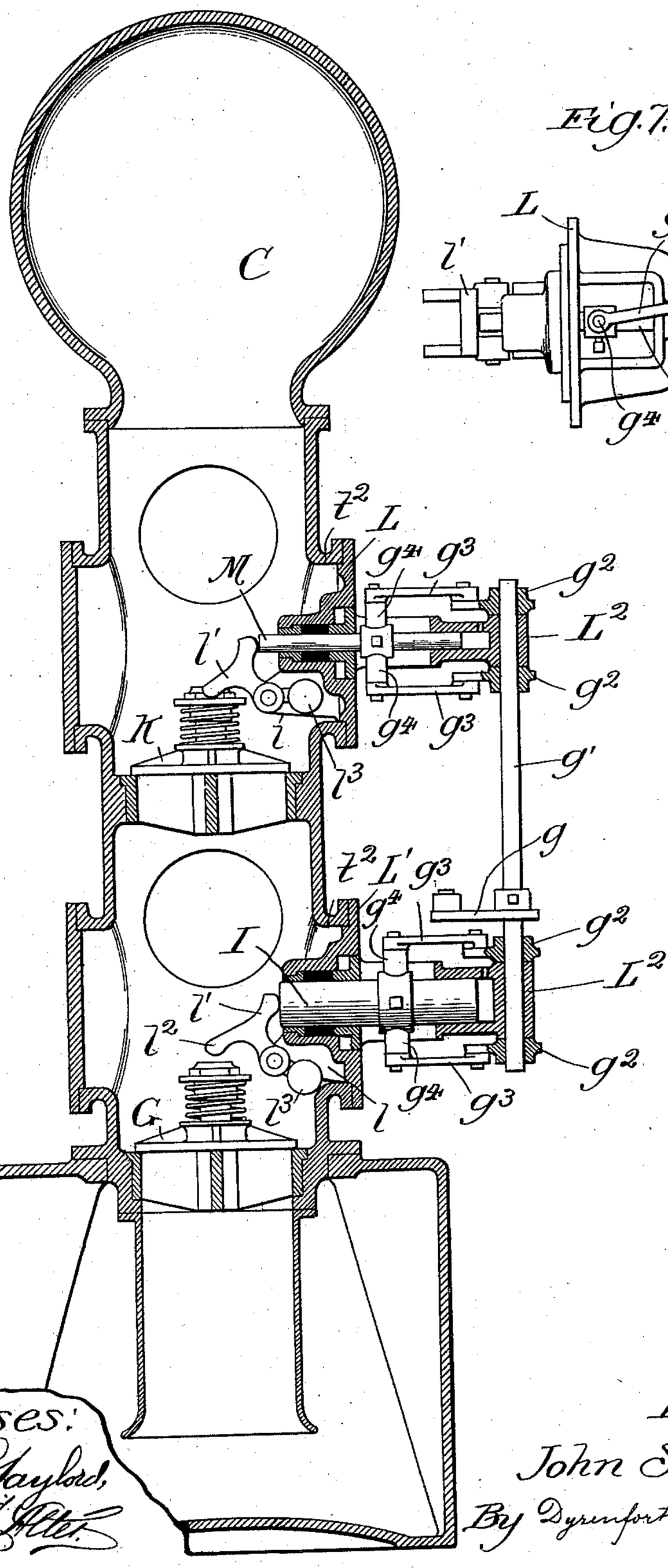
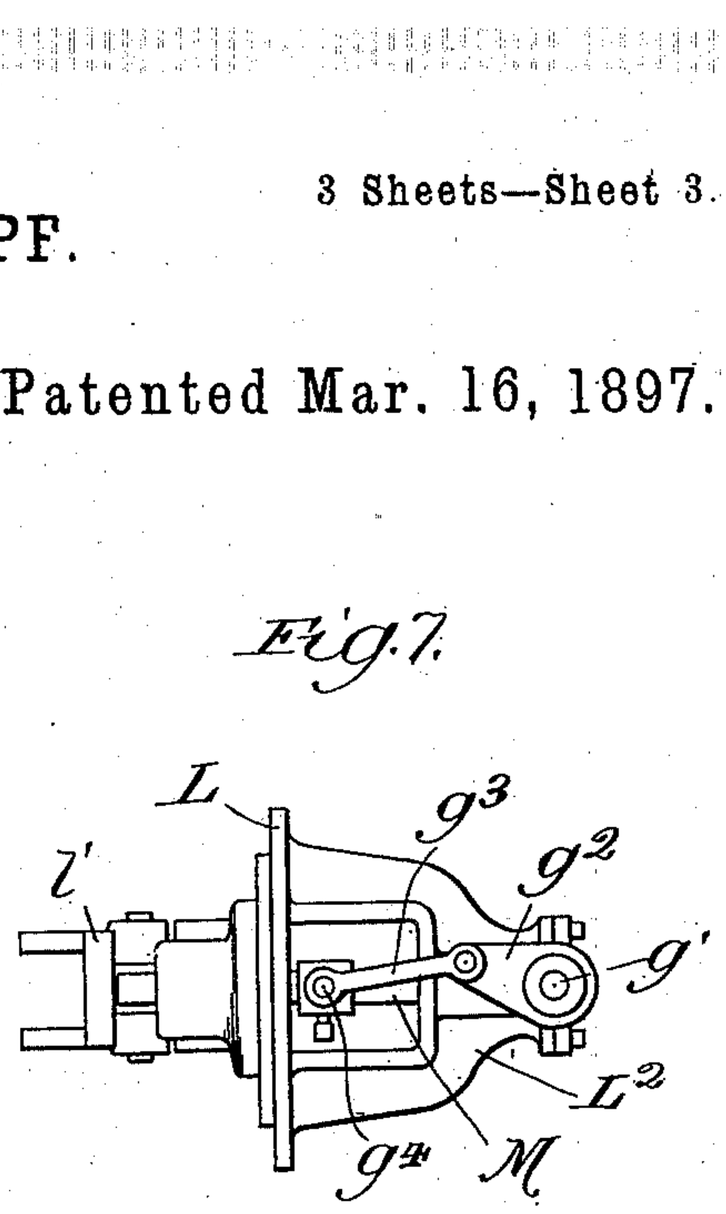


Fig. 7.



Witnesses:
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UNITED STATES PATENT OFFICE.

JOHN STUMPF, OF CHICAGO, ILLINOIS.

PUMP.

SPECIFICATION forming part of Letters Patent No. 578,950, dated March 16, 1897.

Application filed November 2, 1896. Serial No. 610,831. (No model.)

To all whom it may concern:

Be it known that I, JOHN STUMPF, a subject of the Emperor of Germany, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Pumps, of which the following is a specification.

My invention relates to improvements in valve-actuating means for pumps, and particularly water-raising pumps.

The pumps to which my invention is more especially applicable have, as commonly constructed, a chamber provided with an inwardly-opening induction-valve and an outwardly-opening eduction-valve and a piston or plunger working in and out of the chamber. It has been the more common practice hitherto to open and close the valves altogether by the displacing and evacuating actions of the main plunger, whereby in the initial movement of the plunger from the end of its stroke it has first to seat and unseat the valves, which consumes time before useful work, that of drawing in and forcing out the water, commences. Furthermore, the speed of such pumps has been of necessity unduly limited for the reason that a too sudden displacing and evacuating action by the plunger at the beginning of a stroke tends to move the valve with a shock, thus not only noisily, but in a manner which is unduly wearing upon the valves. Various mechanical appliances or valve-gears have been devised and employed to move the valves at about the time the plunger-actuating pitman crosses the dead-center, and while they have proved in a measure successful in permitting greater speed in the operation of the plunger, the advantages they contribute are so slight as compared with their initial cost and the power required for their operation that they have not come into extensive use.

In an application for Letters Patent of the United States filed July 13, 1896, and bearing Serial No. 598,954, I have shown and described valve-operating means in the form of an auxiliary plunger effective in the pump-chamber and operating, while the main plunger is at opposite limits of its traverse, to effect opening and closing movement of the valves by its pressure increasing and diminishing actions upon the fluid. This construction has decided advantages over the purely mechanical valve-operating mechanisms in the matter of reducing shock and thereby permitting greater speed of operation, as well as increasing the amount of useful work of the main plunger in each stroke.

My present object is to improve still further in the direction of diminishing the shock upon the valves and waste of energy of the main plunger by supplementing the auxiliary-plunger construction described in my aforesaid application with mechanical valve-operating means whereby the pump will be practically noiseless in operation, may be operated at increased speed without injury to the valves, and from the initial movement of the main plunger in either direction will perform useful work.

In the drawings, Figure 1 is a broken vertical section of a water-raising pump of approved pattern, showing the preferred arrangement of valves and my improvements in one practical form applied thereto; Fig. 2, a horizontal section taken on irregular line 2 in Fig. 1; Fig. 3, a sectional view of the eduction-valve shown in Fig. 1; Fig. 4, a broken side elevation of a double pump of known construction with my improvements applied; Fig. 5, a horizontal section taken on line 5 of Fig. 4; Fig. 6, a broken vertical and enlarged section taken on line 6 of Fig. 4, and Fig. 7 a detail top plan view of the upper mechanical valve-operating means shown in Figs. 4, 5, and 6.

A is the pump-body containing the chamber, or, as it is commonly called, the "cylinder" A′, B the suction air-chamber, and C the discharge air-chamber. The piston or main plunger D works in a plunger-guide D′ and is upon the end of a stem D^2, which may be the stem of a steam-engine piston, as shown in Figs. 4 and 5, wherein E is the casing of the steam chest and cylinder of an engine of the Corliss type. In a construction wherein the pump is not actuated by an individual steam-engine, as herein illustrated, the stem D^2 may be connected through a reciprocating cross-head with a drive-shaft, or in the same way or otherwise with any suitable driving mechanism.

The pump illustrated in Fig. 1 is a single pump of the differential type, and the pump-

body is provided at the cylinder A′, in line with the plunger D, with an opening *t*, closed by a removable cap F. This opening is necessary for the insertion of the main plunger. In a pump of this type, or in fact any type where practical, I prefer to provide an upwardly and inwardly opening or lifting induction-valve G, and an upwardly and outwardly lifting eduction-valve H, closing, respectively, upon the seats *s* and *r*. The seat *s* is formed with an outer ring *s*′, fitting and fastened in the suction-pipe B′, and a spider s^2, extending from the center of which is a guide-pin s^3. The valve G is formed on its upper side with a central hollow tubular projection *p*, presenting an annular shoulder *p*′, and threaded at its upper end to receive a nut p^2. Surrounding and sliding upon the tubular portion *p* is a loose bearing-piece p^3, held normally against the nut p^2 by a spring p^4, which surrounds said tubular portion and is confined between the shoulder *p*′ and the bearing-piece. At the said tubular portion the valve fits loosely over the guide-pin s^3.

The seat *r* of the eduction-valve H comprises an outer ring *r*′, fastened to the passage C′, leading from the cylinder A′ to the discharge air-chamber C, and a spider r^2, having a central tubular portion r^3, extending above and below the radial arms of the spider. In the lower part of the tubular portion r^3 is an enlarged chamber r^4, and the outer surface of the said lower end portion affords a guide r^5. Extending upward from the enlarged or chamber portion r^4 is a guide-opening r^6, and the outer circumference of the tubular portion above the radial arms of the web affords a guide-surface r^7.

The valve H has a central upward-projecting cup portion *n*, which fits over and slides upon the guide r^7. Passing through an opening in the cup portion is a pin *n*′, which extends downward through the guide-opening r^6 and chambered part r^4, beyond the lower end of the tubular portion r^3, carrying at its lower end a guide-cup n^2, which slides upon the guide-surface r^5. In the chamber r^4 and confined between the upper end of the latter and the guide-cup n^2 is a spring n^3. On the upper end of the pin *n*′ is a nut or stop n^4. The tendency of the spring n^3 is to cause the stop n^4 to bear down upon the cup portion or top of the valve H and press the latter to its seat, as shown in Fig. 1. When, as hereinafter described, the pin is raised to the position shown in Fig. 3, the valve may lift freely from its seat until the cup portion strikes the stop n^4, when further lifting will be against the resistance of the spring n^3, which acts as a cushion to diminish the shock.

The cap F is provided on its inner side with upper and lower bearing lugs or ears *m l*. Pivotally mounted upon the ear *m* is a swinging finger *m*′, preferably in the form of a bell-crank lever, adapted to engage the under surface of the cup n^2. Pivotally mounted upon the ear *l* is a swinging finger *l*′, also in the form of a bell-crank lever, having a bifurcated end portion l^2, adapted to straddle and clear the nut p^2 and engage the bearing-piece p^3 on opposite sides of the nut. In the center of the cap F is a stuffing-box F′, through which works an auxiliary plunger I. On the outer side of the cap F is a bracket F^2, affording a guide-opening *k* for the stem I′ of the auxiliary plunger.

I^2 is an operating-rod connected with a moving part of the pump or engine to be reciprocated longitudinally. The rod I^2 at its end is pivotally connected to one end of a lever I^3, pivoted between its ends at *k*′ upon the bracket F^2. Beyond the pivot *k*′ the lever is preferably bifurcated to afford the forks *h h*, to which links *h*′ *h*′ are pivotally connected, at one end. Fastened upon the stem I′, between the guide-opening *k* in the bracket and the plunger I, are laterally-extending arms h^2, to the outer ends of which the links *h*′ are pivotally connected. The fingers or levers *m*′ *l*′ are in the path of the inner end of the auxiliary plunger I, whereby in its inward movement the plunger strikes the said fingers or levers and turns the finger *m*′ in the upward direction and the finger *l*′ in the downward direction, causing the finger *m*′ thus to engage and press the cup n^2 and pin *n*′ upward, whereby the valve H is released from the pressure of the spring n^3 and may open freely, and the finger *l*′ to engage and bear downward upon the bearing-piece p^3 to press the valve G to its seat.

In Fig. 4 I have shown the rod I^2 to be pivotally connected at its forward end to the wrist-plate E′ of the Corliss cut-off shown. In the case of a Meyer's cut-off engine, the construction of which is well known, the rod I^2 may be connected with either the eccentric which operates the main steam-valve or with the cut-off eccentric. I do not limit my invention, however, to a connection of the auxiliary-plunger operating-rod with any particular moving part either of the pump or engine or other driving mechanism which actuates the pump. It is usually desirable that the driving mechanism for the said rod shall be actuated to move the auxiliary plunger I at the greatest speed when the main plunger is at or near the end of its stroke and the gearing thereof is at or near what may be termed its "dead-center" or the limit of its traverse in one direction. Thus I prefer, usually, to gear the rod I^2 at an angle of about ninety degrees with relation to the main plunger, whereby as the main plunger nears the end of its stroke in the outward direction the auxiliary plunger I will be moved quickly inward to effect the desired displacement and engage and move the fingers or levers *l*′ *m*′ and whereby as the main plunger nears the end of its stroke in the inward direction the auxiliary plunger will be moved quickly outward to effect the desired evacuation of pressure and release the fingers or levers.

As in my aforesaid application, the auxiliary plunger by its displacing action may cause the water in the cylinder A′ to exert sufficient pressure against the valves G H to close the former and open the latter, this pressure being independent of the pressure exerted by the main plunger as it commences to move in the inward direction.

Owing to the fact that the stoppage of the main plunger at either end of its stroke, particularly when running at high speed, is only momentary it would be a physical impossibility to produce full movement of the induction and eduction valves during that period. The best results, namely, those of preventing shock upon the valves and material waste of energy on the part of the main plunger, are obtained by first neutralizing the fluid-pressure from the cylinder against the valve and then quickly closing the valves while the main plunger is at or near the end of its stroke. Where an auxiliary plunger alone is employed, it must, for example, in its inward plunge, as the main plunger is nearing the end of its outward plunge, produce sufficient compression in the cylinder to overcome the then evacuating action of the main plunger, and also produce sufficient pressure against the valves to actuate them, while on the other hand it is necessary to cause the auxiliary plunger as the main plunger nears the inward limit of its stroke to produce sufficient evacuation or lowering of pressure in the cylinder to overcome the pressure produced by the main plunger and effect movement of the valves.

Where only mechanical closing means are employed to close the valves, such means must commence to operate to produce the aforesaid results before the main plunger reaches the end of its stroke. Consequently such mechanism must, for a period at least, operate contrary to the force of the plunger to close the eduction-valve while the main plunger is moving inward and close the induction-valve while the plunger is moving outward. The resistance against closing of the induction-valve, caused by the evacuating action thereof while closing, must also be overcome. By combining the auxiliary plunger and mechanical valve-operating means I obtain better results in a marked degree than can be obtained by the use of either without the other. Thus in operation I prefer to cause the auxiliary plunger to effect such displacement as will neutralize the evacuating action of the main plunger just before the latter reaches the limit of its stroke in the outward direction, and in a measure, at least, the evacuating action of the induction-valve while closing, and at the same time engage the levers or fingers l' m' to press the induction-valve to its seat and remove the pressure of the spring from the eduction-valve, so that the same may open freely when the main plunger starts in the inward direction. While this necessarily produces a slight loss of energy or useful work of the main piston when it is completing its stroke, this loss of energy is very much less than would be the case were the valves operated under the displacing and evacuating actions of the main plunger itself. Furthermore, it causes the valves to be operated in a manner comparatively slow with reference to the movement of the main plunger, thus decreasing the shock upon the valves and permitting the main plunger to be operated at a higher speed, which much more than compensates for any slight loss of energy.

In the outward movement of the auxiliary plunger the lever m' descends, causing the nut n^4, under the action of the spring n^3, to engage and close the valve, the speed of closing being controlled by this return movement of the lever m'. The evacuating action of the induction-valve while closing would tend momentarily to resist or retard such closing movement very materially were this evacuation not neutralized in whole or in part by the displacing action of the auxiliary plunger, and the displacing action of the eduction-valve while closing would tend to retard its closing were it not for the evacuating action of the auxiliary plunger. The engagement of the finger or lever l' is with the bearing-piece p^3 and thus against the spring p^4, whereby the valve may offer a slightly yielding resistance to the action of the said finger or lever, and the cushioning effect thus produced tends to further limit the shock upon said valve, both in its closing and lifting movements. The construction of the induction and eduction valves, involving the springs and attendant parts, also obviates the necessity of a very exact adjustment of the plunge of the auxiliary plunger, as the finger or lever l' may move slightly beyond the required point and compress the spring p^4 to a greater or less degree as the valve is seated, or in case a hard substance, like a pebble, should be caught between the valve and seat the spring will yield under the pressure of the lever.

In Figs. 4, 5, and 6 I have shown my improvements applied to a double-acting pump of a certain largely-used construction wherein it may not be desirable or possible to utilize the existing opening for the insertion of the main plunger as a guide for my auxiliary plunger. Furthermore, in a double pump of this class, particularly in that cylinder which is nearest the engine, it may not be desirable to construct the eduction-valve as I have shown in Figs. 1 and 3, and for this reason I show an induction-valve G like the valve shown in Fig. 1 and an eduction-valve K of similar construction, both having their cushioning-springs upon the upper side. In the side of the body portion of each pump I provide openings t^2, one at the cylinder and the other above the eduction-valve. The upper opening is closed by means of a cap L and the lower opening by means of a cap L′. Extending through a stuffing-box in the cap L′ is an auxiliary plunger I, to all intents and pur-

poses like the auxiliary plunger described in connection with Fig. 1, and working through a stuffing-box in the cap L is a pin or plunger M of small diameter, for the reason that a displacing and evacuating action thereof is not essential. On a bracket or ear *l* on the inner side of each cap L L′ is a finger or lever *l′*, constructed like the same part illustrated in Fig. 1.

In Fig. 6 I show each finger *l′* provided beyond its pivot with a weight l^3, which tends to maintain the active parts of the fingers raised. The finger *l′* in Fig. 1 may also be provided with such a weight to maintain it normally in the raised position shown. The operating-rod I^2 connects at the first pump with the outer end of a crank *g* upon a vertical rock-shaft *g′*, journaled at its upper and lower end portions in brackets L^2 on the caps L L′. Fixed to the rock-shaft *g′* at the upper and lower surfaces of the brackets L^2 are cranks g^2, which at their outer ends carry pivotal links g^3, pivotally connected at their opposite ends to arms g^4, fastened to the pin M and plunger I, respectively. At the second pump is a similar vertical rock-shaft with cranks and links, the crank *g* thereon being pivotally connected through the medium of a tie-rod g^5 with the above-described crank *g*. Necessarily the two lower cranks g^2 extend in a direction more or less at angles to the two upper cranks g^2. In the reciprocation of the rod I^2 the first shaft *g′* is rocked, and through the tie-rod g^5 rocks the second shaft *g′*. The construction is such that in the movement of the first rock-shaft *g′* in one direction it moves the pin M inward and the plunger I outward to the positions shown in Fig. 6 and at the same time moves the corresponding parts in the second pump in the contrary directions. In the outward movement of each auxiliary plunger I it causes the finger or lever *l′* to release its pressure upon the valve G, while the evacuating action of said auxiliary plunger tends to lift the valve. In its rise the bearing-piece p^3 in the construction shown engages the lever or finger *l′* and the shock of its rise is thus cushioned. The same effect is produced with regard to the valve K in the movement of the pin M in the outward direction, when the auxiliary plunger I during its inward movement and consequent compressing action tends to lift the valve K.

In the inward movement of the plunger I or pin M the respective finger *l′* engages the bearing-piece and moves the valve to its seat, the cushioning action being the same as described in connection with the valve G of Fig. 1. The gearing of the valve-closing mechanism in the double pump should be the same with relation to the main plunger as described in connection with the differential pump, and the operations will be the same.

While the mechanical eduction-valve-closing means shown in Fig. 6 differs in construction from that shown in Fig. 1, its operation in effect is the same, because in each case the movement of the lever or finger in one direction frees the valve, so that it may lift without resistance, and in its movement in the opposite direction it causes the valve to be closed by mechanical pressure.

In a double-pump construction wherein each pump is provided with a separate main plunger, as shown in Fig. 1, the valve-closing mechanisms may be introduced through the cap of the opening already provided for the insertion of the main plunger, and my invention contemplates the insertion of the valve-closing mechanisms either through the caps usually provided, as described, or through separate openings and caps expressly provided. Where it is possible to do so, it is usually preferable to insert the mechanisms through the cap of the opening, which is always provided, and thus save the expense which additional openings and caps necessitate.

While I prefer to employ the mechanical closing means at both the induction and eduction valves, its application to either valve alone would improve the action of such valve and be within my invention.

It is to be understood that I do not limit my invention to pumps of any particular type or class, and while I prefer to construct my improvements throughout as shown and described they may be modified in the matter of details of construction and operation without departing from the spirit of my invention as defined by the claims.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a pump, a cylinder or chamber provided with an eduction-valve and an inwardly-lifting induction-valve, a main plunger and driving mechanism, an auxiliary plunger effective in the same cylinder and actuated from the driving mechanism, to alternately increase and diminish the fluid-pressure in the cylinder, while the main plunger is toward the opposite limits of its traverse, in combination with mechanical valve-moving means for the said induction-valve operatively connected with the driving mechanism and acting with the said auxiliary plunger in the direction of effecting closing movement of said induction-valve, substantially as and for the purpose set forth.

2. In a pump, a cylinder or chamber provided with an induction-valve and an outwardly-lifting eduction-valve, a main plunger and driving mechanism, an auxiliary plunger effective in the same cylinder and actuated from the driving mechanism, to alternately increase and diminish the fluid-pressure in the cylinder, while the main plunger is toward the opposite limits of its traverse, in combination with mechanical valve-moving means for the said eduction-valve operatively connected with the driving mechanism and acting with the said auxiliary plunger in the di-

rection of effecting closing movement of said eduction-valve, substantially as and for the purpose set forth.

3. In a pump, a cylinder or chamber provided with an inwardly-lifting induction-valve and an outwardly-lifting eduction-valve, a main plunger and driving mechanism, an auxiliary plunger effective in the same cylinder and actuated from the driving mechanism, to alternately increase and diminish the fluid-pressure in the cylinder, while the main plunger is toward the opposite limits of its traverse, in combination with mechanical valve-moving means operatively connected with the driving mechanism and acting with the said auxiliary plunger in the direction of effecting closing movement of said valves alternately, substantially as and for the purpose set forth.

4. In a pump, a cylinder or chamber provided with an eduction-valve and an inwardly-lifting induction-valve, a main plunger and driving mechanism, an auxiliary plunger effective in the same cylinder and actuated from the driving mechanism, to alternately increase and diminish the fluid-pressure in the cylinder, while the main plunger is toward the opposite limits of its traverse, in combination with yielding mechanical valve-moving means for the said induction-valve operatively connected with the driving mechanism and acting with the said auxiliary plunger in the direction of effecting closing movement of said induction-valve, substantially as and for the purpose set forth.

5. In a pump, a cylinder or chamber provided with an induction-valve and an outwardly-lifting eduction-valve, a main plunger and driving mechanism, an auxiliary plunger effective in the same cylinder and actuated from the driving mechanism, to alternately increase and diminish the fluid-pressure in the cylinder, while the main plunger is toward the opposite limits of its traverse, in combination with yielding mechanical valve-moving means for the said eduction-valve operatively connected with the driving mechanism and acting with the said auxiliary plunger in the direction of effecting closing movement of said eduction-valve, substantially as and for the purpose set forth.

6. In a pump, a cylinder or chamber provided with an inwardly-lifting induction-valve and an outwardly-lifting eduction-valve, a main plunger and driving mechanism, an auxiliary plunger effective in the same cylinder and actuated from the driving mechanism, to alternately increase and diminish the fluid-pressure in the cylinder, while the main plunger is toward the opposite limits of its traverse, in combination with yielding mechanical valve-moving means operatively connected with the driving mechanism and acting with the said auxiliary plunger in the direction of effecting closing movement of said valves alternately, substantially as and for the purpose set forth.

7. In a pump, a cylinder or chamber provided with an inwardly-lifting induction-valve and an outwardly-lifting eduction-valve, a main plunger and driving mechanism, an auxiliary plunger effective in the same cylinder and actuated from the driving mechanism, to alternately increase and diminish the fluid-pressure in the cylinder, while the main plunger is toward the opposite limits of its traverse, in combination with said valve-operating lever mounted in the cylinder in the path of the auxiliary plunger, and to bring about closing movement of said valve in the movement of said auxiliary plunger in one direction, substantially as and for the purpose set forth.

8. In a pump, a cylinder or chamber provided with an eduction-valve and an inwardly-lifting induction-valve, a main plunger and driving mechanism, an auxiliary plunger effective in the same cylinder and actuated from the driving mechanism, to alternately increase and diminish the fluid-pressure in the cylinder, while the main plunger is toward the opposite limits of its traverse, in combination with an induction-valve-closing lever mounted in the cylinder in the path of the auxiliary plunger to be engaged thereby and bring about closing movement of said valve in the inward movement of said auxiliary plunger, substantially as and for the purpose set forth.

9. In a pump, a cylinder or chamber provided with an inwardly-lifting induction-valve and an outwardly-lifting eduction-valve, a main plunger and driving mechanism, an auxiliary plunger effective in the same cylinder and actuated from the driving mechanism, to alternately increase and diminish the fluid-pressure in the cylinder, while the main plunger is toward the opposite limits of its traverse, in combination with a valve-engaging lever for each of said valves, mounted in the cylinder in the path of said auxiliary plunger, and actuated thereby to effect closing movement of said valves respectively in the inward and outward movement of the auxiliary plunger, substantially as and for the purpose set forth.

JOHN STUMPF.

In presence of—
M. J. FROST,
J. H. LEE.