No. 675,859. Patented June 4, 1901.

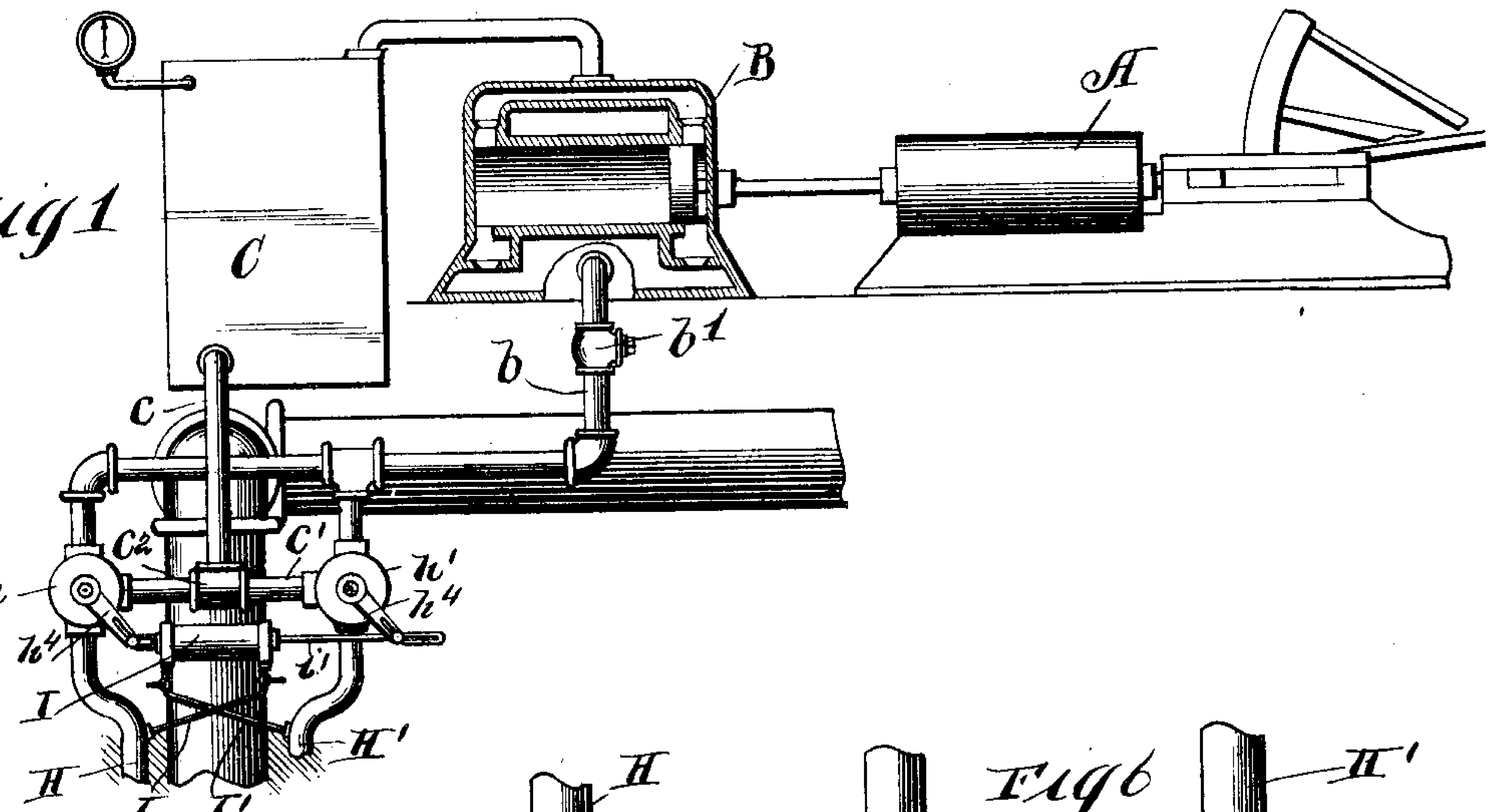
E. M. LAING.

APPARATUS FOR PUMPING.

(Application filed May 23, 1900.)

(No Model.) 2 Sheets—Sheet 1.

Fig 1



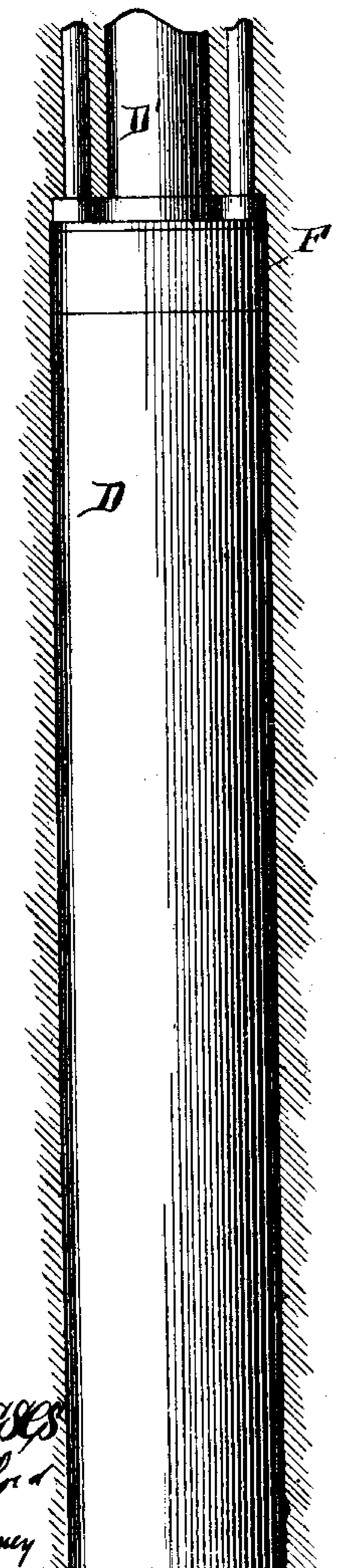
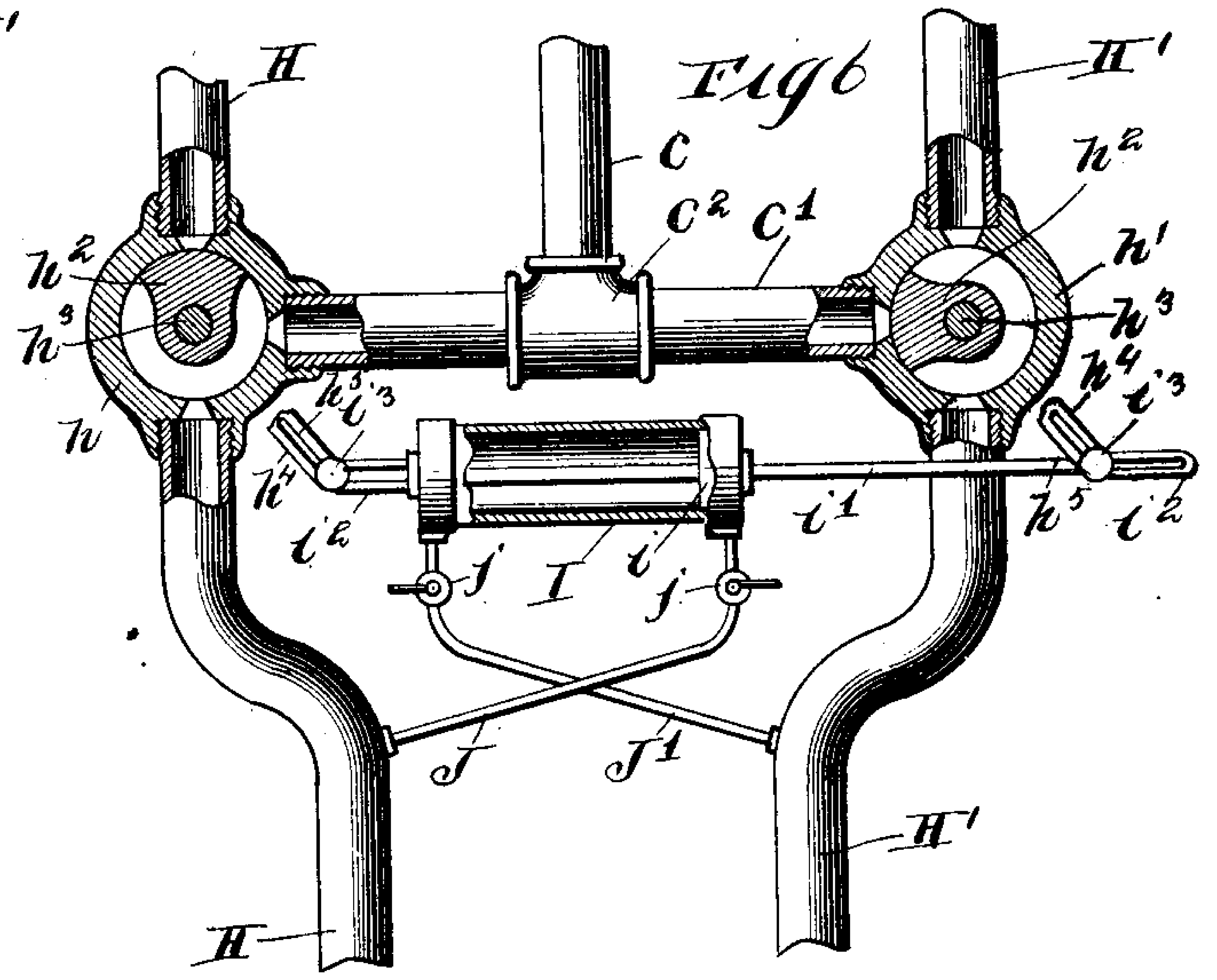
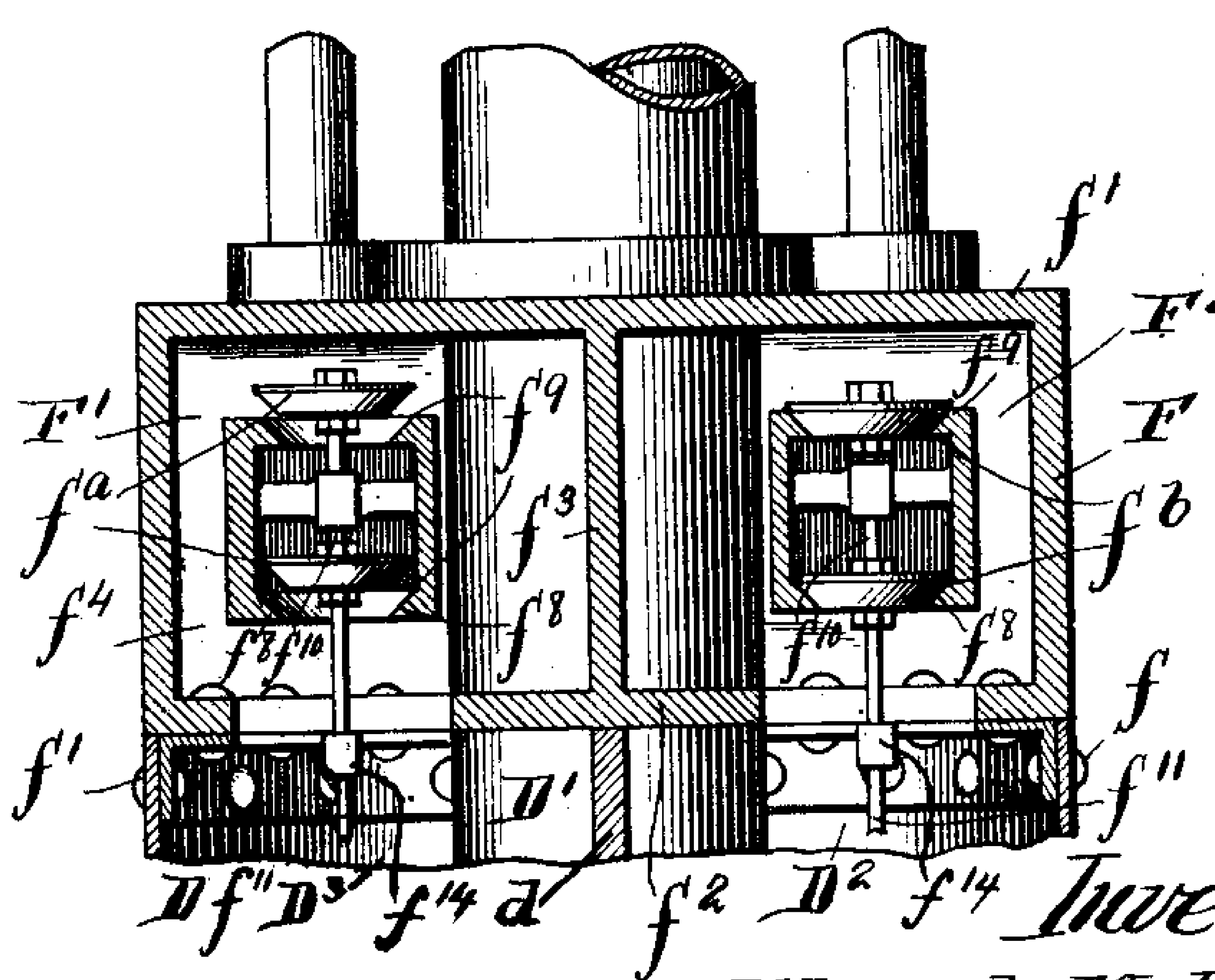


Fig 6





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2 Sheets—Sheet 2.

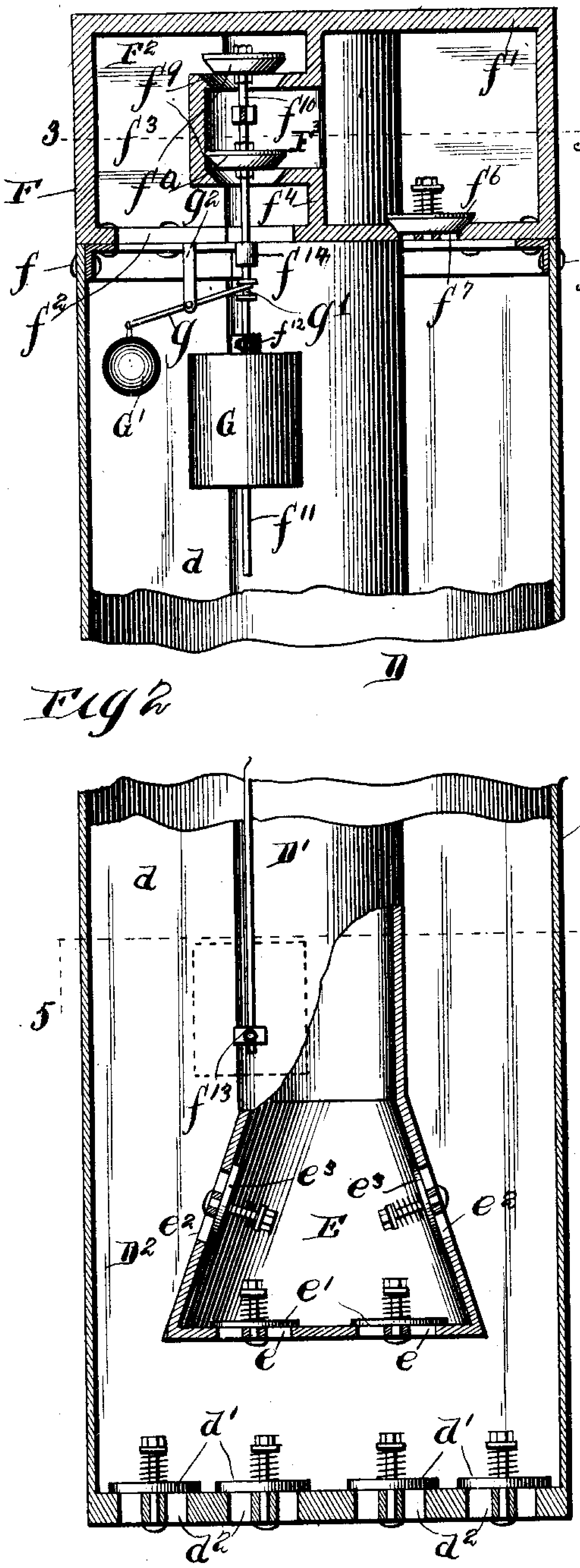

Fig 2.

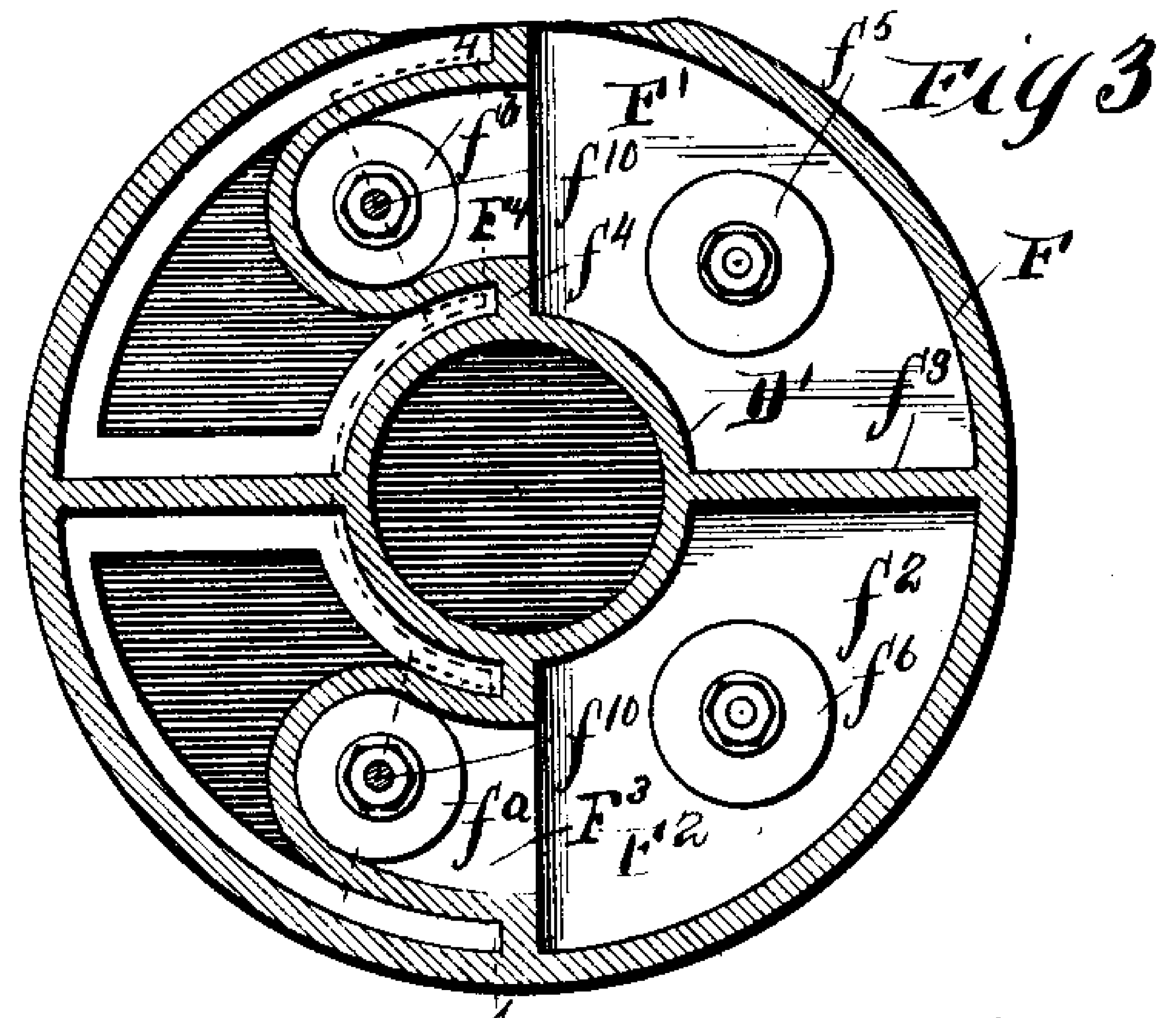

Fig 3

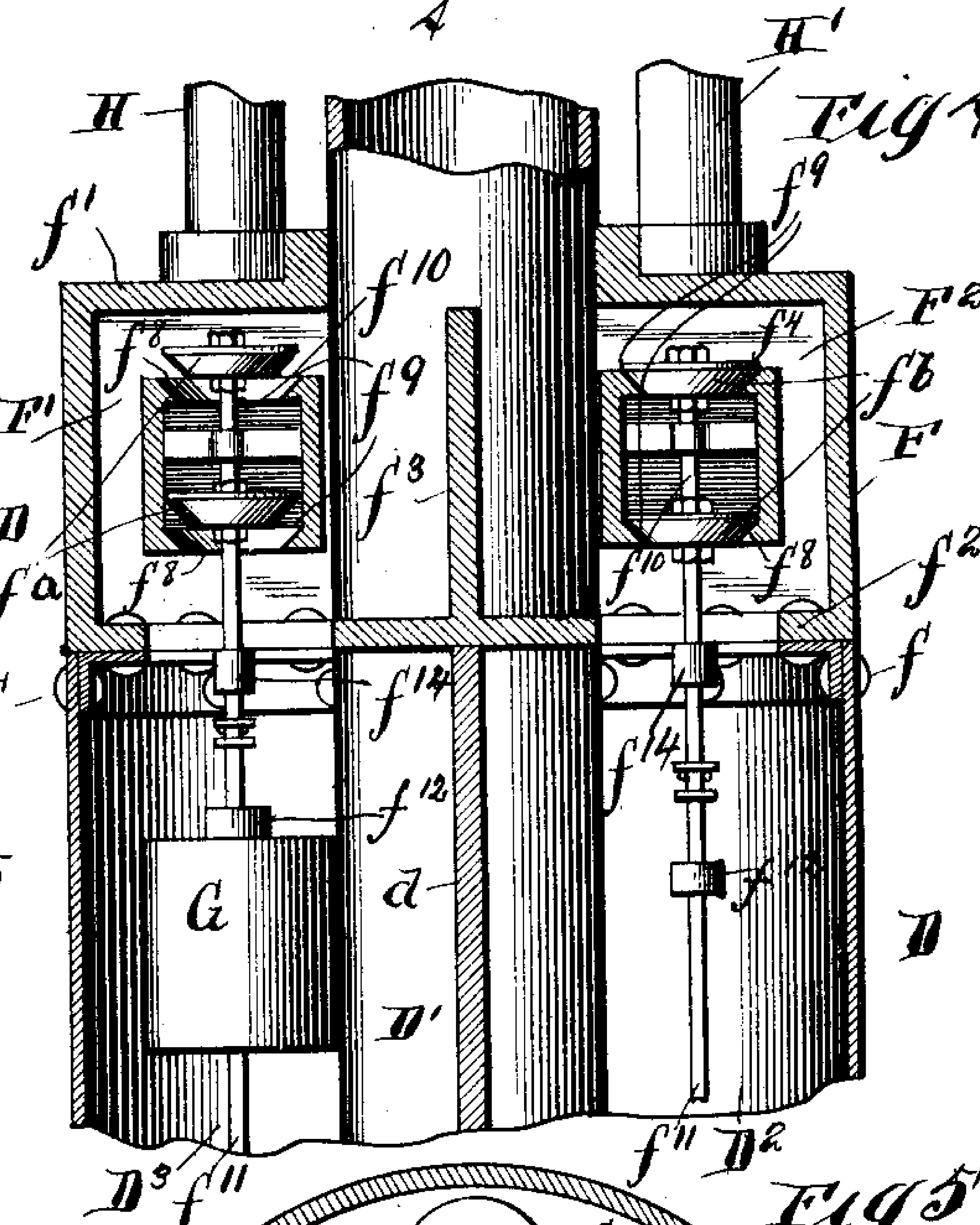

Fig 4

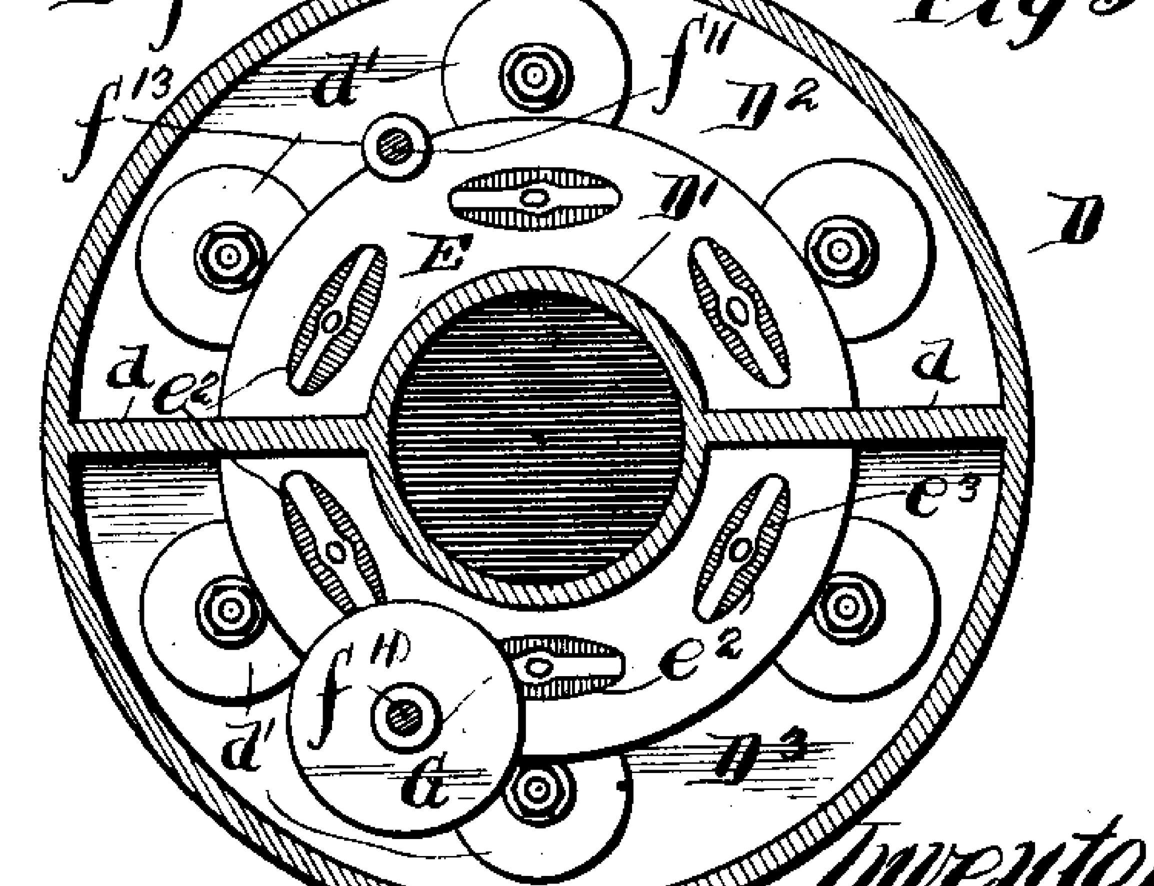

Fig 5

Witnesses:—
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UNITED STATES PATENT OFFICE.

EDWARD M. LAING, OF HIGHLAND PARK, ILLINOIS, ASSIGNOR OF TWO-THIRDS TO JOHN P. MILLER AND JOHN W. LAING, OF CHICAGO, ILLINOIS.

APPARATUS FOR PUMPING.

SPECIFICATION forming part of Letters Patent No. 675,859, dated June 4, 1901.

Application filed May 23, 1900. Serial No. 17,623. (No model.)

To all whom it may concern:

Be it known that I, EDWARD M. LAING, of Highland Park, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Apparatus for Pumping; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to an improvement in pumps of that class in which air under pressure is forced downwardly upon the surface of the water in the well, thereby elevating the water or the like in the pump-barrel.

The invention consists in the matters hereinafter described, and more fully pointed out and defined in the appended claims.

In the drawings, Figure 1 is a view in side elevation and partly in section of a device embodying my invention. Fig. 2 is a longitudinal vertical section, partly broken away, of the pump-barrel and air-chambers located on each side thereof. Fig. 3 is a section taken on line 3 3 of Fig. 2. Fig. 4 is a section taken on line 4 4 of Fig. 3. Fig. 5 is a section taken on line 5 5 of Fig. 2. Fig. 6 is a vertical longitudinal section partly broken away and taken through the upper valve-box of the pump-barrel and air-chambers.

As shown in said drawings, A indicates a motor of any preferred form, that herein shown being a steam or gas engine.

B indicates an air-forcing pump of any desired construction.

C indicates an air-pressure tank adapted to receive the air under pressure from said forcing-pump B and to deliver the same to the air-chamber of the pump-barrel D. Said air-pressure tank C may be of any desired form and construction, the only requisite being that it be of sufficient strength to maintain the desired pressure. The pump-barrel D is designed to be sunk below the level of the water in the well and is provided with a central delivery-pipe D′, extending from near the lower end thereof upwardly to the point where it is desired to deliver the water or other fluid which it is desired to pump from the well. As shown, the said pump-barrel consists of a tube or pipe D′, of any desired diameter, preferably constructed of iron or steel and of sufficient thickness to withstand the desired pressure. Within said pump-barrel are two longitudinal radial partitions *d d*, which may be constructed integral with the inner wall of said barrel and with the outer wall of said delivery-pipe D′, which, as shown in Figs. 1, 2, 3, and 4, is located axially of said barrel. The partitions may be constructed in any desired way to form a joint impervious to air between said partitions and the barrel and the delivery-pipe, so that within the barrel is formed two entirely independent and separated air-chambers D^2 D^3, as indicated in Fig. 5. Said chambers have no communication with each other within said pump-barrel. The lower end of said pump-barrel is provided with a plurality of inwardly-opening valves d', herein shown as spring-pressed to normally close openings d^2 in the end of said pump-barrel and adapted to be lifted by the action of the inflowing water or other fluid to uncover said openings. The lower end of said delivery-pipe is provided with similar openings *e e* on each side of said partitions, and the same are similarly opened and closed by spring-pressed valves e' e', which open upwardly to admit water within the delivery-pipe D′. As shown, the lower end E of said delivery-pipe is flared outwardly, or, in other words, is in conical form. Through the slanting sides thereof are openings e^2 e^2, each of which is covered with inwardly-opening valves e^3. As shown, said valves are spring-preesed; but it is the purpose to so adjust the said valves by any desired means that the same will present no obstacle to the inflow of fluid from said air-pressure chambers D^2 D^3 to said delivery-pipe D′, but will effectually prevent flow in the reverse direction. At the top of said pump-barrel B is located a valve-box F, having the same diameter as the said pump-barrel and rigidly secured thereto in any suitable manner, but preferably by means of rivets *f* or the like. The said valve-box is provided at its upper ends with a closed head or casing f', integrally or otherwise rigidly secured thereto to form a tight joint with the side walls, and at its lower end is likewise provided with a similar tight head or end f^2, extending between the same and said pump-barrel. The said valve-box is also provided with a partition f^3, extending diametrically across the same and corresponding with the partition in the pump-barrel, as clearly indicated in Fig. 3. Said partition divides said valve-box into two separate chambers F' F^2, respectively, and corresponding with and located directly above the chambers D^2 D^3 of the pump-barrel. The said valve-box is also divided diametrically by a partition f^4, extending from said delivery-pipe, on either side thereof, to the side walls of said valve-box at right angles to said main partition f^3. The said valve-box is provided with two valves f^5 f^6, one on each side of the partition f^3, said valves covering suitable openings f^7 in the head f^2, which openings communicate with the air-chambers D^2 D^3. The said valve f^5 is spring-pressed; but it is obvious that the same may be gravity-acting or be controlled by any other desired means, the purpose being to so adjust the valve as to permit free access of the air from the air-pressure chamber of the pump-barrel into the corresponding chamber of the valve-box.

As clearly shown in Figs. 2 and 3, the partition f^4 has laterally-extended walls forming pockets or recesses F^3 F^4 therein, which open toward the valves f^a f^b. These pockets or recesses are each provided with tapered apertures in the upper and lower walls thereof, forming valve-seats f^9. The valves f^a f^b are balanced valves and are connected together by a valve-stem f^{10} and are so adjusted as to normally prevent access of air from said valve-box into the corresponding air-pressure chamber when closed. As shown, the said valve-stem f^{10} joins or is integral with a rod f^{11}, which extends downwardly through the floor of the valve-box F to a point near the lower extremity of the water-delivery pipe D'. Obviously when air is admitted to one of the chambers of the valve-box the pressure thereof will normally act to hold the valve f^6 therein closed. Owing to the construction described, however, the upward and downward pressure of the air on the two valves f^a f^b is approximately equal, and for this reason it requires but slight force to lift said valves from the valve-seats f^9 and to hold the same elevated therefrom to permit passage of air therethrough, as indicated in Fig. 2. Automatic means are provided for moving said balanced valves f^a f^b, as follows: The valve-rod f^{11} is provided at its upper part with an adjustable stop f^{12}. In close proximity to the lower floor f^2 of the valve-box a similar adjustable stop f^{14} is provided. A float G is adjustably positioned to slide up and down on the valve-rod f^{11} as the water-level rises and lowers and is shown in its uppermost position in full lines in Fig. 2 in one chamber, while the corresponding float in the other chamber is shown in said Fig. 2 in dotted lines. A counterbalancing-weight G' is hung on one end of a lever g, the other end of the lever being pivotally engaged with the valve-rod f^{11} at g', as shown. This lever g is pivotally suspended on any suitable arm or bracket, as g^2. As illustrated in Fig. 2, said weight G' acts normally to balance the weight of the valves f^a f^b, thereby permitting the opening and closing of the same to be regulated by the movement of said floats on said valve-stem, as follows: As the water or liquid to be pumped falls lower in said air-pressure chamber D^2 at the point of lowest level the lower end of the float G strikes and rests upon the stop f^{13}, thereby drawing the valve-rod f^{11} downwardly, closing the valve f^b and shutting off the influx of air to the chamber D^2 from the valve-box. At the same moment the water rising in the air-pressure chamber D^3 has reached its highest level and the float on that side of the device comes in contact with its stop f^{12} the valve-rod f^{11} in the chamber D^3 is raised and the valve f^a thereby opened to admit air under pressure to said chamber D^3 from the valve-box F.

My device, so far as explained, operates as follows: Air is forced into one of said air-pressure chambers of the pump-barrel from the air-receptacle C, thereby causing downward pressure on the surface of the water in said barrel and forcing the same upwardly through the valves e' e^3 in the delivery-pipe from that side of the barrel-chamber. This continues until the float G has reached a point where the lower end thereof comes in contact with the stop f^{13} on the rod f^{11}. The balanced valve f^b is now drawn downwardly and closed. The action of the force-pump is then transferred to the other side of the pump-barrel, air under pressure being discharged thereinto through the balanced valve f^a, which was raised by the float G in the other chamber by the action of the float coming in contact with the stop f^{12} on the rod f^{11} at the same moment that the float G in the first-mentioned chamber comes in contact with the lowermost stop. The action is thus alternated back and forward, air being alternately forced into first one chamber and then the other, thereby causing a steady upward movement of the fluid in the delivery-pipe D'.

For the purpose of relieving the pressure in the air-pressure chamber after the water has been expelled therefrom and also for the purpose of enabling said pressure to be utilized to some extent in the pumping operation my device is provided with connections whereby said air under pressure may be delivered back into the intake-pipe of the air-pump B, which connections are as follows: Rigidly secured in the top wall or cover f' of the valve-box and each communicating with one of said chambers therein are the pipes H H', which pipes lead upwardly from said valve-box F and open at their upper ends into the intake-pipe b of the air-pump B. Said pipes H H' are provided near their upper extremities each with a valve, (indicated, respectively, by

$h\ h'$.) As herein shown, said valves are rotary three-way valves. Communicating with said air-pressure tank C is the air-delivery pipe c, which extends to a convenient point between said valves and is provided at its extremity with a transverse pipe c', coupled thereto by means of a T-coupling c^2, the ends of said pipe c' communicating with said valves h or h'. As shown, said valves $h\ h'$ consist of a valve-chamber provided with an internal valve-closure h^2, adapted in one position to close the inlet into the valve-chamber from the pipe c and to permit unobstructed passage of the air upwardly through the pipes H or H' to the suction-pipe b of the air-pump B and in its other position to close the exit leading therefrom to the suction-pipe of the pump and to permit unobstructed passage of air from the pipe c through said valve-chamber and downwardly through said pipe H or H' to the valve-box and thence to the air-pressure chamber in the pump-barrel.

Automatic means are provided for adjusting the valve-closures h^2 so that when one of said closures is in position to permit free flow of the air from one of the chambers of the valve-box to the suction-pipe of the pump the other thereof is so adjusted as to permit the inflow of air from the air-pressure tank to the other chamber of the valve-box and thence to the air-pressure chamber of the pump-barrel. As illustrated in Fig. 6, said adjusting means comprise a cylinder I, located in close proximity to and between said valves $h\ h'$, preferably located horizontally between said pipes H H'. Said cylinder I is provided with a piston i, located upon a piston-rod i', the ends i^2 of which extend outwardly through the cylinder-heads, as shown. Said outer ends i^2 are each provided with a longitudinal slot adapted to receive a pivot-pin i^3. Said valve-closures h^2 are each secured upon a rock-shaft h^3, one end of which projects beyond the outer wall of the valve-casing and carries thereon a lever or crank arm h^4. The free ends of the arms $h^4\ h^4$ are pivotally secured to the slotted ends of the piston-rod by the pivot-pins i^3, as shown in Figs. 1 and 6. It will be noticed that the lower end of each crank-arm h^4 is slotted at h^5 to permit of vertical movement of the arm with respect to said pivot-pin and the end of the piston-rod. Connected to and communicating with each of the air-pressure pipes H H' are relatively small pipes J J', the outer end of each of which communicates with the air-inlet passage of the ports of the cylinder I remote therefrom, or, in other words, as shown, the pipe J communicates with the air-pressure pipe H at one end and communicates with that port of the cylinder I adjacent to the pipe H', and likewise the pipe J' at one end communicates with the pipe H' and opens at its other end into the cylinder I at the port adjacent to the pipe H, the pipes J J' thus crossing, as shown in Fig. 6. The pipes J J' will be of small size usually and will be provided each with a hand-valve j, whereby the amount of air permitted to flow therethrough at a given pressure in a given time may be adjusted at will by the operator. The operation of this part of my device is as follows: When the valves h^2 are adjusted, one to close the exit through the suction-pipe B and the other to close the inlet from the air-pressure pipe c, and the piston is moved to the end of the cylinder I adjacent to the valve closing the inlet from the pressure-pipe, and the crank-arms h^4 positioned as illustrated in Figs. 1 and 6, the apparatus will be found to be adjusted to permit free flow of air from the pressure-tank into the air-pressure chamber D^3 of the pump-barrel, that being the chamber connected with the pipe H. The other air-pressure chamber D^2 will then be in open communication with the suction-pipe b, and any air under pressure therein will immediately exert its pressure to the pump, thereby greatly facilitating the process of compressing the air in the pressure-tank C. The apparatus now being in operation, the fluid is forced downwardly by the air-pressure in the air-pressure chamber D^3 and an upward flow of water is caused to flow through the delivery-pipe D'. As the pressure increases in the pipe H and the air-pressure chamber, causing the water to be forced downwardly therein, a portion of the air flows through the small pipe J into the cylinder I and slowly moves the piston i from the position indicated in Fig. 6 toward the opposite end of the cylinder I, producing a correspondingly slow movement in the valves h^2, which movement continues until the float G has reached its lowest point, or, in other words, comes in contact with the stop f^{13} on the lower end of the rod f^{11}, and thereby closing the valve f^a. The pressure above said valve is thereby suddenly augmented, with the effect that pressure behind said piston i forces the same to the extremity of the cylinder I, thereby instantly shifting said valves h^2 to admit air into the chamber D^2 and to permit the flow of compressed air from the chamber D^3 to the suction-pipe of the pump. At the moment this change in position is effected in the valves h^2 if the mechanism is properly adjusted the float G' comes in contact with the stop f^{12} on the rod f^{11} on that side of the pump, thereby lifting the balanced inlet-valve f^b and permitting air from the pressure-pipe c to flow through the valve h' downwardly in the pipe H' and through said balanced valve f^b into the air-pressure chamber D^2, which at that moment is full of water. This operation is repeated, the compressed air from the pressure-tank C and pump B being forced first into one air-pressure chamber and then into the other alternately until the water reaches the lowest level desired, the air previously compressed and used in the other air-pressure chamber flowing directly into the intake-pipe of the pump to be again forced through the pressure-tank C. This is a matter of great importance, inasmuch as the energy of the air previously compressed is conserved, thereby making it possible to operate a pump constructed in accordance with my invention by means of a motor of much less power than those ordinarily used for similar purposes. It is obvious also that a pump of much smaller size will answer all purposes, for the reason that the greater part of the air delivered thereto for compression is received under considerable pressure, thereby greatly lessening the amount of work required of the pump.

In the pipe *b* I have located a check-valve *b'* of any well-known construction, so arranged that it will open to admit air to the said intake or suction pipe *b*, and thereby replenish any loss that may arise from leakage or from absorption by the water. This valve will obviously also be found to be useful when commencing pumping operation.

It will of course be understood without further illustration or description that while I have shown a single pump a plurality of pumps may be connected with a single compressor and tank—that is, may be connected in series—as desired. It will also be manifest that my invention is not limited to the various details of construction herein illustrated when separately considered, since the invention is broad and comprehensive in scope.

I claim as my invention—

1. In a pumping apparatus, a motor, an air-pump, an air-pressure tank, operative connections between the same, a pump-barrel having a longitudinal partition dividing the same into two unconnected chambers, each of which is provided at its lower end with inwardly-opening valves, a delivery-pipe having its lower or intake end located near the bottom of said pump-barrel, openings in said delivery-pipe communicating with each chamber, inwardly-opening valves on said openings, a valve-box located at the top of said pump-barrel and provided with chambers corresponding to the subjacent barrel-chambers, valve communications between the same, opening inwardly from said pump-barrel and operated by the changing level of liquid within said pump-barrel, valve communications connecting each chamber of the valve-box with the like chamber of said pump-barrel, one of said valves being a balanced valve adapted to be operated by the changing level of the liquid within the pump-chamber, valved pipes or conduits from each chamber of said valve-box to the pressure-pipe of said pump and to the suction-pipe thereof, means for operating the valves in said pipes whereby each chamber of said valve-box is in open communication with the pressure-pipe of said pump when the balanced valve is open and whereby the same is in open communication with the suction-pipe of said pump when said balanced valve is closed.

2. In a pumping apparatus, a longitudinally-chambered pump-barrel provided in each chamber with inwardly-opening valves, a delivery-pipe communicating at its lower end with each of said chambers, a valve-box located on the pump-barrel chambered to correspond with the subjacent barrel-chambers, a plurality of inwardly-opening valves in each of said valve-box chambers, one being a balanced valve, a valve-stem extending downwardly from said balanced valve into the pump-barrel approximately to the bottom thereof and being provided with adjustable stops at points marking the highest and lowest level of the liquid in said chamber when said pump is operated, a vertically-movable float adapted to slide on said rod to open and close said valve by contact with the said stops, and a weight connected with the balanced-valve stem adapted to balance the weight of the valve and hold it in its adjusted position until actuated by the float.

3. In a pumping apparatus, a pump-barrel provided with unconnected longitudinal chambers, a valve-box located at the top of said pump-barrel and having chambers to correspond therewith, each of said valve-box chambers being provided with a plurality of inwardly-opening valves, one of which is a balanced valve, and each being also provided with a valve stem or rod, extending downwardly in the corresponding pump-barrel chamber, stops adjustably located on said valve stem or rod at points which mark approximately the highest and lowest level of liquid in said pump when the same is in operation, a float having sliding engagement with said rod and adapted to open and close said valves by contact with said stops, a counterbalance for the weight of said valve and stem, comprising a lever pivoted at its middle part and engaging with one of its ends said valve-stem or rod and having a counterbalance-weight on the other end.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two witnesses, this 21st day of May, A. D. 1900.

EDWARD M. LAING.

Witnesses:
TAYLOR E. BROWN,
GERTRUDE BRYCE.