No. 756,993. PATENTED APR. 12, 1904.

H. UNZICKER.

VALVE MECHANISM FOR PUMPS.

APPLICATION FILED AUG. 14, 1896.

NO MODEL. 2 SHEETS—SHEET 1.

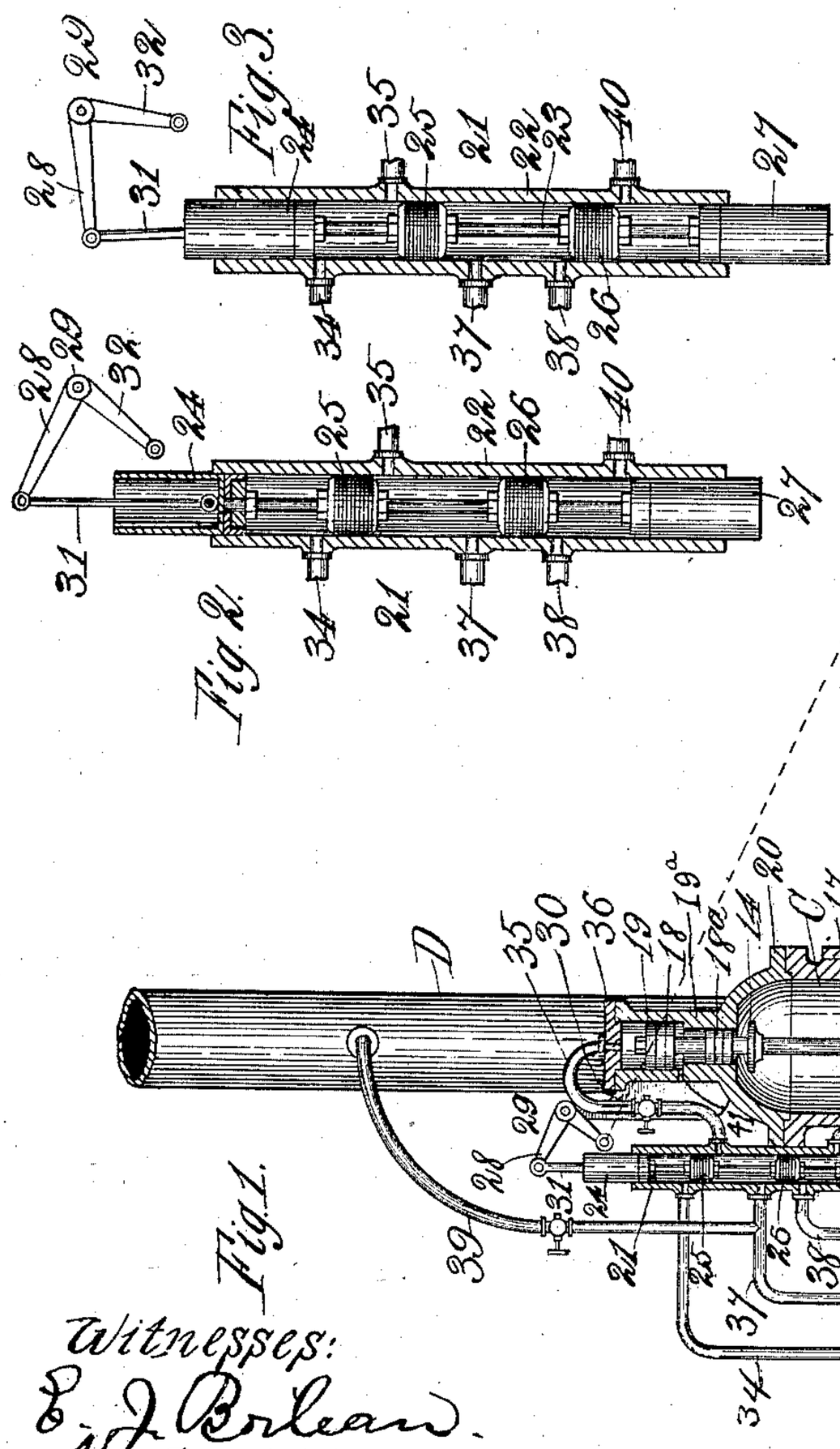

Fig. 2.

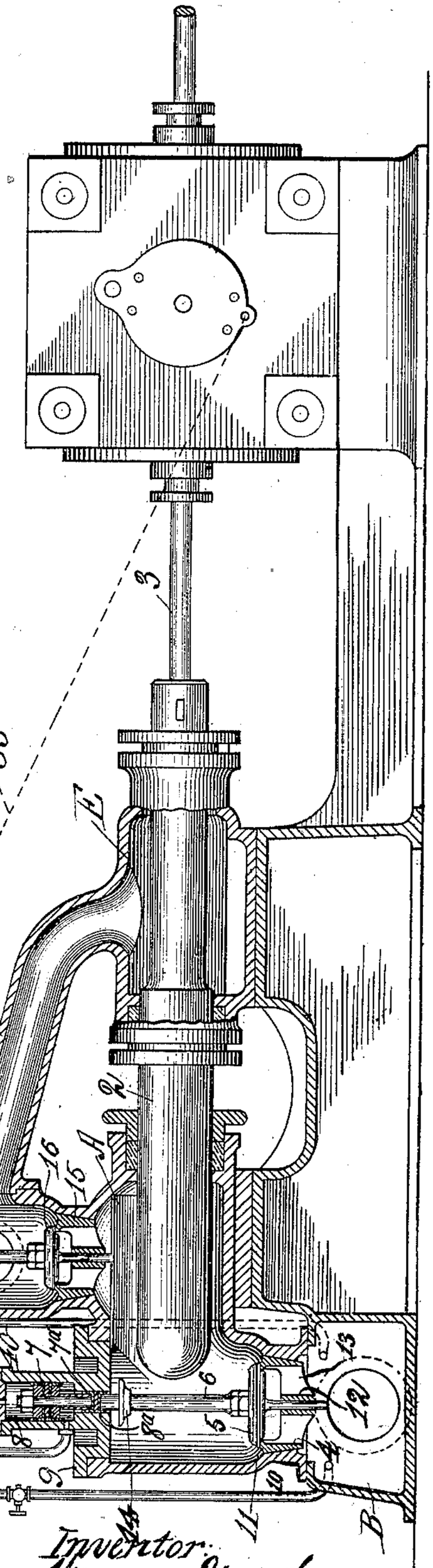

Fig. 3.

Fig. 1.

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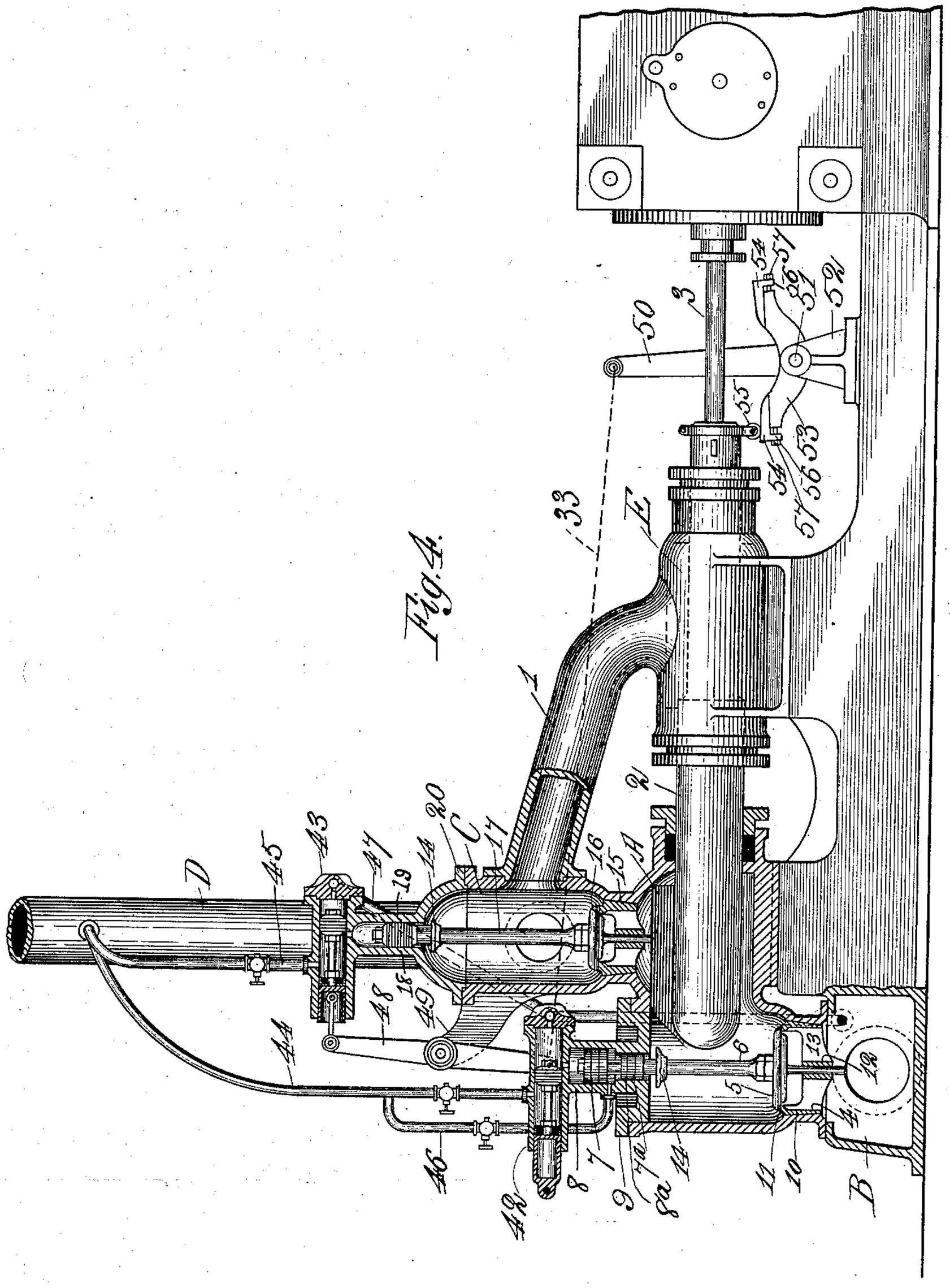
NO MODEL. 2 SHEETS—SHEET 2.

Fig. 4.



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UNITED STATES PATENT OFFICE.

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VALVE MECHANISM FOR PUMPS.

SPECIFICATION forming part of Letters Patent No. 756,993, dated April 12, 1904.

Application filed August 14, 1896. Serial No. 602,787. (No model.)

To all whom it may concern:

Be it known that I, HERMANN UNZICKER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Valve Mechanism for Pumps; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, for which invention foreign Letters Patent have been granted as follows: Great Britain, No. 16,322, dated July 26, 1898; France, No. 280,058, dated July 26, 1898; Austria, No. 4,700-48, dated September 22, 1898; Hungary, No. 13,993, dated July 26, 1898.

My invention relates to a novel construction in a pump, and more particularly to hydraulic valve-gear therefor, the object being to provide such a valve-gear which shall be cheap, durable, and efficient; and the invention consists in the features of construction and combinations of parts hereinafter fully described and claimed.

In the accompanying drawings, illustrating my invention, Figure 1 is a vertical longitudinal section of a pump constructed in accordance with my invention and provided with my valve-gear. Figs. 2 and 3 are detail sectional views of the balanced slide-valve I employ and showing the same in different positions. Fig. 4 is a vertical longitudinal section of a pump provided with a modified form of my valve-gear.

My valve-gear is designed mainly for high-duty pumps, and in the drawings I have shown it applied to a pump of this character, in which A indicates the pump-barrel; B, the suction-chamber, and C the pressure-chamber, from which a stand-pipe D rises. A cylinder E is connected with said pressure-chamber C by a pipe 1 extending from the upper portion of said cylinder E to the side of said pressure-chamber C. The plunger 2, which is connected at one end with the piston-rod 3 of a Corliss engine, passes through said cylinder E into said pump-barrel A and is enlarged at its forward end to twice the cross-sectional area at its rear end portion, so that when moving toward the forward limit of its movement one-half the amount of water forced into said pressure-chamber C thereby will pass through said pipe 1 into said cylinder E, and upon its return stroke said enlarged portion of said plunger will force the water out of said cylinder E into said pressure-chamber C, thus making a very simple double-acting pump. A valve-seat 4 is mounted between said suction-chamber B and said pump-barrel A, upon which the induction-valve 5 is seated. The induction-valve 5 is mounted upon a valve-stem 6, which carries two differential pistons 7 and 7^a. The piston 7 is the larger and uppermost and moves in a cylinder 8 on the head 9 of said pump-barrel A. Said piston 7, which may be termed the "endmost" piston, is so constructed that the area of its upper face is greater than the area of its lower face and that its lower face is of greater area than the upper face of the piston 7^a, which may be termed the "innermost" piston. The piston 7^a moves in a passage 8^a, extending between said cylinder 8 and said pump-barrel A, and the lower face thereof, which is acted upon by the pressure in said pump-barrel, may be of the same or smaller area than said valve-seat 4. The piston 7 is actuated by fluid-pressure from the stand-pipe D, as hereinafter more fully described.

The valve-seat 4 consists of a cylindrical body portion 10, provided with an interiorly-extending flange 11 at its upper end, the upper face of which is turned to form the valve-seat. A hub 12 is mounted in the center of said valve-seat 4 between the spokes 13 and is adapted to receive an extension of said valve-stem 6 below said valve 5 to center the same. A collar 14 on said valve-stem below said head 9 is adapted to limit the upward movement of said induction-valve 5.

The pressure-chamber C is provided at its inlet end with a valve-seat 15 of the same construction as said valve-seat 4, upon which the eduction-valve 16 is mounted. The valve 16 is mounted upon the valve-stem 17, carrying two differential pistons 18 18^a. The piston 18 is the larger and uppermost and moves in a cylinder 19 on the head 20 of the pressure-

chamber C. The area of the upper face of said piston 18 is also greater than the area of the lower face of said piston 18ª, which is acted upon by the pressure in the pressure-chamber of the pump, so that upon bringing equal pressure upon the said upper face of said piston 18 said valve 16 will be moved against the action of the pressure upon said lower face of said piston 18ª. The piston 18ª moves in a passage between said cylinder 19 and the pressure-chamber. The lower face of said piston 18ª is preferably of smaller or equal area with said valve-seat 15. In the drawings I have shown the areas of the lower faces of the pistons 7ª and 18ª less than the areas of the respective valve-seats. The valve-stem 17 is also provided with a collar 14 to limit its upward movement.

A valve-chamber 21 is mounted upon said pump adjacent to said pressure-chamber and is preferably secured thereto. The valve-chamber 21 consists of a cylinder 22, in which a valve-rod 23, carrying pistons 24, 25, 26, and 27, moves. This valve-rod 23 is connected with the arm 28 of a bell-crank lever 29, pivotally mounted upon an arm 30 on said head 20 by means of a connecting-rod 31. The other arm, 32, of said bell-crank lever 29 is connected with the valve-gear of the Corliss engine by means of a rod 33. (Represented by a dotted line in the drawings.)

A pipe 34 is connected with the valve-chamber 21 near its upper end and connects the same with the suction-chamber B. A pipe 35 connects said valve-chamber with the head 36 of said cylinder 19, and a pipe 37 connects the valve-chamber with the lower end of the cylinder 8 and a pipe 38 with the head of the cylinder 8. A pipe 39 connects said pipe 37 with the stand-pipe D. A pipe 40 connects the lower end of said valve-chamber with the suction-chamber B. The pipes 34, 35, 37, 38, and 39 are preferably provided with cocks, as shown, by which the pressure on the pistons may be regulated; but this is not essential to the invention.

The operation of my valve-gear, as shown in Figs. 1, 2, and 3, is as follows: In Fig. 1 I have shown the plunger 2 at the forward limit of its movement and said piston-rod 23 and pistons 24, 25, 26, and 27 at the upper limit of their movement. The plunger is about to begin its return stroke, and at this time the pressure in the pump-barrel A and pressure-chamber C is equal, and consequently the pressure on both sides of the eduction-valve 16 is balanced. The pipes 35 and 37 are in communication with each other through said chamber 21, and water under pressure is supplied thereto from the stand-pipe D through the pipe 39 and flows therethrough into the cylinders 8 and 19, whereby said piston 7 is forced upwardly to open said valve 5 and said piston 18 forced downwardly to close said valve 16. The pipe 38 is at this time in communication with said pipe 40, thus connecting the upper chamber of said cylinder 8 with said suction-chamber B to permit the escape of the water in said upper chamber of said cylinder 8. An opening 41 is provided in the lower end of said cylinder 19 to permit the passage of air to and from the same in accordance with the movements of said piston 18. As the plunger 2 reaches the rearward limit of its movement the valve-rod 23 and pistons 24 25 26 27 are thrown into the position shown in Fig. 3 and so connect the pipes as to reverse the position of the valves 5 and 16. In this position the pipe 35 communicates with the pipe 34 to allow the water in the cylinder 19 to escape to the suction-chamber, when the valve 16 is relieved or partly relieved from the pressure in said pressure-chamber C and is forced upwardly by the excessive pressure in the pump-barrel. At the beginning of the forward stroke of the plunger 2 and just previous to the opening of the valve 16 the pressure upon the upper face of said valve exceeds the pressure upon the lower face thereof by the area of the valve-seat, and to relieve or partially relieve said valve from the excess of pressure for the purpose of causing it to open more quickly said piston 18ª is provided, the lower face of which has an area, as above stated, either equal to or less than said valve-seat. Obviously the pressure against the same will counteract or partially counteract the excessive pressure upon the upper face of said valve 16 due to the area of the lower face being lessened by the area of the valve-seat, and thus cause said valve to open more promptly than it otherwise would. The areas of the lower faces of the pistons 8ª and 18ª must obviously not be greater than the areas of the respective valve-seats, for the reason that the total pressure upon the upper face of the valves 5 and 16 when the same are closed would be less than the total pressure upon the lower faces thereof, and thus said valves would be caused to open before the pressure in the respective chambers on both sides of the same is equal. This premature opening of said valves would necessitate a lost motion, for the reason that the fluid under greatest pressure would flow back into the chamber from whence it was originally forced as soon as the valve opened, and thus equalize the pressure in both. For instance, if the plunger is just about to begin its forward stroke the pressure in the pump-barrel is less than that in the pressure-chamber and gradually increases until it becomes equal to or greater than the pressure in the pressure-chamber before the valve 16 opens, according to the proportionate areas of the valve-seat 15 and the lower face of the piston 18ª. If the area of the lower face of the piston 18ª is equal to the area of the valve-seat 15, then said valve 16 will open as soon as the pressure in the pump-barrel is equal to the pressure in the pressure-chamber. If the area of the lower

face of the piston 18ª were less than the area of the valve-seat 15, then said valve 16 would obviously not open until the pressure in the pump-barrel exceeded the pressure in the pressure-chamber sufficiently to overcome the difference in areas of the upper and lower faces of the piston 16 subjected to the pressure. If, however, the area of the lower face of the piston 18ª exceeded the area of the valve-seat 15, then the valve 16 would open before the pressure in the pump-barrel equaled the pressure in the pressure-chamber, and the fluid in the latter would obviously flow into the pump-barrel instantaneously until the pressure in both were equal, thus obviously causing a lost motion of the plunger. The pressure in the lower chamber of the cylinder 8 is constant, this pressure being that of the stand-pipe D, admitted through pipes 37 and 39, while the upper face of the piston 7 is relieved from pressure by the communication established through pipes 38 and 40 in the position of the valve-rod and pistons 24 25 26 27 (shown in Figs. 1 and 2) as the plunger completes its forward stroke. This results in the opening of the induction-valve 5 as the plunger starts on its return stroke. When the upper face of the piston 7 is subjected to the pressure in the stand-pipe D by the connection of the upper chamber of the cylinder 8 to the stand-pipe through pipes 38, 37, and 39 at the completion of the return stroke of the plunger, that pressure on the upper face of the piston 7, owing to the greater area of this face, will overbalance the pressure in the lower chamber or cylinder 8 acting on the lower face of the piston 7 and force the piston downwardly to close the induction-valve 5 for the next forward stroke of the plunger.

In Fig. 4 I have shown a modified form of construction of my valve-gear the action of which is the same, though accomplished in a different manner. In this construction I mount balanced valve-chambers 42 and 43 upon the head of the cylinders 8 and 19, respectively. Pipes 44 and 45 connect said valve-chambers 42 and 43, respectively, with said stand-pipe D. A pipe 46 connects said pipe 44 with the lower chamber of said cylinder 8, thus keeping constant pressure in said chamber. A pipe 47, connecting with both said valve-chambers 42 and 43, connects the same with the suction-chamber B. The pistons in the valve-chambers 42 43 are connected with the ends of a lever 48, which is pivoted at its middle portion to an arm 49 on said pressure-chamber C. In this construction I have shown the valve-stem 17 provided with only one piston 18. The cylinder 19 in which the same moves opens full into the pressure-chamber C, the lower face of said piston being reduced in size by the cross-sectional area of the valve-stem 17. In the positions shown in said Fig. 4 the upper end of said cylinder 8 would be in communication with said pipe 47 to permit the escape of the water therefrom as said piston 7 is forced upwardly by the pressure in the lower chamber of said cylinder 8. The cylinder 19 is in communication with the pipe 45, thus admitting pressure thereto and forcing said valve 16 down upon its seat. As said plunger 2 reaches the opposite limit of its movement the position of the pistons in valve-chambers 42 43 is reversed, so that said cylinder 19 will communicate with said pipe 47, and the upper chamber of said cylinder 8 will communicate with the pipe 44, thus admitting pressure thereto and causing said valve 5 to be forced upon its seat. One end of said lever 48 or said bell-crank lever 29 may obviously be connected with any moving portion of the Corliss engine driving said pump or may be operated by mechanism connected with the plunger of said pump. In Fig. 4 I have shown said lever 48 connected with the upper end of an arm 50, rigidly mounted upon a rock-shaft 51, mounted in bearings in uprights on the bed of said pump. An arm 53 is rigidly mounted at its middle portion upon said rock-shaft 51 and extends slightly upwardly at both ends. Said arm 53 is provided at its ends with adjustable shoes 54, having inclined upper faces adapted to be engaged by an antifriction-roller 55, mounted upon the projecting end of said plunger 2. Said shoes 54 are provided with downwardly-extending flanges 56, through which adjusting-screws 57 pass into said arm 53; but any other suitable adjusting device could be employed. During the movement of said plunger 2 said antifriction-roller 55 will alternately engage each of said shoes 54 and depress the same, thereby operating said rock-shaft 51 and causing said arm 50 to swing to and fro, thus obviously operating the pistons in valve-chambers 42 and 43. This construction could also be applied to the pump shown in Fig. 1.

The action of my described means for operating the valves is very efficient, and as it is quick and occurs only at the end of each stroke the valves are held in proper position for the full period of the stroke and quickly change their positions at the end thereof. The action is also positive and exceedingly simple, so that repairs are seldom necessary. Obviously my valve mechanism can be applied to an air-compressor with equal advantage, though I have not shown such application in the drawings.

What I claim is—

1. In a pump, an induction-valve mounted within the pump-barrel, a valve-stem on said valve carrying pistons, one of said pistons being adapted to move in a cylinder on the head of said pump-barrel, and the other of said pistons of less area being adapted to move in a passage between said cylinder and said pump-barrel, and valve-controlled connection

between said cylinder and a source of supply of fluid-pressure for actuating said piston to operate said valve.

2. In a pump, a pump-barrel and a pressure-chamber, valves in said pump-barrel and said pressure-chamber provided with valve-stems, pistons on said valve-stems moving in cylinders on the heads of said pump-barrel and said pressure-chamber, passages between said cylinders and said pump-barrel and pressure-chamber, pistons of less area than said pistons in said cylinders movable in said passages, connection between said cylinders and a source of supply of fluid under pressure, and valve mechanism interposed between said cylinders and said source of supply of fluid-pressure for controlling the influx and efflux thereof to actuate said pistons at intervals to operate said valves.

3. In a pump, induction and eduction valves mounted upon valve-stems provided with differential pistons, said pistons having greatest area moving in auxiliary cylinders on said pump, and pistons of less area moving in passages between said auxiliary cylinders and said pump, connection between said auxiliary cylinders and a source of supply of fluid-pressure for actuating said pistons moving in said auxiliary cylinders, and a valve interposed between said auxiliary cylinders and said source of supply of fluid under pressure and operated from any moving portion of said pump or engine driving the same, for controlling the induction and eduction of fluid under pressure to and from said auxiliary cylinders.

4. In a pump, induction and eduction valves connected with plungers moving in auxiliary cylinders on said pump, connection between said cylinders and a source of supply of fluid-pressure, and means for alternately admitting such fluid-pressure to corresponding ends of said plungers at opposite limits of the movement of the plunger of said pump, the faces of said plungers acted upon by said fluid-pressure to cause said valves respectively to open being of areas not greater than the areas of the respective valve-seats of said valves.

5. In a pump, induction and eduction valves connected with plungers moving in auxiliary cylinders on said pump, a pipe connecting the lower chamber of one of said cylinders with the stand-pipe, a balanced valve connected with said stand-pipe, pipes connecting the upper chambers of said auxiliary cylinders with said valve, pipes connecting said valve with the suction-chamber of said pump, and means for operating said valve for alternately connecting said pipes communicating with the upper chambers of said auxiliary cylinders with said stand-pipe and said suction-chamber, whereby said induction and eduction valves will be operated.

6. In a pump, a valve mounted upon a valve-stem carrying pistons at its other end, the end piston having a greater area than the inner piston, a cylinder in which one of said pistons moves, alternate connection between said cylinder and a source of supply of fluid-pressure and a waste-pipe, a passage between said cylinder and a chamber of said pump in which the inner one of said pistons moves, and a valve-seat upon which said valve is mounted, said face of said inner piston communicating with said chamber of said pump being of not greater area than the valve-seat.

7. In a pump, an eduction-valve mounted upon a valve-stem carrying differential pistons at one end, a cylinder in which one of said pistons moves, a passage between said cylinder and the pressure-chamber in which the other of said pistons moves, the area of the face of said last-named piston acted upon by the pressure in said pressure-chamber being less than the area of the other piston and not greater than the area of the valve-seat of said eduction-valve.

8. The combination of induction pump-valve 5, cylinder 8, piston 7 on the valve-stem in said cylinder, pipes 37 and 38 connecting with the cylinder on opposite sides of said piston, pressure and exhaust pipes 39, 40, valve mechanism actuated by a moving part of the pump for connecting said pipe 38 alternately with the pressure and exhaust pipes, and piston 7^a on the valve-stem subjected to the pressure in the pump-chamber.

9. The combination of eduction pump-valve 16, cylinder 19, piston 18 in said cylinder on the valve-stem, pipe 35 connecting with the cylinder 19 for admitting pressure on piston 18 tending to close the valve, pressure and exhaust pipes 37, 34, valve mechanism actuated by a moving part of the pump for connecting pipe 37 alternately with the pressure and exhaust pipes, and piston 18^a on the valve-stem acting to aid in opening the valve and subjected to the pressure acting on the back of the valve.

In testimony whereof I affix my signature in presence of two witnesses.

HERMANN UNZICKER.

Witnesses:

RUDOLPH WM. LOTZ,

E. J. BOILEAU.