No. 665,598.

Patented Jan. 8, 1901.

W. E. EBY.

STEAM PUMP.

(Application filed Jan. 17, 1900.)

(No Model.)

4 Sheets—Sheet 1.

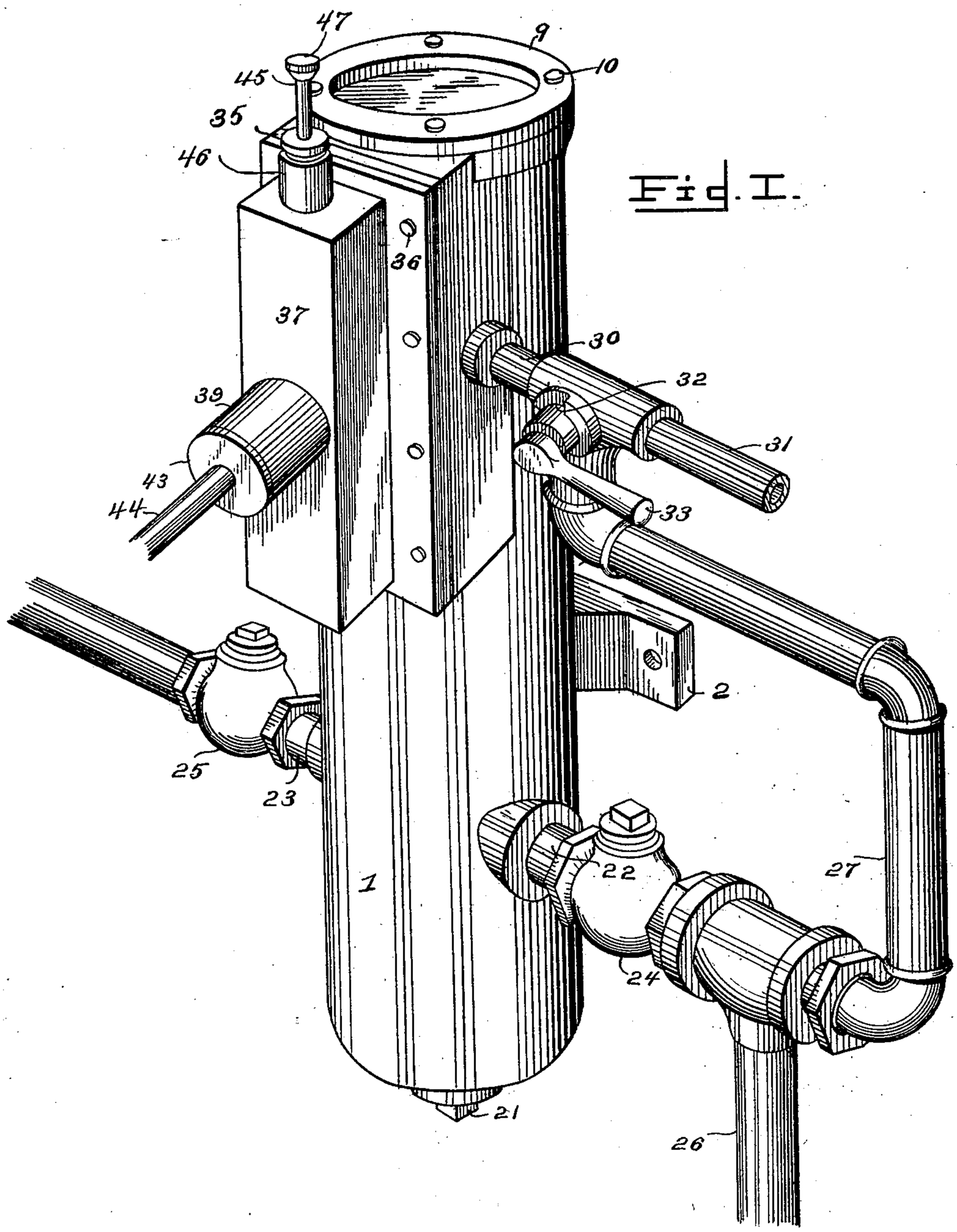

Fig. I.

Witnesses
Frank G. Campbell
Geo. H. Chandlee.

Walton E. Eby, Inventor.
By his Attorneys,
C. A. Snow & Co.

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4 Sheets—Sheet 2.

Fig. 2.

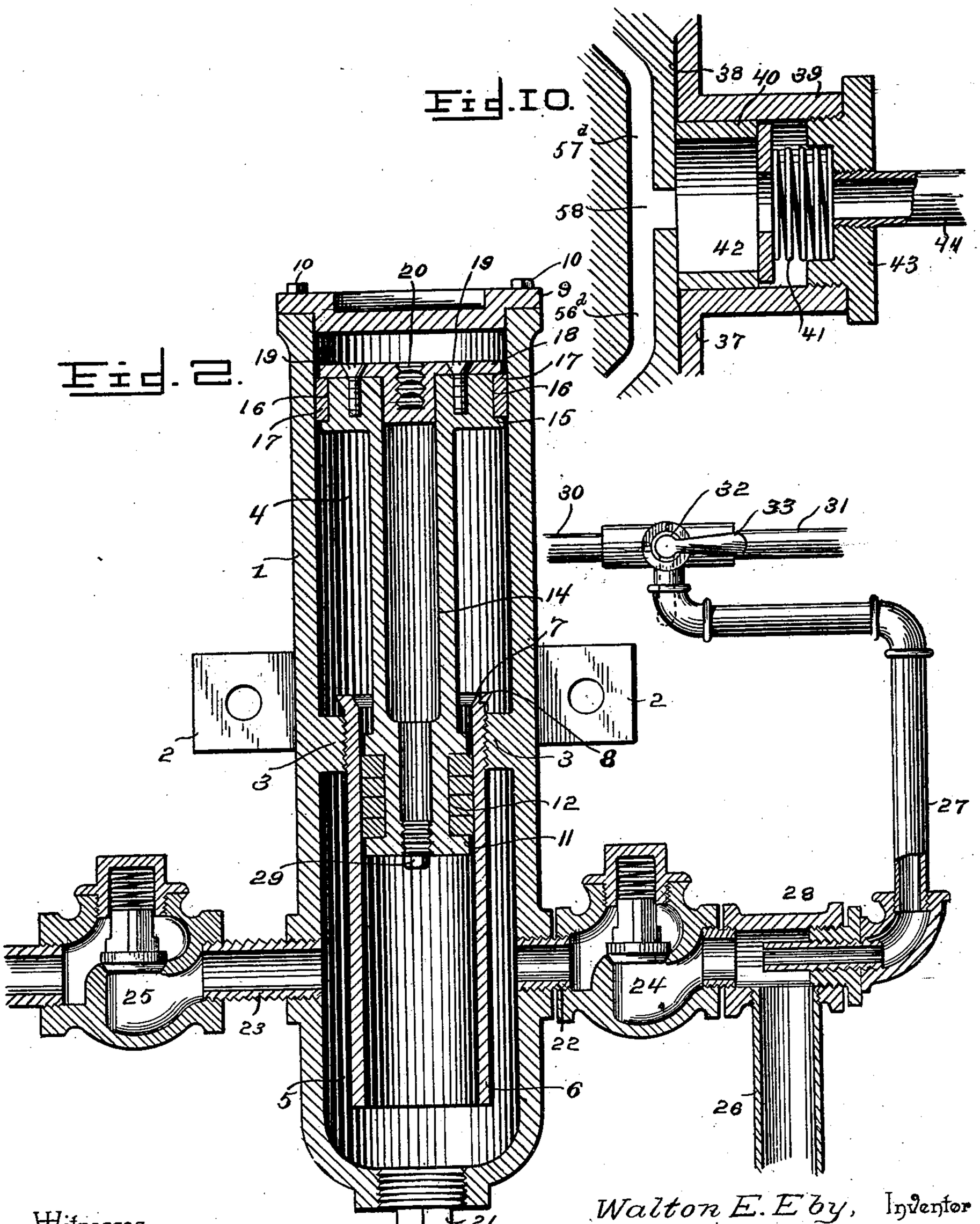

Fig. 10.

Witnesses
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(No Model.) 4 Sheets—Sheet 3.

Fig. 8.

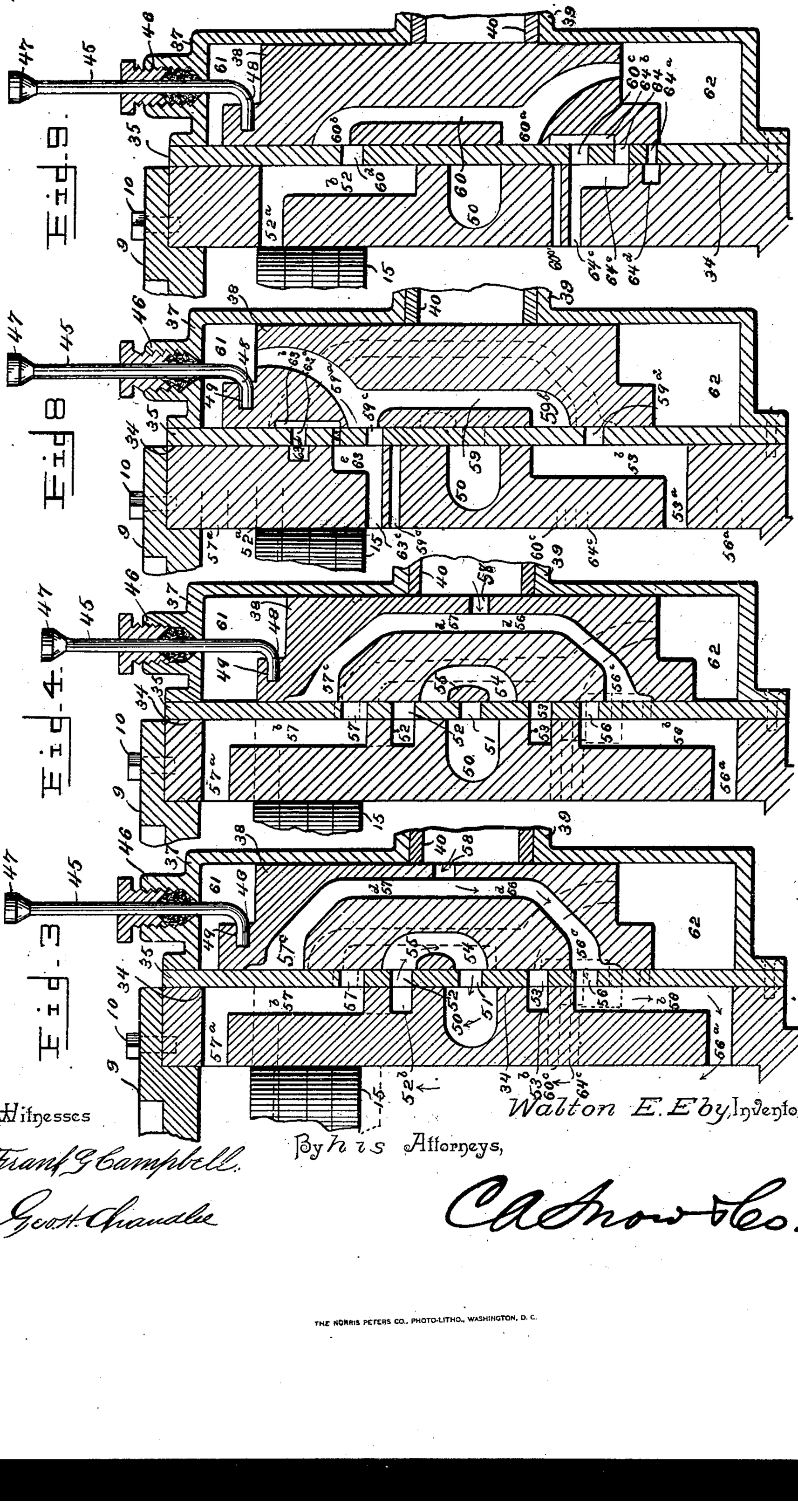

Fig. 4.

Fig. 3.

Witnesses

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(No Model.) 4 Sheets—Sheet 4.

Fig. 7.

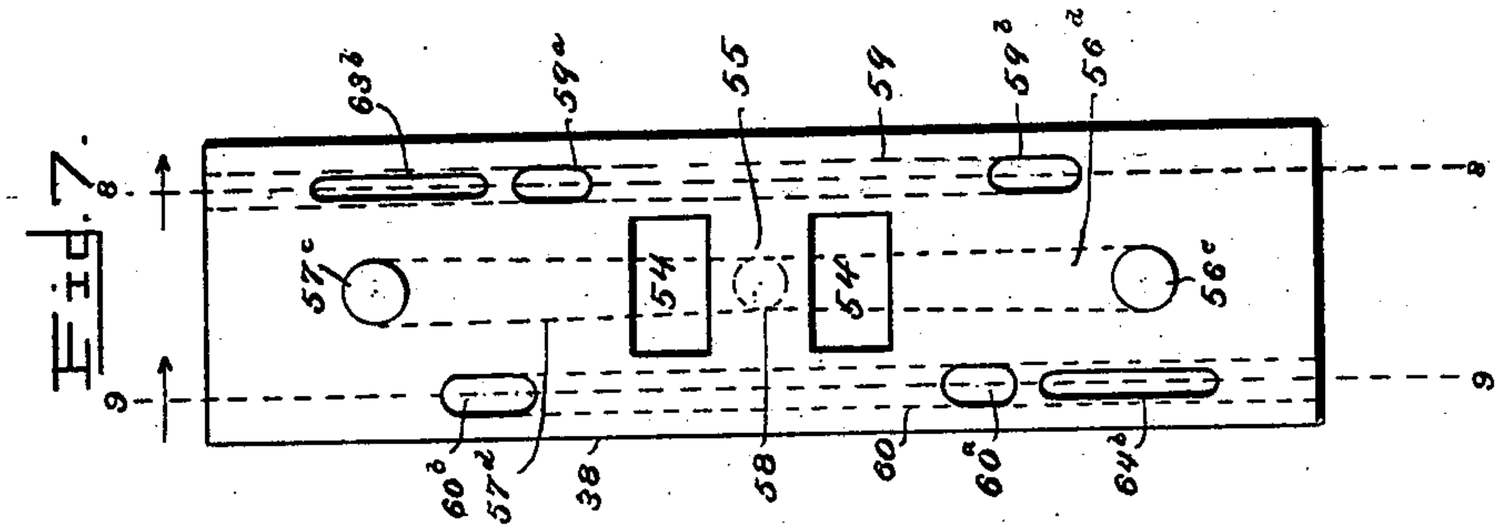


Fig. 6.

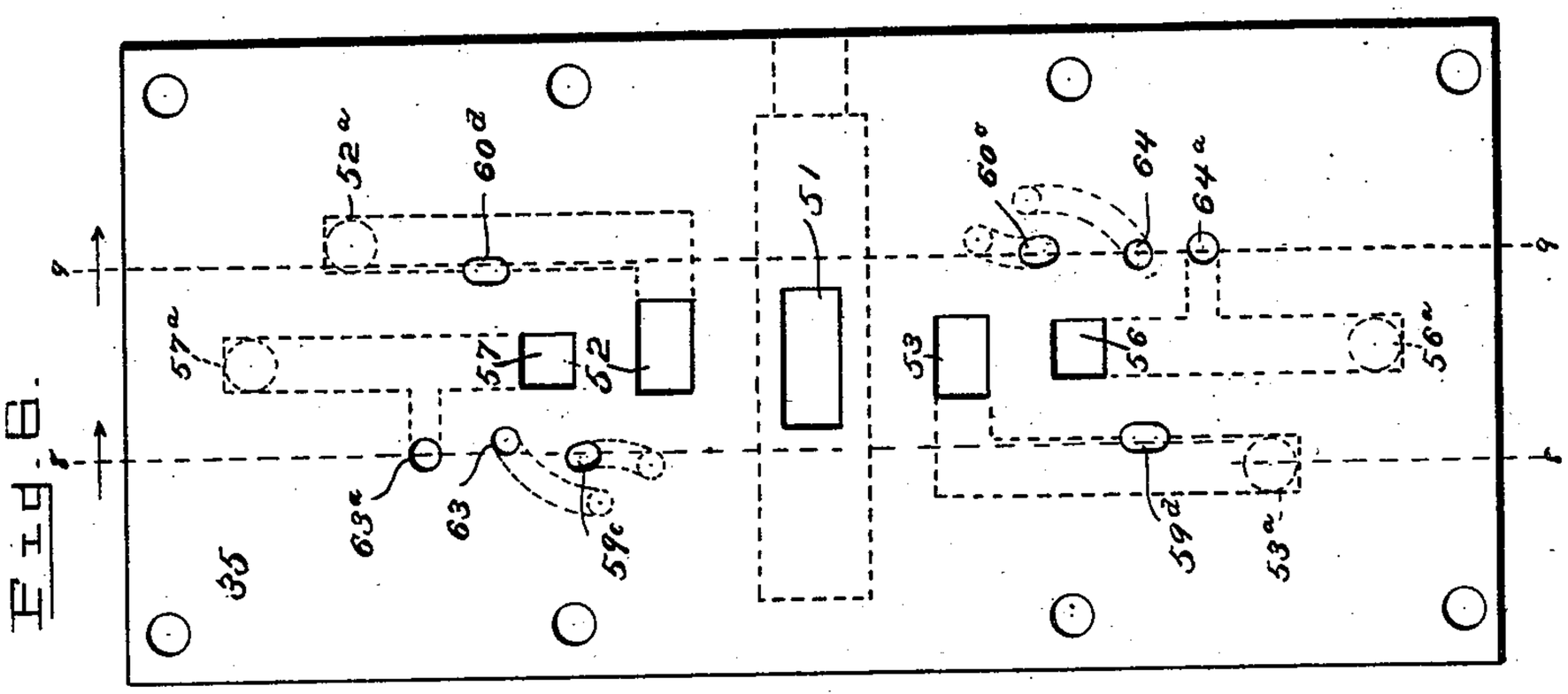
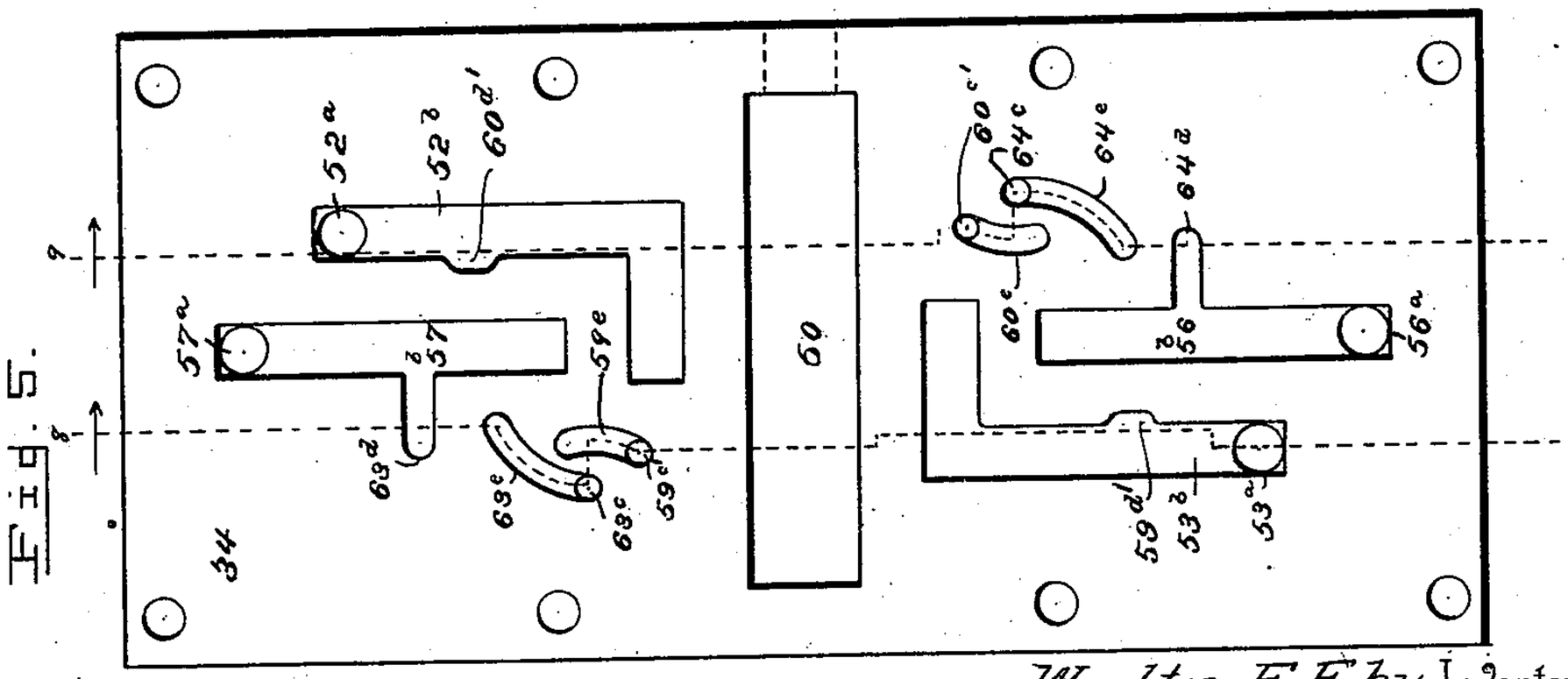


Fig. 5.



Witnesses
Frank G. Campbell.
Geo. H. Chandlee

Walton E. Eby, Inventor.
By his Attorneys,
C. A. Snow & Co.

UNITED STATES PATENT OFFICE.

WALTON E. EBY, OF ROANOKE, VIRGINIA, ASSIGNOR OF ONE-HALF TO MALCOLM W. BRYAN, OF SAME PLACE.

STEAM-PUMP.

SPECIFICATION forming part of Letters Patent No. 665,598, dated January 8, 1901.

Application filed January 17, 1900 Serial No. 1,777. (No model.)

To all whom it may concern:

Be it known that I, WALTON E. EBY, a citizen of the United States, residing at Roanoke, in the county of Roanoke and State of Virginia, have invented a new and useful Steam-Pump, of which the following is a specification.

My invention relates to steam-pumps, and has for its object to provide a simple, compact, and efficient pump adapted for supplying boilers and for analogous uses and so constructed as to provide for the utilization of the exhaust-steam and other waste heat of the motive agent in raising the temperature of the water supplied to the boiler.

Further objects and advantages of this invention will appear in the following description and the novel features thereof will be particularly pointed out in the appended claims.

In the drawings, Figure 1 is a perspective view of a pump mechanism constructed in accordance with my invention. Fig. 2 is an elevation, partly in section, of the same. Fig. 3 is an enlarged central longitudinal section of the valve mechanism and the contiguous portion of the cylinder-piston, taken in the plane of the cylinder feed-ports, showing the valve in one of its operative positions with the piston in full lines at one end of its stroke just prior to the reversal of the valve and in dotted lines in the position which it occupies before exposing the equalizing-ports. Fig. 4 is a similar view showing the valve in its intermediate or balanced position. Fig. 5 is a plan view of the valve-seat rest to show the positions of the channels and ports in the cylinder. Fig. 6 is a similar view of the valve-seat, showing in dotted lines the positions of the cylinder ports and channels. Fig. 7 is an inverted plan view of the valve. Fig. 8 is a sectional view similar to Figs. 3 and 4, taken in the plane indicated by the lines 8 8 of Figs. 5, 6, and 7. Fig. 9 is a similar section taken in the plane indicated by the lines 9 9 of Figs. 5, 6, and 7. Fig. 10 is a detail sectional view of a portion of the valve mechanism to show the follower, which forms a steam-tight contact with the valve.

Similar numerals of reference indicate corresponding parts in all the figures of the drawings.

The apparatus embodying my invention is shown in the drawings, Figs. 1 and 2, as arranged in an upright or vertical position with the main cylindrical casing 1, which comprises the piston and plunger cylinders, provided with attaching-ears 2 or a suitable base-plate adapted to be secured to a boiler or other supporting object, (not shown;) but it will be understood that the said casing may be arranged in either a horizontal or any other position to suit the conditions under which it is to be operated. Said main cylindrical casing is divided interiorly by an annular partition 3 to form a steam or piston cylinder 4 and a water or plunger cylinder 5 and removably fitted, as by threading, in the opening of said partition, and extending axially of the water or plunger cylinder is a pump-barrel 6, terminating at its outer end short of the closed end of the cylinder 5 and having a flared inner end 7, provided with wrench or key seats 8, whereby the barrel may be unseated or returned to its normal position by means of a key or wrench inserted into the cylinder 4 through the headed outer end of the latter, said cylinder 4 being provided with a removable head 9, secured in place by means of bolts 10 or the equivalents thereof.

Fitted for reciprocatory movement in the pump-barrel is the pump-plunger 11, which is exteriorly channeled or reduced, as shown at 12, for the reception of the exterior packing of waste or any other suitable material, such packing being thus held between the abrupt shoulders at the ends of the reduced portion of the plunger, and the flared mouth at the inner end of the barrel being designed to facilitate the introduction of the plunger, with its packing, into the barrel without disturbing the packing.

The plunger is of hollow or tubular construction, and its bore communicates with that of the hollow or tubular plunger-stem 14, said stem, as illustrated in the drawings, being formed integrally with the plunger and terminating at the opposite end from the plunger in a piston-head 15, which operates in the cylinder 4. The piston-head 15 is also turned down or reduced, as shown at 16, for the reception of packing, preferably consisting of metallic rings 17, and these packing-rings are held from displacement by a cap-plate 18, secured to the body portion of the

piston-head by means of screws 19 or equivalent fastening devices. Also said cap-plate is provided at its center with an interiorly-threaded socket 20, constituting a wrench-seat for the reception of a suitable tool adapted to be introduced through the outer end of the cylinder 4 in order to withdraw the piston and connected plunger from the casing. The outer (or, in this case, lower) end of the water-cylinder 5 is provided with a drain-opening fitted with a plug 21, whereby the liquid contents of the plunger-cylinder may be withdrawn when the pump is not in operation.

Communicating with the pump-cylinder 5, exteriorly of the pump-barrel 6, are feed and discharge pipes 22 and 23, provided, respectively, with check-valves 24 and 25, which open in a common direction or respectively toward and from the cylinder, whereby during the upward or inward stroke of the pump-plunger water is inducted through the feed-pipe 22, while during the opposite or downward or outward stroke of the plunger the check-valve 24 is seated and the previously-inducted contents of the cylinder are expelled through the discharge-pipe 23. In communication with the feed-pipe 22, at the opposite side of the check-valve 24 from the point of communication of said feed-pipe with the cylinder, is a supply-pipe 26, entering the feed-pipe transversely or laterally, and also communicating with said feed-pipe and in axial alinement therewith is an exhaust-conductor 27, extending from the exhaust-port of the steam or motive cylinder and having a nozzle 28, which projects into the feed-pipe across the inlet or mouth of the supply-pipe 26, whereby when said conductor 27 is used to convey the exhaust motive fluid from the motive-cylinder said fluid is projected axially into the feed-pipe to enter the pump-cylinder with the water or other liquid which is being pumped, and thereby partly heat such liquid, whereby the liquid is introduced into the boiler in a semiheated condition. Also the discharge of the exhaust motive agent across the mouth of the supply-pipe 26 produces a suction, by which liquid is inducted through the supply-pipe to assist in feeding the pump-cylinder.

As a further means of raising the temperature of the liquid which passes through the pump-cylinder, I provide for the communication of liquid within the pump-cylinder to the interior of the pump-plunger and stem 14, the remote or lower end of the bore of the plunger being fitted with a removable plug 29, which when removed allows the water or other liquid in the pump-cylinder to circulate through the stem 14, which is heated by the steam or other motive agent in the engine-cylinder.

The exhaust-pipe 30 of the engine is provided with a direct outlet 31, and the conductor 27 has a valved connection with the exhaust-pipe 30, this valve, which is indicated at 32, being of the three-way type, whereby the exhaust motive agent may be directed either into the conductor 27 or through the outlet 31, according to whether the valve-operating handle 33 is in the position indicated in full lines in Fig. 2 or in dotted lines in the same figure.

The valve mechanism which I employ in connection with the motive-cylinder is adapted for use in connection with any cylinder of a reciprocatory-piston engine, but is particularly adapted for use in connection with a pump which is necessarily exposed more or less, and in devising the valve mechanism it has been my object to protect the working parts thereof from accumulations of dust and other foreign matter and at the same time so construct the same as to avoid jar or hammer both of the valve and of the cylinder-piston and insure a practically-noiseless operation. In carrying out this feature of my invention I construct the piston-cylinder with a valve-seat rest 34, upon which is arranged a valve-seat 35, consisting of a plate, preferably of Babbitt or other antifriction material, provided with suitable valve-seat ports, hereinafter described in detail, which communicate with cylinder ports and channels formed in the cylinder or valve-seat rest. Arranged upon the valve-seat and secured in place in common with said valve-seat by suitable botls 36 is a valve-casing 37, in which fits for reciprocation a slide-valve 38, which is of the "piston-valve" type, from the fact that, as will hereinafter appear, the change of position of said valve to open the different ports for the admission and exhaust of motive agent is accomplished by the pressure, applied alternately in different directions, of the motive agent. The valve-casing or valve-cylinder 37 is of such interior cross-sectional dimensions as to snugly fit the valve, and communicating with the interior thereof is a central extension or collar 39, forming an inlet for motive agent to the valve-casing. Fitted for reciprocation in the collar or inlet is a sleeve 40, bearing at its inner end against the contiguous surface of the valve to form a steam-tight contact and yieldingly held in such contact by a spring 41, which is seated at its inner end upon a washer 42, bearing against the outer end of said sleeve 40. The outer end of the spring 41 bears against a cap 43, which is fitted in the outer end of the collar or inlet 39, and arranged in a central opening in said cap and communicating with the interior of the collar is a steam or other motive-agent supply pipe 44. Also the valve is provided with a longitudinally-extending stem 45, projecting through a guide and stuffing-box 46 in the end of the valve-casing and terminating at its outer end in a grip or knob 47, said stem being provided at its inner end with a stud or lateral extension 48, which is fitted in a socket 49 in the valve near one end. This stem serves the double function of an indicator to disclose to the engineer

whether the valve is operating properly and as a means for starting the engine by giving an initial operation to the valve.

Formed in the valve-seat rest of the piston-cylinder is an exhaust-cavity 50, with which communicates an exhaust-port 51 in the valve-seat, and formed in the valve-seat at equal intervals from and upon opposite sides of the exhaust-port (spaced longitudinally) are outlet-ports 52 and 53, either of which is adapted to be connected with the exhaust-port by means of an exhaust-cavity 54 in the face of the valve 38, said valve exhaust-cavity being arched, with the spaced ports in its face separated by a bridge 55, which is of a width greater than that of the exhaust-port 51 to provide a sufficient lap for the operation hereinafter explained. The throw or amplitude of movement of the valve is sufficient to connect either of the outlet-ports 52 53 with the exhaust-port 51, according to the direction of movement of the piston.

Formed in the cylinder-wall adjacent to its extremities are cylinder outlet-ports 52^a and 53^a, which are respectively in communication with the valve-seat outlet-ports 52 and 53 by means of longitudinal exhaust-channels 52^b and 53^b, formed in the valve-seat rest and covered by the valve-seat. Also formed in the valve-seat are valve-seat inlet-ports 56 and 57, communicating with cylinder inlet-ports 56^a and 57^a through inlet-channels 56^b and 57^b, extending longitudinally of the cylinder, said inlet-ports 56 and 57 being spaced apart at an interval greater than the valve-seat outlet-ports 52 and 53, and formed in the valve for respective communication with said valve-seat inlet-ports 56 and 57 are feed-ports 56^c and 57^c, with which communicate feed-channels 56^d and 57^d, having a common supply-port 58, which is in communication with the supply-pipe 44 for motive agent.

From the above description of the ports it will be seen that the feed-ports of the valve are in communication at all times with the supply-port of the valve-casing and that when the feed-port 56^c of said valve is in communication with the valve-seat inlet-port 56 in order to supply motive agent to the cylinder through the cylinder inlet-port 56^a the exhaust-cavity 54 of the valve is in position to connect the valve-seat outlet-port 52 with exhaust-port 51, as shown in Fig. 3, and is thus in position to exhaust motive agent from the cylinder through the cylinder outlet-port 52^a. While in the opposite position of the valve, with its feed-port 57^c in registration with the valve-seat inlet-port 57, motive agent will be admitted to the cylinder through the cylinder inlet-ports 57^a and will be exhausted from the cylinder in advance of the piston through the cylinder outlet-port 53^a and the valve-seat outlet-port 53.

The ends of the valve cylinder or casing 37 being closed and the ends of the valve fitting snugly therein to form piston-valve heads, it will be understood that by so disposing the ports and channels as at proper times to admit fluid-pressure to said valve cylinder or casing at one end and exhaust fluid from the other end, thereby producing an unequal pressure upon opposite ends of the valve, the latter may be actuated to bring different cylinder, feed, and exhaust ports into registration, or, in other words, to reverse the valve. In the construction illustrated the valve is provided, preferably at opposite sides of the plane of the feed-channels 56^d 57^d, with channels 59 and 60, each of which is open at one end in communication with the valve cylinder or casing and is closed at the opposite end. The channel 59 is in communication with the chamber 61 of the valve cylinder or casing, while the channel 60 is in communication with the chamber 62 of the valve cylinder or casing, and also formed in the valve, in communication, respectively, with the channels 59 and 60, are valve-reversing channel-ports 59^a 59^b and 60^a 60^b, 59^a and 59^b being, respectively, feed and exhaust ports in communication with the channel 59 and the ports 60^a and 60^b being, respectively, feed and exhaust ports in communication with the channel 60. Also formed in the valve-seat, upon opposite sides of the longitudinal plane of the ports 51, 52, 53, 56, and 57, or respectively in the longitudinal planes of the channels 59 and 60, are reversing feed and exhaust ports 59^c 59^d and 60^c 60^d, and these reversing valve-seat ports 59^c, 59^d, 60^c, and 60^d are respectively in communication with the interior of the cylinder by means of cylinder reversing-ports $59^{c'}$, $59^{d'}$, $60^{c'}$, and $60^{d'}$, the ports $59^{d'}$ and $60^{d'}$, respectively, breaking into the cylinder outlet-channels 53^b and 52^b and being in the transverse planes, respectively, of the cylinder outlet-ports 53^a and 52^a.

In addition to the above-described ports I also employ safety-ports arranged, preferably, in the longitudinal planes of the reversing ports and channels, and hence clearly shown in Figs. 8 and 9, a pair of valve-seat safety-ports 63 and 63^a being formed in the valve-seat contiguous to but beyond the reversing valve-seat port 59^c and a similar pair of safety-ports 64 and 64^a being formed in the valve-seat contiguous to and beyond the reversing valve-seat ports 60^c and the face of the valve being provided with safety-chambers 63^b and 64^b, designed when the valve is in the proper position to bridge, and thus connect, respectively, the ports 63 63^a and 64 64^a. The safety valve-seat ports are in communication with safety cylinder-ports 63^c 63^d and 64^c 64^d, the ports 63^c and 64^c being in communication with the cylinder and the ports 63^d and 64^d being in communication with the cylinder inlet-channels 57^b and 56^b, suitable channels 63^e and 64^e being formed in the valve-seat rest to properly connect the safety valve-seat ports with the safety cylinder-ports and corresponding channels 59^e and 60^e being formed in the valve-seat rest to properly connect the valve-seat reversing-ports 59^c and

60^{c} with the cylinder reversing-ports 59$^{c'}$ and 60$^{c'}$, all as clearly illustrated in full lines in Fig. 5 and in dotted lines in Fig. 6.

With the valve in the position indicated in Fig. 3 the motive agent is entering the cylinder through the cylinder inlet-port 56^{a} and the piston is moving in the direction indicated by the arrow in said figure and the cylinder is exhausting through the cylinder exit-port 52^{a} and the port 52 into the exhaust-cavity 50, all as indicated by arrows. When the piston has advanced in the direction indicated by the arrows sufficiently to discover the cylinder reversing-port 59$^{c'}$, the motive agent passes through said reversing-port, through the valve-seat reversing-port 59^{c} into the reversing-channel 59, and thence into the chamber 61 at one end of the valve, and as the valve-reversing port 60^{b} is in communication with the valve-seat reversing-port 60^{d} it is obvious that pressure in the chamber 62 will be relieved by exhaust through the channel 60 and into the outlet-channel 52^{b}. This will cause the valve to move toward its other position; but when the valve reaches an intermediate point, where the bridge 55 closes the exhaust-port 51, the valve-seat reversing-port 59^{c} has been closed, the piston has advanced sufficiently to close the cylinder exhaust-port 52^{a}, and the ports 59^{b} and 60^{a} have been brought, respectively, into communication with the valve-seat reversing-ports 59^{d} and 60^{c}. Owing to the lap and lead afforded by the excess of width of the bridge 55 over the exhaust-opening 51 and the relative positions of the ports 59^{b}, 60^{a}, 59^{d}, and 60^{c}, the port 59^{d} will be opened slightly in advance of the port 60^{c}, and hence steam is prevented from exhausting by reason of the exhaust-port 51 being closed and the valve becomes balanced. Just as this relation between the parts is attained, however, and before the valve ceases motion by reason of the impulse given thereto by the admission of "live" motive agent into the chamber 61 the valve feed-port 57^{c} comes into communication with the valve-seat inlet-port 57 and the bridge 55 slightly exposes the exhaust 51. This immediately gives egress to the motive agent in the valve-casing chamber 62, while the pressure of the contents of the chamber 61, admitted through the cylinder reversing-port 59^{b}, quickly throws the valve to the limit of its movement in the direction in which it has been advancing and wholly opens the valve-seat inlet-port 57 and causes the cavity 54 of the valve to connect the port 53 with the exhaust-cavity 50. If when the piston has advanced in the direction indicated by the arrows in Fig. 3 sufficiently to expose the cylinder reversing-port 59$^{c'}$ the valve for any reason should refuse to move, as above indicated, under the influence of motive agent admitted to the chamber 61, a further movement of the piston sufficient to expose the cylinder safety-port 63^{c} will allow motive agent in the cylinder to pass upwardly through said cylinder safety-port 63^{c} and the valve-seat safety-port 63, through the cavity 63^{b} in the face of the valve, downwardly through the ports 63^{a} and 63^{d} into the cylinder inlet-channel 57^{b}, and thence into the cylinder in advance of the piston through the cylinder inlet-port 57^{a}, thereby equalizing the pressure upon opposite sides of the piston and stopping the engine. Furthermore, it will be noted that the cylinder inlet-ports 52^{a} and 53^{a} are located at a sufficient distance from the opposite ends or heads of the cylinder to form a steam-cushion, and the steam remaining in the valve-casing in advance of the valve during its reversal and which is allowed to exhaust when the communication between the valve-channel, as 60, and the exhaust-port 51 is established forms a cushion to prevent hammer of the valve.

All of the operating parts of the mechanism, as will be seen from the foregoing description, are concealed and protected from accumulations of dust, and hence may be kept in a properly-lubricated condition to insure prompt operation with the least friction and practically noiselessly. Furthermore, the automatic reversal of the valve by means of the exposure of the reversing-ports by the cylinder-piston avoids those inconveniences of displacement which are incident to valve-gear employing eccentric and other connections heretofore in common use.

Various changes in the form, proportion, and the minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of this invention.

What is claimed is—

1. A pump comprising a cylinder having an interior annular flange located between its ends to form an upper piston-cylinder and a lower water-chamber, steam supply and exhaust pipes for the piston-cylinder, a plunger-cylinder engaged with the flange and extending into the water-chamber from the wall of which it is separated by an interspace, valved water inlet and outlet pipes communicating with the interspace below the flange to permit an air-receiver between them and the flange, a piston arranged in the piston-cylinder, and a plunger operating in the plunger-cylinder and having a hollow stem connected with said piston and accessible to the liquid contents of the plunger-cylinder, whereby the liquid in the plunger-cylinder may be heated by circulation through the hollow stem, which in turn is heated by the steam in the piston-cylinder, said plunger-cylinder being in communication with the valved water inlet and outlet pipes, substantially as specified.

2. A pump comprising a cylinder having an interior annular flange located between its ends to form an upper piston-cylinder and a lower water-chamber, steam supply and exhaust pipes for the piston-cylinder, a plunger-cylinder engaged with the flange and extending into the water-chamber from the wall of

which it is separated by an interspace, valved water inlet and outlet pipes communicating with the interspace below the flange to permit an air-receiver between them and the flange, a piston arranged in the piston-cylinder, and a plunger operating in the plunger-cylinder and having a hollow stem connected with said piston and accessible to the liquid contents of the plunger-cylinder, whereby the liquid in the plunger-cylinder may be heated by circulation through the hollow stem, which in turn is heated by the steam in the piston-cylinder, said plunger-cylinder being in communication with the valved water inlet and outlet pipes, said stem being adapted to receive a closure at its open end for cutting off communication between the plunger-stem and the plunger-cylinder, substantially as specified.

3. A pump comprising a cylinder having an interior annular flange located between its ends to form an upper piston-cylinder and a lower water-chamber, steam supply and exhaust pipes for the piston-cylinder, a plunger-cylinder engaged with the flange and extending into the water-chamber from the wall of which it is separated by an interspace, valved water inlet and outlet pipes communicating with the interspace below the flange to permit an air-receiver between them and the flange, a piston arranged in the piston-cylinder, and a plunger operating in the plunger-cylinder and having a hollow stem connected with said piston and accessible to the liquid contents of the plunger-cylinder, whereby the liquid in the plunger-cylinder may be heated by circulation through the hollow stem, which in turn is heated by the steam in the piston-cylinder, said plunger-cylinder being in communication with the valved water inlet and outlet pipes, and a movable plug fitted in the end of the hollow stem to cut off communication between the interior of said stem and the plunger-cylinder, the outer end of the plunger-cylinder also being fitted with a removable plug 21 to give access to the adjacent end of the hollow stem, substantially as specified.

4. A pump comprising a cylinder having an interior annular flange located between its ends to form an upper piston-cylinder and a lower water-chamber, steam supply and exhaust pipes for the piston-cylinder, a plunger-cylinder engaged with the flange and extending into the water-chamber from the wall of which it is separated by an interspace, valved water inlet and outlet pipes communicating with the interspace below the flange to permit an air-receiver between them and the flange, a piston arranged in the piston-cylinder, a plunger operating in the plunger-cylinder and having a hollow stem connected with said piston and accessible to the liquid contents of the plunger-cylinder whereby the liquid in the plunger-cylinder may be heated by circulation in the hollow stem, which in turn is heated by the steam in the piston-cylinder, connections between the exhaust-pipe of the piston-cylinder and the inlet-pipe of the pump-cylinder for supplying exhaust-steam to the latter, and means for regulating the supply of exhaust-steam to the pump-cylinder.

5. A pump comprising a cylinder having an interior annular flange located between its ends to form an upper piston-cylinder and a lower water-chamber, steam supply and exhaust pipes for the piston-cylinder, a plunger-cylinder engaged with the flange and extending into the water-chamber from the wall of which it is separated by an interspace, valved water inlet and outlet pipes communicating with the interspace below the flange to permit an air-receiver between them and the flange, a piston arranged in the piston-cylinder, a plunger operating in the plunger-cylinder and having a hollow stem connected with said piston and accessible to the liquid contents of the plunger-cylinder whereby the liquid in the plunger-cylinder may be heated by circulation through the hollow stem, which in turn is heated by the steam in the piston-cylinder, means for cutting off communication between the plunger-stem and the plunger-cylinder, a pipe leading from the steam-exhaust to the water-inlet pipe to supply steam to the latter, and means for regulating the supply of steam to the water-supply pipe.

6. A pump comprising a cylinder having an interior annular flange located between its ends to form an upper piston-cylinder and a lower water-chamber, steam supply and exhaust pipes for the piston-cylinder, a plunger-cylinder engaged with the flange and extending into the water-chamber from the wall of which it is separated by an interspace, valved water inlet and outlet pipes communicating with the interspace below the flange to permit an air-receiver between them and the flange, a piston arranged in the piston-cylinder, and a plunger operating in the plunger-cylinder and having a hollow stem connected with said piston and accessible to the liquid contents of the plunger-cylinder whereby the liquid in the plunger-cylinder may be heated by circulation through the hollow stem, which in turn is heated by the steam in the piston-cylinder, a movable plug fitted in the end of the hollow stem to cut off communication between the interior of the stem and the plunger-cylinder, the outer end of the plunger-cylinder being also fitted with the movable plug to give access to the adjacent ends of the hollow cylinder, and a pipe leading from the steam-exhaust to the water-inlet pipe, and means for regulating the passage of the steam through said communicating pipe.

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

WALTON E. EBY.

Witnesses:
J. H. MORRIS,
L. M. ZOLL.