(No Model.) 3 Sheets—Sheet 1.

H. A. SANFORD.

AUTOMATIC FEED FOR STEAM BOILERS.

No. 324,417. Patented Aug. 18, 1885.

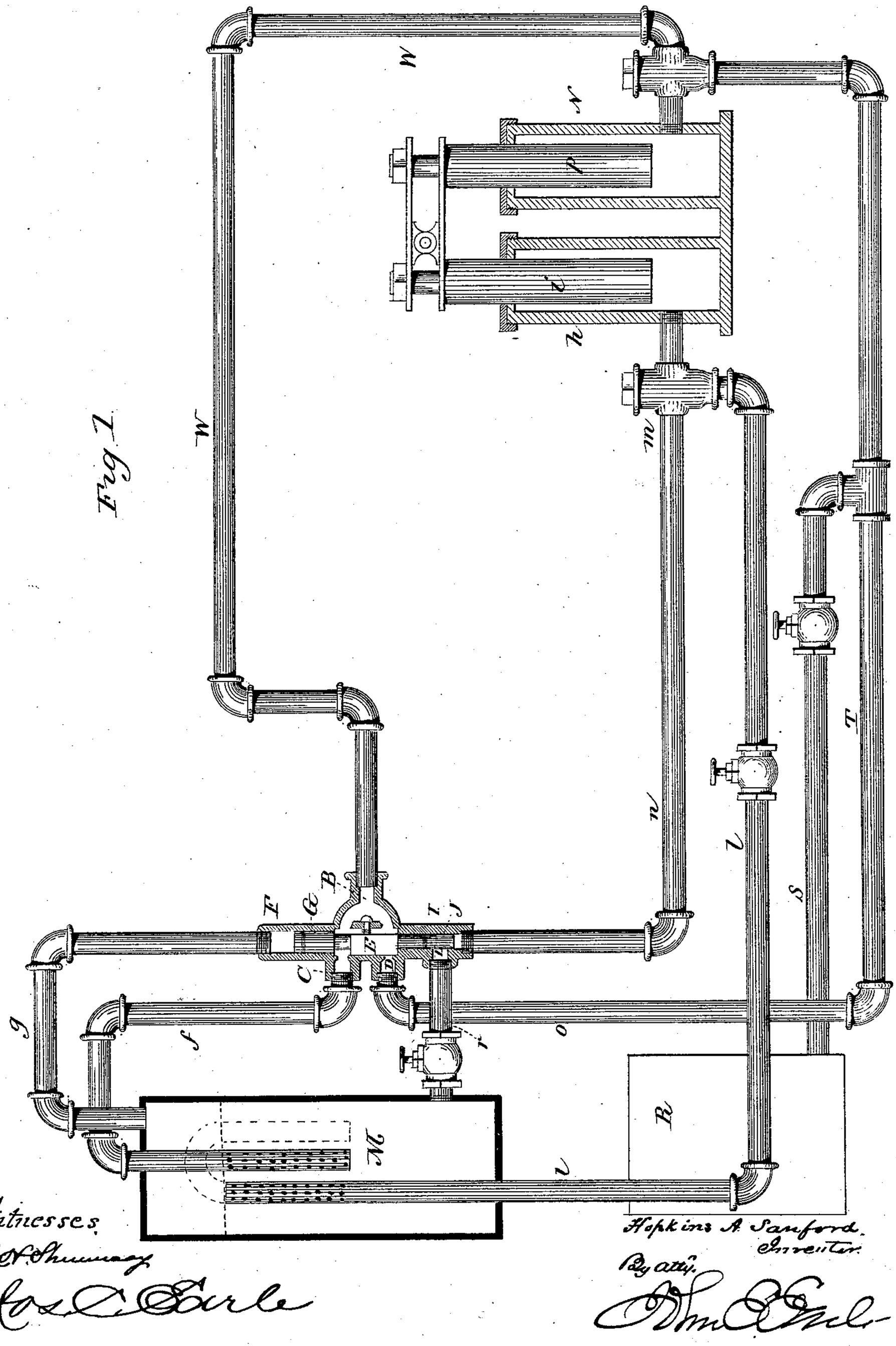

Fig. 1.

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Fig. 2.

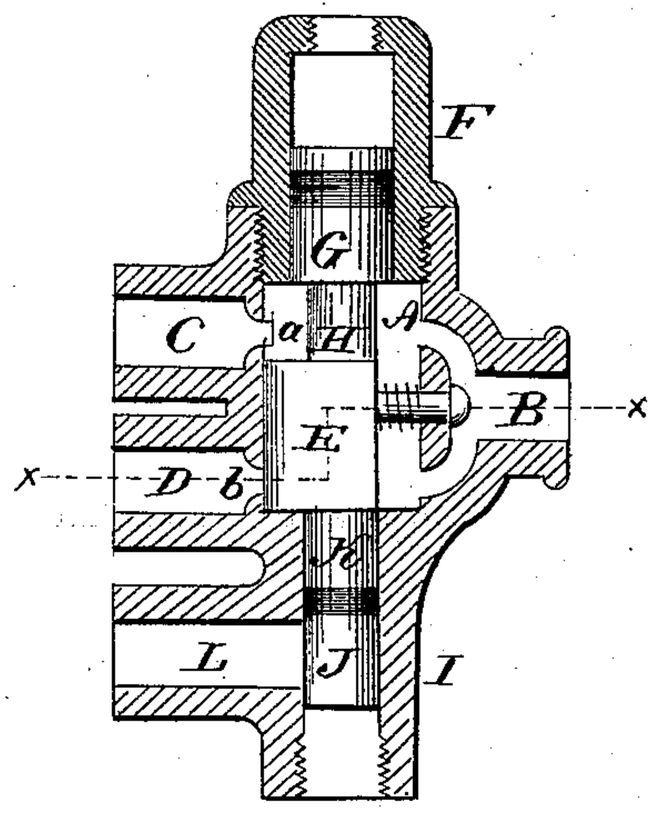


Fig. 3.

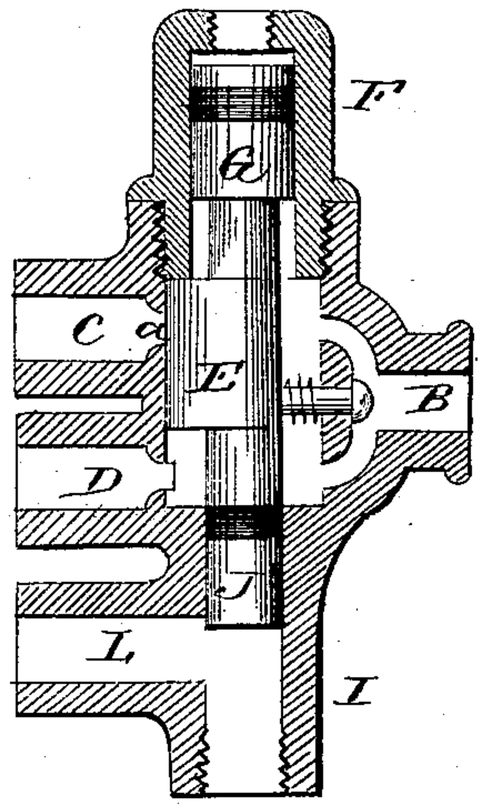


Fig. 7

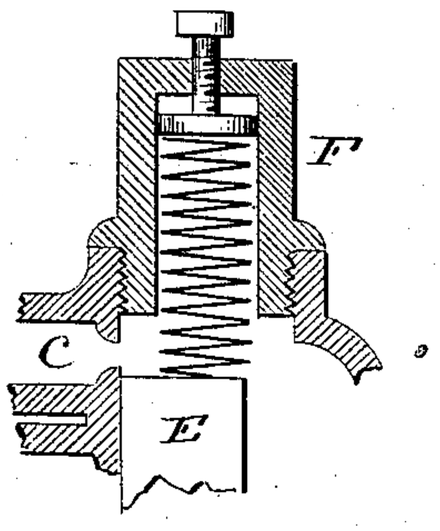
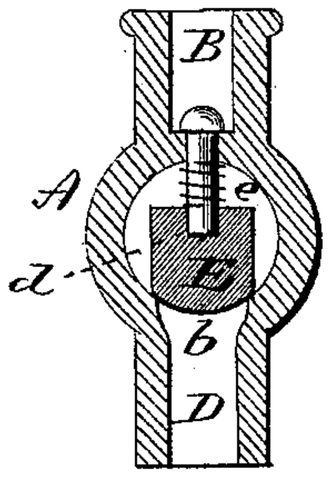


Fig. 4.



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AUTOMATIC FEED FOR STEAM BOILERS.

No. 324,417. Patented Aug. 18, 1885.

Fig. 5.

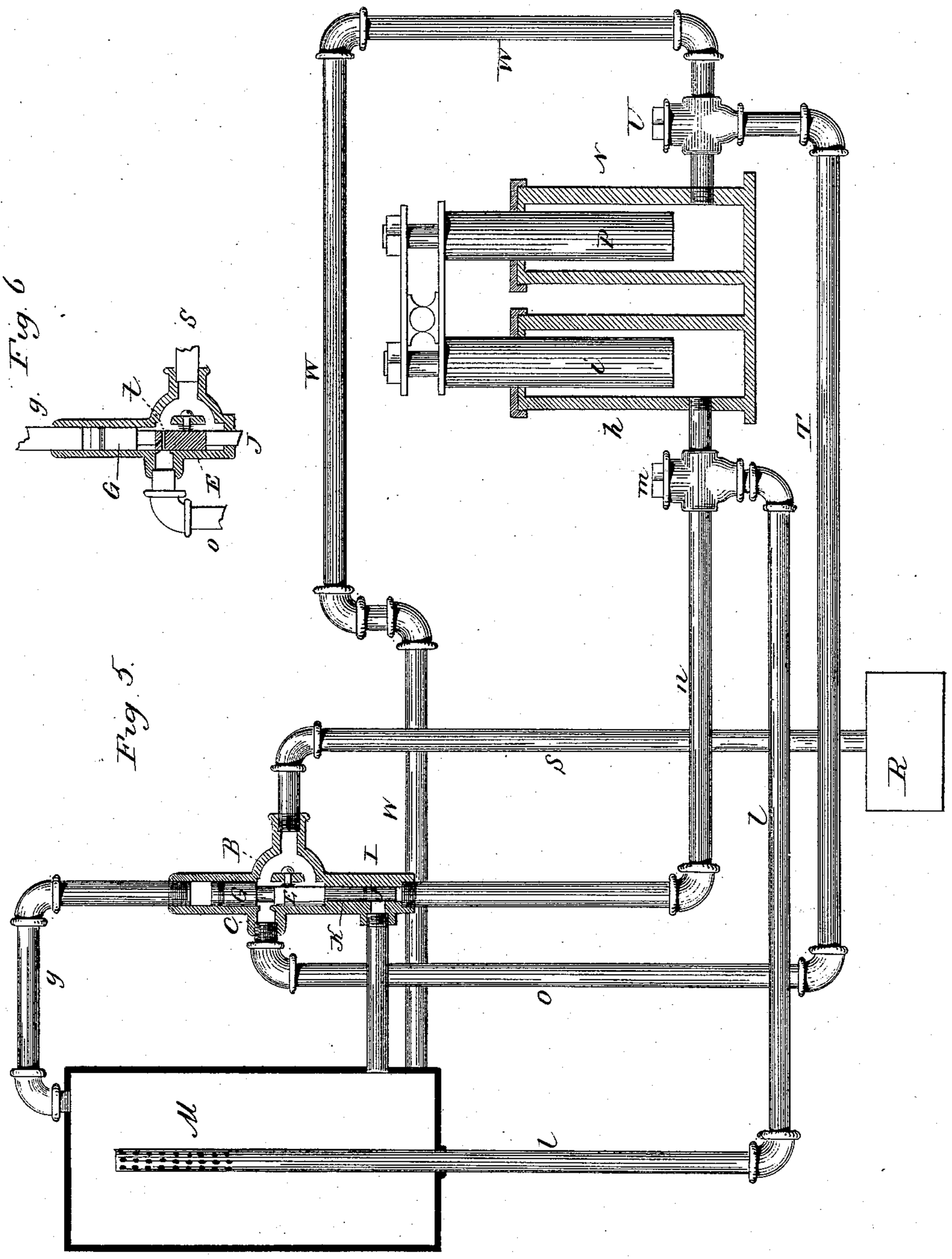

Fig. 6.

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UNITED STATES PATENT OFFICE.

HOPKINS A. SANFORD, OF NEW HAVEN, CONNECTICUT, ASSIGNOR TO THE AUTOMATIC SAFETY BOILER AND ENGINE COMPANY, OF SAME PLACE.

AUTOMATIC FEED FOR STEAM-BOILERS.

SPECIFICATION forming part of Letters Patent No. 324,417, dated August 18, 1885.

Application filed October 13, 1884. (No model.)

To all whom it may concern:

Be it known that I, HOPKINS A. SANFORD, of New Haven, in the county of New Haven and State of Connecticut, have invented new Improvements in Automatic Feeds for Steam-Boilers; and I do hereby declare the following, when taken in connection with the accompanying drawings, and the letters of reference marked thereon, to be a full, clear, and exact description of the same, and which said drawings constitute part of this specification, and represent, in—

Figure 1, a vertical section of the valve arrangement and pumps in connection with the boiler for automatic feed; Fig. 2, a vertical central sectional view of the valve arrangement, showing the valve as in its down or position of opening the passage for the feed-water to the boiler; Fig. 3, the same, showing the valve as reversed to cut off the flow of feed-water to the boiler; Fig. 4, a transverse section on line *x x* of Fig. 2; Fig. 5, a vertical sectional view illustrating modified form of the valve arrangement as arranged between the water-supply and the feed-pump, instead of between the feed-pump and boiler, as in Fig. 1, the valve open for the flow of water to the boiler; Fig. 6, a vertical section of the valve in its reversed position—that is, to cut off the flow of water to the boiler; Fig. 7, a modification.

This invention relates to an improvement in device for supplying feed-water to steam-boilers, and particularly to that class in which the supply of water is governed by the proper water-level in the boiler, the object of the invention being the construction of an automatic mechanism between the pumps and the boiler, whereby under the constantly-running pumps the delivery of the feed-water to the boiler will be permitted or cut off accordingly as the water is below or reaches the water-level in the boiler; and the invention consists, principally, in differential pistons arranged in a cylinder, the larger diameter exposed to boiler-pressure, the two pistons operating a valve to open or close the water-way to the boiler, as more fully hereinafter described.

The peculiar valve arrangement is shown enlarged in Figs. 2 and 3, and I will first describe its construction.

A is the valve-chamber, to which an inlet, B, opens, and from it are two outlets, C D, each outlet opening into the chamber in the form of a port, respectively, *a b*. The interior of the valve-chamber is preferably made cylindrical, as seen in Fig. 4.

E is the valve, its face of shape corresponding to the interior of the chamber, and so as to work upon the ports *a b*—say, as from the position seen in Fig. 2 to that in Fig. 3 and return. It is guided by a fixed stud, *d*, standing in a groove in the back of the valve, and upon the stud a spring, *e*, is arranged to bear upon the valve and hold its working-face in proper contact with the surface of the chamber at the ports. Above the valve-chamber is a cylinder, F, in which works a piston, G. The piston is free in the cylinder for movement in either direction, and from it a stem, H, extends onto the upper end of the valve E. The cylinder F is open at its upper end for the introduction of a steam-pipe. Below the valve-chamber is a second cylinder, I, of less area than the cylinder F above, and, preferably, the two cylinders are made in axial line with each other and with the valve-chamber A. In the cylinder I is a piston, J, which, like the piston G above, is free for movement up or down, as the case may be, and from it a stem, K, bears against that end of the valve E, as shown. From the cylinder I an outlet, L, is provided. The arrangement of the two pistons and valve is such that when the two pistons are in contact with the valve, as seen in Fig. 2, and the valve at its lowest position, so as to close the passage D and leave the passage C open to the valve-chamber, the piston J closes the passage L; but when the piston and valve are moved up, as seen in Fig. 3, to the other extreme, then the valve E closes the passage C, opens communication between the passage D and the valve-chamber, and the piston J opens the passage L. The lower end of the cylinder I is fitted to receive a tube leading thereto.

I will now proceed to describe the application of this valve arrangement to the feeding of a steam-boiler, and as illustrated in Fig. 1, in which M represents the steam-boiler, the transverse broken line indicating the water-level; N, the feed-water pump, its

plunger P having a reciprocating movement imparted to it in the usual manner for feed-water pumps; R, the reservoir from which the feed-water is drawn; S, the pipe from the reservoir, which leads into a pipe, T, in connection, through the valve U, with the pump, and from the valve U a pipe, W, leads to the inlet B of the valve-chamber A, so that the pump N, drawing water from the reservoir, will force it through the passage B into the valve-chamber A.

From the passage C a pipe, *f*, leads into the boiler. This is best done by introducing the end of the pipe downward into the boiler and perforating its lower end up to the water-line, and so that the valve standing down, and so as to leave the passage C open, the water forced by the pump N through the pipe W will pass through the valve-chamber and the pipe *f* to the boiler. From the boiler a pipe, *g*, opens into the cylinder F above the piston G, so as to expose the face of the larger piston to steam-boiler pressure.

h is the regulator-pump, and which, like the pump N, is provided with a plunger, *i*. These two may be connected, as shown, and so as to work simultaneously.

From the boiler a pipe, *l*, opens at the water-line. This is best done by arranging the pipe, as shown, in a vertical position, with openings above the water-line—say, as by extending the pipe above the water-line, and making numerous perforations therein down to the water-line. This pipe *l* leads to a valve, *m*, and so that the pump *h* will draw from the boiler. From the valve *m* a pipe, *n*, leads to the cylinder I below the piston J. From the passage D of the valve-chamber a pipe, *o*, leads to the pipe T, and so that the pump N may draw either through the pipe *o* or the pipe S, as the case may be. From the passage L in the cylinder I a pipe, *r*, leads to the boiler, preferably below the water-line. This completes the arrangement of pumps and system of pipes with relation to the valve and the boiler, and in illustrating its operation I will suppose the water in the boiler to be below the water-level. The piston G being exposed to the steam-pressure of the boiler and larger than the piston J holds the valve E in its down position—that is, so as to open the passage C from the valve-chamber to the boiler. In this condition the lower passage, D, in the valve-chamber, and the passage L in the cylinder J, are both closed. The feed-pump N, at work, will draw water from the feed-water reservoir through the pipe S and T and force it through the pipe W, through the valve-chamber, passage C, and pipe *f* into the boiler, and will so continue to force a flow of water to the boiler until the water shall have risen to the proper level. While the pump N is thus working the water in the boiler has been below the openings into the pipe *l*. The pump *h*, therefore, has been simply drawing steam, by which no effect is produced; but when the water, under the action of the feed-pump, shall have risen to or slightly above the water-level, then the water will flow from the boiler through the pipe *l*, and the pump *h* will now draw water from the boiler and force it through the pipe *n* beneath the smaller piston J. The action of the pump upon this water produces a pressure considerably greater than that of the boiler-pressure; hence will raise the piston J, valve E, and the piston G against that boiler-pressure and to the position seen in Fig. 3. In this position the passage C from the valve-chamber to the boiler is closed, and the passage D from the valve-chamber is open. This opening of the passage D from the valve-chamber permits the water which the feed-pump has discharged into the valve-chamber to pass into the pipe *o*, thence to the pipe T, and return to the feed-pump N, so that while the feed-pump continues its work the water will simply circulate through the pipe W, valve-chamber, and pipes *o* and T. At the same time the passage *l* is open through the pipe R to the boiler. The pump *h*, continuing its work, draws the water from the boiler through the pipe *l*, and returns it through the pipe *n*, passage L, and pipe R to the boiler, thus simply drawing the water from the boiler and returning it thereto. The two pumps will thus continue their work until such time as the water falls to its proper level, and when that level is reached the pump *h* will cease to draw water from the boiler and will take steam only, and by the steam so taken from the boiler the pump cannot raise the total pressure upon the piston J to equal the total pressure upon the piston G; hence the piston G will descend and force the valve E and the piston J down, to close the passages D and L and open the passage C. This done, water from the feed-pump again flows through the passage C and pump *f* to the boiler until the water stands at the water-level or above. Then the pistons again reverse, and will so continue to act, and as the water rises or falls the supply will be cut off or water forced into the boiler, as the case may be, maintaining water in the boiler at substantially a predetermined level. This valve arrangement, instead of being introduced between the feed-pump and boiler, may be introduced between the reservoir and feed-water pump, and as seen in Fig. 5. Under such an arrangement the lower passage, D, from the valve-chamber is omitted, and the upper discharge, C, only employed; and instead of connecting the pipe *o* to the lower passage, as before, it is connected to the upper passage, C, and leads therefrom through the pipe T to the valve U, and the feed-pipe W leads directly to the boiler M, instead of to the valve-chamber. From the reservoir a pipe, S, runs directly to the valve-chamber through the passage B. The pipe *l* extends from the boiler above the water-line to the valve *m* of the pump *h*, as before, and the pipe *n* leads from the valve to the cylinder I, below the piston J, as before. Under this arrangement, suppose the water to be below

water-level, the valve E down under the pressure of the steam upon the piston above, and so as to open the passage C. The pump N working draws water from the reservoir through the pipe S, through the valve-chamber, thence through the pipes *o* T, through the valve U to the pump, and forces it through the pipe W directly to the boiler, and will so continue to work until the water in the boiler shall have risen above the water-level. When it has so risen the pump *h* draws water as before from the boiler and forces it beneath the piston J, to raise that piston, the valve E, and the piston G, as seen in Fig. 6, and until the valve E closes the passage C. Then the reservoir is cut off and the feed-pump ceases to draw water, and will work "dead," or, to give it a little freedom, a slight passage, *t*, may be made through the valve E, as seen in Fig. 6, so that the pump may draw a slight amount of water, but so little as to be of no effect in the boiler, and the valve will stand in this position until the water in the boiler shall have fallen so low that the pump again draws steam, when the piston and valve will descend as before, opening the communication between the feed-pump and boiler for the supply of water. In cases where a stand-pipe is employed outside the boiler, and through which the boiler is supplied, M in the illustration may represent such stand-pipe.

I have illustrated the two pumps as common plunger-pumps, to the plungers of which reciprocating movement is imparted to draw and force in the well-known manner; but it will be understood that any known or equivalent pump may be substituted for either or both pumps. I have also for convenience illustrated the two pumps as near each other, and so that the two plungers might be operated by the same mechanism; but it will be understood that these pumps may be entirely detached or arranged in positions distant from each other, and either located as convenience may dictate.

I have represented the pump *l*, through which the regulator-pump draws water from the boiler, as opening above the water-level, and so that the pipe is at all times open to steam; but the pipe *l* may open below water-level—say, as indicated in broken lines Fig. 1. In this case the regulator-pump will draw water so long as the highest opening is below water-level; but whenever that water-level is reached, then the opening will permit the steam to enter above the water, and from that time the regulator-pump will draw steam until the water in the boiler rises above the highest opening.

It will be understood that the valves U and *m* of the pumps are such valves as are usually applied in this position, and may be any suitable valve to answer the purpose.

I have represented the larger piston G as open to the pressure of steam from the boiler; but instead of applying such steam-pressure to force the piston downward, and against which the pressure of water on the piston J will act, a spring may be introduced in place of the steam-pressure, as seen in Fig. 7, and made adjustable by a set-screw or otherwise. In that case the differential diameters of the two cylinders are unnecessary.

I am aware of Patent No. 288,591, and do not wish to be understood as claiming anything therein shown or described.

I claim—

1. The combination of the valve-chamber A, having an inlet-passage, B, and an outlet-passage, C, a valve, E, arranged in said chamber, and movable therein to open or close said outlet-passage C, two cylinders arranged in line with said valve-chamber, one at one end and the other at the opposite end, that at one end larger than the one at the opposite end, and a piston in each of said cylinders, arranged to bear upon said valve and impart to the said valve a reciprocating movement, whereby the said outlet-passage is opened and closed, each of said cylinders provided with an opening to the face of the piston, and the cylinder of smaller diameter provided with an outlet-passage, L, opened or closed by the movement of the said piston, substantially as described.

2. The combination of the valve-chamber A, constructed with the inlet-passage B, the two outlet-passages C D, the valve E, arranged in said chamber and movable therein to open either of said outlet-passages and close the other, two cylinders arranged the one at one end of said valve-chamber, the other at the opposite end, that at one end larger than the one at the opposite end, and a piston in each of said cylinders, and arranged to bear upon the valve, each of said cylinders provided with an opening to the face of the piston, the cylinder of smaller diameter provided with an outlet-passage, L, and so as to be opened or closed by the movement of the piston in said smaller cylinder, substantially as described.

3. The combination of the cylindrical valve-chamber A, constructed with the inlet-passage B, and with the outlet-passage C, the valve E, arranged in said cylindrical chamber, having a working-face corresponding to the inner surface of said chamber, the said valve constructed with a longitudinal groove upon its back, a fixed stud, *d*, in said chamber standing in said groove as a guide for the movement of said valve, and two cylinders, one at one end and the other at the opposite end of said valve-chamber, and substantially concentric therewith, that at one end of larger diameter than the one at the opposite end, each cylinder provided with a piston movable therein, each cylinder constructed with an opening to the face of the piston, each piston arranged to bear upon its respective end of said valve, and the cylinder of smaller diameter constructed with an outlet-passage, L, substantially as described.

4. The combination of the cylindrical valve-chamber A, constructed with the inlet-passage

B, the two outlet-passages C D, the valve E, arranged in said chamber and movable therein to open either of said outlet-passages and close the other, having a working-face corresponding to the inner surface of said chamber, the said valve constructed with a longitudinal groove upon its back, a fixed stud, *d*, in said chamber standing in said groove as a guide for the movement of said valve, and two cylinders, one at one end and the other at the opposite end of said valve-chamber, and substantially concentric therewith, that at one end of larger diameter than the one at the opposite end, each cylinder provided with a piston movable therein, and each cylinder constructed with an opening to the face of the piston, each piston arranged to bear upon its respective end of the said valve, and the cylinder of smaller diameter constructed with an outlet-passage, L, substantially as described.

5. The combination of the valve-chamber A, provided with the inlet B and outlets C D, the valve E, arranged in said chamber and movable therein to open either of said outlet-passages and close the other, the cylinder F, piston G arranged therein and so as to bear upon one end of the valve, said cylinder in connection with the boiler to receive the steam therefrom upon the face of the cylinder, the cylinder I of less diameter than the cylinder F, the piston J therein arranged to bear upon the opposite end of said valve, a passage from said cylinder I to the boiler below the water-level, a feed-pump on its draft in connection with the feed-water supply, and also from the valve-chamber through the outlet D, and in its force in connection with the valve-chamber through the inlet B, said valve-chamber through the outlet C in connection with the boiler, and a second pump, *h*, on its draft in connection with the boiler at water-level, and on its force in connection with the cylinder I, below the piston J, substantially as described.

6. The combination of the valve-chamber A, having an inlet-passage, B, and an outlet-passage, C, a valve, E, arranged in said chamber and movable therein to open or close said outlet-passage C, a cylinder, I, in line with said valve-chamber, piston in said cylinder arranged to bear upon one end of the valve, and a resistance at the opposite end of the valve, equal at least to the boiler-pressure, the said cylinder I provided with an outlet-passage, L, said passage opened or closed by the movement of said piston, substantially as described.

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