(No Model.) 2 Sheets—Sheet 1.

N. CURTIS.

BOILER FEEDER.

No. 348,893. Patented Sept. 7, 1886.

Fig. 1.

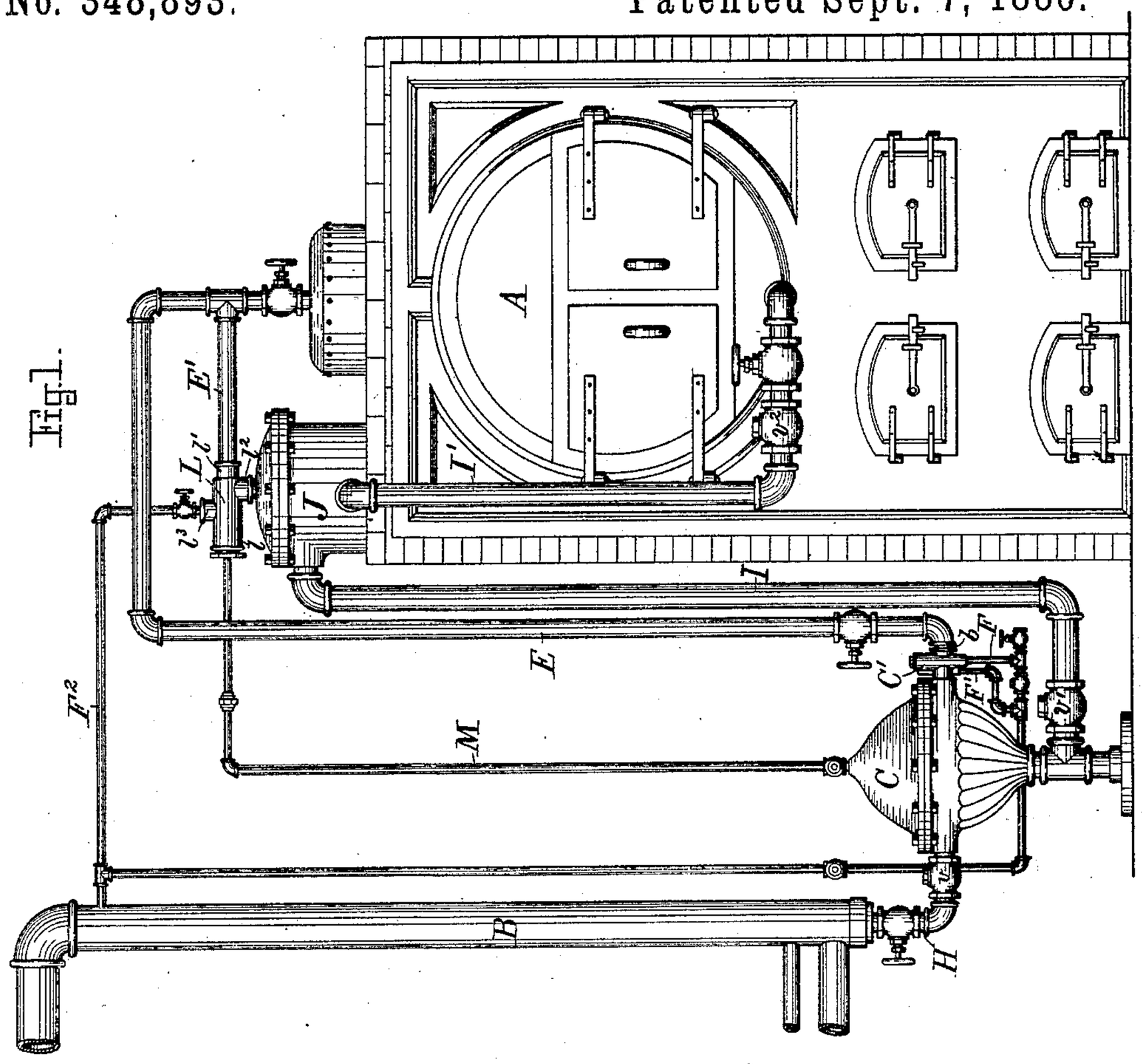


Fig. 3.

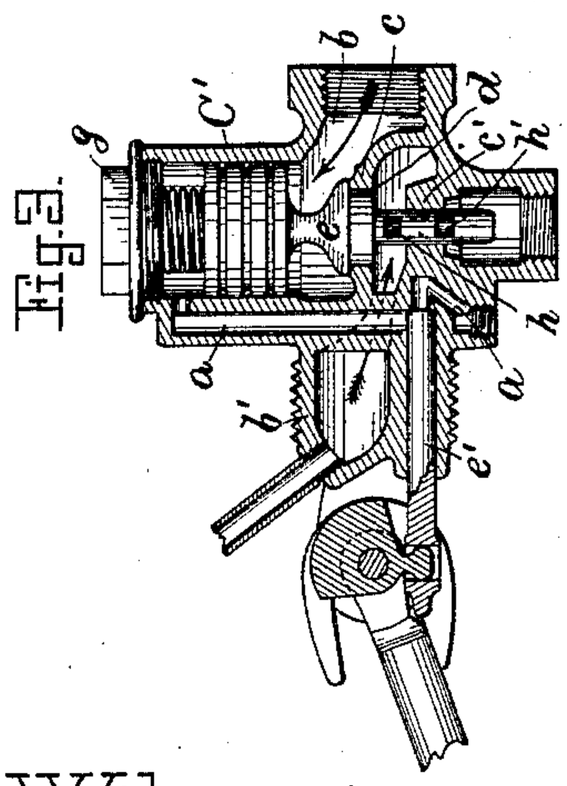


Fig. 2.

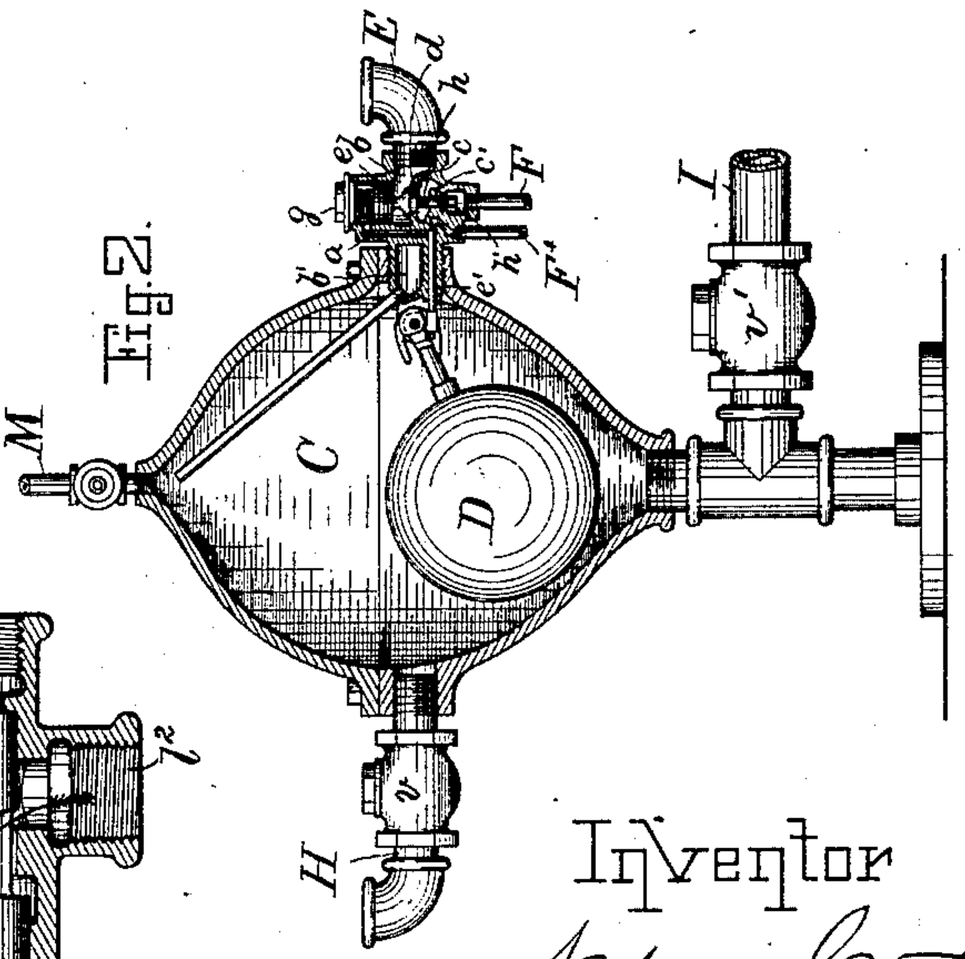
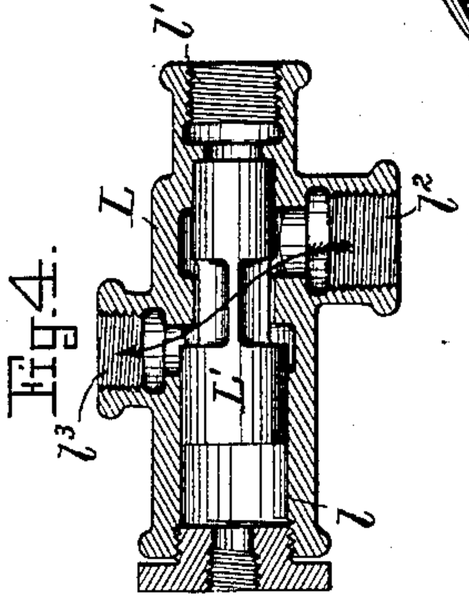


Fig. 4.



Witnesses

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Inventor

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(No Model.) 2 Sheets—Sheet 2.

N. CURTIS.

BOILER FEEDER.

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Fig. 5.

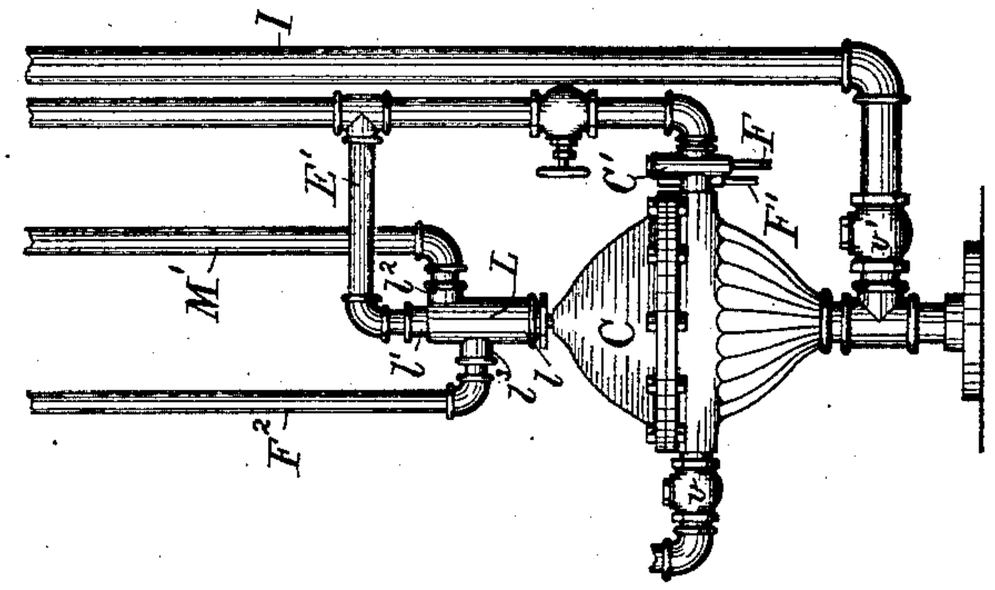


Fig. 6.

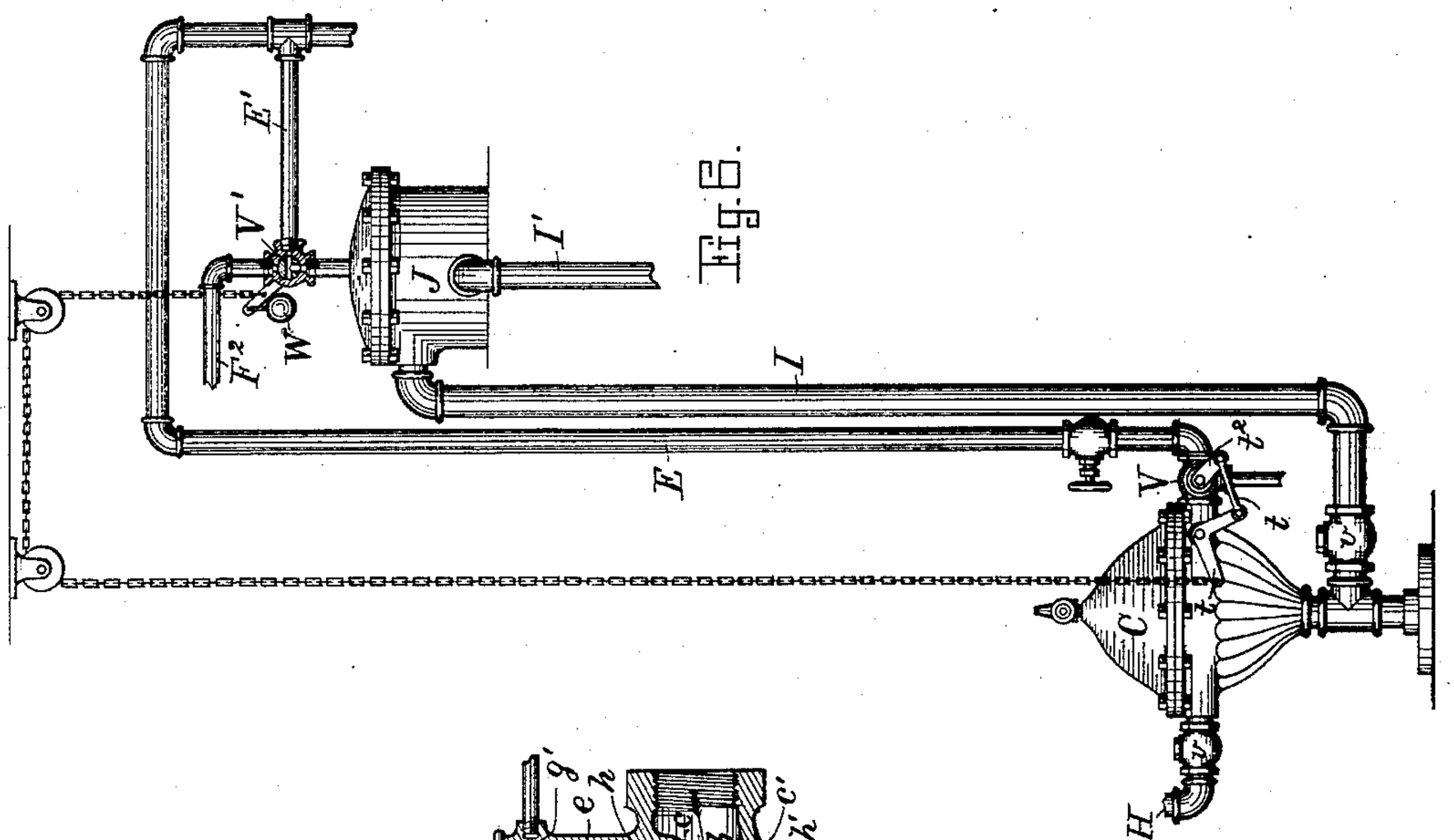
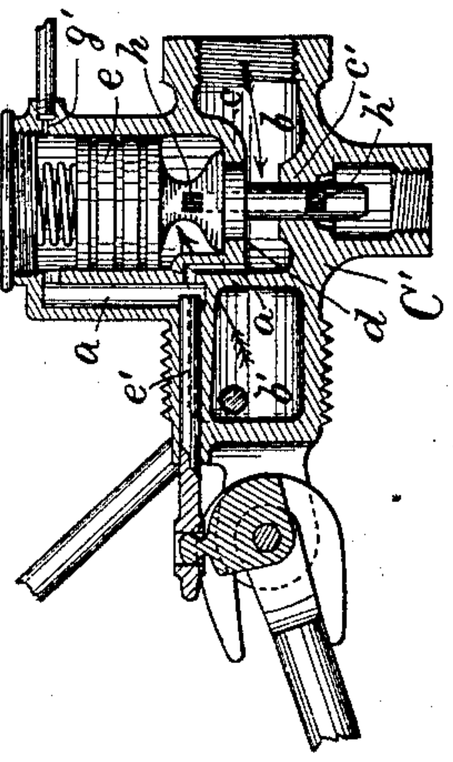


Fig. 7.



Witnesses

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UNITED STATES PATENT OFFICE.

NELSON CURTIS, OF BOSTON, MASSACHUSETTS.

BOILER-FEEDER.

SPECIFICATION forming part of Letters Patent No. 348,893, dated September 7, 1886.

Application filed May 13, 1886. Serial No. 202,030. (No model.)

To all whom it may concern:

Be it known that I, NELSON CURTIS, of Boston, Massachusetts, have invented a new and useful Improvement in Automatic Boiler-Feeds, of which the following is a specification.

The principal object of the invention is to provide for the return, automatically, of the water of condensation of a steam system to the boiler from coils or surfaces in which there is little or no pressure, and some portions of which are below the water-level of the boiler. The invention, however, is not confined to the return to the boiler of water condensed in the steam system, but is applicable to any boiler-feed in which the source of supply, being under little or no pressure, is below the water-level of the boiler, or, being under pressure, is under a pressure less than that of the boiler. By the use of my improved trap, moreover, exhaust-steam from engines worked by steam from the boiler may be utilized for heating purposes with little or no back-pressure upon the engines, and the waste of condensation afterward automatically returned to the boiler. The trap consists, essentially, of two connecting chambers, one of which is below the water-level of the boiler as well as below the source of supply, while the other is above the water-level of the boiler, each chamber being provided with a valve system of its own to control the ingress and egress of steam, but both valve systems being controlled automatically by the amount of water in the lower chamber.

The principal feature of the invention consists in controlling the two valve systems automatically by the amount of water in the lower chamber, as will hereinafter clearly be seen. Each chamber, with its valve mechanism, taken by itself, differs but little in mode of operation from an ordinary return-trap. When there is little or no pressure in the source of supply, the ordinary return-trap is below the source of supply and above the boiler, and is connected with each by a pipe having a check-valve. It is provided with valve mechanism controlled by the amount of water in the trap, and usually does not differ essentially in mode of operation from the sliding valve of a steam-engine. Usually the trap is provided with a float, and, when the water is low and the float is down, the inlet-port is closed and the steam in the trap is either condensed or allowed to escape through an exhaust-port. The steam-pressure in the trap being reduced, the water of condensation flows freely into the chamber until the float rises sufficiently to shift the valves, when, the inlet-port being now open and the exhaust shut, the chamber fills with steam above the water. The steam-pressure above and below the water in the chamber being thus made equal, the water falls by gravity into the boiler. In an old form of return-trap, however, the trap itself is sometimes made movable to shift its valve mechanism according to the weight or amount of water within it, as in the well-known "Albany" trap. It is evident, however, that the full operation of neither of my chambers with its valve system can be exactly like that of an ordinary return-trap, since water cannot under any circumstances fall into the boiler from the chamber which is below the water-level of the boiler, nor can water not under pressure flow from the source of supply into the chamber that is above the level of the source of supply, whether or not there be boiler-pressure in that chamber; but it is equally evident that the lower chamber can be made to discharge the water in it when there is steam-pressure above that water, if the steam-pressure below the water be removed, and equally evident that water from below can be forced into the upper chamber by steam-pressure when there is no steam-pressure or less steam-pressure in the upper chamber. Accordingly the water in the lower chamber may be forced into the upper chamber when the water of the lower chamber rises sufficiently to open the steam-inlet port and close the exhaust-port of that chamber, if at the same time there be no steam-pressure or sufficiently less steam-pressure in the upper chamber, and water once in the upper chamber may be made to fall into the boiler by gravity, if steam-pressure be let in upon it above equal to that below. In working out my invention, therefore, I have made use of two chambers—a lower and an upper—filling the upper from the lower and discharging the upper into the boiler. I have placed the second or upper chamber in a passage-way leading from the first or lower chamber to the boiler, and I have given to each

chamber a separate passage-way from the dome of the boiler, and placed in each passage-way a valve-system-controlling inlet and exhaust-ports to their respective chambers, and I have operated the valve system of the first chamber by a float in that chamber in the manner already described. I found, however, that it would not answer my purpose, and indeed that it was impracticable to place a second float in the second chamber and work the valve system of such second chamber by such second separate float. I then conceived the idea of placing both valve systems under the control of the float of the first or lower chamber, so that when the float rises in the first chamber and opens its inlet-port and closes its exhaust-port it will by the same movement close the inlet and open the exhaust port of the second chamber, and when it fills will reverse the condition of each chamber—that is, while steam is on in one chamber it is off in the other. There are several ways in which this conception may be worked out. In the drawings I show the best way which I have devised, and details of apparatus shown form subordinate parts of my invention; but, as in substance already stated, my invention, as a whole, lies in combining with a boiler and a condensing-surface which, being under little or no pressure, is in whole or in part below the water-level of the boiler, suitable connecting-pipes and two chambers—one below and the other above the water-level of the boiler—and each provided with a valve-system, but both valve systems being controlled by the amount of water in the lower chamber.

An important detail of the invention consists in connecting with a steam-chamber provided with a valve mechanism operated by a float in said chamber to control the admission of steam thereto a second valve mechanism operated by the steam so admitted.

In the drawings, Figure 1 is a front elevation of apparatus embodying my invention, including the boiler, the condensing-surface, the upper and lower chambers, and connecting-pipes or passage-ways and valves. Fig. 2 is a sectional elevation of the lower chamber, including valve mechanism immediately employed therewith, and shows also the pipes immediately connected with the lower chamber. Fig. 3 is a sectional elevation, upon a larger scale, of the valve mechanism shown in Fig. 2. Fig. 4 is a sectional elevation of valve mechanism employed in connection with the upper chamber. Figs. 5, 6, and 7 are partial views of modifications of apparatus embodying my invention, as will hereinafter more fully appear.

A is the boiler.

B is a portion of the condensing-surface or source of supply, in this instance consisting of pipes supposed to lead from steam-heaters.

C is the lower chamber and D is the float in said lower chamber.

C′ is a valve-casing containing the valve mechanism of the chamber C. The valve-casing C′ has a hollow arm, *b*, that opens from the interior of the valve-casing above a partition, *c*, therein, containing a port, *d*, and forming a seat for the differential piston-valve *e*. This hollow arm *b* communicates with the boiler by a pipe, E. A second hollow arm, *b′*, furnishes a passage from the interior of the valve-casing C′, below the partition *c* and port *d* to the interior of the chamber C. The piston-valve *e* has a stem passing through a hole in a second partition, *c′*, of considerable thickness in the interior of the valve-casing, as shown, and this stem is in part hollow, to afford communication between two ports, *h* and *h′*, the former of which at all times opens into the interior of the valve-casing between the partitions *c* and *c′*, while the latter, *h′*, opens into the interior of the valve-casing below the partition *c′* only when the valve *e* is on its seat and is closed by the partition *c′* when the valve *e* is raised from its seat. The upper end of the valve-casing C′ is closed by a screw-plug, *g*, as shown. The lower end, below the partition *c′*, is open, but when the apparatus is set up as a whole communicates, by a relief-pipe, F, with the inlet-pipe to the steam system, as shown. One side of the valve-casing C′ is thicker than the other, and contains a small passage-way, *a*, opening at one end into the interior of the valve-casing above the piston, while its lower end is threaded to receive a relief-pipe, F′, opening into the air or into the heating system. The hollow arm *b′* is cast thick enough at one side to contain a hole in which fits, as shown, a sliding auxiliary valve, *e′*, one end of which is connected by a friction-joint with the rod of the float D, while the other, according to its position as determined by the float, opens or closes the small passage-way *a*. The piston of the differential piston-valve *e* is of larger area than the valve proper or the part closing the port *d*, and yet somewhat loosely fits the interior of the casing. When the float D is down, the passage *a* is closed, and there is no escape for steam passing by the loosely-fitting piston of the valve *e*, and boiler-steam entering through the arm *b* will not raise the valve *e*, but, on the contrary, hold it upon its seat. When, however, the float is up, the passage *a* is open, and, there being no longer an equilibrium of pressure above and below the piston, steam entering through the arm *b* striking the lower surface of the piston, which is of greater area than the portion of the valve *e* resting on the valve-seat, raises the valve *e* from its seat. When the float is up, steam from the boiler passing through pipe E will enter chamber C through port *d*, while the exhaust through port *h′* is cut off, and when the float is down steam from the boiler is cut off and the said exhaust-port opened; but, as elsewhere herein more fully appears, this valve mechanism, although so minutely described, is not in itself of the substance of my present invention, broadly considered, for without departing from my in-

vention so considered any valve mechanism to control the inlet and exhaust ports of chamber C, operated by the amount of water in the said chamber, might be substituted for the valve mechanism described as belonging to said chamber.

H is an inlet-pipe connecting the condensing-surface B with the lower chamber, C. It has a check-valve at *v*.

I is an outlet-pipe to chamber C, and connects lower chamber, C, with upper chamber, J, while I′ is a pipe connecting the upper chamber, J, with the boiler. The pipes I and I′ have respectively check-valves at v' and v^2.

L is a valve-casing containing the valve mechanism of the second or upper chamber, J. It is a casting substantially in the form of a hollow cross, having four arms, *l*, *l′*, l^2, and l^3, opening into each other. The arm *l* communicates by a small pipe, M, with the top of the lower chamber, C. The arm *l′* is connected with the dome of the boiler, as shown, through a pipe, E′, branching from pipe E. Arm l^2 screws into the top of the upper chamber, J, and arm l^3 is provided, as shown, with a relief-pipe, F^2, connecting with the heating-pipes.

L′ is a differential sliding valve working longitudinally in arms *l* and *l′*. Its smaller end is exposed to boiler steam through pipe E and branch pipe E′, while its larger end is exposed to boiler-steam passing through pipe E, lower chamber, C, and pipe M, when the port *d* is open and exhaust *h′* is closed.

The shape or construction of valve L′ in connection with its casing L is such that when boiler-steam acts upon smaller end in arm *l′* alone there is a steam-passage from the arm *l′* to the arm l^2, and consequently from the boiler to the top of the chamber J, and there is no steam-passage from l^2 to l^3, or, in other words, the exhaust from chamber J through pipe F^2 is cut off; but, when boiler-pressure is admitted to the larger end of valve L′ in arm *l*, the valve L′ shifts to close communication through pipes E and E′ from the boiler to the chamber J and to open a relief to chamber J through pipe F^2. Now, to follow the working of the apparatus as a whole, it will readily be seen that when steam is admitted to chamber C by the rising of the float in that chamber, steam-pressure is immediately exerted through pipe M upon the larger end of valve L′, to shift that valve and open the exhaust to chamber J. The check-valve at v^2 in pipe I′ closes, and there is little or no steam-pressure in pipe I, and the steam-pressure in chamber C above the water now forces that water up into the chamber J. Then, the float falling, the boiler-pressure is cut off from chamber C, and consequently from the large end of differential valve L′, which valve accordingly shifts, thereby admitting steam to chamber J, above the surface of the water just forced into it, equalizing the steam-pressure through pipe I′ and allowing the water in chamber J to fall by gravity into the boiler. It is hardly necessary to point out that the operation of the differential valve L′ does not differ from that of differential valve *e*, except that one opens when the other closes, and they always occupy positions the reverse of each other as affecting the conditions of their respective chambers. Both of them are under the instantaneous control of the small auxiliary valve *e′*, which in turn is under the easy control of the single float.

It is evident that wide departures from the construction of the apparatus just described may be made without departing from the feature of my invention, that requires that the two valve systems shall be under the control of one float. For instance, it is not essential that the valve mechanism controlling the ingress and egress of steam to the chamber shall be in the immediate vicinity of their respective chambers.

At Fig. 5 I show a modification of construction by which the valve-casing L, with the valve therein, connects directly with the top of the chamber C, instead of by means of the long pipe M. The pipe E′ connects with pipe E, as in the construction first shown, while pipe F^2 may be connected with the steam system, and a pipe, M′, may be made to connect with the top of the chamber J. So, also, it is obvious that for the valve system shown, with either or both chambers, there might be substituted a two-way valve worked, in one case by the float of the first chamber, and in the other by the float of the first chamber and a weight. Such a modification is shown at Fig. 6. In this case the float of chamber C is shown with a projecting arm, *t*, working through packing in the shell of the chamber, which arm is connected by a connecting-rod, *t′*, with a lever, t^2, operating the two-way valve V, belonging to said chamber C, while a chain working in connection with suitable pulleys and a weight, W, controls the two-way valve V′ of the second chamber, as shown.

At Fig. 7 is shown a modification of the valve mechanism of the lower chamber. The hollow arm *b* communicates with the interior of the casing below the partition *c*, and the passage *a* leads from the interior of the casing below the partition *c* to the interior above the piston of the piston-valve *e*. The valve *e′* works across the passage *a* as before, but the float is so pivoted thereto as to open the passage in falling and to close it in rising. A pin-hole passage, *g′*, is made through the shell of the casing above the piston of the piston-valve. The port *h* in the valve-stem is above partition *c*.

I am aware that boiler-feeds have been employed heretofore which in construction have consisted of two chambers—one above the boiler and the other below the source of supply and steam-connections—whereby steam could be introduced into the lower chamber to force water therein into the upper chamber, and in which thereafter steam could be introduced into the upper chamber to equalize the steam-pressure above and below the water, to allow the latter to fall by gravity

into the boiler; but such apparatus has not been provided with an automatic valve-shifting apparatus controlled by the amount of water in the lower chamber, and I make no claim thereto. Nor do I claim herein a trap provided with the valve-shifting mechanism of the lower chamber, the same being claimed in my application No. 202,029, filed herewith.

I claim—

1. The combination, with a boiler and a source of water-supply and pipe-connections, of a trap consisting, essentially, of two connecting chambers, one of which is below the water-level of the boiler as well as below the source of water-supply, while the other is above the water-level of the boiler, each chamber being provided with a valve system of its own to control the ingress and egress of steam, and a single valve-shifting mechanism for both valves, adapted to be automatically controlled by the amount of water in the lower chamber, substantially as described, for the purpose specified.

2. The combination, with a boiler and a source of water-supply and pipe-connections, of a trap consisting, essentially, of two connecting chambers, one of which is provided with a float and is below the water-level of the boiler as well as below the source of water-supply, while the other is above the water-level of the boiler, each chamber being provided with a valve system of its own to control the ingress and egress of steam, but both valve systems being under the control of the said float, substantially as described, for the purpose specified.

3. The combination, with boiler A and condensing-surface or water-supply B, of chambers C and J, the former provided with float D, pipes H, I, and I′, E, E′, and M, valve-casing L, having a passage opening into said chamber J, and provided with differential valve L′, controlling said passage, and a valve mechanism for said chamber C, controlled by said float D, substantially as described, for the purpose specified.

4. The combination, with chamber C, provided with float D, and a valve mechanism controlled by said float, of the valve-casing L, communicating with said chamber and with the boiler, and provided with differential valve L′, arranged to be operated in one direction by steam from said chamber and in the other by steam directly from the boiler, substantially as described.

NELSON CURTIS.

Witnesses:
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W. W. SWAN.