E. D. SHEPARDSON.

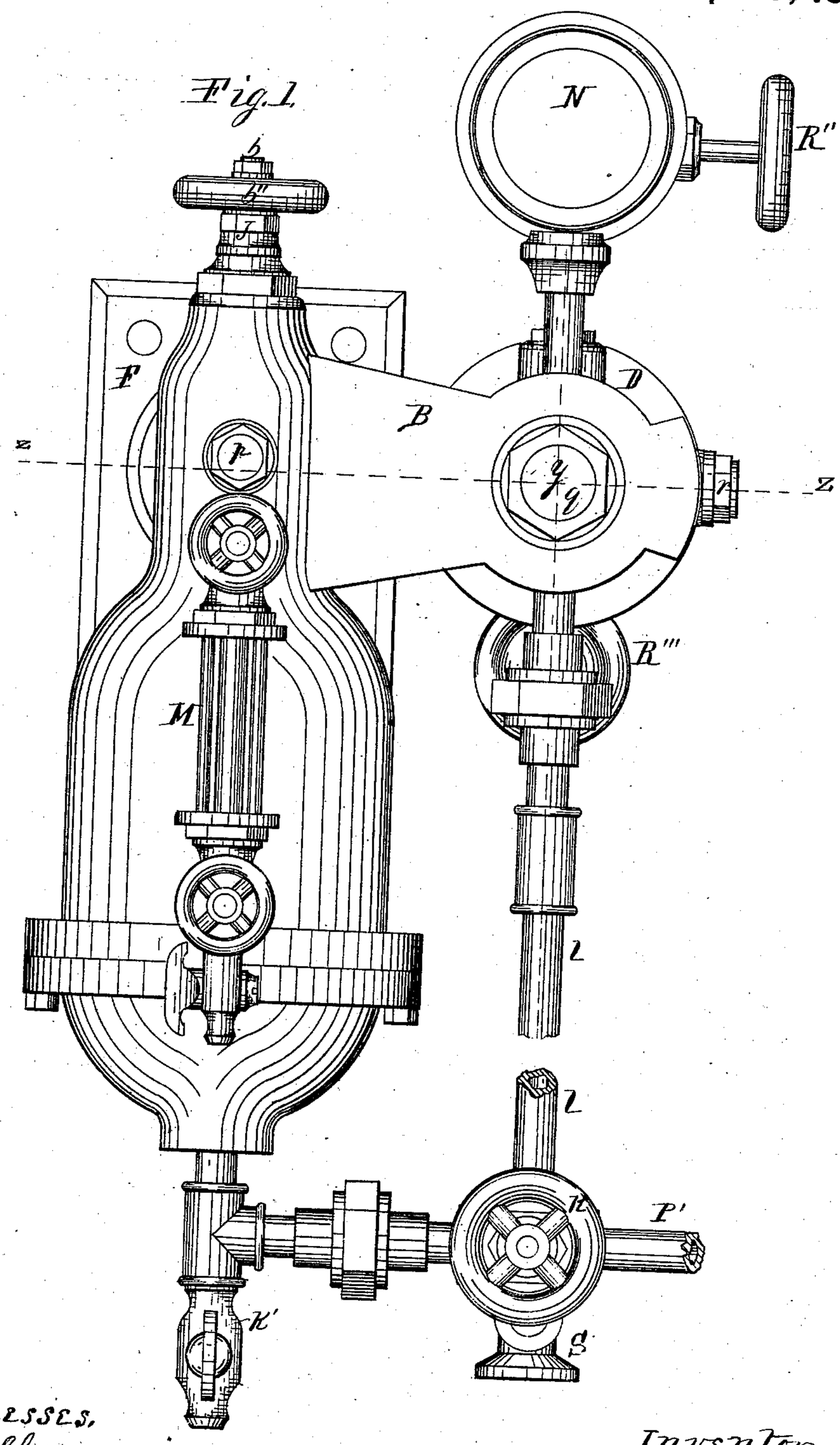
6 Sheets—Sheet 1.

Feed Water Regulator.

No. 231,938.

Patented Sept. 7, 1880.

Fig. 1.



Witnesses,
H. H. Shores
W. F. Lemmister

Inventor
Edward D. Shepardson,
Per Jacob Behel
Atty.

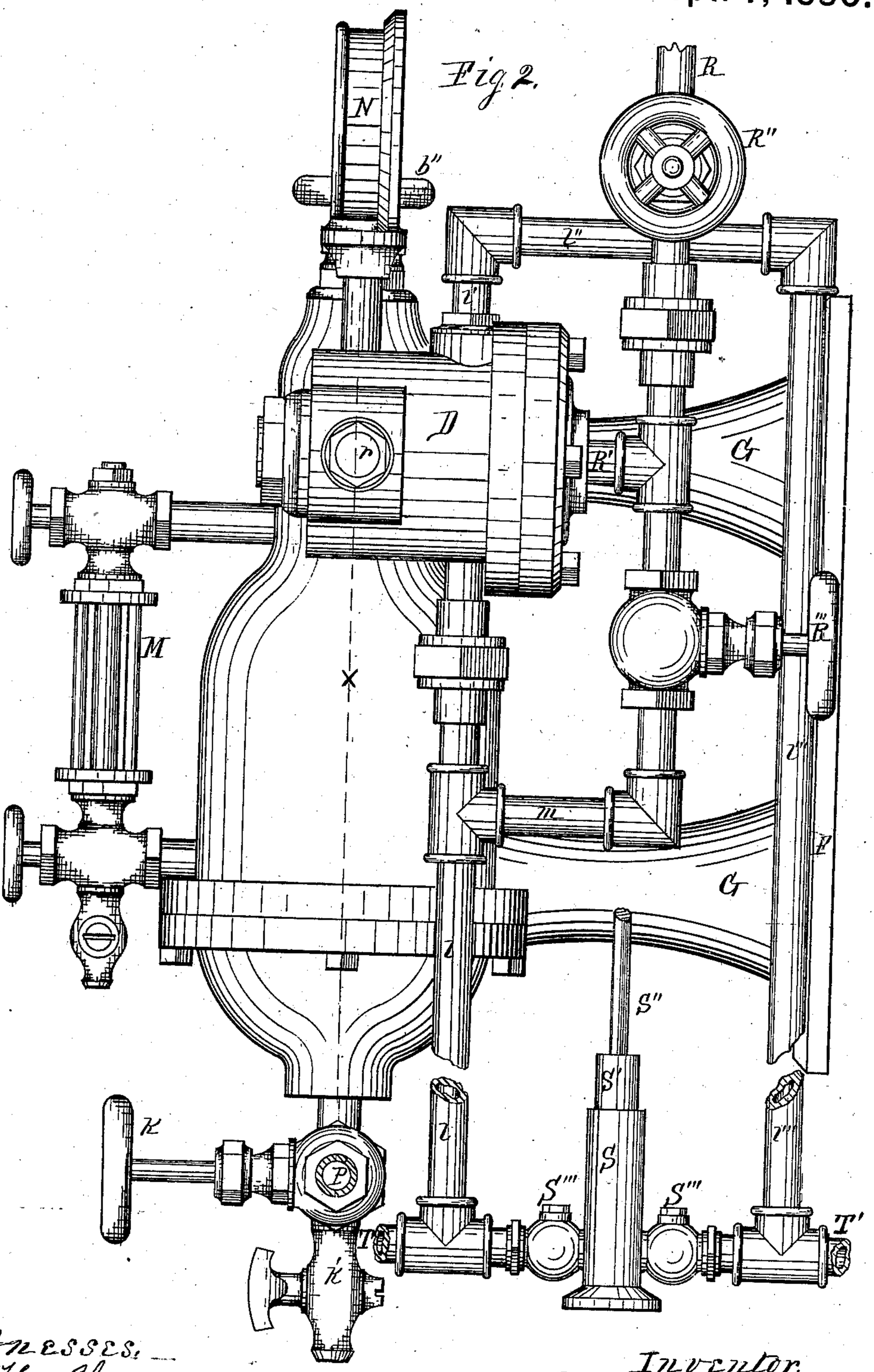
E. D. SHEPARDSON.
Feed Water Regulator.

6 Sheets—Sheet 2.

No. 231,938.

Patented Sept. 7, 1880.

Fig 2.



Witnesses,
H. H. Shores
W. F. Hemmiker

Inventor.
Edward D. Shepardson
Per Jacob Behel,
Atty.

E. D. SHEPARDSON.

6 Sheets—Sheet 3.

Feed Water Regulator.

No. 231,938.

Patented Sept. 7, 1880.

Fig. 5.

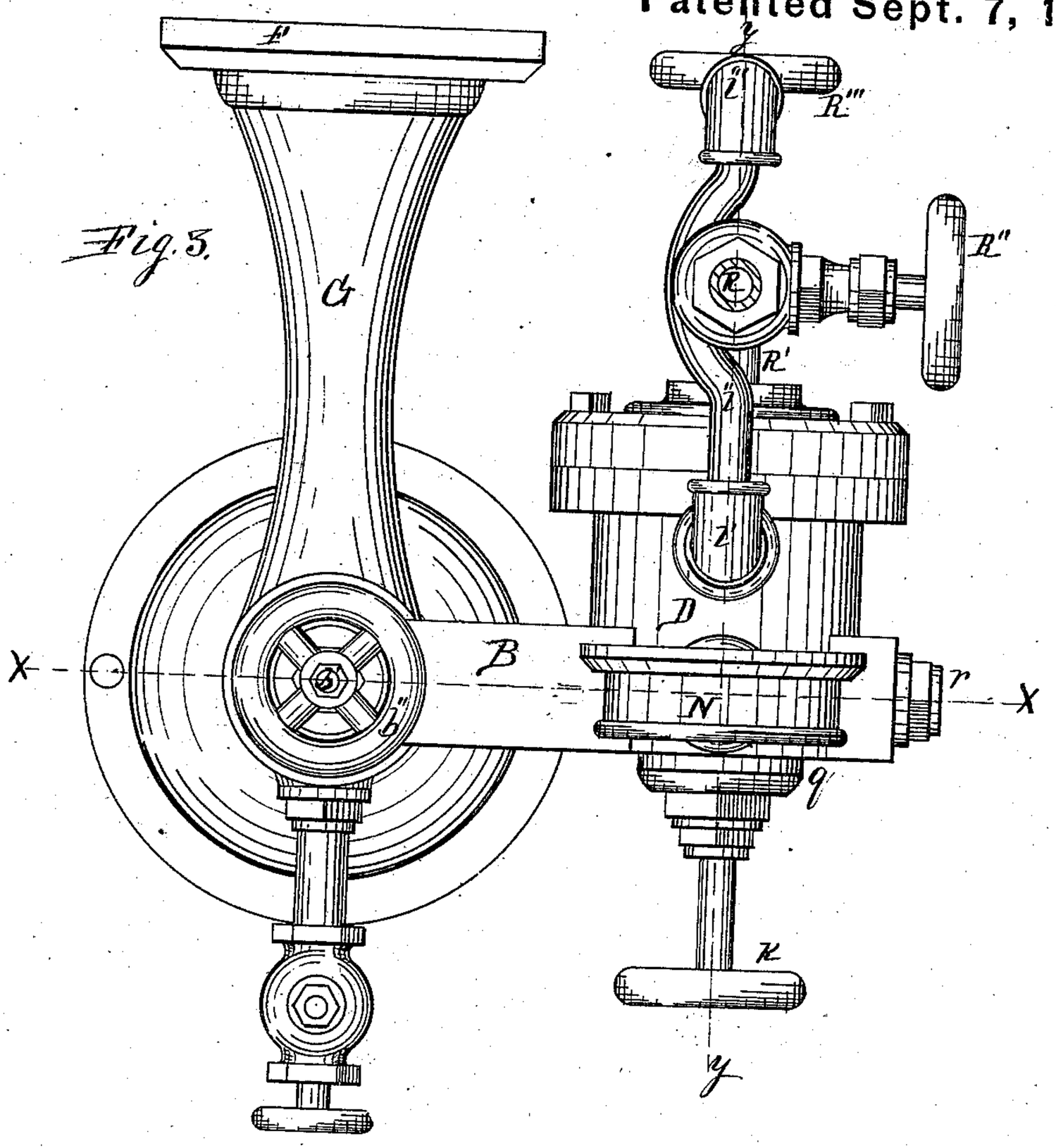
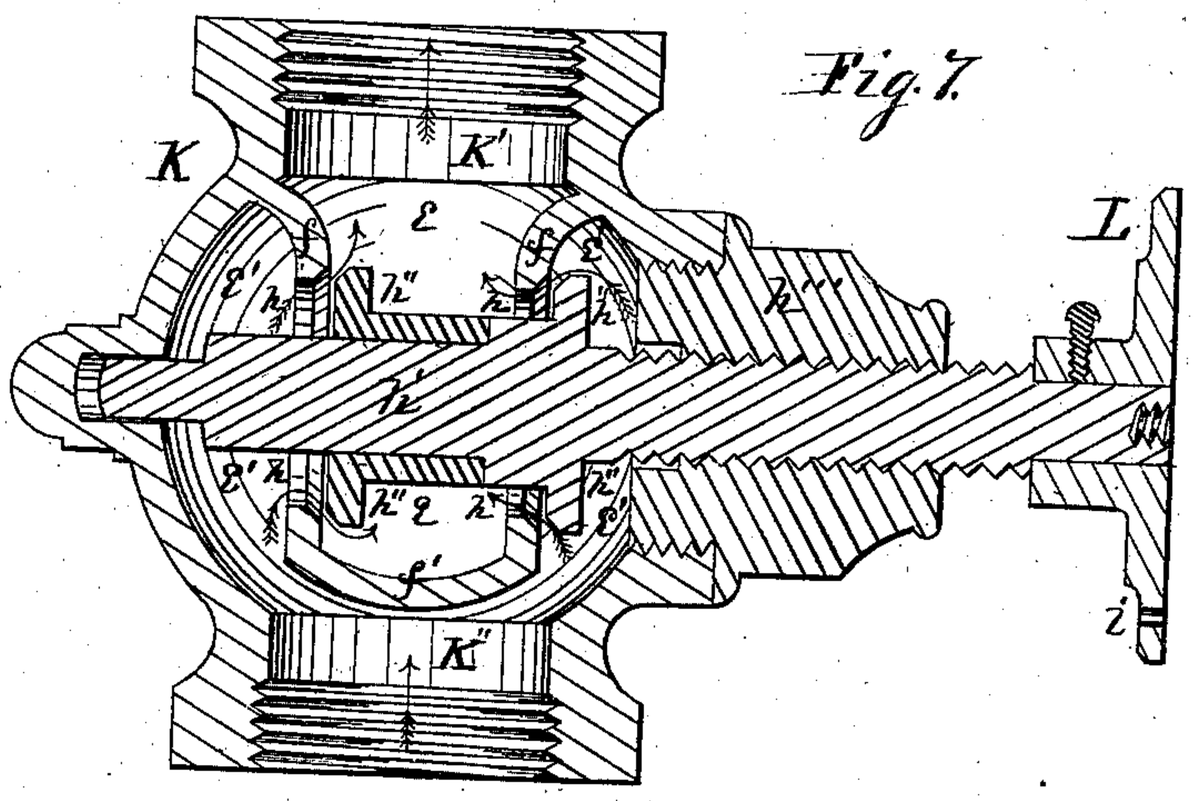


Fig. 7.



Witnesses.
H. H. Shores.
W. F. Lemmiken

Inventor.
Edward D. Shepardson.
Per. Jacob Behel.
Atty.

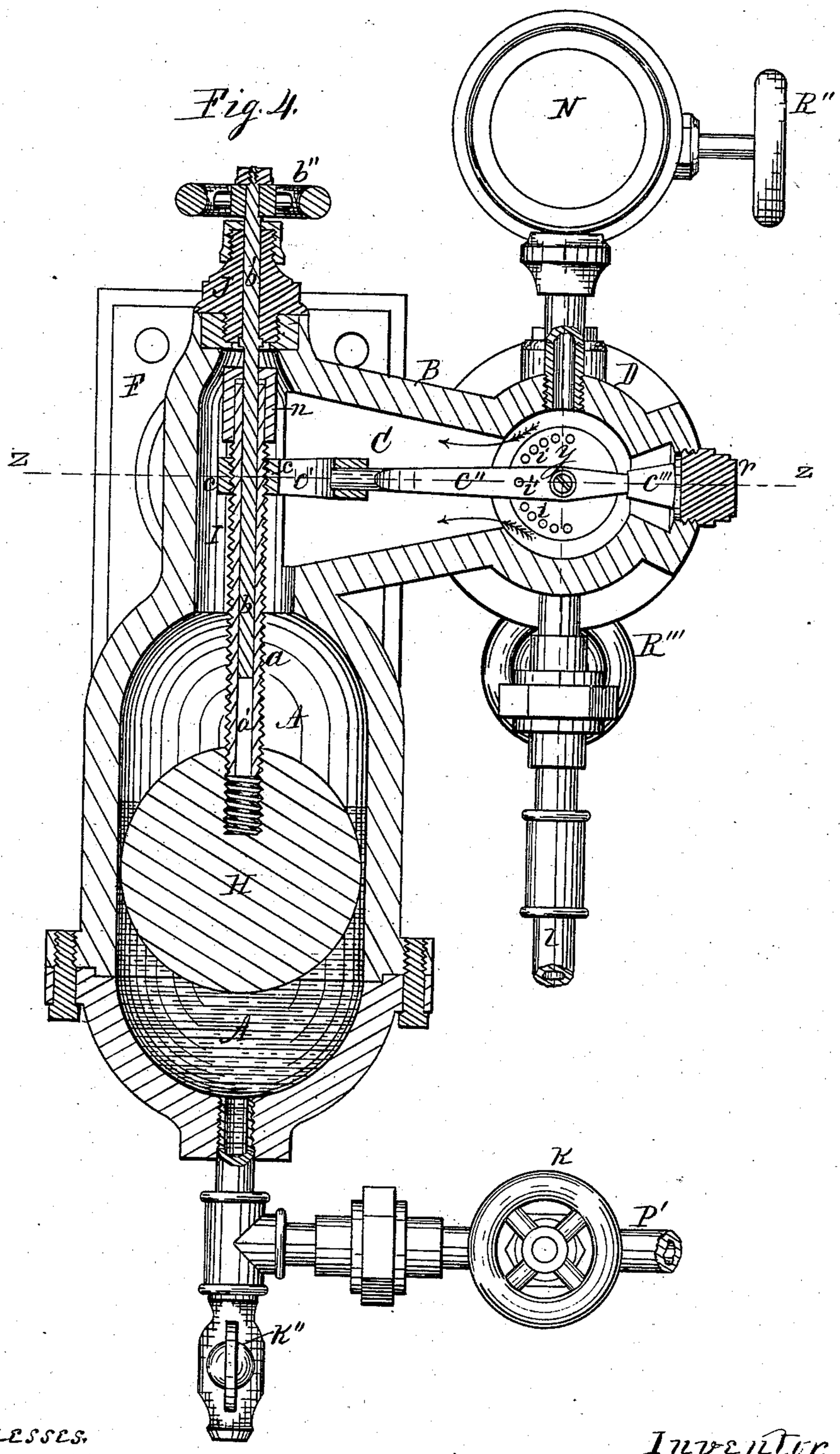
6 Sheets—Sheet 4.

E. D. SHEPARDSON.

Feed Water Regulator.

No. 231,938. **Patented Sept. 7, 1880.**

Fig. 4.



Witnesses.
H. H. Shores
W. F. Lemmerken

Inventor.
Edward D. Shepardson.
Per Jacob Behel.
Atty.

E. D. SHEPARDSON.

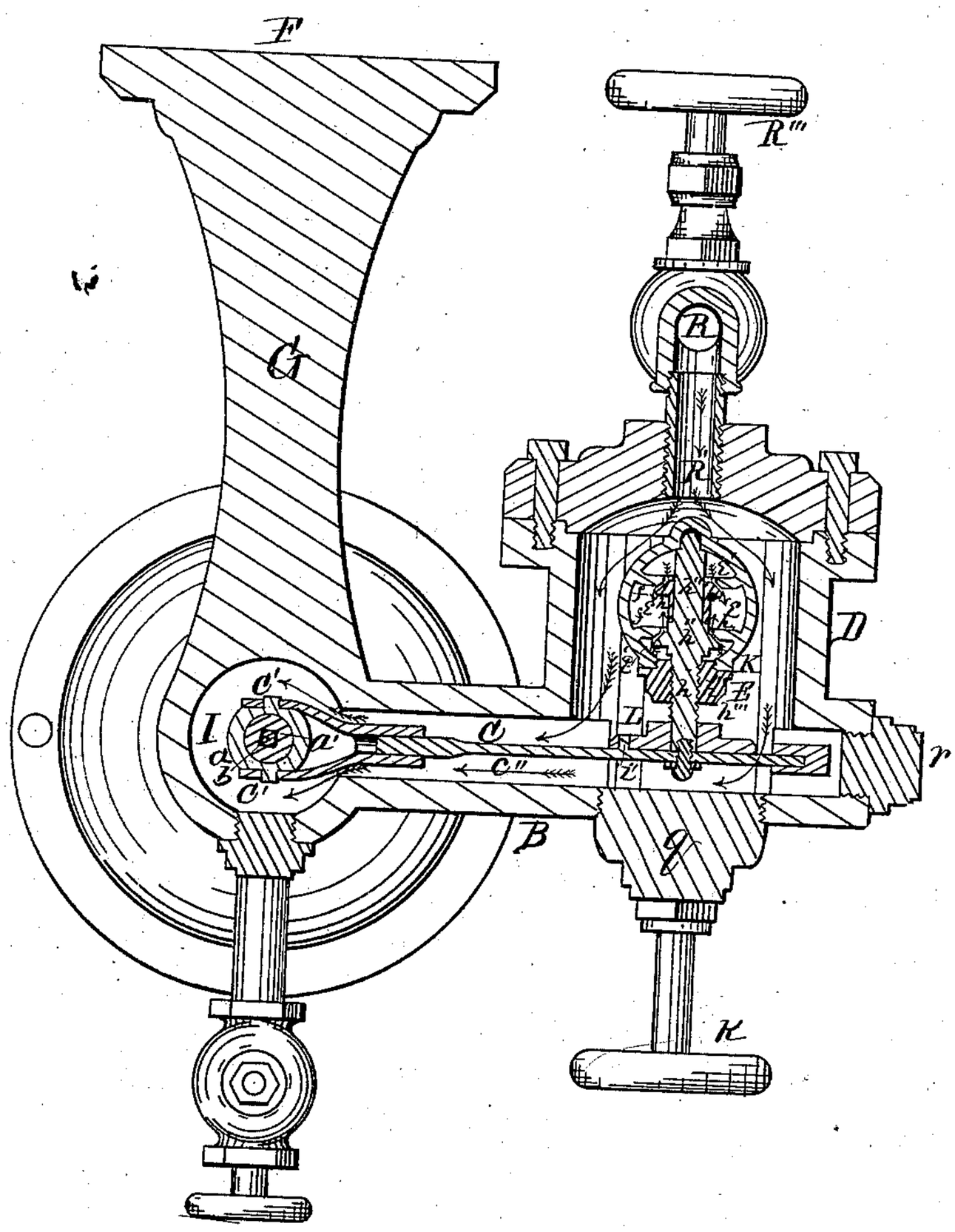
6 Sheets—Sheet 5.

Feed Water Regulator.

No. 231,938.

Patented Sept. 7, 1880.

Fig. 6.



Witnesses.
H. H. Shores
T. M. Flannikan

Inventor.
Edward D. Shepardson.
Per. Jacob Behel.
Atty.

E. D. SHEPARDSON.

6 Sheets—Sheet 6.

Feed Water Regulator.

No. 231,938.

Patented Sept. 7, 1880.

Fig. 5.

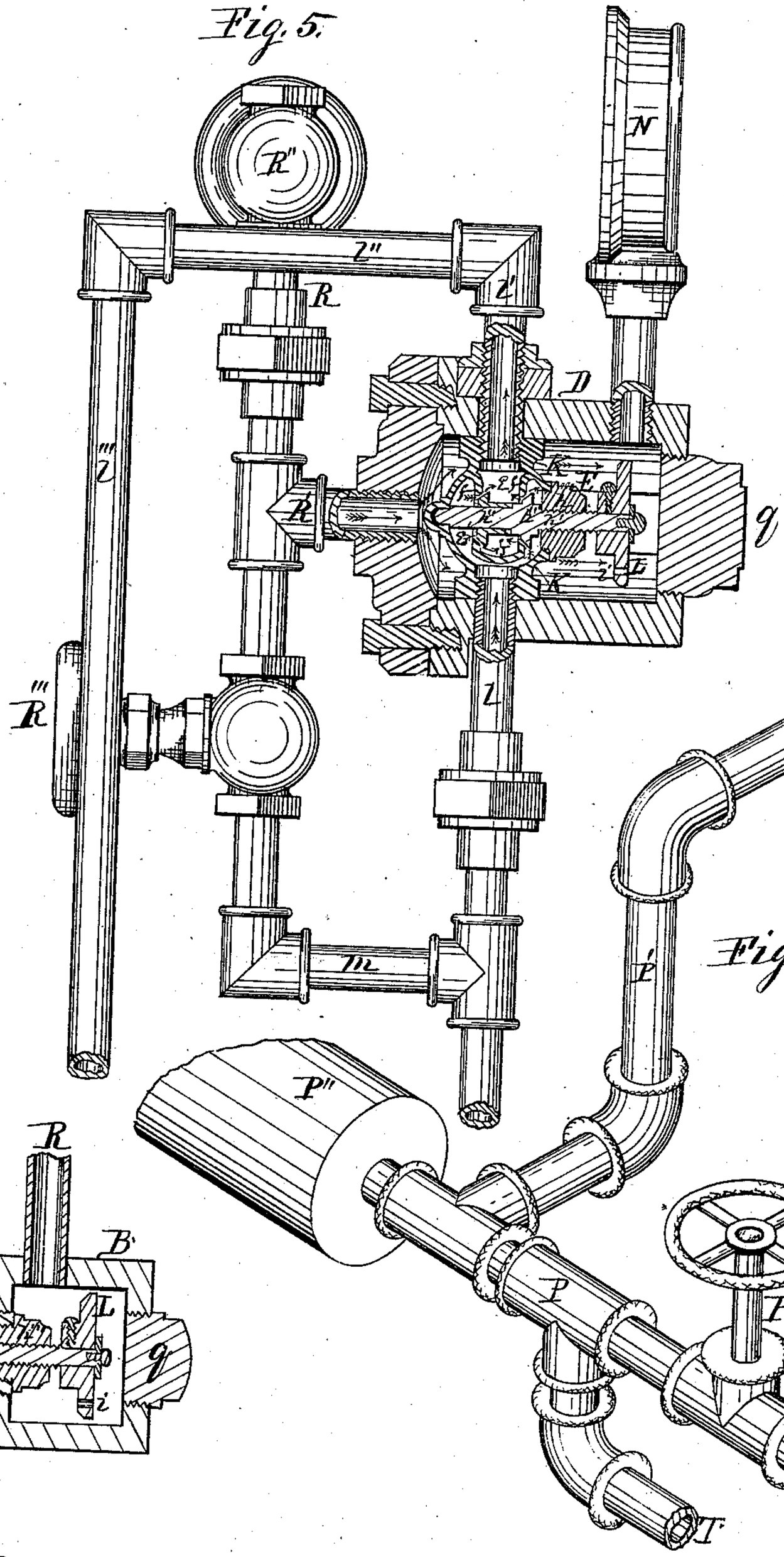


Fig. 8.

Fig. 9.

Witnesses.
H. H. Shores
W. F. Lemmon

Inventor.
Edward D. Shepardson.
Per. Jacob Behel.
Atty.

UNITED STATES PATENT OFFICE.

EDWARD D. SHEPARDSON, OF PITTSFIELD, ILLINOIS.

FEED-WATER REGULATOR.

SPECIFICATION forming part of Letters Patent No. 231,938, dated September 7, 1880.

Application filed February 13, 1880.

To all whom it may concern:

Be it known that I, EDWARD D. SHEPARDSON, of Pittsfield, in the county of Pike and State of Illinois, have invented a new and useful Feed-Water Regulator for Steam-Boilers, of which the following is a specification.

My invention relates to feed-water regulators in which the flow of the water is regulated by the rising and falling of the water in the boiler, and is capable of use in connection with plunger or steam pumps employed to supply the water to the boiler; and it consists, mainly, in suitable balance-valves connected by suitable mechanism with the water of the boiler, the rise and fall of which controls the effective operation of the pump or the flow of water therefrom to the boiler. These and other improvements, to be hereinafter described, constitute the subject-matter of this specification.

In the accompanying drawings, illustrating my improvements, Figure 1 is a front elevation of an apparatus embodying my invention, of suitable construction, to be mounted in any suitable position, as on the room-walls of the boiler, engine, office, or in other convenient place. Fig. 2 is a side elevation of the same apparatus, and Fig. 3 a plan view. Fig. 4 is a view from the front, mainly in section, on dotted lines *x;* Fig. 5, a view from the left side, partly in section, on dotted lines *y;* Fig. 6, a horizontal or transverse section on dotted lines *z;* Fig. 7, a vertical central section of globe-valve enlarged; Fig. 8, an isometrical representation, showing the connection of the regulator and mud-drum; Fig. 9, a view showing the valve-connection without the use of the valve-chamber.

In my improved regulator, in this instance, the float-cylinder is made in convenient parts suitably connected to produce a cylinder of a form convenient to receive the working parts of the regulator and the necessary pipe-connections to connect it with the boiler, pump, and tank. This cylinder is formed with a float-chamber, A, to receive a suitable float. It is also provided with a hollow arm, B, projecting laterally from its upper neck portion, the chamber C of which connects with the chamber of the float-cylinder, and is designed to receive a suitable lever to connect the float with the valve.

D is a valve-chamber which projects rearward from the rear side and outer end of the hollow arm B, and is provided with a chamber, E, to receive a suitable valve to control the flow of the water to the boiler. These parts constitute the casing of my improved regulator, and it is provided with a bed-plate, F, connected by standards G, employed to fix it in position.

H represents a float suitably formed and of a size adapted to rise and fall freely within the chamber with the rise and fall of the water within it. To this float is fixed a vertical shaft, *a*, which rises in the neck portion I of the cylinder-chamber, and is hollow, having an axial opening, *a'*, of square form in section, adapted to receive the square shaft *b* to slide thereon freely. The upper portion, *b'*, of the square shaft is cylindrical in form, and is fitted to pass upward through the stuffing-box J, fixed in place on the upper end of the float-cylinder, in which it may be turned in either direction by means of a hand-wheel, *b''*, mounted on its upper end for the purpose, and will cause the float-shaft to revolve with it by means of its square shaft-connection, and still permit the float to rise and fall within its chamber freely.

The float-shaft *a* is screw-threaded, and is fitted with a thimble screw-nut, *c*, having trunnions projecting radially from its opposite sides, on which are pivoted the arms of a yoke, *c'*, having its free end fitted to receive the free end of the lever *c''*, forming a free joint-connection therewith to permit the float to rise and fall without cramping.

K represents a globe-valve in which the globe is divided into two chambers, *e* and *e'*, by parallel transverse walls *f*, which are connected by a cap, *f'*, all of which join with the outer walls of the globe in such a manner that the chamber *e* communicates with the opening K', and the chamber *e'* communicates with the opening K''. The transverse walls *f* are each fitted with a valve-seat, *h*, on the axial center of the screw-threaded valve-shaft *h'*, on which are mounted valves *h''*, adapted to enter and close the valve-seats in the transverse walls. The free end of the valve-shaft *h'* is supported in a suitable bearing in the wall of the globe, and its screw-threaded portion is supported in

a screw-threaded bearing in the plug *h'''*, which is removably supported in the globe-wall by screw-thread connection. The valve-shaft thus supported in its bearings is free to oscillate, which movement will cause it to move endwise, to open or close the valves toward or from their seats, by means of its screw-threaded bearing, as the shaft is made to oscillate in one or the other direction.

From the foregoing it will be seen that in use the force exerted by steam, water, or other fluids or gases from either the center or outer chamber will be equal on the opposite sides of the valves, and cannot operate to destroy or disturb their balance; neither will any unequal pressure from one or the other chamber operate to change their equilibrium. I thus produce a globe-valve balanced under any pressure, equal or unequal, from one or both chambers. This globe-valve is placed within the valve-cylinder in such a manner that the openings K′ and K″ will receive suitable pipes passing through the outer walls of the valve-cylinder, to produce a circuit through the plunger-pump, with which it is connected, hereinafter to be described.

On the outer end portion of the valve-shaft is fixed a disk, L, fitted with a series of holes, *i*, near its periphery, on a concentric line parallel thereto. The valve-lever *c″* is fixed to the outer end center of the valve-shaft, and extends through the chamber C of the hollow arm B, having its inner end to enter the opening in the free end of the yoke on the float-shaft, forming a free joint-connection therewith, as hereinbefore described. This lever is fitted with a stud, *i′*, to enter the holes *i* in the disk L, to so connect it with the disk as to cause the shaft and the valves mounted thereon to oscillate with the vibratory movements of the lever caused by the up and down movements of the float, and the series of holes *i*, in connection with the stud-pin *i′*, furnish the means whereby the valves may be adjusted relatively with their seats to require a greater or less movement of the float to close the valves to their seats.

The outer end of the lever *c″* is fitted with a weight, *c‴*, to counterbalance the longer arm of the lever, and, if desired, the yoke-connection therewith; but this same result may be accomplished by a slight increase of the buoyancy of the float, and thus dispense with the counter-weight.

At M is represented a glass water-gage of the usual form, fitted with the usual appliances, and connected to the float-cylinder in such position as to show the height of the water therein.

At N is represented a steam-gage of the usual construction, and in this instance is mounted on the lever-chamber, its stem connecting therewith, and is employed to indicate the pressure of the steam.

At F is represented the bed-plate, connected to the float-cylinder by means of standards G. The bed-plate is employed to fix the regulator in an upright position in any convenient place and at such a relative height with the boiler that the water-line of the regulator shall be in the same horizontal plane with the water-line of the boiler; and when in such position, suitably mounted, it is connected with the boiler below the water-line (preferably with the blow-off pipe P) by means of a suitable pipe, P′, through which the water-connection between the boiler and the regulator is formed. This connection will always insure pure water in the regulator, to prevent clogging the parts and staining the glass gage, and being located some distance from the water-surface in the boiler, will not be disturbed by foaming; and its connection with the blow-off pipe P, between the mud-drum P″, the water-induction pipe T, and the blow-off valve P‴, by which the feed-water and blow-off will pass the connection of the regulator supply-pipe, will prevent its clogging. The regulator supply-pipe is provided with a valve, *k*, by which to shut off the water-supply to the regulator when required for the examination or repairs of the regulator. The regulator is also provided with a blow-off valve, *k′*, employed to empty the float-chamber.

At R is represented the steam-induction pipe, the continuation of which is designed to connect with the boiler at any convenient point sufficiently above the water-line therein to prevent the water from the boiler being carried over through it. This pipe connects with the valve-cylinder by means of a branch pipe, R′, through which the steam from the boiler is admitted to the float-chamber, through the chamber E of the valve-cylinder D and through the chamber C of the hollow arm B, as indicated by the arrows in these parts in Figs. 4, 5, and 6. The induction-pipe R is fitted with a valve, R″, by means of which the flow of steam to the regulator may be shut off when desired, for the examination or repairs of the regulator or any other purpose requiring its use.

The induction-pipe R is continued below the branch pipe R′, and is provided with a valve, R‴, by which it may be closed or opened to prevent or permit the passage of the steam through the pipe. The further extension of this pipe and its purpose will be hereinafter described.

I have represented my improved regulator in connection with a plunger-pump of ordinary construction, in which S represents the pump proper, with plunger S′, plunger-rod S″, and valves S‴. The continuations of the broken pipes T, Figs. 2 and 8, are designed to connect, forming a water-induction pipe-connection of the pump with the blow-off pipe near the mud-drum, through which to supply water to the boiler. The continuation of the broken pipe T′ is designed to connect with the water-supply tank. At *l* is represented a portion of a circuit-pipe, one end of which is connected with the side chambers of the globe-valve in the valve-cylinder, and its other end is con-

nected with the water-induction pipe T, between the pump and its connection with the boiler. At l' is represented a pipe which connects with the center chamber of the globe-valve in the valve-cylinder, and is connected with the horizontal portion l'', which is connected with the portion l''', that connects with the water-supply pipe T′, between the pump and the water-supply, in such a manner as to produce a complete circuit with the water-supply pipe through the pump and through the globe-valve.

From the foregoing it will be seen that with my improved regulator, constructed and applied substantially as described and shown, the water-line will be maintained on the same horizontal plane in the boiler and regulator by means of the water-connection hereinbefore described, and that the water-supply will be furnished to the boiler by a pump connected therewith, substantially as shown and described, put in connection with suitable machinery operated by the steam generated in the boiler or otherwise, and the steam-pressure will be the same in the boiler and regulator, by means of their steam-connection, as herein described.

It will be readily seen that under these circumstances the float in the regulator will rise and fall with the rise and fall of the water in the boiler; and as it falls it will carry with it the lever connected with the screw-shaft of the valve, which movement will operate, through the left-hand screw-thread bearing thereof, to move the shaft endwise and close the valve, and compel the water thrown by the pump to pass into the boiler direct. This action, if continued, will soon cause the water to rise in the boiler and in the regulator, which will cause the float to rise and reverse the movement of the valve-shaft through its connection with the rising float, and cause the valves to open to permit the water thrown by the pump, or a portion thereof, to flow through the pipe connected with the induction-pipe between the pump and boiler, and through the valve and the pipes which connect with the supply-pipe between the pump and the tank or water-supply, to be again passed through the pump, to continue its circuit of least resistance when the valves are open.

From the above it will be seen that my invention, constructed and arranged as herein described, contains the elements, in suitable combinations, by which I produce a complete automatic water-feed capable of regulating the water to the water-line in the boiler within very narrow limits.

The water-line in the boiler may be varied within the limits of the regulator without changing its relative position therewith. This is readily accomplished by turning the hand-wheel b'' to the right, which will cause the float to rise relatively with the valve-operating lever by means of its screw-threaded shaft-connection therewith, and the water-line will rise in the boiler with the rise of the float relatively with the valve-lever, and the reverse movement of the hand-wheel will reverse all the actions and lower the water-line in the boiler with the lowering of the float relatively with the valve-lever.

In the foregoing I have described my improved regulator in connection with a plunger-pump; but it is also capable of use in connection with a steam-pump, in which connection it is found to be a very perfect regulator. In its application to a steam-pump the steam-induction pipe R is continued below the branch pipe R′, and connects with the pipe l below the valve-cylinder by means of the pipe m, and the portion of pipe l below the connection of the pipe m is removed, and the end thereof below m, and its connection with the water-induction pipe, is suitably closed with screw-plugs or otherwise. The pipe l''' is disconnected from the supply-pipe T′ and connected to the steam-pump, which may occupy substantially the same position of the plunger-pump above described, suitably connected with the water-induction pipe and the water-supply pipe. In this application with the steam-pump it will require a right-hand screw-thread on the valve-shaft, instead of the left-hand screw-thread above described, to reverse the movement of the valves to cause them to open with the downward movement of the float and the valve-lever thereto attached, caused by the lowering of the water in the boiler. This action, thus opening the valves with the descent of the float, will permit steam to flow from the boiler through the valves in the direction indicated by the arrows to the pump, through the circuit formed by the steam-induction pipe R and the continuation m and l, connecting it with the outside chambers of the valve, thence through the valves and through the pipes l', l'', and l''', which connect with the pump, to set it in operation to force water into the boiler through the pipe T. This action will cause the water in the boiler, and consequently in the regulator, to rise, which will cause the float to rise with it, and when it has reached the water-line, or very soon thereafter, will close the valves and shut off the flow of steam to the pump, which will stop its action and the flow of water to the boiler.

When in use this action will be so balanced that a very slight movement of the valves will suffice to hold the water in the boiler practically on the water-line.

In the foregoing I have represented my improved balanced valve incased in a cylinder projecting from the rear side of the hollow arm; but this cylinder may be readily dispensed with, and the globe-valve itself may be fitted directly into the hollow arm by screw-joint connection, as clearly represented in Fig. 9, or it may be connected therewith in any other suitable manner. In this application of the valve the steam-induction pipe R may be connected with any convenient portion of the

regulator above the water-line. In this instance I have represented it connected with the upper surface of the hollow arm. The like parts in this figure are designated by like letters of reference employed in the description of the other figures.

Instead of the vertical shaft of the float being provided with square axial opening, as hereinbefore described, it may be cylindrical in form, provided with a cap portion, as at *n*, fitted with a square opening to receive the square shaft *b*, which will cause the float-shaft to revolve with the movement of the square shaft.

To render my regulator easy of access for the purpose of repairs and for adjustment, I have provided it with removable screw-plugs *p*, *q*, and *r*, by means of which the several parts can be readily adjusted, removed, or replaced, as may be required.

I am aware that prior to my invention feed-water regulators have been made in which floats operated by the rise and fall of the water in the boiler were employed to regulate the flow of the feed-water. I therefore do not claim the use of the float in this connection, broadly; but

I claim as my invention—

1. The combination, with a float-cylinder and a float having a shaft secured thereto, said shaft provided with an axial opening of square or angular shape in cross-section, of a guide-shaft located in the opening in the shaft connected with the float, and of corresponding angular form in cross-section to the opening in said shaft, substantially as set forth.

2. The combination, with a float-shaft provided with an axial opening in square or angular form in cross-section, of a shaft fitted to enter said axial opening and having its upper portion fitted to revolve in a suitable bearing on the float-cylinder, and fitted with suitable appliances by which the shaft may be turned in its bearing to the right or left to cause the float-shaft to revolve therewith, substantially as and for the purpose hereinbefore set forth.

3. The combination, with the screw-threaded float-shaft, of a screw-threaded thimble-nut suitably connected with the valve-lever to vary the position of the thimble-nut on the float-shaft by means of its connection with the hand-wheel mounted on the square shaft, substantially as and for the purpose hereinbefore set forth.

4. The combination, with a screw-threaded thimble-nut mounted on the float-shaft, of a lever suitably connected with the valve and having a free joint-connection with the thimble-nut, substantially as and for the purpose hereinbefore set forth.

5. The combination, with the float-lever, of a balanced valve provided with a screw-threaded stem at one end and supported in the valve-casing at its opposite end, said valve-casing being divided into two chambers, each furnished with an independent connection for an induction and exhaust pipe, and valves seating upon valve-seats formed in the walls forming said chambers, substantially as set forth.

6. The herein-described valve, in combination with the float-cylinder, as and for the purpose hereinbefore set forth.

7. The combination, with the screw-threaded valve-shaft, of a disk mounted thereon and a lever adjustably fixed thereto, the disk and lever provided with means for the relative radial adjustment of the lever and disk, as and for the purpose hereinbefore set forth.

8. The combination, with the float and float-lever, of the balanced valve having a screw-threaded stem and devices, substantially as hereinbefore set forth, for automatically regulating the flow of feed-water to the boiler, substantially as set forth.

9. The combination, with a feed-water regulator, substantially as herein described, of a water-supply pipe communicating with the boiler-supply pipe at a point between the mud-drum and blow-off pipe, substantially as set forth.

10. The combination, with the valve-chamber connecting with the float-lever chamber of the regulator, of the steam-pipe forming a steam-conduit from the steam-boiler around said valve-chamber through the float-lever chamber to the float-chamber, substantially as set forth.

11. The combination, with the feed-water float-chamber, and mechanism, substantially as hereinbefore described, of the valves and circulating-pipes, substantially as described, whereby the water is automatically forced directly into the boiler or through the circuit-pipes, substantially as set forth.

EDWARD D. SHEPARDSON.

Witnesses:

J. L. DOBBIN,

GEORGE SANDERSON.