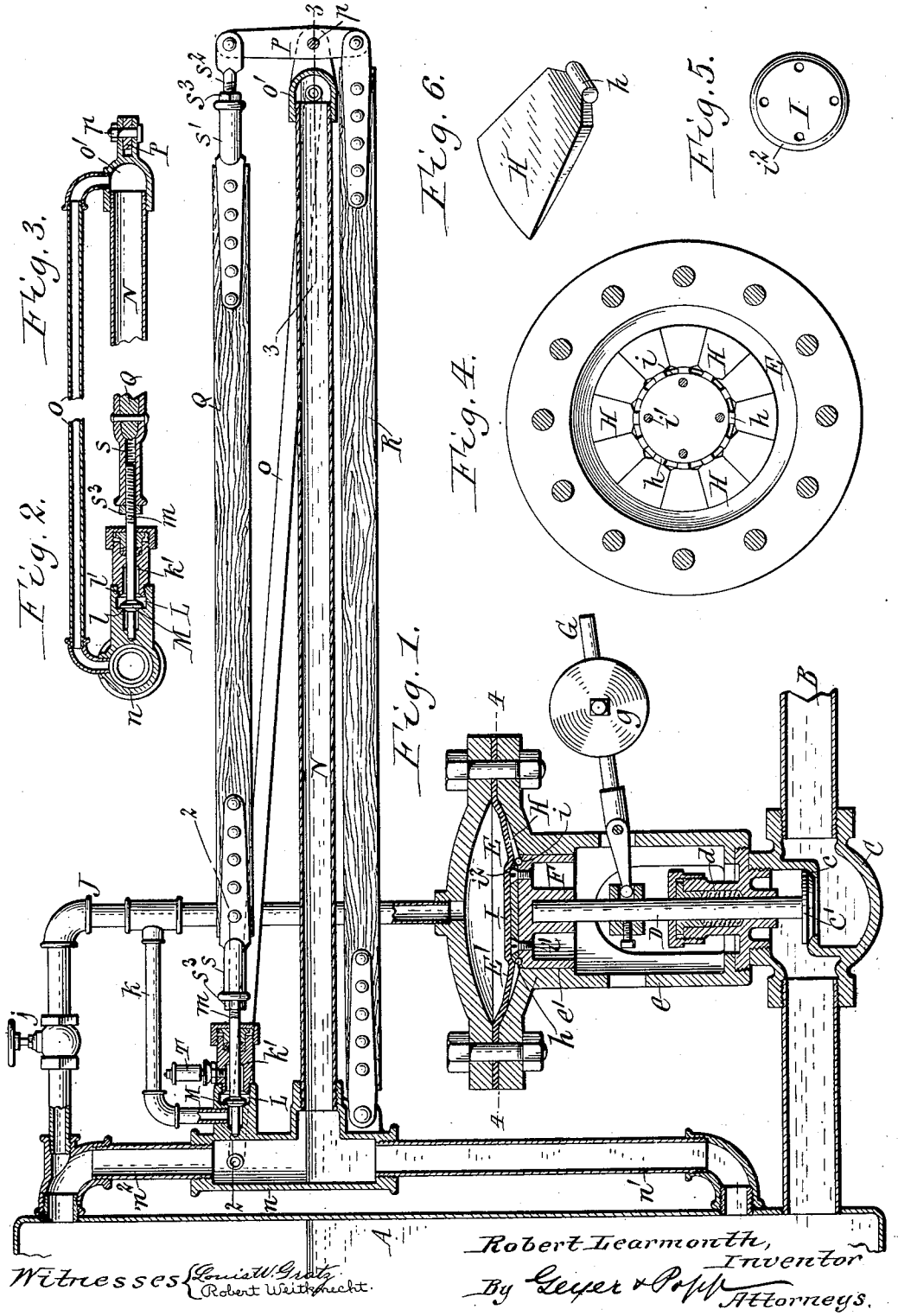
No. 731,191. PATENTED JUNE 16, 1903.

R. LEARMONTH.

FEED WATER REGULATOR.

APPLICATION FILED MAR. 5, 1903.

NO MODEL. 2 SHEETS—SHEET 1.



Witnesses { Louis W. Gratz, Robert Weitknecht.

Robert Learmonth, Inventor

By Geyer & Popp Attorneys.

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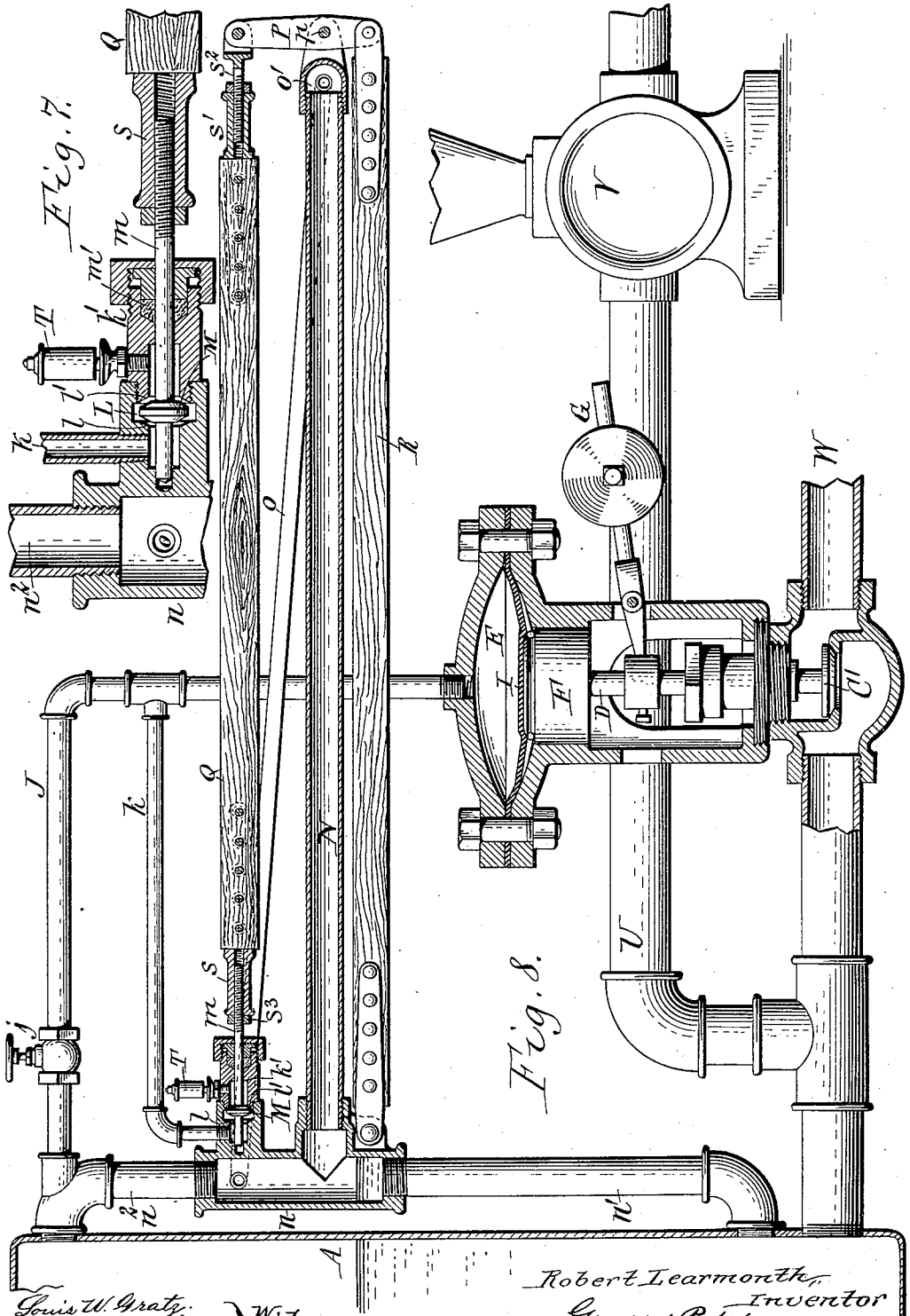

Witnesses.
Louis W. Gratz.
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No. 731,191. Patented June 16, 1903.

UNITED STATES PATENT OFFICE.

ROBERT LEARMONTH, OF BUFFALO, NEW YORK.

FEED-WATER REGULATOR.

SPECIFICATION forming part of Letters Patent No. 731,191, dated June 16, 1903.

Application filed March 5, 1903. Serial No. 146,262. (No model.)

To all whom it may concern:

Be it known that I, ROBERT LEARMONTH, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Feed-Water Regulators, of which the following is a specification.

This invention relates to that class of feed-water regulators in which the water-supply is primarily controlled by a thermostatic tube which communicates with the water and steam spaces of the boiler and which controls a valve connected with the water-supply.

One of the objects of this invention is to produce a feed-water regulator of this character which is simple and inexpensive in construction, reliable in operation, and not liable to get out of order.

Another object of this invention is to so organize the regulator that the same can be used for automatically opening or closing a valve arranged in the water-supply pipe of a system in which the water-supply permits of being interrupted, or the same can be used for opening and closing a valve arranged in a waste-pipe connected with the supply-pipe in a system in which it is desirable to keep the water-supply pump constantly in operation.

My invention has the further object to improve the construction of the feed-water-regulating valve in several respects.

In the accompanying drawings, consisting of two sheets, Figure 1 is a vertical longitudinal section of my improved feed-water regulator applied to a boiler having a water-supply which can be interrupted. Figs. 2 and 3 are fragmentary horizontal sections in lines 2 2 and 3 3, Fig. 1, respectively. Fig. 4 is a horizontal section of the diaphragm-motor for actuating the regulating-valve, the section being taken in line 4 4, Fig. 1. Fig. 5 is a bottom plan view of the socket-disk which is secured to the upper end of the regulating-valve piston. Fig. 6 is a perspective view of one of the plates for bridging the joint between the regulating-valve piston and the bottom of the diaphragm-chamber. Fig. 7 is a vertical longitudinal section of the vent-valve and connecting parts on an enlarged scale. Fig. 8 is a vertical longitudinal section of my improved feed-water regulator applied to a system in which the water-supply is constant.

Similar letters of reference indicate corresponding parts throughout the several views.

Referring to Figs. 1 to 7, A represents a steam-boiler of any suitable construction, and B a pipe connecting the lower part or water-space of the boiler with a water-supply which permits of being interrupted. The flow of water through this pipe into the boiler is controlled by a regulating-valve consisting of a casing C, connected with said pipe and having a seat *c* and a valve *c'*, which is movable toward and from the seat for opening or closing the water-supply. The valve is secured to the lower end of an upright stem or rod D, which slides vertically through a stuffing box or gland *d* in the top of the valve-casing. This valve is closed by means of a diaphragm-motor, which may be of any suitable construction, but preferably consists of a diaphragm-chamber E, connected by a standard *e* with the valve-casing and provided in its bottom with a vertical cylinder *e'*, a piston F, sliding vertically in said cylinder and connected with the upper end of the rod D, and a flexible diaphragm E', arranged between the top and bottom of the chamber and adapted to be pressed downwardly against the top of the piston for closing the valve by means of a pressure fluid entering an inlet in the top of the diaphragm-chamber. The opening of the valve is effected by a lever G, pivoted on the standard *e* and having one of its arms pivotally connected with the valve-rod, while its opposite arm is provided with an adjustable weight *g*. This means of opening the valve is superior to a spring, because the weight always acts positively and is not liable to give out, like a spring. Moreover, the effect of the lever may be varied by adjusting the weight toward or from the fulcrum thereof, and by observing the movement of the weight-lever the same serves as an indicator, which permits of determining how the regulating-valve is working.

It has been found in practice that the flexible diaphragm wears rapidly by being pressed against the upper edges of the piston and cylinder. In order to obviate this result, the joint between the piston and cylinder is bridged by an annular series of plates H, which support the diaphragm at said joint. These plates have the form of segments and

bear closely against one another at their sides. Each of the supporting-plates is pivotally connected at its inner end with the upper end of the piston, while its outer end is tapered and rests loosely on the bottom of the diaphragm-chamber. The pivotal connection between the piston and the plates may be produced in various ways. In the preferred form (shown in Figs. 1, 4, 5, and 6) this connection consists of an annular channel or groove *i*, formed in the upper end of the piston adjacent to the margin or periphery thereof, a fastening plate or disk I, secured to the top of the piston by screws *i'* and having a marginal channel or groove i^2 on its under side, which faces the channel in the piston, and knuckles *h*, arranged on the inner end of the supporting-plates and engaging loosely with the annular socket formed by the opposing channels of the piston and fastening-plate. The knuckles are preferably cylindrical, and the annular socket receiving the same is somewhat more than semicircular in cross-section and corresponds to said knuckles, whereby the latter are confined in said socket and the supporting-plates are prevented from becoming displaced.

The admission of pressure fluid into the diaphragm-chamber is controlled for causing the same to close the regulating-valve or to permit the same to be opened by a thermostatic device which is constructed as follows:

J represents a fluid-pressure pipe or conduit connecting the steam-space of the boiler with the upper part of the diaphragm-chamber and containing a hand-valve *j*. Between the valve *j* and the diaphragm-motor the conduit J is connected with the atmosphere by a vent-passage or branch conduit formed partly by a pipe *k* and partly by a valve-casing *k'*. Within the latter are formed a valve-chamber L and two opposing valve-seats *l l'*, arranged on the inner and outer ends of the valve-chamber, respectively.

M represents a vent-valve arranged in the valve-chamber and adapted to move toward either seat *l l'* for closing the vent-passage. This valve is mounted on a stem or rod *m*, which slides through a stuffing-box *m'* on the outer end of the vent-valve casing. When the vent-valve is closed, the full pressure of the steam is exerted against the top of the diaphragm, and the latter depresses the piston and closes the regulating-valve. When the vent-valve is opened, the steam in the pressure-pipe J is allowed to escape to the atmosphere, thereby relieving the pressure upon the diaphragm and permitting the regulating-valve to be opened by the weighted lever aided by the pressure of the water-supply underneath the regulating-valve.

N represents a horizontal thermostatic tube, preferably of metal, which readily expands and contracts lengthwise under the effects of heat and cold and furnishes the motion for operating the vent-valve. At its inner or fixed end the tube is connected with a fixed or rigid supporting-head *n*, containing a chamber which is connected at its lower end with the water-space of the boiler by a pipe *n'*, while its upper end is connected by a pipe n^2 with the steam-space of the boiler. The thermostatic tube is located horizontally in line with the normal water-level which is to be maintained in the boiler. As the water rises in the boiler to the normal level it also enters the tube and causes the same to contract, owing to the cooling effect of the water. When the water in the boiler is lowered by evaporation or otherwise, the water runs out of the tube and is replaced by steam from the boiler, causing the tube to expand by reason of the heat of the steam. In order to prevent the water from being trapped or caught in the tube and interfering with its free expansion and contraction, the outer end of the tube is connected with the steam-space at a point above the inner or fixed end of the tube. This is preferably effected by an inclined equalizing-pipe *o*, connected at its elevated inner end with the chamber of the supporting-head above the tube and connected at its outer end with a cap *o'*, attached to the outer end of the thermostatic tube, as shown in Figs. 1, 2, and 3. As the water enters the tube the steam is driven from the tube at both ends thereof. As the level of the water descends the same runs out of the tube from its outer end toward its inner end, this movement of the water being permitted by the steam entering the outer end of the tube as the water recedes. In the absence of any provision for replacing the water in the outer end of the tube with steam this water would be held in the tube by the steam-pressure, and thus defeat any lengthening or shortening effect of the tube.

The casing of the vent-valve is arranged adjacent to the fixed end of the thermostatic tube and is preferably formed in one piece with the supporting-head above the tube, as shown in Fig. 1. The longitudinal movement of the tube due to contraction and expansion is transmitted to the vent-valve by means of a transmitting-lever P, pivoted transversely by a pin *p* on the outer cap of the tube, and upper and lower connecting-bars Q R, arranged lengthwise on opposite sides of the tube. The upper bar is connected at opposite ends with the upper arm of the transmitting-lever and with the vent-valve rod, and the other bar is pivotally connected with the lower arm of said lever and a fixed support preferably formed on the supporting-head *n*. During the expansion and contraction of the thermostatic tube the transverse lever is caused to turn at its lower end, because the lower bar connects the same with a fixed support and serves as a fulcrum therefor, thereby causing the entire effective movement of the lever to take place at its upper end, which is connected by the upper shifting bar with the vent-valve.

When the boiler is filled with water to the

normal height, the thermostatic tube is also filled with water and contracted, whereby the transmitting-lever and shifting bar are moved inwardly, and the vent-valve is drawn against the inner seat *l* of the valve-chamber, thereby closing the vent-passage and causing the water-regulating valve to be closed by the steam-pressure. When the tube expands and moves the lever and upper bar outwardly, the vent-valve is opened, causing the steam-pressure on the water-regulating valve to be relieved, so that this valve opens and admits water to the boiler.

Inasmuch as the longitudinal extension or contraction of the thermostatic tube is inconsiderable, it is necessary to multiply the extent of this movement, so that the same can be employed effectively for opening and closing the vent-valve. This is accomplished by pivotally connecting the tube and transmitting-lever below the middle of the latter and as near the fulcrum of the same as possible.

In order to obtain the full effect of the thermostatic tube, the shifting and fulcrum bars should be so constructed that they remain practically unaffected by changes in temperature and be incapable of longitudinal extension or contraction; otherwise the movement of the tube would be neutralized or counteracted in a measure. For this purpose the bodies of the shifting and fulcrum bars are constructed of wood the grain of which runs lengthwise. As the expansion and contraction of the wood in the direction of its grain is not perceptible, the length of the bars is not varied by rising or falling of the temperature of the tube, which for convenience and compactness must be necessarily arranged close to the shifting and fulcrum bars.

To permit of adjusting the vent-valve, means are provided for shortening or lengthening the connection between the same and the upper end of the transmitting-lever. As shown in Figs. 1 and 2, this adjustment is effected by means of a screw-threaded socket *s*, arranged on the inner end of the shifting bar and receiving the outer screw-threaded end of the vent-valve rod, a similar socket *s'*, arranged on the outer end of the shifting bar and receiving a screw-threaded rod s^2, pivoted on the upper end of the transmitting-lever, and jam or lock nuts s^3, arranged on said rods and bearing against the sockets. Upon loosening these nuts and turning the shifting bar or screw-rods one with reference to the other the length of the connection between the vent-valve and the transmitting-lever may be varied.

Instead of venting the steam from the pressure-pipe J directly into the atmosphere the steam is utilized for operating a signal. This signal preferably consists of a whistle T, which is connected with the outlet of the vent-valve casing, so that the steam issuing therefrom blows the whistle. When the water in the boiler drops below normal and the whistle is sounded by the opening of the vent-valve, the attendant is notified, thereby enabling him to determine whether the feed-water regulator is working properly.

If desired, my improved feed-water regulator may be utilized for controlling the feed of water to a boiler which is supplied from a source which is not interrupted. This condition prevails on board of ships in which the pump supplying water to the boilers runs constantly to keep them from becoming dry, and in such cases the surplus water is discharged overboard by means of a waste-pipe connected with the supply-pipe and containing a valve which is opened when the water in the boiler has risen to the normal level. In Fig. 8, showing my improvement installed in a system of the kind last described, U represents the main water-supply pipe, which connects a constantly-operating pump V with the boiler, and W represents a waste-pipe connected with the supply-pipe and containing a valve C', which is controlled by a diaphragm-motor in the same manner as the valve *c'* in the first-described organization.

When the water in the boiler is below normal and steam enters the thermostatic tube, the vent-valve is moved outwardly against the outer seat *l'* of its casing, as shown in Fig. 8, thereby causing the steam conducted by pipe J to depress the diaphragm and close the waste-pipe valve C', whereby all of the water from the pump V is caused to enter the boiler. When the thermostatic tube cools and contracts by the water rising to normal and entering the same, the vent-valve is moved inwardly from the seat *l'*, thereby opening the vent-passage and relieving the diaphragm from the steam-pressure, whereby the valve C' of the waste-pipe is permitted to open and the surplus water is discharged so long as the water in the boiler is at the normal level. By thus providing the vent-valve casing with seats on opposite sides of the vent-valve it is possible to close the vent-passage either by the expansion or contraction of the thermostatic tube, thereby rendering the same apparatus capable of being used in either of the systems described for supplying feed-water to boilers.

I claim as my invention—

1. A feed-water regulator for boilers, comprising a regulating-valve, a steam-operated actuating device for said valve, a fixed supporting-head connected with the steam and water spaces of the boiler, a thermostatic tube rigidly connected at one end with said head, a transmitting-lever pivoted on the opposite end of said tube, a conduit connecting the steam-space of the boiler with said actuating device and having a vent-passage leading to the atmosphere, a valve-casing arranged adjacent to said head and forming part of said vent-passage, a vent-valve arranged in said casing and controlling the vent-passage, and two bars arranged lengthwise on opposite sides of said tube, one of said bars connect-

ing said vent-valve with one arm of said lever while the other bar connects the other arm of said lever with the supporting-head, substantially as set forth.

2. In a feed-water regulator, the combination of a water-supply for a boiler, a regulating-valve for said supply, an actuating device for said water-valve operated by steam-pressure, a fixed supporting-head containing a chamber connected with the steam and water spaces of the boiler, a thermostatic tube connected at one end with said chamber and free at its opposite end, a transmitting-lever pivoted on the free end of said tube, a conduit connecting the steam-space of the boiler with said actuating device and having a vent-passage leading to the atmosphere, a valve-casing mounted on said head and forming part of said vent-passage, a vent-valve arranged in said casing and controlling the vent-passage, and two bars arranged lengthwise on opposite sides of said tube, one of said bars connecting said vent-valve with one arm of said lever while the other bar connects the other arm of said lever with the supporting-head, substantially as set forth.

3. In a feed-water regulator, the combination of a water-supply for a boiler, a regulating-valve for said supply, an actuating device for said water-valve operated by steam-pressure, a fixed supporting-head containing a chamber connected with the steam and water spaces of the boiler, a thermostatic tube connected at one end with said chamber and free at its opposite end, a transmitting-lever pivoted on the free end of said tube, a conduit connecting the steam-space of the boiler with said actuating device and having a vent-passage leading to the atmosphere, a valve-casing mounted on said head and forming part of said vent-passage, a vent-valve arranged in said casing and controlling the vent-passage, and two bars arranged lengthwise on opposite sides of said tube, one of said bars connecting one arm of said lever with the fixed head while the other bar is adjustably connected with the other arm of said lever and said vent-valve, substantially as set forth.

4. In a feed-water regulator, the combination of a water-supply for a boiler, a regulating-valve for said supply, an actuating device for said water-valve operated by steam-pressure, a fixed supporting-head containing a chamber connected with the steam and water spaces of the boiler, a thermostatic tube connected at one end with said chamber and free at its opposite end, a transmitting-lever pivoted on the free end of said tube, a conduit connecting the steam-space of the boiler with said actuating device and having a vent-passage leading to the atmosphere, a valve-casing mounted on said head and forming part of said vent-passage, a vent-valve arranged in said casing and controlling the vent-passage, a fulcrum-bar arranged lengthwise on one side of said tube and pivotally connected at its opposite end with the fixed head and with one arm of said lever, a shifting bar arranged lengthwise on the opposite side of said tube and provided at its opposite end with screw-sockets, a screw-rod engaging one of said sockets and pivotally connected with the other arm of said lever, and a screw-rod engaging with the other socket and connected with the vent-valve, substantially as set forth.

5. The combination of a regulating-valve, an actuating device for closing said valve operated by fluid-pressure, a thermostatic tube having one of its ends fixed while its opposite end is free, a conduit for conducting a pressure fluid to said actuating device having a vent-passage leading to the atmosphere, a valve-casing forming part of said vent-passage and having two opposing valve-seats, a vent-valve arranged between said seats and capable of closing the vent-passage by moving against either seat, and means for transmitting the movement of said tube to said vent-valve, substantially as set forth.

6. In a feed-water regulator, the combination of a water-supply for a boiler, a regulating-valve for said water-supply, an actuating device for closing said valve operated by fluid-pressure, a thermostatic tube connected with the steam and water spaces of the boiler and having one of its ends fixed while its opposite end is free, a transmitting-lever pivoted on the free end of said tube, a conduit for conducting a pressure fluid to said actuating device having a vent-passage leading to the atmosphere, a valve-casing forming part of said vent-passage and having two opposing valve-seats, a vent-valve arranged between said seats and capable of closing the vent-passage by moving against either seat, and means for transmitting the movement of said lever to said vent-valve, substantially as set forth.

7. In a feed-water regulator, the combination of a water-supply for a boiler, a regulating-valve for said water-supply, an actuating device for closing said valve operated by fluid-pressure, a thermostatic tube connected with the steam and water spaces of the boiler and having one of its ends fixed while its opposite end is free, a transmitting-lever pivoted on the free end of said tube, a conduit for conducting a pressure fluid to said actuating device having a vent-passage leading to the atmosphere, a valve-casing forming part of said vent-passage and having two opposing valve-seats, a vent-valve arranged between said seats and capable of closing the vent-passage by moving against either seat, a shifting bar arranged lengthwise on one side of said tube and connected at its opposite ends with said vent-valve and with one arm of said lever, and a fulcrum-bar arranged lengthwise on the opposite side of said tube and connected at opposite ends with the other arm of said lever and with a support adjacent to the fixed end of the tube, substantially as set forth.

8. In a feed-water regulator, the combina-

tion of a water-supply for a boiler, a regulating-valve for said water-supply, an actuating device for closing said valve operated by fluid-pressure, a thermostatic tube connected with the steam and water spaces of the boiler and having one of its ends fixed while its opposite end is free, a transmitting-lever pivoted on the free end of said tube, a conduit for conducting a pressure fluid to said actuating device having a vent-passage leading to the atmosphere, a whistle connected with the vent-passage, a vent-valve controlling the vent-passage, and means for operating the vent-valve by the movement of said tube, substantially as set forth.

9. The combination of a regulating-valve, an actuating device for closing said valve operated by fluid-pressure, a thermostatic tube having one of its ends fixed while its opposite end is free, a conduit for conducting a pressure fluid to said actuating device having a vent-passage leading to the atmosphere, a whistle connected with the vent-passage, a vent-valve controlling the vent-passage, and means for operating the vent-valve by the movement of said tube, substantially as set forth.

10. In a feed-water regulator, the combination of a water-supply for a boiler, a regulating-valve for said water-supply, an actuating device for closing said valve operated by fluid-pressure, a metallic thermostatic tube connected with the steam and water spaces of the boiler and having one of its ends fixed while its opposite end is free, a transmitting-lever pivoted on the free end of said tube, a vent-valve for controlling the pressure fluid to said actuating device arranged adjacent to the fixed end of said tube, and two longitudinally-grained wooden bars arranged lengthwise on opposite sides of said tube, one of the bars being connected at opposite ends with one arm of said lever and with said vent-valve while the other bar is connected at opposite ends with the other arm of said lever and a support adjacent to the fixed end of said tube, substantially as set forth.

11. The combination of a regulating-valve, an actuating device for closing said valve operated by fluid-pressure, a metallic thermostatic tube having one of its ends fixed while its opposite end is free, a transmitting-lever pivoted on the free end of said tube, a vent-valve for controlling the pressure fluid to said actuating device arranged adjacent to the fixed end of said tube, and two transmitting-bars constructed of wood and arranged lengthwise on opposite sides of said tube, one of the bars being connected at opposite ends with one arm of said lever and with said vent-valve while the other bar is connected at opposite ends with the other arm of said lever and a support adjacent to the fixed end of said tube, substantially as set forth.

12. In a feed-water regulator, the combination of a water-supply for a boiler, a regulating-valve for said supply, an actuating device for said valve operated by steam-pressure, a fixed supporting-head containing a chamber connected with the steam and water spaces of the boiler, a horizontal thermostatic tube connected at its inner end with said chamber and free at its outer end, a cap arranged at the outer end of said tube, a transmitting-lever pivoted on said cap, a conduit connecting the steam-space of the boiler with said actuating device and having a vent-passage leading to the atmosphere, a valve-casing formed on the supporting-head and forming part of said vent-passage, a vent-valve arranged in said casing and controlling said vent-passage, a shifting bar arranged lengthwise on one side of the tube and connected at opposite ends with one arm of said lever and with said vent-valve, a fulcrum-bar arranged lengthwise on the opposite side of said tube and connected at opposite ends with the other arm of said lever and with said head, and an inclined equalizing-pipe connected at its upper end with the chamber in the supporting-head above the thermostatic tube while its lower end is connected with said cap and communicates with the outer end of said tube, substantially as set forth.

13. In a feed-water regulator for boilers, the combination of a regulating-valve, an actuating device for said valve operated by steam-pressure, a fixed supporting-head containing a chamber connected with the steam and water spaces of the boiler, a horizontal thermostatic tube connected at its inner end with said chamber and free at its outer end, a transmitting-lever pivoted on the free end of the tube, a conduit connecting the steam-space of the boiler with said actuating device and having a vent-passage leading to the atmosphere, a valve-casing arranged adjacent to the supporting-head and forming part of said vent-passage, a vent-valve arranged in said casing and controlling said vent-passage, a shifting bar arranged lengthwise on one side of the tube and connected at opposite ends with one arm of said lever and with said vent-valve, a fulcrum-bar arranged lengthwise on the opposite side of said tube and connected at opposite ends with the other arm of said lever and with said head, and an inclined equalizing-pipe connected at its upper end with the chamber in the supporting-head above the thermostatic tube while its lower end is connected with the outer end of said tube, substantially as set forth.

14. In a feed-water-regulating valve, the combination of a valve-casing having a valve-seat, a valve movable toward and from said seat, a diaphragm-chamber having a cylinder in its bottom and a pressure-fluid inlet in its top, a piston arranged in said cylinder and connected with said valve, a flexible diaphragm arranged in said chamber between the top and bottom thereof, and an annular series of supporting-plates resting at their

inner and outer ends on the piston and the bottom of said chamber, substantially as set forth.

15. In a feed-water-regulating valve, the combination of a valve-casing having a valve-seat, a valve movable toward and from said seat, a diaphragm-chamber having a cylinder in its bottom and a pressure-fluid inlet in its top, a piston arranged in said cylinder and connected with said valve, a flexible diaphragm arranged in said chamber between the top and bottom thereof, and an annular series of supporting-plates each of which is pivotally connected at its inner end with said piston and rests at its outer end on the bottom of the chamber, substantially as set forth.

16. In a feed-water-regulating valve, the combination of a valve-casing having a valve-seat, a valve movable toward and from said seat, a diaphragm-chamber having a cylinder in its bottom and a pressure-fluid inlet in its top, a piston arranged in said cylinder and connected on its under side with said valve while its upper side is provided with a marginal channel, a fastening-plate secured to the top of the piston and provided on the under side of its margin with an annular channel which faces the channel in the piston and forms with the same an annular socket, and an annular series of supporting-plates which bridge the joint between the piston and the diaphragm-chamber and each of which is provided at its inner end with a knuckle turning in said socket and resting at its outer end on the bottom of the diaphragm, substantially as set forth.

17. In a feed-water-regulating valve, the combination of a valve-casing provided with a seat, a valve movable toward and from the seat, a diaphragm-chamber having a cylinder in its bottom and a pressure-fluid inlet in its top, a piston arranged in said cylinder and connected by a rod with said valve, a weight-lever connected with said rod for opening said valve, and a diaphragm arranged in said chamber between the top and bottom thereof and adapted to close said valve when pressed against said piston, substantially as set forth.

Witness my hand this 3d day of March, 1903.

ROBERT LEARMONTH.

Witnesses:
THEO. L. POPP,
EMMA M. GRAHAM.