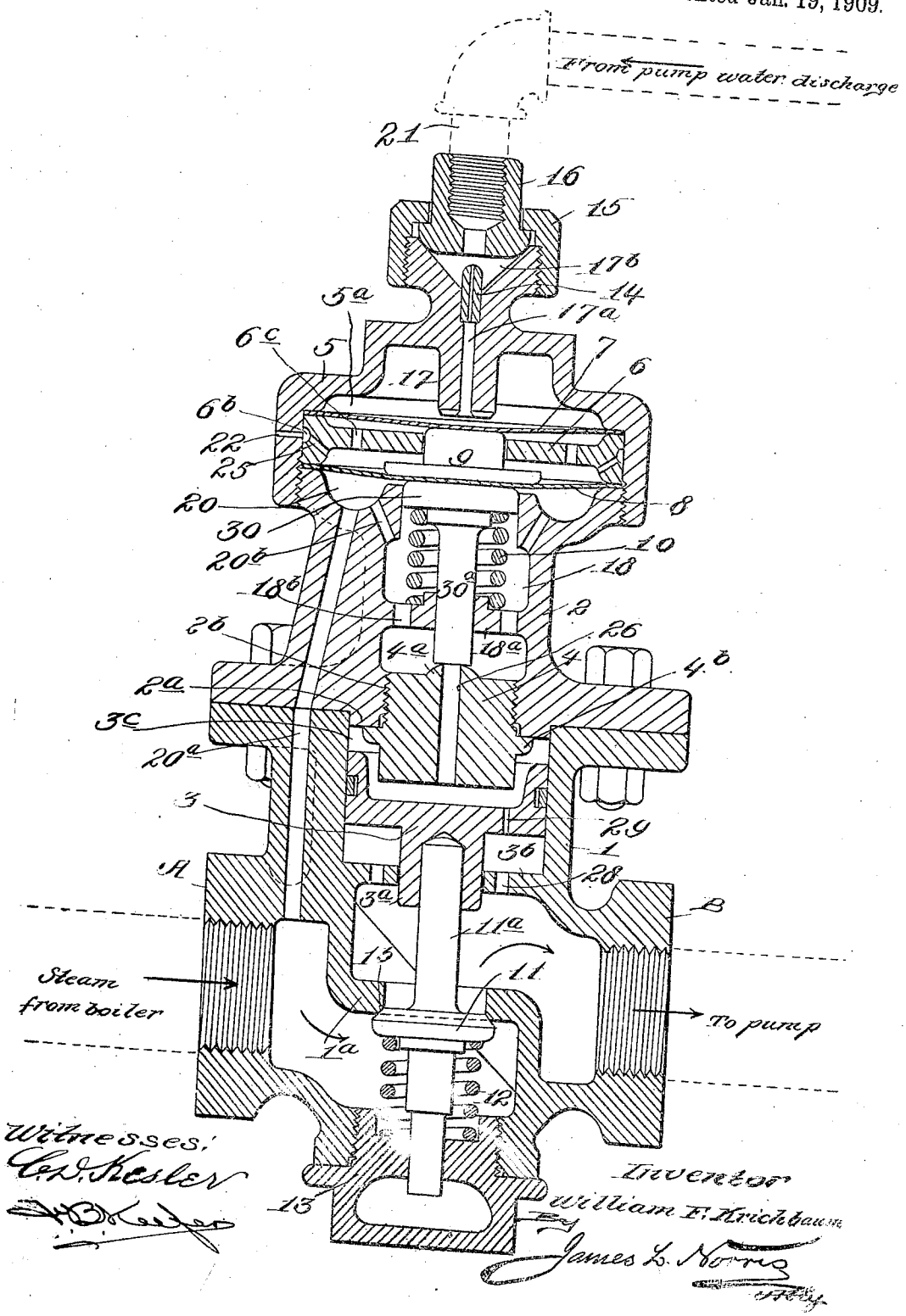
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REGULATOR.

APPLICATION FILED MAR. 5, 1907.

910,292.

Patented Jan. 19, 1909.



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UNITED STATES PATENT OFFICE.

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REGULATOR.

No. 910,292. Specification of Letters Patent. Patented Jan. 19, 1909.

Application filed March 5, 1907. Serial No. 360,656.

To all whom it may concern:

Be it known that I, WILLIAM F. KRICHBAUM, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented new and useful Improvements in Feed-Water Regulators or Controllers, of which the following is a specification.

This invention relates to a boiler feed pump regulator and has been devised to control and maintain the discharge pressure in excess of the pressure carried in the boiler in accordance with the requirements of the pump under certain conditions of operation.

The present invention is of that type of regulators or automatic controlling devices which are operated by the initial or boiler pressure acting upon a piston and which actuates a main valve to open the same, the admission of the initial or boiler pressure to the piston being controlled by an auxiliary or secondary valve, which in turn is operated by two diaphragms subject to any variation of the initial or discharge pressures desired to be maintained.

The objects of this invention are to provide a controlling device which will automatically maintain an excess water discharge pressure of say about fifteen pounds above the initial or boiler pressure at whatever point the latter may be, and to provide a self-contained pressure controlling device which is of simple construction and devoid of stuffing boxes or adjustable devices and thus avoid outside means for tampering with the adjustment and operation of the regulator or controlling device.

The accompanying drawing illustrates a transverse vertical section of a pressure regulator or controlling device embodying the features of the invention, and referring thereto the numeral 1 designates the body portion of the valve, apertured and threaded at one end A to receive an initial pressure supply pipe, as shown by dotted lines, and also threaded and apertured at the other end B to receive a continuation of said pipe beyond the valve, the said body 1 having a partition 1^a separating the apertured and threaded ends A and B and forming at its under side a horizontal seat 1^b for a valve 11. This vlave 11 has a stem 11^a projecting above and below the same, the lower portion of the stem being centered by a plug 13 and surrounded by a coiled spring 12 which supports the weight of the valve and piston and has a tendency to close the valve when the piston is relieved of opposing pressure, as will be more fully hereinafter explained. The upper portion of the stem 11^a is centered and engaged by a piston 3 having a reduced shank 3^a movably extending through a partition 3^b in the body 1 at a suitable distance above the partition 1^a.

On the upper end of the body 1 of the valve a top piece or upper valve casing 2 is mounted, the said upper portion of the body of the valve and top piece or casing 2 being suitably flanged and connected by means of bolts, as shown. The top piece or casing 2 has a central boss 2^a at its lower end which projects downwardly into the top of the chamber 3^c in which the piston 3 is mounted and has movement. In the center of the bottom of the top piece or casing 2 and also extending through the boss 2^a is a threaded opening 2^b, and in this opening is fitted a screw-threaded seating plug 4 having a passage or bore 26 extending centrally therethrough; and surrounding the upper extremity of this bore or passage and projecting above the top of the plug is a raised seat 4^a. It is obvious that instead of threading and screwing the plug 4 into place as above described, said plug could be otherwise secured in position, and to regulate the penetration of the plug into the top piece it is provided with a circumferential flange 4^b which is adapted to bear against the boss 2^a to make a sealed joint. Above the plug 4 a central enlarged passage 18 is formed in the top piece or upper casing 2 and is provided with an intermediate spider 18^a having openings 18^b extending therethrough. Within this passage 18 a controlling valve 30 is mounted. It has a depending stem or shank 30^a extending downwardly through the center of the passage 18 and the spider 18^a and normally resting on the seat 4^a over the bore or passage 26 in the plug 4. The upper end of the top piece or upper casing 2 is formed with an annular semi-circular channel 20 having communication with the initial supply pressure receiving end A of the valve through the medium of a passage 20^a extending vertically through the body 1 of the valve and also through the top piece or upper valve casing 2. The channel 20 also has communication with the passage 18 by means of inwardly extending ports 20^b running from said channel 20 to the passage at intervals.

On the upper end of the top piece or upper casing 2 a diaphragm cap 5 is secured, the greatest diameter of this cap being at its lower extremity or at the portion thereof that is secured to the top piece to form a diaphragm chamber 5^a of which the channel 20 is a part. This diaphragm chamber is horizontally divided by a partition or septum 6, so constructed as to permit of the downward movement of diaphragm 7 and upward movement of the opposite diaphragm 8, and having raised faces to secure the diaphragms 7 and 8 at their edges, thus making a sealed joint between the channel 20 in top casing 2 and diaphragm cap 5. The partition or septum 6 is provided with a circular groove 6^b extending around the same and with a series of apertures 6^c extending therethrough said partition or septum having a port 25 leading from circular groove 6^b into the space between the two diaphragms. A diaphragm washer 9 is disposed between the diaphragms 7 and 8 and operates as a movement transmitting means for one diaphragm with respect to the other, and has a reduced portion movably extending through an opening in the partition or septum 6. The washer or motion transmitting member 9 engages both diaphragms, and has an upper contacting area of less diameter than the lower contacting area the lower increased diametrical portion of the said washer or member bearing on the diaphragm 8 and the upper reduced contacting area of said member engaging the under side of the diaphragm 7. The valve 30 is also normally held in contact with the under side of the diaphragm 8, and surrounding the shank 30^a of the said valve is a spring 10 which operates to hold the valve against the diaphragm 8, said spring engaging the valve at its upper end and the spider 18^a at its lower end. The diaphragm cap 5 gradually reduces in diameter towards its upper end, and extending therefrom into the upper portion of the diaphragm chamber 5^a directly over the center of the upper diaphragm 7 is a pendant 17 having its lower terminal above or out of contact with the said diaphragm 7, and extending centrally through the pendant and the portion of the diaphragm cap immediately above is a bore 17^a that primarily communicates with an upper inverted conical cup 17^b in the upper end of the said cap 5.

In the upper extremity of the bore 17^a is a tubular bushing 14 projecting upwardly into the cup 17^b, having a hole of smaller diameter than bore 17^a to restrict the passage of water and prevent pulsation of the diaphragm resulting with each stroke of the pump, which would soon crystallize the metal of which the diaphragms are composed and cause them to break. The projection of the bushing 14 above the bottom of the inverted conical cup 17^b is to obviate the lodgment of any sediment on the upper end of said bushing, and to assist in overcoming this disadvantage said upper end of the bushing is rounded as shown. In view of the small bore of the bushing any tendency to pulsation of the diaphragm immediately below in response in the stroke of the pump will be dissipated. Over the upper end of the diaphragm cap 5 is a hollow nut 15 in which is fitted a thimble 16 in which a pipe 21, shown in dotted lines, is secured and connected to the water discharge from pump. In the diaphragm cap 5 is located a tell-tale port 22 communicating with the circular peripheral groove 6^b in the dividing partition or septum 6. This groove 6^b communicates with the space between the diaphragms 7 and 8 by the port 25 to which reference has been hereinbefore made. In case there should be rupture of either of the diaphragms, steam will enter the space between the same and will enter the port 25, circular groove 6^b, and from the latter pass to the atmosphere by way of the tell-tale port 22, so that by virtue of the said tell-tale port such rupture or other breakage will be indicated exteriorly of the regulator. This tell-tale port serves an additional function in that it presents the accumulation of pressure in the space between the two diaphragms and thereby prevents the regulator from becoming inoperative from such cause.

The member 9 may be properly termed a washer having differential contacting areas, and though it is preferred that this particular element be used, it will be understood that the same result may be obtained by using diaphragms of different diameters. By the use of the member 9 or washer, there is less liability of rupture of the diaphragms, but an obvious substitute for this member would be the use of diaphragms having different diameters.

The valve 30 serves as an auxiliary valve and will be referred to by such term in the claims hereto appended. It will also be noted that the piston 3 is considerably larger in area than the main valve 11 cooperating with the partition 1^a between the opposite ends or inlet and outlet A and B respectively. The purpose of this difference of area is to insure displacement of the valve 11 from its seat by the piston when the latter is operated, as will he hereinafter set forth. The lower wall of piston 3 is provided with a port 29 of reduced diameter and in the partition 3^b ports 28 are also provided, the purpose of ports 28 being to allow the pressure under piston 3 to equalize with that on the outlet side of the valve. The piston is made smaller in diameter than chamber 3^c and is provided with a snap ring to prevent steam passing between piston 3 and wall of chamber 3^c.

The operation of the device is as follows:

The initial supply pressure enters at A and passes through the passage 20^a to the channel 20 and exerts its influence on the lower diaphragm 8, raising both diaphragms 7 and 8 through the medium of the member or washer 9 between the said diaphragms and permitting the auxiliary valve 30 to open, the spring 10 operating to force the valve upwardly or to follow the diaphragms. The upward movement of the auxiliary valve 30 lifts the stem 30^a clear of the raised seat 4^a and uncovers the bore or passage 26 in the plug 4 and permits the pressure to pass downwardly from the channel 20 through the ports 20^b into the chamber 18, through the openings 18^b of the spider 18^a and into the piston chamber 3^c above the piston 3 through the bore or passage 26, above noted. By this means the piston 3 is forced downwardly and depresses the valve 11 from its seat 1^b formed in the partition 1^a, the downward movement of the valve 11 being resisted by the initial supply pressure and the spring 12. The release of the valve 11 from its seat as just explained establishes communication between the inlet and outlet ends of the valve, and the fluid is permitted to pass from A to B and thence to the pump. As the pump compresses its discharge to an excess of fifteen pounds above the initial supply pressure it forces the diaphragms 7 and 8 downwardly against the said opposing initial supply pressure and seats the auxiliary valve 30, allowing any pressure above the piston 3 to escape through ports 29 and 28 and equalize with the pressure on the under side of piston 3 as heretofore explained. At the same time the initial supply pressure, assisted by spring 12, seats valve 11.

When the pump has compressed its discharge to 15 pounds in excess of the initial supply pressure the steam throttle, or high pressure stop valve on the pump should be opened wide, and the regulator will then automatically maintain the said fifteen pounds water discharge pressure in excess of the initial supply pressure regardless of the increase or decrease of the said initial supply pressure. If for any reason the initial or boiler pressure should fall or increase, the improved controlling device will automatically maintain an excess of fifteen pounds of water discharge pressure over the initial or boiler pressure or over any fall or increase of the initial or boiler pressure. In other words, the water discharge pressure automatically increases or decreases in proportion to the increase or decrease of the initial or boiler pressure. For illustration, if, as is frequently the case, on naval vessels where the initial pressure is two-hundred fifty pounds while at sea, the discharge pressure from the pump would be two-hundred sixty-five pounds; and when in port or at anchor the boiler pressure is reduced to eighty pounds, then the discharge pressure from the pump would be ninety-five pounds. This illustration is given to show that the operation is entirely automatic. The excess in water discharge pressure over the initial or boiler pressure may be varied by changing the diameter of the member or washer 9, thus changing the mean effective area of one diaphragm. For illustration, the washer or member 9 at bottom being one and one-half inches and at the top one inch, the mean effective area of the lower diaphragm would be approximately 3.54 square inches and the mean effective area of the upper diaphragm 2.40 square inches. It is obvious with this difference between the two mean effective areas if there was a pressure of one-hundred pounds on the lower side of the one diaphragm it would require an excess pressure of say fifteen pounds on the top of the upper diaphragm to overcome the pressure on the opposite side of the lower diaphragm.

By means of the regulator or controller hereinbefore specified, water and fuel are saved, wire drawing over the seats of the feed valves is avoided. It will be understood that the several parts of the regulator or controller may be secured by means other than those shown, and, furthermore, that modifications may be adopted in the details of construction without in the least departing from the spirit of the invention.

Some of the appended claims indicate that the initial or boiler pressure operates on the outer side of one of the diaphragms and that water discharge pressure from a pump operates on the outer side of the other diaphragm. It is believed that it will be clear what is meant by this language. However, it is deemed desirable to state that in the present case the outer side of the diaphragm 7 is the upper surface thereof while the outer side of the diaphragm 8 is the under surface thereof. It is believed from the statements just made that it is not essential that the diaphragms stand horizontally or substantially horizontally as they are shown in the drawings, but, in view of the fact that they are thus represented, it is deemed desirable to point out how such language applies to the relation shown.

What I claim is:

1. A regulator or controller of the class specified, having an inlet and an outlet with a valve therebetween, comprising two opposite diaphragms having their inner sides adjacent, loose means between the diaphragms for transferring the effect of one diaphragm to the other, means operated by the diaphragms to control the open and closed condition of the said valve, and passage means and connections whereby the initial or boiler pressure operates on the outer

side of one diaphragm and water discharge pressure from a pump operates on the outer side of the other diaphragm.

2. A regulator or controller of the class specified having an inlet and an outlet with a valve therebetween, comprising two opposed conjointly operating diaphragms, a septum interposed between the diaphragms and having openings therein, means actuated by the diaphragms to control the open and closed condition of the said valve and passages and connections leading to the diaphragms whereby the initial or boiler pressure operates on the outer side of one diaphragm and the water discharge pressure from a pump operates on the outer side of the second diaphragm.

3. In a regulator or controller of the class specified having an inlet and an outlet, the combination of a valve controlling communication between the inlet and outlet, opposite diaphragms having their inner sides adjacent, and means actuated by the diaphragms, to control the open and closed condition of the said valve, the one diaphragm being exposed to the pressure in the inlet of the regulator and the other diaphragm having operative exposure to a pump whereby the initial or boiler pressure operates on the outer side of one diaphragm and is opposed by the water discharge pressure from the pump on the outer side of the second diaphragm, the diaphragms by their automatic operation controlling the open and closed condition of said valve.

4. A controller or regulator of the class specified, comprising a valve interposed between an inlet and an outlet, a pressure chamber, two opposite disconnected diaphragms with their inner sides adjacent for conjoint operation exposed respectively to the initial or boiler pressure and to the discharge pressure from a pump, and means for enabling the diaphragms to act conjointly, the diaphragms being mounted in the pressure chamber and automatically operative to close the said valve when the water discharge pressure of the pump is more than a certain amount in excess of the initial or boiler pressure.

5. In a controller or regulator of the class specified, the combination of inlet and outlet and a valve between the same, the inlet and outlet being adapted to be connected respectively to an initial pressure supply pipe and a pump; two diaphragms arranged in opposition, one of the diaphragms being exposed to the initial supply pressure and the other to the w. ter discharge of the pump, and a washer interposed between the diaphragms having contacting areas of different diameters engaging the diaphragms, the diaphragms operating to control the open and closed condition of the said valve.

6. A device of the class specified, having an inlet and an outlet adapted to be connected to an initial pressure supply pipe and to a pump, a valve interposed between the inlet and outlet, a diaphragm chamber having two diaphragms arranged therein in opposition to each other, and substantially parallel, the one diaphragm being situated above the other, the diaphragm chamber having tell-tale ports communicating therewith between the diaphragms, the diaphragms being respectively exposed to boiler and pump pressure, means serving to control the open and closed condition of the valve and actuated by the diaphragms, and a device interposed between the diaphragms for operating one by the power of the other.

7. In a device of the class specified, the combination with an inlet and an outlet adapted to be connected to an initial pressure supply means and a pump, a valve interposed between the said inlet and outlet, two diaphragms arranged in opposition to each other, a septum interposed between the diaphragms and having openings therein, means for causing joint operation of the diaphragms the one diaphragm exposed to the initial pressure from the supply means and the other diaphragm exposed to the pressure of the water discharge of the pump, a reduced bushing to prevent pulsations of the pump being transmitted to the upper diaphragm, and means between the lower diaphragm and valve and including an auxiliary valve and piston to control the open and closed condition of the first named valve.

8. A device of the class specified, having an inlet and an outlet adapted to be connected to an initial pressure supply pipe and to a pump, a valve interposed between the inlet and outlet to control communication between them, two opposed diaphragms, one of the diaphragms being exposed to the initial pressure from the supply pipe and the other diaphragm being exposed to the pressure of the water discharge of the pump, an auxiliary valve held against one of the diaphragms and controlling the open and closed condition of a passage, a piston engaging with the first named valve, a washer interposed between the two diaphragms having portions of differing diameters continually contacting with both of the diaphragms, and a separating means between the diaphragms having openings therein, the space between the diaphragm also having tell-tale ports communicating therewith and extending out to the exterior of the device.

9. In a device of the class specified, an inlet and an outlet respectively connectible to an initial pressure supply means and a pump, a valve interposed between said inlet and outlet, two opposite disconnected diaphragms with inner sides adjacent, having movement transferring means between them, one of the diaphragms being exposed to the

initial pressure from the supply means and the other diaphragm being exposed to the pressure of the water discharge of the pump, operating means interposed between one diaphragm and the said valve, and a restricted bushing in the communicating means for the other diaphragm adapted to be connected to the water discharge of the pump to prevent the pulsation of the pump affecting the said diaphragm.

10. A regulator or controller of the class specified having an inlet and an outlet with a valve therebetween comprising a diaphragm chamber having two coöperating diaphragms in opposed substantially parallel relation, the diaphragms having a space between them, and the one arranged above the other, said regulator having a tell-tale port opening into the space between the diaphragms, means actuated by the diaphragms to control the open and closed condition of the said valve, and passage means and connections whereby the initial or boiler pressure operates on the outer side of one diaphragm and water discharge pressure from a pump operates on the outer side of the other diaphragm.

11. A regulator or controller of the class specified having an inlet and an outlet with a valve therebetween comprising two coöperating diaphragms, means actuated by the diaphragms to control the open and closed condition of the said valve, and a partition between the diaphragms peripherally engaging the same, said partition having a peripheral groove and also having a port leading from said groove into the space between the diaphragms, the regulator having a tell-tale port in communication with the atmosphere and said groove respectively, the diaphragms being respectively operated by boiler and water discharge pressure.

12. A regulator or controller of the class specified having an inlet and an outlet with a valve therebetween, comprising two coöperating diaphragms in opposed relation having their inner sides adjacent to each other, a pressure chamber in which said diaphragms are disposed, passage means and connections whereby the initial or boiler pressure operates on the outer side of one diaphragm and water discharge pressure from a pump operates on the outer side of the other diaphragm, a piston controlling the valve and operable by steam pressure, and an auxiliary valve structurally independent of the diaphragms for controlling the supply of steam to the piston and closable to cut off the steam by one of said diaphragms, the auxiliary valve having a loose relation to the diaphragms.

13. A regulator or controller of the class specified comprising a casing having a steam pressure inlet and an outlet and a diaphragm chamber, two opposite diaphragms in the said chamber coöperative with each other, the diaphragms having their inner sides adjacent and substantially parallel, means for directing steam and water pressures against the outer sides of said diaphragms, a main valve in the casing for controlling the steam pressure, a piston controlling the main valve and operable by steam pressure, and an auxiliary valve for controlling the supply of steam to the piston and closable toward its seat to cut off the steam by one of said diaphragms.

14. A regulator of the class specified comprising a body having a pressure chamber, a cap removably fitted to the body, diaphragms disposed in the pressure chamber and peripherally seated against the body and cap respectively, a partition located between and peripherally engaging the diaphragms and held in place by said cap, passage means and connections whereby the initial or boiler pressure operates on the outer side of one diaphragm, and water discharge pressure from a pump operates on the outer side of the other diaphragm, loose means between the diaphragms for transferring the effect of one to the other, a main valve controlling the steam from the boiler to the pump, a piston for governing the action of said main valve, and an auxiliary valve for controlling the supply of steam to the piston and closable toward its seat for such purpose, by one of said diaphragms.

15. A regulator or controller of the class specified having an inlet and an outlet with a valve therebetween, comprising a diaphragm chamber, two diaphragms arranged and oppositely disposed in said chamber with faces thereof adjacent, means actuated by the diaphragms to control the open and closed condition of the said valve, and passage means and connections whereby the initial or boiler pressure operates on the outer side of one diaphragm and water discharge pressure from a pump operates on the outer side of the other diaphragm.

16. A regulator or controller of the class specified having an inlet and an outlet with a valve therebetween, comprising a diaphragm chamber, a plurality of diaphragms oppositely disposed and all located in the said chamber, having their inner sides adjacent, means for transferring the effect of one diaphragm to the other, means actuated by the diaphragms to control the open and closed condition of the said valve, and passage means and connections whereby the initial or boiler pressure operates on the outer side of one diaphragm and water discharge pressure from a pump operates on the outer side of the other diaphragm.

17. A regulator or controller of the class specified having an inlet and an outlet with a valve therebetween, comprising two opposite diaphragms having their inner sides adjacent, a pressure chamber in which both diaphragms are mounted, means interposed be-

tween and loosely engaging the opposite sides of the diaphragms for transferring the effect of one diaphragm to the other, means actuated by the diaphragms to control the open and closed condition of the said valve, and passage means and connections whereby the initial or boiler pressure operates on the outer side of one diaphragm and water discharge pressure from a pump operates on the outer side of the other diaphragm.

18. A regulator or controller of the class specified having an inlet and an outlet with a valve therebetween, comprising two movable elements with inner opposing adjacently situated sides having means coöperating therewith whereby the initial or boiler pressure operates on the outer side of one element and water discharge pressure from a pump operates on the outer side of the other element, a chamber in which said elements are disposed, and devices actuated by said elements to control the open and closed condition of the said valve.

19. A regulator or controller of the class specified having an inlet and an outlet with a valve therebetween, comprising two opposite diaphragms, means common to both of the diaphragms for peripherally holding them to their seats, means actuated by the diaphragms to control the open and closed condition of the said valve, and passage means and connections whereby the initial or boiler pressure operates on the outer side of one diaphragm and water discharge pressure from a pump operates on the outer side of the other diaphragm.

20. A regulator or controller of the class specified having an inlet and an outlet with a valve therebetween, comprising two opposite diaphragms, with their inner sides or faces adjacent to each other, a loosely supported member interposed between the diaphragms and having contact faces of differing diameters engaging the respective diaphragms, means actuated by the diaphragms to control the open and closed condition of the said valve, and passage means and connections whereby the initial or boiler pressure operates on one diaphragm and water discharge pressure from a pump operates on the other diaphragm.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

WILLIAM F. KRICHBAUM.

Witnesses:

J. E. RUTH,

JOHN G. HEHNSTAEDTER.