No. 647,758. Patented Apr. 17, 1900.

R. S. ORR.

WATER HEATER.

(Application filed Apr. 15, 1899.)

(No Model.) 2 Sheets—Sheet 1.

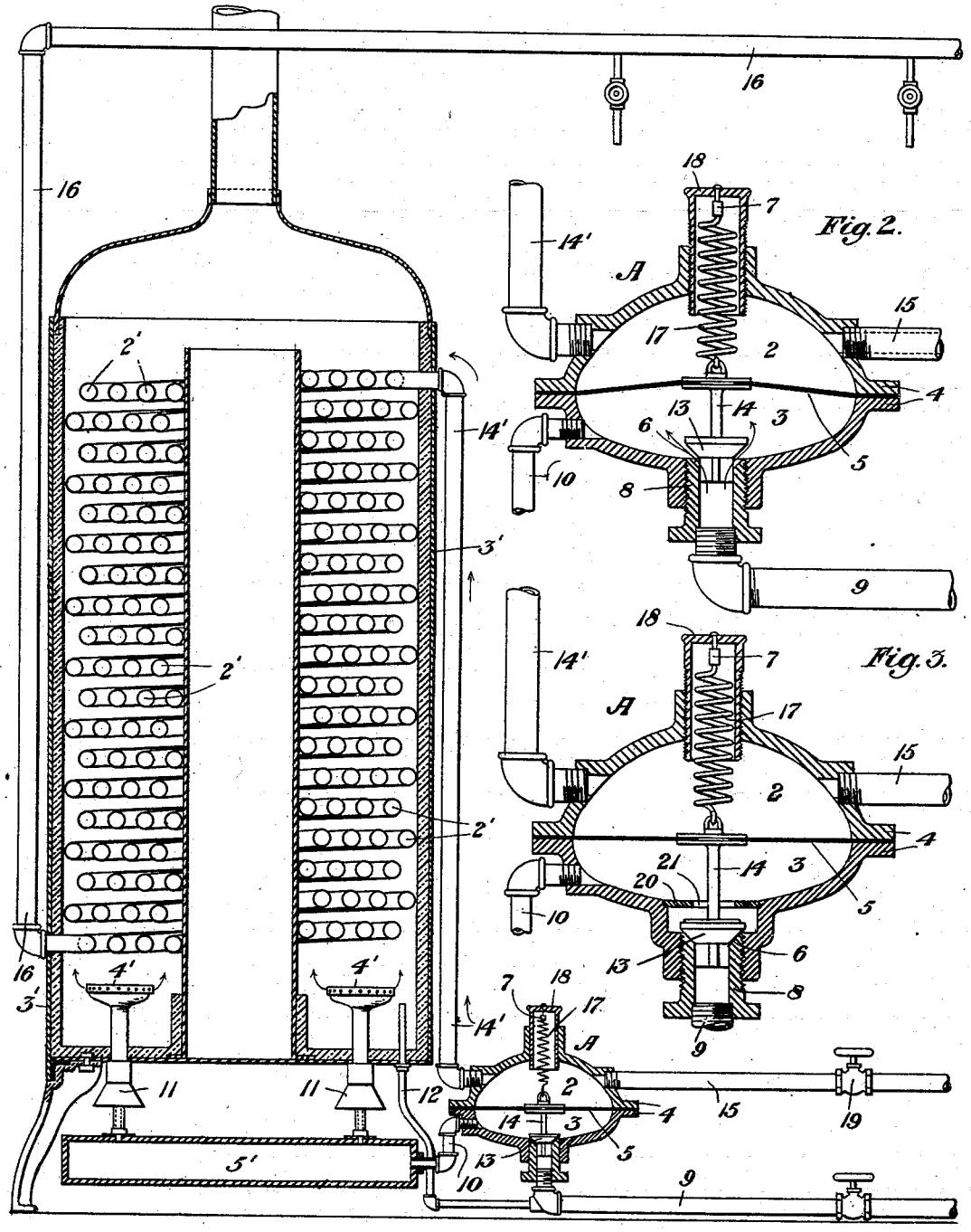

Fig. 2.

Fig. 3.

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

Fig. 4.

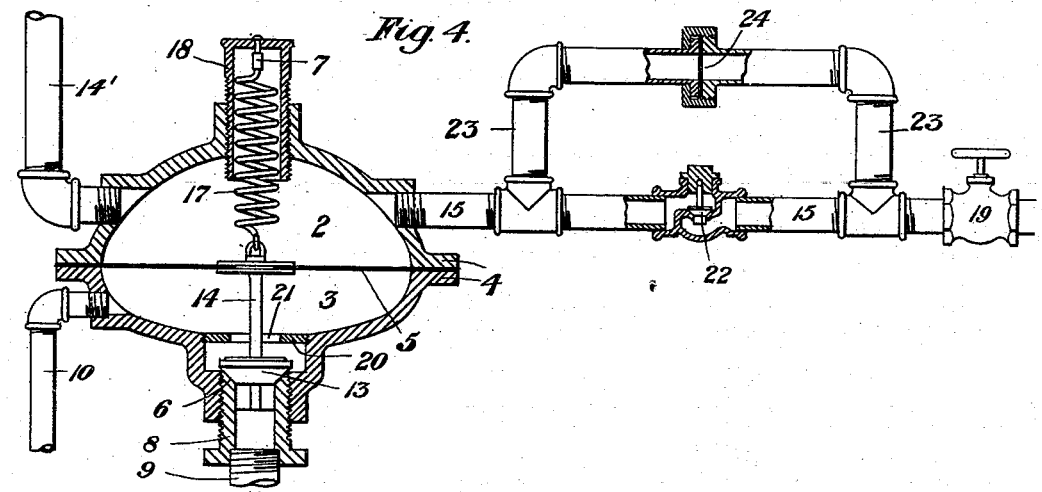


Fig. 5.

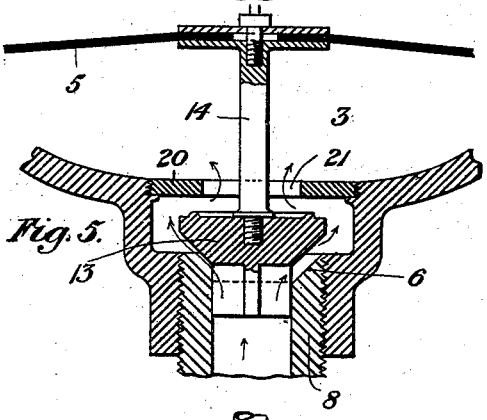
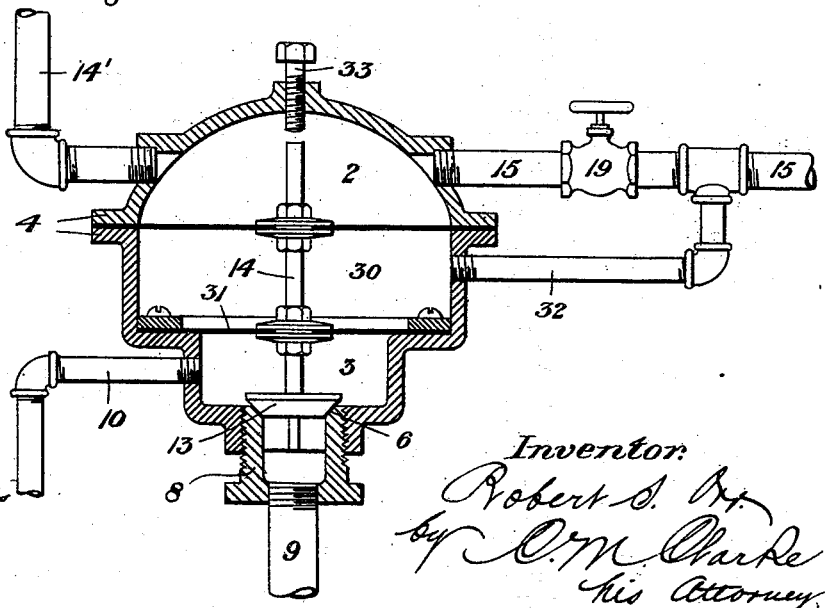


Fig. 6.



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UNITED STATES PATENT OFFICE.

ROBERT S. ORR, OF ALLEGHENY, PENNSYLVANIA.

WATER-HEATER.

SPECIFICATION forming part of Letters Patent No. 647,758, dated April 17, 1900.

Application filed April 15, 1899. Serial No. 713,143. (No model.)

To all whom it may concern:

Be it known that I, ROBERT S. ORR, a citizen of the United States, residing at Allegheny, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Water-Heaters, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a view in sectional elevation, illustrating the application of my improved regulator to a water-heater. Fig. 2 is a vertical section of the regulator, on an enlarged scale, showing the gas-valve open, permitting gas to flow to the burner. Fig. 3 is a similar view showing the double-seated gas-valve. Fig. 4 is a similar view showing the water-inlet pipe provided with a safety by-pass and diaphragm, permitting rupture to occur in such diaphragm to prevent bursting in other parts of the apparatus in case of possible derangement preventing seating of the valve. Fig. 5 is a sectional detail view showing the action of the valve when open. Fig. 6 is a similar view illustrating a construction employing a double diaphragm and dispensing with the retracting-spring.

My invention relates to the class of automatic water-heaters wherein the generation of heat is dependent on the flow of water; and it consists in the improved regulating-valve whereby the flow of the gas is controlled by and in proportion to the varying pressure of water passing through the regulator-chamber.

Referring now to the drawings, I have shown the application of my invention to the most usual form of this class of devices, wherein a coil of pipes 2 is arranged within a suitable shell 3 and in the path of circulation of the products of combustion of fuel-gas from burners 4′, supplied from a common pipe or chamber 5′. In the generality of this class of water-heaters the supply of fuel-gas to the burners is dependent upon and necessarily in proportion to the amount of water withdrawn and passing through the heating-coil, it being obvious that a greater heat is required to produce the same desired temperature when the water is passing rapidly through the coils with least time exposure than when passing through slowly with greater time exposure, and to this extent I do not claim invention, as such operation is evidenced by the following patents, to wit: United States patent to Chambers, No. 74,045, of February 4, 1868; British patent to Foulis, No. 10,555 of 1885; United States patents to Barnsted, No. 398,022, of February 19, 1889; Seamans, No. 422,841, of March 4, 1890; Rudd, No. 443,797, of December 30, 1890, and others of later date, as shown by the state of the art.

The regulator which forms the subject-matter of the present invention is shown incorporated with the heater in the general view and on a larger scale in various modified constructions in the subsequent detail views of the drawings.

The regulator is denominated by the letter A and is formed with a water-chamber 2 and gas-chamber 3 within suitably-shaped inclosing shell-like sections secured together by flanges 4. Extending across and forming a horizontal partition between these chambers is a diaphragm 5, of any suitable flexible material, as rubber, secured between these flanges and capable of movement in either direction. In the gas-chamber is a valve-seat 6 on the upper end of a hollow bushing 8, set up into the gas-chamber by means of screw-threads or otherwise, permitting adjustment of its position, and into this bushing is introduced the delivery end of a gas-supply pipe 9. A gas-delivery pipe 10 leads from the interior of the chamber 3 to the burner-chamber 5′, from which it passes to the burners 4′, air being furnished through mixers 11, while a pilot-light is kept constantly burning from the end of pipe 12, leading directly from the gas-supply pipe 9.

The flow of gas into the chamber 3, and consequently the supply to the burners, is controlled by a valve 13, normally seated upon the valve-seat 6 at top of the bushing 8, which valve is connected with the diaphragm by a stem 14, so that it will be seen that pressure upon the top of the diaphragm will seat the valve, while upward motion of the diaphragm will unseat it, permitting the gas to flow. Water to the heating-coils is furnished through pipe 14′, leading from the upper chamber 2, while a supply-pipe 15 from the main is introduced into the same chamber, and it will thus be seen that when there is no cir-

culation of water the static water-pressure will be maintained in the chamber 2 and will exert a pressure on the diaphragm 5, which pressure is sufficient to always keep the valve 13 seated. When any faucet or faucets in the delivery-pipe 16, leading from the heating-coil to any point of distribution, are opened, the pressure in the chamber 2 is immediately reduced, and I have provided means to raise the diaphragm and valve as against such reduced water-pressure consisting of a spring 17, the lower end of which is secured to the diaphragm and the upper end by means of an intervening swivel-joint 7 to an adjustable screw 18, set by screw-threads into the upper shell of the regulator-case. By turning this screw up or down the retracting action of the spring may be varied and adjusted very accurately to whatever normal pressure of water may exist in the main. In this manner it will be seen that reductions of water-pressure in the chamber 2 will result in an opening of the gas-valve in direct proportion to such reduction, so that if a very gradual flow of water is produced the decrease in pressure will be proportionally small, resulting in but a slight opening of the valve, while in case of a stronger flow the reduction in pressure will be greater and the proportionate opening of the valve also greater, admitting a proportionally greater flow of gas. Upon closing the water valve or faucet the static pressure in chamber 2 will be reëstablished and the flow of gas will be immediately shut off.

In order to secure a sufficient difference between the static pressure in the main and water-chamber 2 and the running pressure through the chamber when water is being drawn at any point, and thus to insure the operation of the diaphragm and valve, I employ means for partially shutting off the water-flow through the supply-pipe 15, such as a local-pressure-controlling valve 19, by which the rate of flow of water to the chamber 2 may be very accurately controlled and regulated. Another advantage of the local-pressure-controlling valve is that the regulator may be used with main-pressures of considerable variation, as it permits the pressures to be adapted to the tension of the diaphragm by proper regulation of the flow through the valve. In addition to the above function the local-pressure-controlling valve serves to control the flow of water in conformity with the capacity of the heater.

In case the pressure of water in the main is unusually low the diameter of the diaphragm may be proportionally greater; but ordinarily the tension of the spring 17 may be varied sufficiently to compensate for all such variations in the water-pressure of the main. It will be understood that in its normal position the static pressure of the water in the main is very quickly established and maintained in the chamber 2.

It frequently happens that the static pressure in the main pipe is reduced by reason of excessive drainage therefrom in use or in case of bursting of a main, and in such event the pressure in chamber 2 will be proportionally diminished and the diaphragm will rise, opening the valve. To provide against such an emergency and prevent further action in case a faucet should be opened, I have provided an upper valve-seat 20, (shown in Fig. 3,) against which the upper face or valve 13 will seat, thus shutting off the flow of gas until the static pressure is reëstablished, when the valve will be seated downwardly in the usual manner. It will be seen that this secondary valve-seat 20 is provided with a central opening 21 of sufficient area to permit the flow of gas in the ordinary operation. In case of any possible derangement which would prevent the normal operation I have provided the construction shown in Fig. 4. A check-valve 22 is inserted in the feed-pipe 15 between the local-pressure-controlling valve and chamber 2, which check-valve will be seated in case the pressure is reduced in the main, thus preventing escape of water outwardly to the main, so that it will be impossible in case of such reduction for the gas-valve to remain open longer than sufficient to generate sufficient heat in the coils to cause enough back pressure to cause reseating of the valve. In the case of such derangement the valve would remain open, admitting gas, which in turn would raise the temperature in the coils, and such operations would continue until all the water in the coils was converted to steam. By using the check-valve any pressure due to such action is confined to the chamber 2, resulting in closing the valve and shutting off the steam. At each side of such check-valve are connected the terminals of a by-pass pipe 23. At any point in such pipe is inserted a safety-diaphragm 24, of any suitable material, such as lead, and of sufficient strength to withstand ordinary pressures, but which will burst under such excessive pressure as would be dangerous and threaten to burst any portion of the apparatus. In this construction in case of excessive pressure, as I have described or in case foreign matter should interfere with the operation of the valve, the check-valve 22 will be seated and the diaphragm 24 will burst, relieving the pressure in the main and preventing accident.

It will be understood that in the forms that I have described the retractile power of the spring 17 may be very accurately adjusted to provide for the operation of the valve in conformity with whatever pressure may exist in the main.

In Fig. 6 I have shown a construction in which the static water-pressure replaces the spring of the former construction. In this case I have provided a secondary water-pressure chamber 30 below the usual chamber 2, which must always be in open communication with the main, between which chamber 30 and the valve-chamber is a secondary dia-

phragm 31, secured, like the diaphragm 5, to the valve-stem 14. This secondary diaphragm is employed to provide a partition between the secondary chamber 30 and the valve-chamber, and in order to permit the main diaphragm 5 to perform its functions under the varying pressures existing between the upper and lower chambers 2 and 30 the diaphragm 31 must be of considerably-less diameter. Into the chamber 30 is introduced a branch pipe 32 of the main feed-pipe 15, such branch pipe being connected thereto necessarily beyond the local-pressure-controlling valve. When the faucets are all closed, both sides of diaphragm 5 are subjected to the same pressure, and consequently an equilibrium will be established which will not be disturbed until pressure in chamber 2 is diminished by opening one or more of the faucets, and the pressure upon diaphragm 31, owing to such equilibrium, will keep the valve 13 seated. Upon diminution of pressure in chamber 2 the undiminished pressure in chamber 30 will exert a raising action on the upper diaphragm, due to its greater exposed area, which will raise the valve 13 from its seat. Upon pressure being reëstablished in chamber 2 the normal conditions will be again resumed and the valve will be seated. For the purpose of controlling the upward travel of the valve-stem a screw 33 is inserted in the case, which limits its motion at any desired point.

The construction and operation of my improved regulating-valve is very simple and efficient, not liable to get out of order, and it can be built at low cost.

The diaphragms are not subject to derangement by reason of foreign matter or collection of sediment, such as affects other forms of regulator-valves, by reason of the cleansing action of the circulating water through the chamber 2, and they may be easily and quickly renewed in case it is desired.

Various changes and modifications may be made in the construction or design by the skilled mechanic without departing from my invention, and I do not desire to be limited to the exact construction shown, but to include all such changes within my invention as expressed in the following claims.

What I claim is—

1. In combination with a burner and a water-heater; a regulator situate between the main water-pipe and the heater and provided with a water-chamber through which all the water to the heater passes; a water-inlet pipe leading from the main water-pipe directly into the water-chamber; a positively-operated local-pressure-controlling valve between the main water-pipe and the water-chamber, by which the water-supply to the water-chamber may be positively regulated; a water-outlet pipe leading directly from the water-chamber and connected with the heater; a flexible diaphragm in the regulator subject to the water-pressure in the water-chamber and forming one wall thereof; a valve connected with the diaphragm for controlling the flow of gas to the burner; and mechanism for retracting the diaphragm and opening the gas-valve upon flow of water through the water-chamber to the heater, such mechanism being made operative by the reduction of pressure in the water-chamber due to the difference between the static and running pressures.

2. A regulator for water-heaters provided with upper and lower water-chambers, an intervening diaphragm of flexible material, a gas-chamber below the lower water-chamber, an intervening diaphragm of flexible material of reduced area, gas inlet and outlet pipes leading to the gas-chamber, a valve adapted to regulate the flow of gas therethrough connected to both diaphragms, a water-outlet pipe leading from the water-chamber, a water-inlet pipe leading thereinto provided with a local-pressure-controlling valve, a branch pipe leading from the water-inlet pipe beyond the local-pressure-controlling valve to the lower water-chamber, substantially as set forth.

3. A regulator for water-heaters provided with upper and lower water-chambers 2 and 30, an intervening diaphragm of flexible material, a gas-chamber below the lower water-chamber, an intervening diaphragm of flexible material of reduced area, gas inlet and outlet pipes leading to the gas-chamber, a valve adapted to regulate the flow of gas therethrough connected to both diaphragms, a water-pressure pipe communicating with the main and chamber 2, a local-pressure-controlling valve adapted to control such pressure, and a direct water-pressure connection from the supply-main beyond the local-pressure-controlling valve to chamber 30 whereby a practically-constant pressure is maintained in such chamber, substantially as set forth.

In testimony whereof I have hereunto set my hand.

ROBERT S. ORR.

Witnesses:
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C. M. CLARKE.