

F. L. O. WADSWORTH.
 WATER HEATER CONSTRUCTION.
 APPLICATION FILED NOV. 10, 1911.

1,069,046.

Patented July 29, 1913.

2 SHEETS—SHEET 1.

Fig. 2

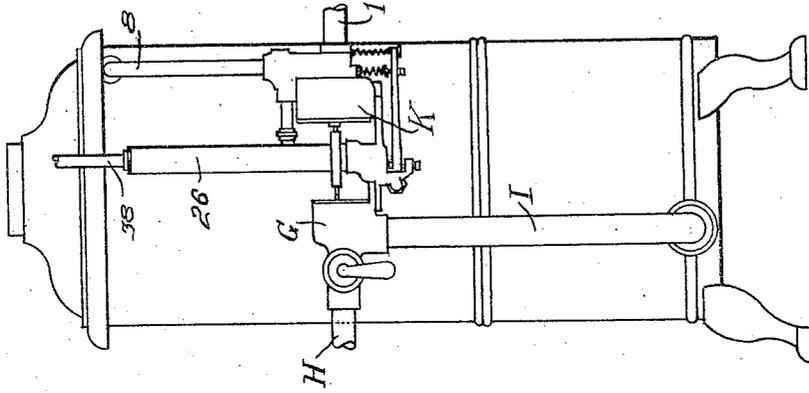
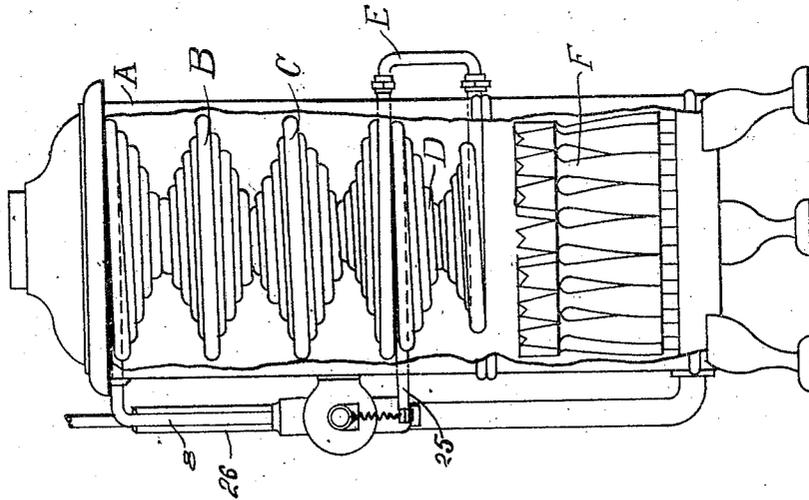


Fig. 1



WITNESSES

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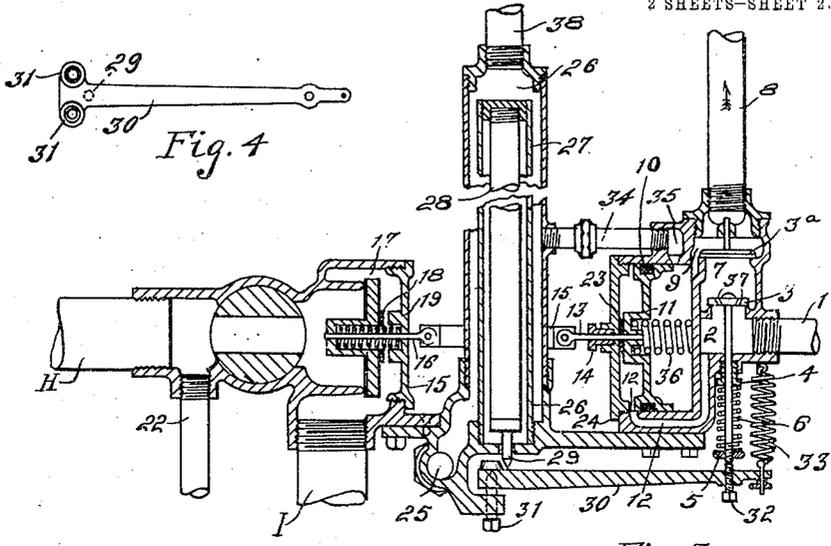


Fig. 4

Fig. 3

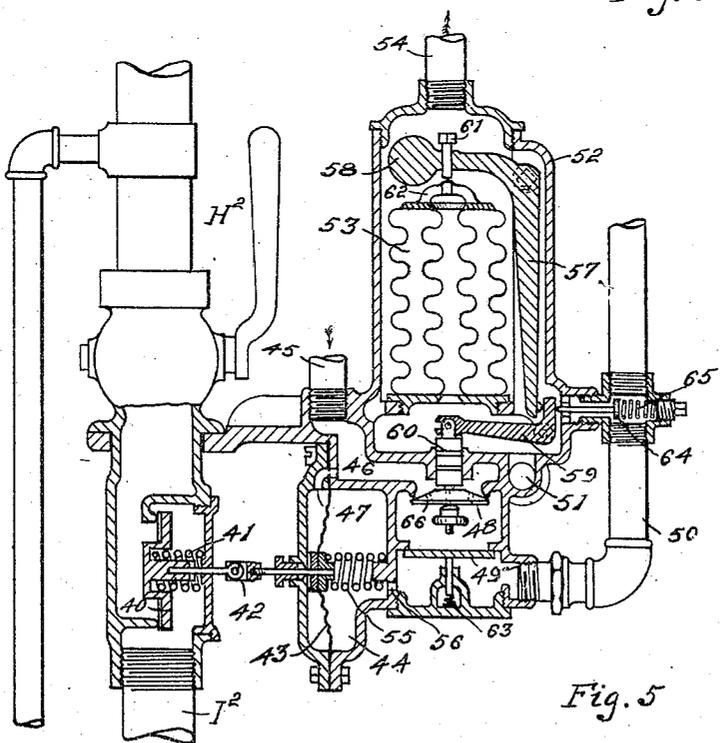


Fig. 5

WITNESSES

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UNITED STATES PATENT OFFICE.

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WATER-HEATER CONSTRUCTION.

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To all whom it may concern:

Be it known that I, FRANK L. O. WADSWORTH, a citizen of the United States, residing at Sewickley, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Water-Heater Construction, of which the following is a specification.

My invention relates to improvements in water heater construction and has for its general object; the temperature regulation of the fuel supply to the burners of a water heater by a combined water-flow and thermostatic control of a single fluid pressure operated member. Broadly stated this control is effected by exposing the opposite sides of the fluid pressure actuated member to differences in pressure set up by the flow of the fluid through the heater circuit, and changing these differences in pressure by changing the resistance to the flow of the water in that circuit.

My invention has for a further object, the provision of various forms of simple and reliable means for effecting the above objects.

Certain embodiments of the invention are illustrated in the accompanying drawings, wherein—

Figures 1 and 2 are front and side elevations respectively of a heater with my improved controlling mechanism applied thereto; Fig. 3 is a section on an enlarged scale through the controlling mechanism wherein my invention particularly resides; Fig. 4 is a detail of the thermostat lever employed; and Fig. 5 is a section through a modified form of the invention.

Referring to Figs. 1 and 2, A is the casing of the heater; B and C are the upper coils, of tubing; D is the lower reverse coil connected to the upper coils by means of the pipe E; F are the burners mounted on the usual burner ring; G is the gas valve casing having the inlet pipe H and the outlet pipe I leading to the burner ring; and K is the casing of the controlling mechanism. It will be understood that the general heater construction shown and described is only one of many which may be used, and that the controlling mechanism as shown in Figs. 4 and 5 is of general application.

In the construction shown in Figs. 2 and 3, 1 is the cold water supply pipe leading from the water main to the automatic control mechanism. This pipe enters a cham-

ber 2 of the casing K closed at the top by a spring controlled check valve 3, the stem of which leads through a stuffing box 4 at one end of the chamber and is provided at its outer end with a nut 5, by means of which the tension of the spring 6 can be varied. It will be noted that the arrangement of parts is such that the stem of the check valve is exposed to unbalanced water pressure which tends to keep the valve closed and thus supplements the action of the spring 6. This arrangement is of importance because it affords an automatic regulation of the closing pressure on the check valve which varies proportionally to the pressure of the liquid in the heater. By varying the relative sizes of the stem and check valve seat, the proportionality between the closing pressure on the check valve (due to the joint action of the water pressure and the spring 6 on the stem) to the differences of pressure produced by the flow of water through the valve can be varied to any extent desired. Above the check valve is a second chamber 7 which is closed at the top by a light gravity controlled check valve 3^a. The opening above this valve 3^a communicates with the pipe 8 leading to the cold water inlet of the heater chamber or coils (Fig. 2), and communicates also by the port 9 with the right hand end of the cylinder 10 in which is located the fluid pressure actuated piston member 11 (see Figs. 1 and 2). The port 12 leads from the chamber 2 to the left hand end of the cylinder 10, so that the piston member 11 is exposed on its two sides respectively to the pressures existing in the chamber 2 and pipe 8. The piston member 11 is operatively connected with the stem 13 which passes through the stuffing box 14 of the cylinder 10 and is coupled at its outer end by a yoke 15 to the stem 16 of the gas valve 17. This gas valve is of large diameter so as to secure a full port opening with a very small longitudinal movement, and is provided on its rear face with a leather washer 18 opposite a boss 19 on the opposing face of the valve box and is so adjusted relative thereto that the opening movement of the parts brings its rear face into contact with said end and seals the opening around the stem 16, thus avoiding the use of a stuffing box for that stem. The opening of the valve 17 allows the gas to pass from the supply pipe H to the pipe I which communicates with the

main burners of the water heater. This same valve box also contains an ordinary plug valve and has a connection back of this plug valve for a small pipe 22 leading to the pilot light, which is used to ignite the gas supply which passes to the main burners through the pipe I. The central boss of the piston 11 is also provided with a washer 23 which in the closed position of the valves is seated against the opposing face of the cylinder head 24 and prevents leakage around the stem 13.

After passing through the heating chamber or coils, the hot water issues from a passage 25 (see Fig. 1), and enters a thermostat chamber 26. Located in this thermostat chamber is a positive thermostat element of the usual construction consisting of an outer expansion tube 27 secured in the lower end of the thermostat chamber, and an inner negative element 28 of nickel-steel, Invar-metal or porcelain which is secured at its upper end to the adjacent part of the tube 27 and carries at its lower end a knife edge terminal 29 engaging with the thermostat lever 30. This thermostat lever 30 is mounted on two screws 31—31 (see Fig. 3), and carries at its outer end an adjustable screw 32 which is opposite the end of the stem of the check valve 3; and the various operating parts of the thermostat are kept in engagement by means of a tension spring 33. A pipe connection 34 leads from the thermostat chamber 26 to a narrow port opening 35 located just in advance of the forward edge of the piston member 11.

The operation of this apparatus is as follows: When the water is at rest the pressures in all parts of the apparatus are uniform and the piston member 11 is held in the position shown in the figure by the action of the spring 36. Small perforations 37 are provided in the check valve head 3 and these perforations allow a certain amount of liquid to pass through the heater without raising the check valve from its seat, thus providing for "leaky faucets." But when any considerable flow of water is turned on—for example by opening one of the faucets in the house supply pipe 38 which leads from the thermostat chamber 26—the check valve 7 is raised from its seat against the pressure of the water and the pressure of the spring 6 on its stem, and the resistance to the flow of the water against these resisting pressures sets up a difference in pressure in the liquid in the chamber 2 and the pipe 8, thus establishing a difference of pressure on the two sides of the piston member 11. The withdrawal of water through the port 25 assists in this action. The piston 11 is thus moved to the right against the pressure or tension of its restraining spring 36, thus opening the gas valve 17 and allowing fuel to flow to the main burners where it is ig-

nited by the pilot light. The forward movement of the piston also closes the port 35 compelling all the water to flow through the heating receptacle. When the flow of water is shut off, the check valves 3 and 3^a close, the pressures of the liquids in the two ends of the cylinder 10 are equalized, and the spring 36 returns the piston 11 to its initial left hand position, thereby closing the gas valve 17 and shutting off the supply of fuel from the burners. If, while the water is still flowing, the temperature of the liquid in the thermostat chamber rises above a certain point—determined by the adjustment of the screw 32—, the expansion of the member 27 will lift the negative member 28 sufficiently to allow the spring 33 to bring the screw 32 into contact with the stem of the check valve 3, and thus support the check valve in its raised position against the combined water and spring pressure which tends to force it to its seat. In order to secure this result, the spring 33 is made sufficiently stiff to overcome the combined pressures of the water and spring 6 on the stem of the valve 3. When the water passing through this valve is relieved of the work of supporting the valve head, the pressures in the chambers 2 and the pipe 8 are equalized,—or the difference in these pressures is at once greatly reduced—and the piston member 11 is moved as before by the spring 36 to its initial position, thus closing the gas valve 17. This movement once more opens the port 35 allowing a small amount of cold water to flow directly into the thermostat chamber and aid in more rapidly cooling off the thermostat parts. When the temperature falls again—the water still flowing—the contraction of the expansion member 27 of the thermostat presses down the thermostat lever 30, taking away the support of the check valve 3 and subjecting the water passing through that check valve to the restraining pressures acting on the check valve head, thereby again setting up the operative differences of pressures on the two sides of the piston member 10 and once more opening the gas valve 17. One important feature of my construction is that the operative parts are so arranged that the movements of those parts subject the stems 13 and 16 to tension only. As a result of this it is possible to make these stems of very small diameter, and thus eliminate nearly all of the friction of these stems in their bearings. This arrangement further makes it possible—as already explained—to dispense entirely with the usual stuffing box for the gas valve stem, for when said valve is closed no gas can flow into the front part of the valve box and when it is opened the space around the stem is sealed effectually by the engagement of the washer 18 with the boss 19. It further renders it possible to adjust the stuffing box 14 quite loosely on

the stem 13, because the opening around that stem is also sealed, quite independently of the stuffing box by the engagement of the washer 23 with the cylinder head 24, and the only time when said stuffing box is necessary at all is the comparatively small portion of time when the piston 11 has been moved to the right, and the gas turned on. The operation of the control mechanism is such moreover, that the piston 11 is either in the position shown or is moved fully over to the right; in other words, it is such that the valve mechanism is either fully open or fully closed, and one of the washers 18 or 23 is therefore always in contact with its seat. Another advantage of my improved control mechanism is that, as no water has to pass through the cylinder 10, or from one side to the other of the piston 11, there is but little chance of the movements of the parts becoming clogged with sediment or corroded. The parts of the cylinder in which the piston moves contains no ports over which the piston's packing ring has to pass, and as a small leakage from one end of the cylinder to the other is of no consequence, I can use a loosely packed very freely moving piston, that will operate under all conditions on very small differences of pressure, and will never be liable to stick or bind in any part of its movement.

But in order to absolutely remove any possibility of any of the parts "sticking" in their open position—when the gas is turned on—and thus overheating the apparatus when no water is flowing, I provide the auxiliary check valve 3^a. This has no action except that of a safety device. If, however, the piston 11 should "stick" in its right hand position, when the flow of water is stopped, it will be immediately forced back to the closed position as follows: on the cessation of flow the valve 3^a returns to its seat and confines the water in the heater between it and the now closed house service pipe 38. The heating up of this confined body of liquid, by the continued supply of fuel to the main burners, will generate a positive pressure in the heating receptacle, and this pressure will be transmitted through the port 9 to the right hand side of the piston member 11, and will force said member back to its left hand position, thus closing off the gas valve 17. The auxiliary check valve 3^a also acts in preventing any back flow from the heater and house service pipe when a faucet is opened in the cold water supply pipe 1; and consequently avoids any "rebounding" or recoil of the water into the heater when the said cold water faucet is once more shut. This prevents the well known "reaction" effect, to which many water flow control heaters,—having water flow gas controlling valves—are subject; and which, when present, results

in a temporary opening of the gas supply valve with the closing of the cold water faucet.

The provision of the by-pass port 35 which is closed and opened by the movement of the water actuated member is also a feature of my improvements. This port assists, as already explained, in setting up an initial difference of pressure on the two sides of the piston member 11, when the flow of water is first started, and thus assists in the rapid opening movement of the said piston member, and the gas valve controlled thereby. But it has also another important function, and this is to establish a free circulation passage between the inlet and outlet openings to the heater receptacle or coils when no water is flowing; and thus permit the liquid in said receptacle to circulate freely therein under the influence of the heat of the pilot light. It has still the further function—already explained—of admitting a small amount of cold water directly to the thermostat chamber 26 immediately upon the return of the piston member 11 to the "closed" position by the action of the thermostat. This results in the more rapid cooling down of the thermostat, prevents the "lag" of that member, and aids in securing greater sensitiveness of action, and closer regulation of the temperature of the flowing liquid.

In Fig. 5 a section through a modified form of controlling mechanism is illustrated, the principle and general construction however, being substantially the same as that shown in Fig. 3. In this construction of Fig. 5, H² is the gas supply pipe leading to the valve 40, and I² is the gas pipe leading from the valve to the burner ring. The gas valve is normally held closed by means of the spring 41, but may be moved to open position by means of the stem 42' connected to the diaphragm 43 located in the chamber 44. 45 is the cold water inlet pipe from the main leading to the passage-way 46, which has a branch 47 leading to the left hand side of the diaphragm, and another branch leading to the right past the valves 48 and 49, which valves 48 and 49 correspond to the valves 3 and 3^a in the structure of Fig. 3. After passing the valve 48, the incoming cold water passes through the pipe 50, which corresponds to the pipe 8 in the construction of Fig. 3, such pipe 50 being connected to the upper coil of the heater. The water after passing through the heater emerges from the lower reverse coil through the passage 51 at the lower end of the thermostat casing 52. In the thermostat casing 52 is a corrugated metal box 53 filled with an expansible liquid, such as ether or crude oil, and the upper end of the casing is provided with an outlet pipe 54 leading to the house service pipe, such pipe 54 corresponding to the pipe 38 in the construction of Fig. 3.

The diaphragm 43 normally occupies the position shown in the drawing, being held in such position by means of the spring 55, but when the outlet from the heater is opened, the pressure on the right hand side of the diaphragm is decreased by reason of the port 56 and the check valves 48 and 49, so that the diaphragm moves to the right causing the opening of the valve 40 and a flow of gas to the burners of the heater. When the outlet from the heater is closed the valve 48 is maintained in closed position by means of the lever 57, which is provided with a weighted end 58 and engages the short arm of the lever 59, thus maintaining the valve in the position shown. When the outlet is opened, this tendency of the valve 48 to remain closed, is augmented by reason of the fact that the pressure in the thermostat casing 52 is less than the pressure in the chamber carrying the valve 48, the stem 60 being made large in order that the differential pressure thereon may be increased. The lever 57 is provided with an adjusting screw 61, adapted to engage a stud upon the plate 62 carried by the corrugated thermostat box 53, and if during the withdrawal of water from the heater, the temperature thereof rises above a predetermined point for which the thermostat is set, the stud upon the plate 62 engages the end of the screw 61, thus permitting the valve 48 to open by gravity. The opening of the valve 48 reduces the differential pressure on the opposite sides of the diaphragm 43, so that such diaphragm moves to the left under the influence of the spring 55 and the gas valve is closed. As heretofore indicated, the valve 49 corresponds in function to the valve 3^a, but instead of being held closed by gravity as is the valve 3^a in the construction of Fig. 3, this valve 49 is held in closed position by means of the spring 63. In order to permit a circulation from the thermostat casing to the upper coil of the heater when the outlet from the heater is closed, the check valve 64 is provided, such check valve being normally held in open position by the short arm of the lever 59. When the outlet from the heater is opened, however, this valve will be closed by the spring 65. The opening of the valve 48 and the moving of the short arm of the lever 59 to the left permitting of such closure at this time, so that it is impossible for the cold water flowing through the pipe 50 to pass the valve 64 and flow into the casing 52 and reduce the temperature of the outflowing water. The valve 48 is provided with the small passages 66 corresponding to the passages 37

in the valve 3 of Fig. 3. The operation of the apparatus as just described will be obvious, such operation being substantially the same as that heretofore described in connection with Fig. 3.

Having thus described my invention and illustrated its use, what I claim as new and desire to secure by Letters Patent is the following:—

1. In an automatic water heater, a burner, a gas valve for controlling the supply of gas to the burner, a pair of pressure chambers connected to different portions of the heater having different water pressures when the outlet from the heater is open, a member actuated by the differential pressures in the chambers for opening the gas valve, a by-pass between the two chambers, a valve in the by-pass, thermostatic means governed by the temperature of the water in the heater and arranged to open the said valve and permit the equalization of pressure in the two chambers when the temperature of the water rises above a predetermined point, and a check valve arranged to close and cut off a back flow of pressure to one chamber and permit such back flow to the other chamber in case the said member and the gas valve stick in open position and the temperature of the water in the heater rises above a predetermined point.

2. In an automatic water heater, a burner, a gas valve for controlling the supply of gas to the burner, a pair of pressure chambers connected to different portions of the heater having different water pressures when the outlet from the heater is open, a member actuated by the differential pressures in the chambers for opening the gas valve, a by-pass between the two chambers, a valve in the by-pass, thermostatic means governed by the temperature of the water in the heater and arranged to open the said valve and permit the equalization of pressure in the two chambers when the temperature of the water rises above a predetermined point, and a check valve in the said by-pass positioned to cut off a back flow of pressure to one chamber in case the said member and gas valve stick in open position and the temperature of the water in the heater rises above a predetermined point.

In testimony whereof I have hereunto signed my name in the presence of the two subscribed witnesses.

FRANK L. O. WADSWORTH.

Witnesses:

LETTIA A. MYERS,
DOERING BELLINGER.