No. 607,660. Patented July 19, 1898.

J. A. MILLER.

HEATER.

(Application filed Oct. 6, 1896.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1

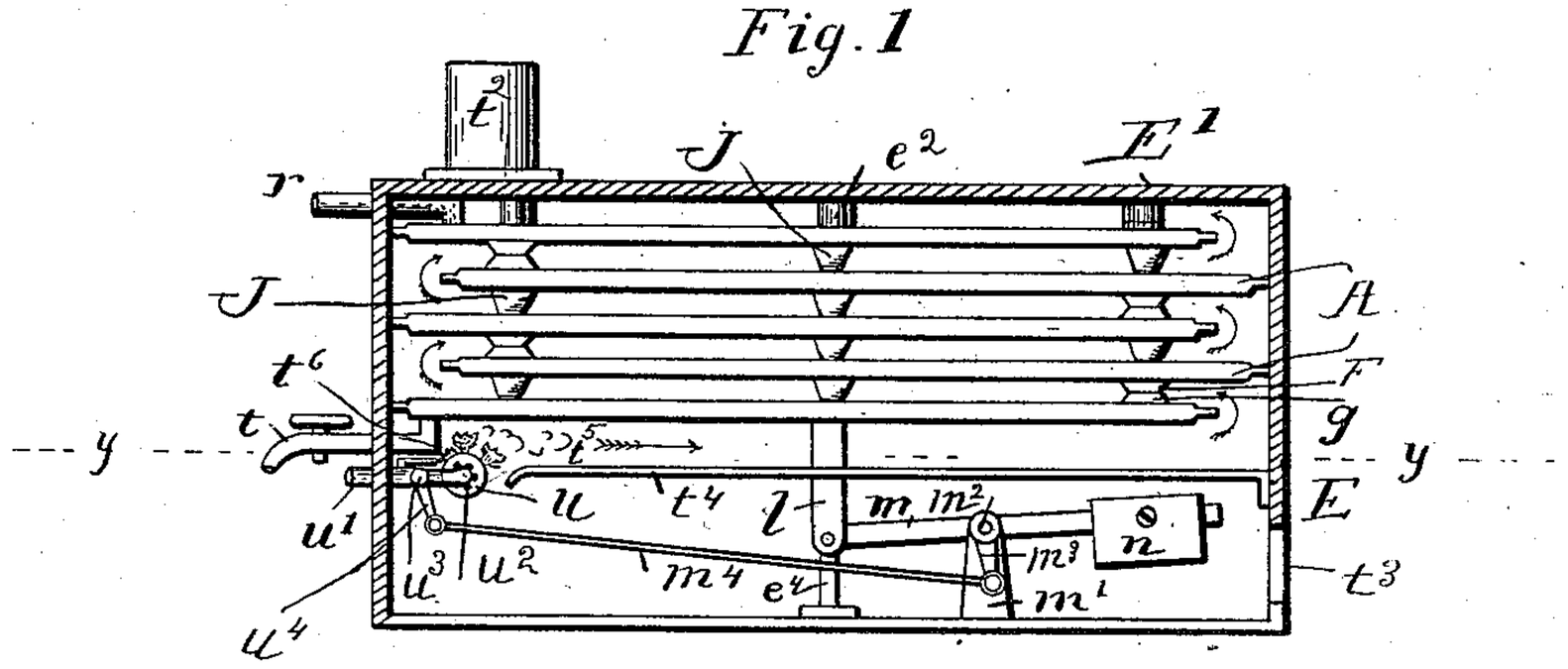


Fig. 2

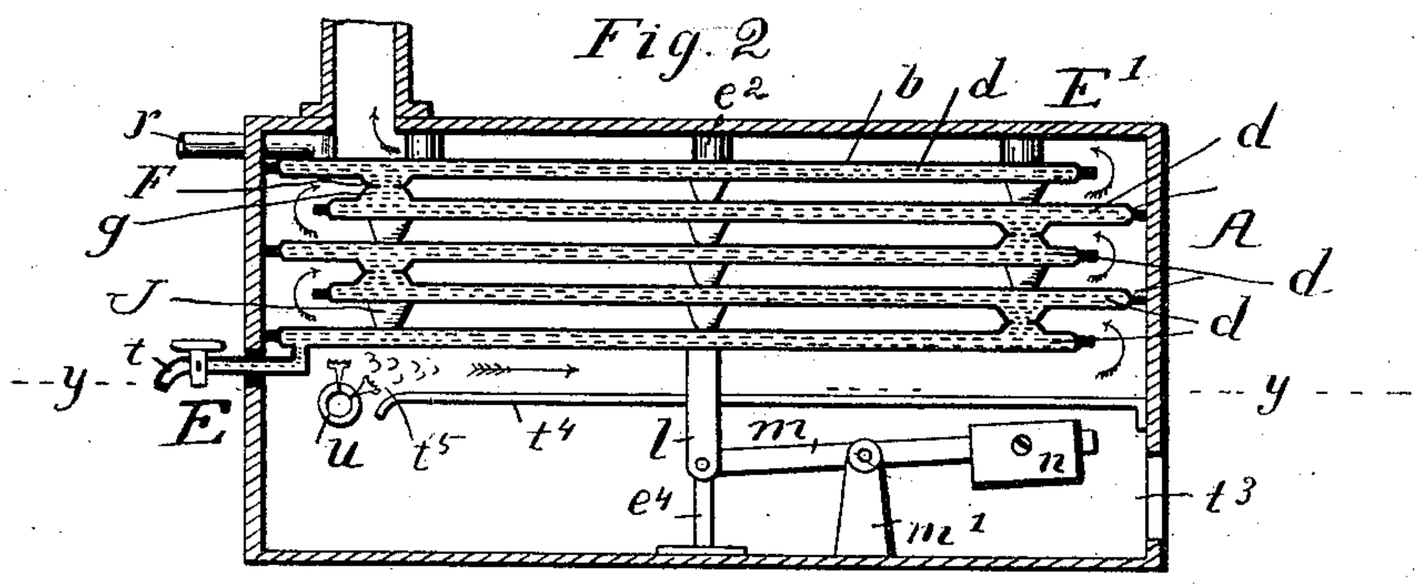
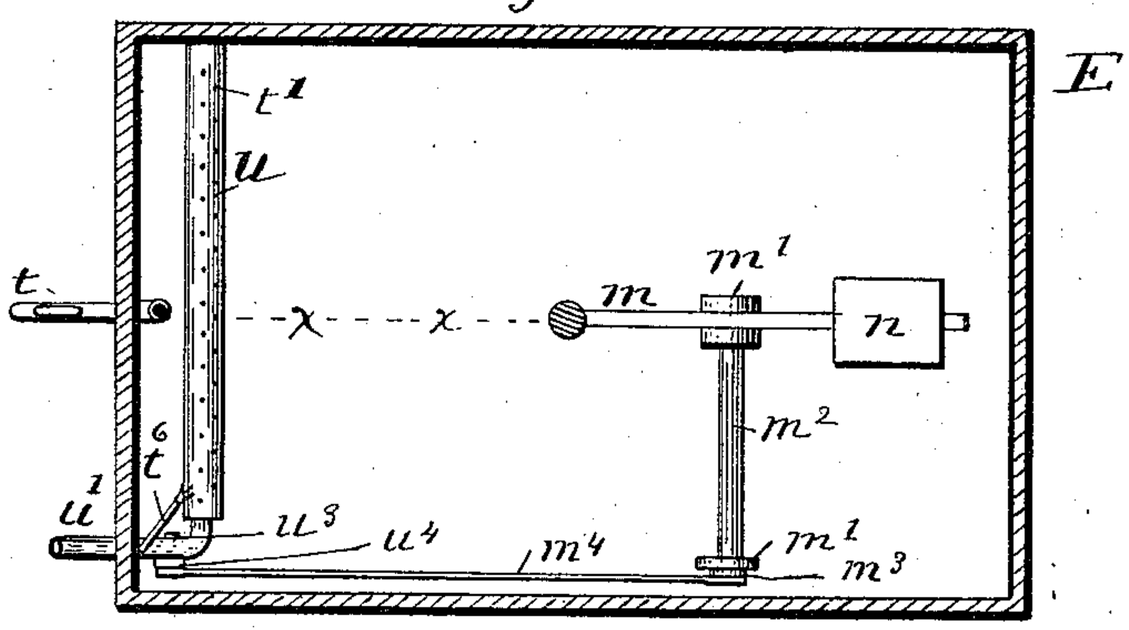


Fig. 3



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By Georg L. Barnes Atty.

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Fig. 4

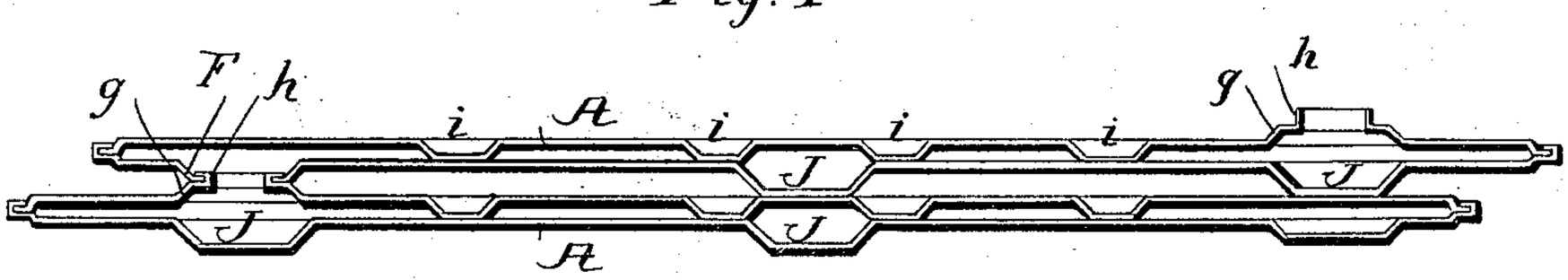


Fig. 5

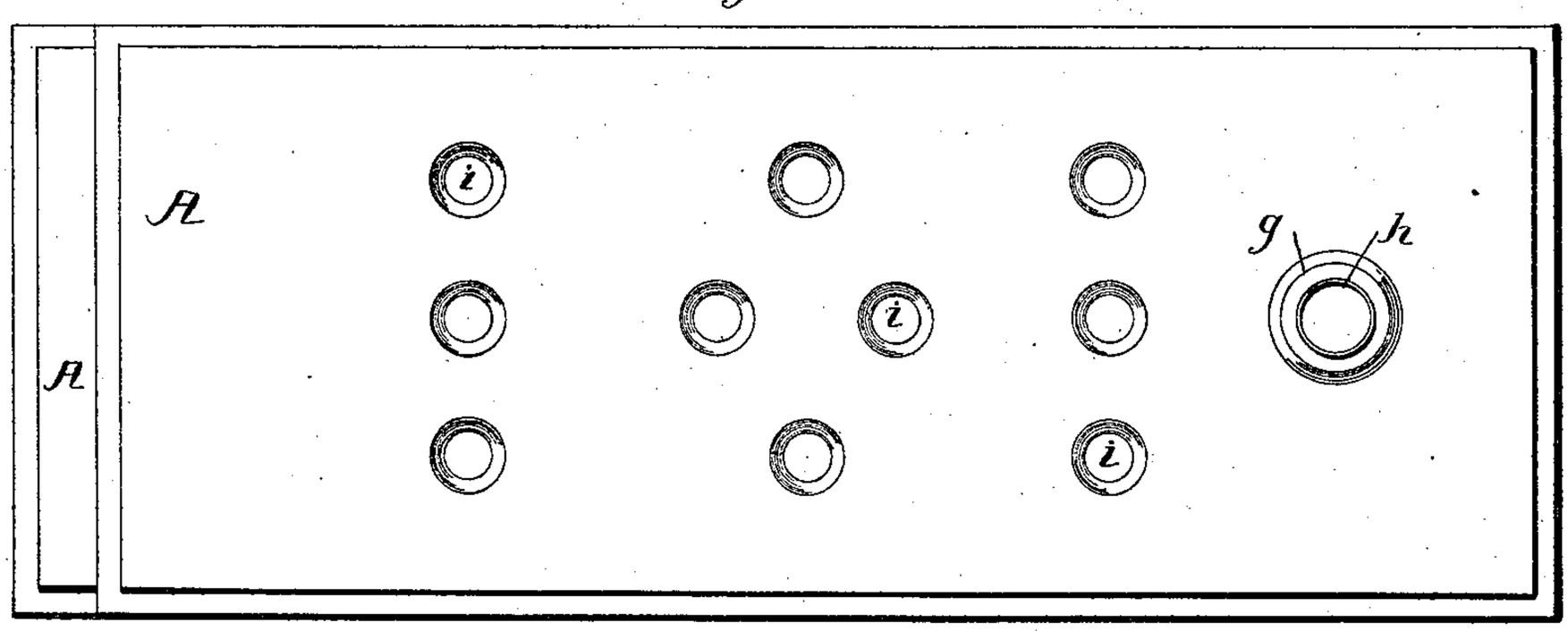
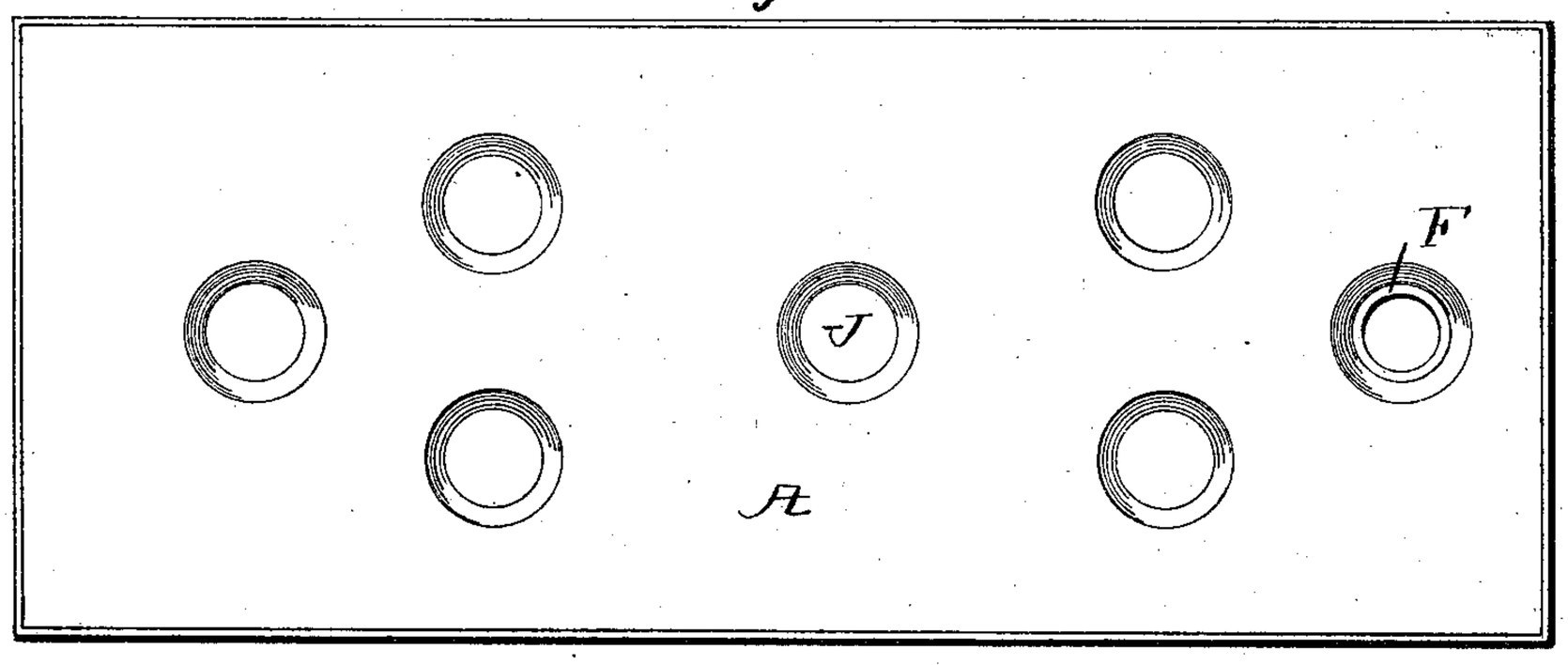


Fig. 6



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UNITED STATES PATENT OFFICE.

JAMES ACTON MILLER, OF NEW HAVEN, CONNECTICUT.

HEATER.

SPECIFICATION forming part of Letters Patent No. 607,660, dated July 19, 1898.

Application filed October 6, 1896. Serial No. 608,029. (No model.)

To all whom it may concern:

Be it known that I, JAMES ACTON MILLER, a citizen of the United States, and a resident of New Haven, in the county of New Haven and State of Connecticut, have invented certain new and useful Improvements in Heaters, of which the following is a specification.

My invention relates to an automatic water-heater, the object being to provide a heater in which the application of the heat shall be controlled by or depend upon the operation of drawing water from or circulating through the heater, whereby the instantaneous heating of the liquid is effected as it flows through the apparatus and the heat-supply at all times proportioned to the quantity of water drawn or circulated. The invention contemplates the use of gas for fuel, the flame being automatically lighted and extinguished, respectively, by the acts of opening and closing the discharge-cock for drawing water.

The invention consists in the novel arrangement and combination of a series of diaphragm heating-cells or thin expansible sections arranged in continuous connection and means for regulating the heat-supply in inverse proportion to the expansive action of the cells or pressure therein.

The invention further consists in the construction of parts, all as hereinafter more fully described and claimed.

In the accompanying drawings, forming a part of this specification, Figure 1 is a side elevation of my automatic heater with the side of the case or jacket removed to show the interior. Fig. 2 is a central vertical longitudinal section on line X X, Fig. 3. Fig. 3 is a plan section on line *y y* of Fig. 2. Fig. 4 is an enlarged longitudinal vertical section through a pair of detached heating-cells, showing the construction. Fig. 5 is a plan view of Fig. 4. Fig. 6 is a plan view of the lower half of a heating-cell, the upper half being removed to show the construction.

Referring to the drawings, A designates the heating-cells, formed of the thin parallel plates *b*, fastened or riveted together at their edges in any well-known or suitable manner, that shown consisting of folding the edge of one of the plates over the other and then "setting" it down, as shown in Fig. 4, afterward brazing the joint to render it water-tight. The edges of the plates are offset slightly from the plane of the plates, as shown, and the two plates forming a cell are placed together in opposite order, thus forming a space *d* between them. The cells are placed horizontally over each other, but each offset longitudinally from the one below in alternative order, so that the end edges of the cells form zigzag lines, as shown; but the side edges of the cells are placed vertically over each other, as shown in Fig. 5, and fit tightly against the sides of the inclosing case or jacket E. The projecting ends of the cells also fit tightly against the ends of the case, and the cells thus arranged form a continuous zigzag passage throughout the apparatus between the cells and around alternate ends thereof, as shown in Figs. 1 and 2 and designated by the arrows therein.

The cells are connected together at alternate ends to form a continuous zigzag passage *d d d d d* within the cells throughout the apparatus, corresponding to that between the cells hereinbefore described. Such connection is preferably made by raising an annular cone F on one of the plates and a corresponding cone *g* and vertical annular flange *h* on the opposite plate of the next cell, which annular flange *h*, being inserted through the annular cone F and then riveted over and the joint brazed, forms a tight, practical, and cheap construction. Suitable depressions *i* are formed in one of the plates for the purpose of holding the two plates of a cell apart or preventing their collapse, as shown in Figs. 4 and 5, and suitable depressions J are formed in the opposite plate to maintain the cells at a fixed distance apart, as shown in Figs. 1, 2, 4, and 6. All of said depressions, the annular cones F *g*, flange *h*, and the configuration of the edges of the plates may be formed by a single stamping process in the thin sheet metal of which the plates are constructed.

The series of cells are arranged within the case E, supported upon a rod *l*, which is mounted upon one end of a balance beam or lever *m*, pivoted to the brackets *m'*, and upon the opposite end of which a weight *n* is hung and by means of which the cells are suspended all in contact and in the upper part of the case, but held at a short distance from the top E' by lugs e^2 thereon, forming a passage

between the uppermost cell and the top E', similar to and comprising a part of the passage between the cells. The weight of part *n* should exceed that sufficient to counterbalance the weight of the series of heating-cells, and it is preferably arranged movably upon its lever, as shown, thus permitting adjustment of the amount of the weight by setting the weight toward or away from the center.

The upper end of the series of cells is connected by an inlet-pipe *r* to the water-main or other supply of water under pressure, and an outlet-faucet or stop-cock *t* is connected to the lower end of the series of cells or passage through the cells, whereby as the water is drawn off at said outlet it flows in at the inlet-pipe *r* and circulates throughout the series of cells. Under the lowest cell, in juxtaposition to the outlet, a horizontal tube or mixing-chamber *u* is arranged, having the gas-supply pipe *u'* connected at one end thereof in any suitable manner to provide a limited air-supply in combination with the gas-jets—as, for instance, through channels u^2 around the gas-pipe *u'*, where it enters the end of the mixing-chamber, as shown. In the gas-supply pipe *u'* is placed a valve u^3, similar to the stop-cock *t*, having the exterior rock-arm u^4 and adapted to regulate or shut off the flow of gas to the mingling-chamber. To the balance-beam *m* a shaft m^2 is secured, journaled in the brackets *m'*, and on the end of the shaft is a rock-arm m^3, which is connected by rod or connection m^4 to the rock-arm u^4 of the valve. With this construction the descent of the weighted end of the balance-beam will open the valve and allow the gas to flow into the mingling-chamber. The mingling chamber or tube is provided with perforations *t'*, through which the gas escapes in jets, which, being ignited, produces a flame t^5 and causes a current of hot air to circulate throughout the entire length of the flue or passage designated by and in the direction of the arrows, a suitable chimney t^2 being provided at the upper end of the flue, and an air-inlet t^3 in the case E underneath the cells, preferably at that end of the case opposite the mingling-tube, with a baffle-plate t^4, arranged as shown, to conduct the air to the end adjacent the mingling-tube before coming in contact with the lower cell of the series. A single gas-jet or ordinary pilot-light t^6 is brought from the gas-tubes at a point interior to the valve u^3, whereby the said pilot-light will not become extinguished by closing the valve, but will always remain burning and in readiness to ignite the gas-jets of the mingling-tube when gas is admitted thereto.

Constructed as thus described and claimed the operation of this automatic heater is as follows: The series of cells or diaphragms A being filled with water or other liquid under pressure, expansive or diaphragmatic action of the cells will take place, which, multiplied or increasing with each cell, will thus depress the rod *l* and corresponding end of the balance-beam *m* and elevate the weight *n*, thereby holding the valve u^3 closed by means of the connections between the valve and the balance-beam, such expansion, if necessary, being limited in amount by suitable stop mechanism—as, for instance, by the pedestal e^4, placed under the end of the rod *l*. The pilot-light being burning, if the outlet-cock *t* be operated and the water in the cells thereby drawn off the pressure in the cells will be reduced and so remain as long as the water is flowing, thereby allowing the cells or diaphragms A to contract and collapse by the force of the weight *n*, and thus open the valve u^3 by means of the connection between the valve and balance-beam. Gas will thus be admitted to the mixing-chamber *u* and, issuing therefrom in jets, will be ignited by the pilot-light, and the flame and heated gases will flow along the passage indicated by the arrows and escape by the chimney t^2, thus being brought in contact with both the lower and upper sides of all the cells. The body of water in the cells being spread out in very thin sheets and the heating-surface of the apparatus being relatively very great and the water being admitted at that end of the series of cells where the heated gases are most cool and drawn off from the end where said gases are hottest the water will be instantaneously heated simply by flowing through the apparatus. Consequently hot water will always flow from the outlet though the contents of the apparatus are cold at the instant of turning the cock *t*. When the said cock is shut, the flame of the gas-jets will also be instantly extinguished, as before set forth, and the action of the apparatus is thus rendered automatic.

For kitchen and laboratory purposes this heater is adapted to replace at small cost the expensive and cumbrous apparatus usual for maintaining a reservoir of hot water of sufficient capacity to insure an adequate supply of hot water at all times, and in addition renders the use of a fire at such times as it may not be desired entirely unnecessary.

It will readily be understood that the arrangement of the series of cells may be inverted or the reverse of that shown—that is, the bottom cell may rest on suitable supports and remain stationary and the weight for holding the cells collapsed placed on top of the series. The expansion of the cells due to pressure would then be upward and the weight upon the cells alone would produce the result hereinbefore described in connection with the apparatus shown. In such case the inlet-pipe would be movable and the outlet-pipe stationary, which is just the reverse of the preferred construction shown, wherein the inlet-pipe is stationary and the outlet-pipe movable. As the inlet-pipe is connected to other and stationary pipes, it cannot be made movable as readily as the outlet-pipe,

which is unconnected with any system of pipes, and is therefore free to move with the cells of the apparatus.

In cases of very large heating apparatus it is not necessary to make all the cells of the heating series of the diaphragm construction, for a composite system may be employed in which a portion of the cells are of non-elastic plates and the remainder of the cells adapted to expand under pressure. For instance, in the heater shown in Figs. 1 and 2 the three upper cells might be hollow rigid castings incapable of material expansion and the two lower cells of the series alone made elastic plates, whereby by properly proportioning the connections to the regulating-valve of the gas-supply sufficient diaphragmatic action would be obtained to suit the purposes of the invention.

I claim and desire to secure by Letters Patent—

1. In a liquid-heater the combination of a series of flexible or extensible chambers forming a water-receptacle, said chambers being connected at their alternate ends to form a continuous zigzag passage and bearing upon each other in the direction of their flexibility, said receptacle having an inlet-passage and a controllable outlet-passage, a source of heat for said receptacle, means for preventing the expansion of the receptacle in one direction and means connected with the free end of said receptacle and adapted to regulate the source of heat, substantially as described.

2. In a liquid-heater the combination of a series of flexible or extensible chambers forming a water-receptacle, said chambers being connected at their alternate ends to form a continuous zigzag passage and bearing upon each other in the direction of their flexibility, said receptacle having an inlet-passage and a controllable outlet-passage, rigid separating means between the chambers and between the receptacle and the casing at one end, a source of heat for said receptacle, means for preventing the expansion of the receptacle in one direction and means connected with the free end of said receptacle and adapted to regulate the source of heat, substantially as described.

JAMES ACTON MILLER.

Witnesses:
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GEORGE L. BARNES.