

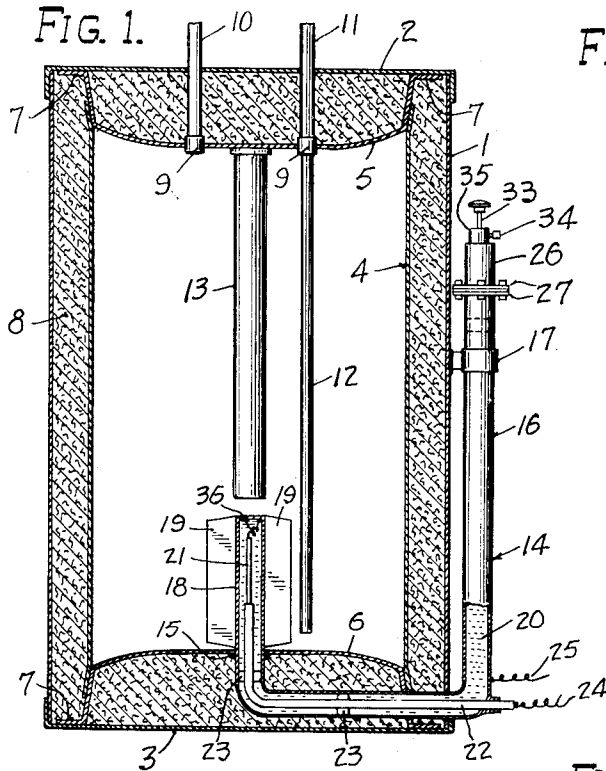
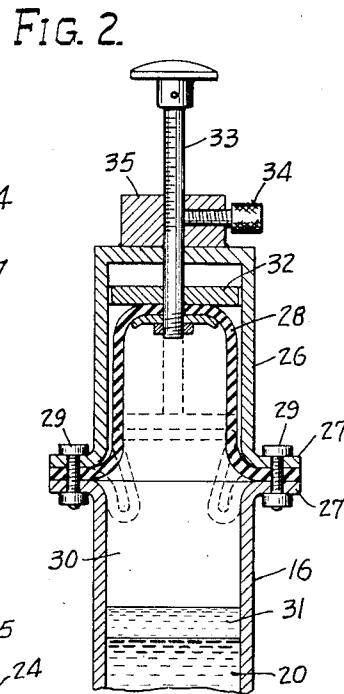
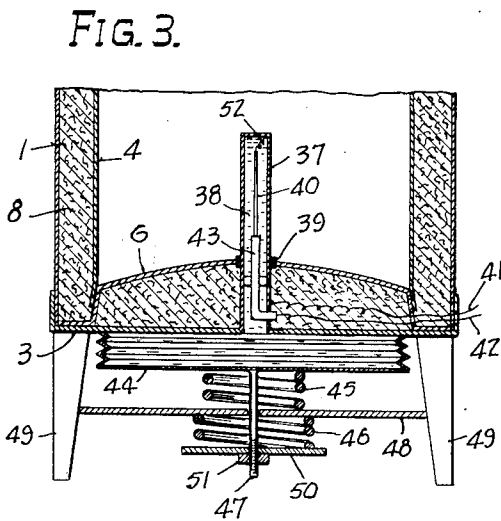
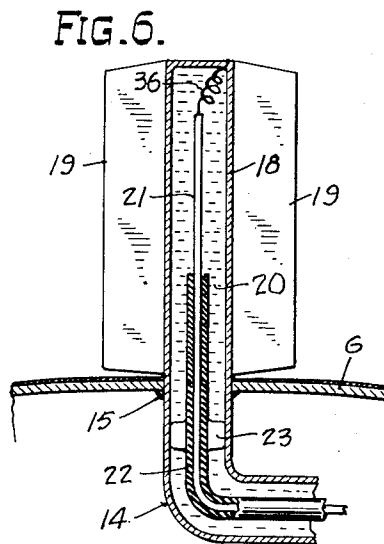
March 12, 1957

O. E. ANDRUS
HOT WATER HEATER

2,785,274

Filed July 15, 1954

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

FIG. 5.

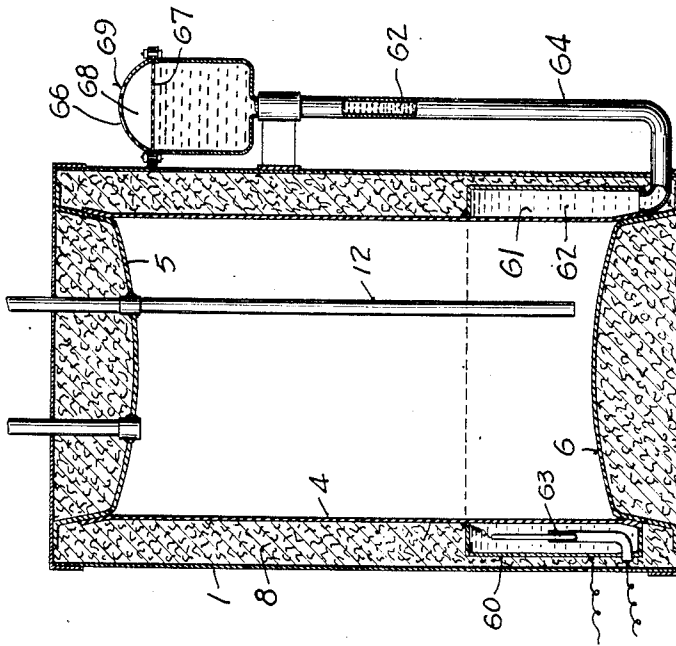
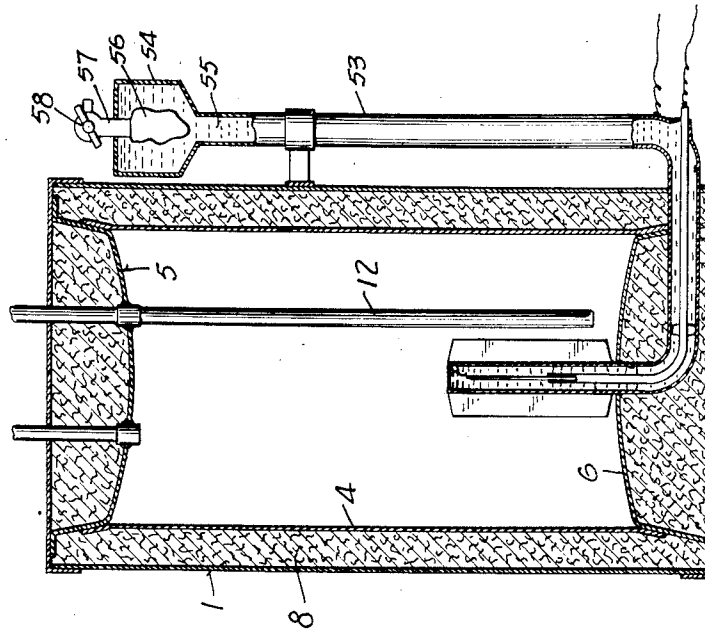


FIG. 4.



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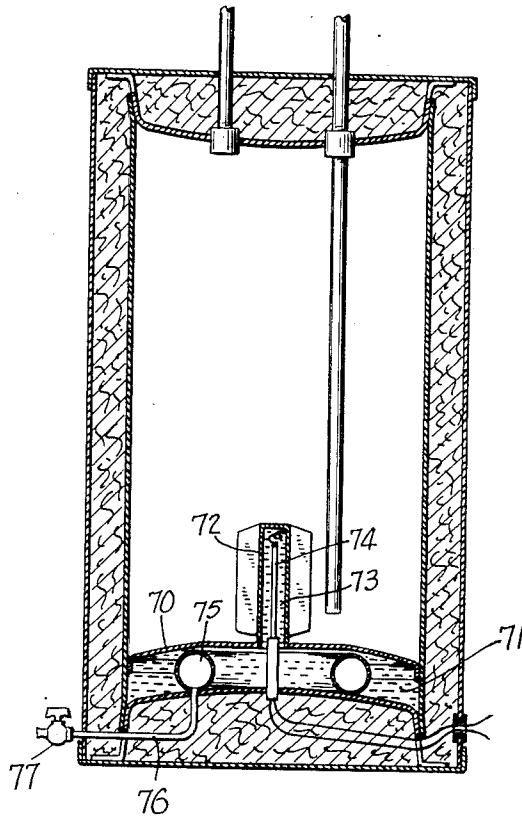
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3 Sheets-Sheet 3

FIG. 7.



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2,785,274

HOT WATER HEATER

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Application July 15, 1954, Serial No. 443,557

14 Claims. (Cl. 219—40)

This invention relates to hot water heaters and more particularly to a water heater having an automatic throttling-type of heat control.

An object of the present invention is to provide an electric water heater for automatically heating water which utilizes an adjustable temperature control which is electrolytic in nature.

Another object is to provide a water heater wherein scale formation is substantially eliminated.

Another object is to provide a water heater wherein the water is automatically heated by an electrolyte and vapors from the electrolyte, both being contained in a sealed chamber which is in heat conductive relation with the water.

Another object is the prevention of high temperature burnout of heating elements as the combined result of scale formation and constant wattage output.

Still another object is to provide a hot water heater wherein the temperature of the discharge water may be conveniently controlled by varying the pressure in the electrolyte chamber.

Still another object is to provide an inexpensive water heater of extremely simple construction which requires a minimum of care and maintenance.

The present invention is directed to a hot water heater having an electrolyte contained within a sealed chamber disposed in heat conductive relation to the water within the tank. An electric current is passed through the electrolyte to heat the same and heat is transferred from the electrolyte and its vapor to the water in the tank.

The temperature to which the water is heated is regulated by a throttling-type control whereby steam generated by heating of the electrolyte tends to drive the electrolyte out of the heating chamber, thereby automatically decreasing the electrical current to that amount necessary to compensate for heat losses. Upon withdrawal of hot water from the heater and replacement of the same with cold water the steam condenses due to heat transfer to the cooler water, the pressure of the steam decreases and the electrolyte pushes back into the heating chamber, thereby gradually increasing the current flow and again heating the electrolyte and the water in the heater to the temperature necessary for regeneration of steam in the electrolyte chamber. Thus a simple rugged electrolytic device serves in conjunction with a water heater as a low-temperature heating element, an adjustable thermostat, a temperature limiting safety device, and a current throttling switch.

By varying the pressure on the electrolyte within the chamber, the boiling point of the same may be controlled and hence the temperature of the discharge water may be regulated.

Other advantages and features of the invention will appear in the course of the following description.

In the drawings:

Figure 1 is a vertical section of the hot water heater of the present invention;

Fig. 2 is an enlarged fragmentary view of Figure 1, showing the structure for varying the pressure on the electrolyte;

Fig. 3 is a second embodiment of the present invention with the pressure on the electrolyte being regulated by means of a spring loaded bellows;

Fig. 4 is a third embodiment of the invention showing the use of a fluid-filled plastic bag to control the pressure on the electrolyte;

Fig. 5 is a fourth embodiment of the invention showing the use of a girdle-type heating chamber;

Fig. 6 is an enlarged fragmentary view of Figure 1 showing the heating chamber; and

Fig. 7 is a vertical section of a fifth embodiment of the invention.

Referring to the drawings there is shown in Figs. 1 and 2 an embodiment of the present invention as applied to a water heater comprising a generally cylindrical external casing 1 which is closed at the top by a circular flanged cap 2 and at the bottom by a similar flanged cap 3.

The water to be heated is contained within a tank 4. Tank 4 consists of a generally cylindrical body portion which is spaced inwardly from casing 1 and is provided with flared ends to receive the heads 5 and 6 which are secured to the upper and lower ends, respectively, of tank 4 by welding or the like. Heads 5 and 6 are each provided with an outer annular flange 7 which is suitably secured to the respective top cap 2 and bottom cap 3. The interior surfaces of tank 4 may be provided with a protective corrosion-resistant coating such as glass, plastic or the like.

To insulate the tank against heat loss to the atmosphere an insulating material 8 is disposed within the annular space between casing 1 and the tank 4 and within the space between heads 5 and 6 and the corresponding caps 2 and 3.

To provide means for introducing and withdrawing water from tank 4, upper head 5 is provided with a pair of suitable openings which receive spuds 9. A hot water outlet pipe 10 is threadedly engaged with one of the spuds 9 and extends upwardly through a suitable opening in top cap 2. The other of the spuds 9 serves to join a water inlet pipe 11 which extends through a suitable opening in cap 2 to a dip tube 12 which extends downwardly within tank 4 to a point adjacent lower head 6.

Corrosion of the tank 4 may be resisted by cathodically protecting the tank. The cathodic protection may be accomplished by providing the tank with an expendable metal rod 13. Rod 13 is secured in electrical contact with head 5 and extends downwardly therefrom within tank 4. The rod 13 is composed of a metal having a higher electrical potential than that of the metal of the tank 4 so that the rod will become the anode in an electrolytic circuit set up within the tank due to the dissimilarity of metals in contact with the water and will corrode preferentially to the tank 4.

Heating of the water in tank 4 is accomplished by heating an electrolyte contained within a heating chamber disposed in heat conductive relation with the water in tank 4. The heating chamber may take the form of a generally U-shaped tube 14 which extends downwardly adjacent the outer surface of casing 1 from a point slightly below the top of tank 4 to the bottom thereof, then inwardly through suitable aligned apertures in casing 1 and in the side surface of head 6, and finally upwardly through an opening in the central portion of head 6 into the tank 4. The tube 14 is secured within head 6 in a water-tight manner, as by welding or the like, indicated by 15. The external arm 16 of tube 14 is attached to casing 1 by brackets 17.

The internal arm 18 of U-tube 14 which extends up-

3

wardly into tank 4 is sealed at the upper extremity thereof.

Tube 14 may be constructed of any electrical conductive material which is corrosion resistant under the conditions and is otherwise suitable in the electrolytic process. For cathodic protection purposes this tube may be electrically insulated externally with a coating of vitreous enamel, glass, plastic or the like.

To aid in the transfer of heat from the vapor or steam generated within tube 14 to the surrounding water in tank 4, the internal arm 18 of tube 14 is provided with a plurality of external fins 19 which extend outwardly into the water to be heated.

The heat transfer medium of the present water heater takes the form of an electrolyte 20 which is contained within tube 14. The level of the electrolyte 20 in the external arm 16 of tube 14 is substantially beneath the upper end of that arm. However, as the external arm 16 has a substantially greater length than the internal arm 18 of the tube, the level of the electrolyte in the external arm 16 extends above the upper end of the internal arm 18 so that the electrolyte will completely fill the shorter internal arm. The electrolyte may be any of a number of liquids which will conduct an electric current and which is not electrolytically corrosive to the metal tube 14 and to the electrode immersed therein. A very pure dilute solution of sodium hydroxide serves as an extremely satisfactory electrolyte for it has the aforementioned properties, is readily available and economically practical.

The electrolyte is heated and vaporized by an electric current which passes through the electrolyte 20 between an electrode 21 disposed within tube 14 and the tube itself. Electrode 21 is inserted through a suitable sealed opening in the base portion of the external arm 16 of tube 14 and extends through the base portion of tube 14 and upwardly into the internal arm 18 thereof. Electrode 21 may be made of any suitable metal which is electrically conductive and is otherwise suitable in the electrolytic process.

The upper portion of the electrode 21 disposed within the internal arm 18 is bare or uninsulated while the remaining portion of the electrode including that extending outside of tank 4 is covered with an insulating coating 22, as shown in Figure 1.

It is preferable to proportion the uninsulated portion to the insulated portion of the electrode 21 so that the heated water in the tube will not be forced into the horizontal or external vertical sections of the tube at any time.

Electrode 21 may be centered within tube 14 by a plurality of fins 23. It is necessary that fins 23 be made of insulating material or be suitably insulated from the tube 14 or the electrode 21 in order to prevent the current from passing through the fins 23 between electrode 21 and tube 14.

A lead wire 24 from a suitable source of electricity, preferably alternating current, is connected to electrode 21 and a second grounded lead 25 is attached to tube 14. It is desirable that the live lead 24 be attached to the electrode 21, and the grounded lead to the metal of the water heater as it is usual practice to connect electrically grounded piping to the water heater tank. The customary voltages of 110 and 220 are entirely satisfactory, although it is possible to use lower voltages.

The temperature to which the water in tank 4 is heated is regulated by a throttling-type control whereby steam, generated by heating of the electrolyte 20, drives the level of the electrolyte within arm 18 downwardly toward the insulated portion of electrode 21, thereby decreasing the flow of the electric current. As the steam within arm 18 condenses due to heat transfer to the water within the tank, the pressure of the steam decreases and the level of the electrolyte rises within arm 18 allowing it to make electrical contact with more of the surface of electrode 21 thereby permitting increased current to flow

4

to add heat to the electrolyte and regenerate steam. By this throttling-type control, the current will automatically vary in an attempt to keep the water at a predetermined temperature.

To initially heat the water in the tank the current is passed through the electrolyte between the bare portion of electrode 21 and the tube 14 causing the electrolyte to be heated. The heat transfer from tube 14 and fins 19 is designed for a predetermined rate of temperature rise. When the temperature of the electrolyte reaches the boiling point thereof, the electrolyte will boil and steam will be generated within the internal arm 18. The surrounding water at this time is at a temperature approximating the boiling temperature of the electrolyte.

As the temperature of the water approaches that of the electrolyte the heat transfer between the two media lessens and continued heating of the electrolyte causes the pressure of the steam within arm 18 to increase and drive the level of the electrolyte downwardly within arm 18. As the level of the electrolyte drops, the electric current approaches a minimum which is determined by the heat loss of the heater. The steam in arm 18 does not conduct a current.

Water is frequently drawn from the tank causing the temperature at the bottom of tank 4 to drop below the steam temperature. Heat will then flow from arm 18 and fins 19 to the water, causing condensation of the steam and an upward movement of the level of the electrolyte within the internal arm 18 due to the decrease in steam pressure. As described previously, when the level of the electrolyte rises the current increases with resultant increase in heat input. As the water temperature approaches that of the electrolyte the current again diminishes to a minimum. Thus, the electrolytic mechanism automatically tends to maintain a constant temperature in the water of the heater.

The steam temperature and thus the temperature to which the water in tank 4 is heated is determined by the pressure on the surface of the electrolyte within the external arm 16 of tube 14. That is, the pressure on the surface of the electrolyte contained within the external arm 16 determines the temperature at which the electrolyte will boil and thereby determines the temperature to which the water in tank 4 will be heated. Under ideal conditions, if the pressure on the electrolyte is atmospheric pressure at sea level, say 14.7 pounds per square inch, the electrolyte will boil slightly in excess 212° F.; the steam will approximate that temperature as will the water in tank 4. If the pressure on the electrolyte is above 14.7 pounds per square inch the electrolyte will boil at a correspondingly higher temperature. Conversely, the electrolyte will boil at a correspondingly lower temperature if the pressure is below 14.7 pounds per square inch.

A means is provided to vary the pressure on the electrolyte within the external arm 16 of tube 14 in order to control the steam temperature and thereby control the discharge temperature of the water in tank 4. This means may be accomplished, as shown in Fig. 2, by closing off the upper end of the external arm 16 of tube 14 with a cylindrical cap 26.

Arm 16 and cap 26 are provided with matching outwardly extending flanges 27. Arm 16 is sealed to the atmosphere by a flexible cup-shaped bag 28 having an annular flange which is secured in an air-tight manner between the matching flanges 27 of cap 26 and arm 16 by bolts 29.

A quantity of air or other fluid is entrapped within the space 30 defined by bag 28 and the surface of the electrolyte 20. The pressure of the fluid within space 30 determines the boiling temperature of the electrolyte.

A layer of oil 31 or the like may be disposed on the surface of the electrolyte within the external arm 16 to prevent the air entrapped within space 30 from being absorbed in the electrolyte 20.

5

The pressure on the electrolyte may be varied, and therefore the discharge water temperature may be controlled, by moving bag 28 upwardly or downwardly within cap 26, thereby expanding or compressing the gas contained in the space 30.

Movement of bag 28 may be accomplished by suitably securing the upper portion of the bag to a plunger 32, which is slidably movable within cap 26. A stem 33 is attached to plunger 32 and extends upwardly through a suitable hole in cap 26 to the exterior.

The stem 33 may be provided with graduated markings which indicate the discharge water temperature determined by the pressure of the fluid within space 30 on the electrolyte at that particular position of plunger 32.

The stem 33 may be locked at any desired position by means of set screw 34 which is threadedly engaged in an opening in collar 35 and bears against the stem 33.

As shown in Fig. 2, the plunger 32 is in an upward position thereby causing the fluid or air within space 30 to be in a relatively expanded condition. When the plunger 32 is in the dotted position shown in Fig. 2, the fluid in space 30 will be in a relatively compressed condition.

The pressure exerted by the steam generated in the internal arm 18 of tube 14 tends to force the liquid electrolyte 20 upwardly in the external arm 16 of the U-tube 14, and the pressure head thus developed in the external arm will tend to compress the fluid in space 30. As the pressure of the fluid in space 30 is increased as steam is generated, the boiling temperature of the electrolyte will be raised due to the increased pressure thereon. Thus, when setting the original pressure in space 30 by adjustment of plunger 32, the subsequent pressure head developed during normal operation should be taken into account and the original pressure setting should be reduced by an amount necessary to compensate for the pressure head developed in order to obtain the desired boiling temperature of the electrolyte.

Electrolysis of the electrolyte 20 may occur as the same is heated by the electric current, causing oxygen and hydrogen to accumulate within the upper portion of the internal arm 18 of tube 14. To convert these gases back to water, a filament wire 36 interconnects the tip of the bare portion of the electrode 21 with the tube 14. The filament 36 is designed with a thickness such that a temperature in the range of 1100° F. to 1200° F. will be developed in the filament at operating currents in order that any oxygen and hydrogen produced by the electrolysis of the electrolyte may be converted into water vapor. The oxygen and hydrogen produced in the internal arm 18 of tube 14 may react at ordinary temperatures to form water; however, the reaction is slow, and oxygen and hydrogen may accumulate within the upper end of the internal arm 18 and displace the electrolyte within the internal arm, thereby reducing the current flow for any given electrolyte temperature. Thus, the filament 36 is employed to hasten the conversion of the oxygen and hydrogen into water vapor. In addition, the accumulation of hydrogen and oxygen within the internal arm 18 of tube 14 would constitute a dangerous explosive mixture, and it is essential that these gases be converted to water as quickly as they may be produced. It is contemplated that any other suitable means may be employed in place of filament 36 to hasten the conversion of the gases to water vapor such as a spark plug with electrical ignition means.

A second embodiment of the invention is shown in Fig. 3. In this embodiment a sealed tube 37 containing the electrolyte 38 extends upwardly through aligned openings in bottom cap 3 of casing 1 and lower head 6 of tank 4 into the tank. The tube 37 is sealed in a water-tight manner within the opening in lower head 6 as indicated by 39.

The electrolyte 38 is heated within tube 37 in a man-

6

ner corresponding to that of the first embodiment whereby a current passes between the tube 37 and the bare portion of an electrode 40 which is disposed within tube 37. Electrode 40 is bent adjacent the lower portion of tube 37 and extends outwardly, in a water-tight manner, through an opening in the wall of the tube to the exterior thereof.

Suitable lead wires 41 and 42 are connected to the tube 37 and to the end of electrode 40, respectively.

The portion of electrode 40 contained within that portion of tube 37 which is disposed within tank 4 is bare or exposed while the remaining portion of the electrode is covered with an electrically insulating coating, indicated by 43.

During operation of the heater the pressure of the steam generated within tube 37 is relieved by a bellows 44 which is in communicating relation with the lower end of tube 37. The electrolyte 38 contained in the tube 37 normally fills the bellows 44. Steam is generated within tube 37 due to the current flowing through the electrolyte between electrode 40 and tube 37. The pressure of the steam will force the electrolyte downwardly, causing bellows 44 to expand and thereby tending to bring the steam pressure and the exterior pressure on the bellows into equilibrium.

To control the boiling temperature of the electrolyte, which determines the discharge water temperature, the exterior pressure on bellows 44 may be varied by springs 45 and 46. A stud 47 is secured to the undersurface of bellows 44 and extends downwardly therefrom. Spring 45 encircles stud 47 and is interposed between the underside of bellows 44 and a fixed, generally circular plate 48 which is secured to the legs 49 of the heater. Spring 46 is disposed around stud 47 beneath spring 45 and bears between plate 48 and a disc 50 movably carried by the lower end of stud 47. The force of spring 46 may be varied by the lowering or raising of disc 50 through the threaded adjustment of nut 51 on the lower threaded end of stud 47.

Spring 45 acts to compress bellows 44 and works against the expansion of the steam pressure in tube 37, while spring 46 acts to expand bellows 44 and works to aid the expansion of steam pressure in tube 37. By initially adjusting the compression of spring 46 by means of nut 51 any final equilibrium pressure of the steam in tube 37 can be obtained, either above or below atmospheric pressure, and the steam pressure will determine the steam temperature and thus the temperature to which the water in tank 4 is heated.

For example, if a discharge water temperature of below 212° F. is desired, with atmospheric pressure being about 14.7 pounds per square inch, the spring 46 is initially compressed by nut 51 and disc 50 to a position where it overbalances the force of spring 45 and tends to expand bellows 44 and provide a void or vacuum in the upper end of tube 37. When operation is begun and steam is generated within tube 37, the electrolyte is forced downwardly by the steam pressure to additionally expand bellows 44 and the expansion of the bellows is aided by spring 46 so that the final equilibrium pressure of the steam within tube 37 will be below atmospheric pressure.

Conversely, if a boiling temperature above the temperature corresponding to atmospheric pressure is desired, the compression of spring 46 may be relaxed so that during operation an equilibrium steam pressure greater than atmospheric pressure is obtained within tube 37.

As in the case of the first embodiment a heated filament wire 52 or other suitable means may be employed to connect electrode 40 and tube 37 and hasten the conversion of any hydrogen and oxygen produced by electrolysis into water.

Fig. 4 illustrates a third embodiment of the present invention. In this embodiment the upper end of the external arm of the generally U-shaped tube 53, corre-

sponding to tube 14 of the first embodiment, is increased in cross sectional size to provide a reservoir 54 and is sealed to the atmosphere.

Tube 53 and reservoir 54 are completely filled with the electrolyte 55.

To permit the expansion of the steam generated within the internal arm of tube 53 a flexible bag 56 composed of rubber, plastic or the like is disposed within reservoir 54. Bag 56 is adapted to contain a fluid, such as air or nitrogen, and the pressure of the fluid within bag 56 determines the pressure on the electrolyte and thus the boiling temperature of the electrolyte.

A nozzle 57 extends through a suitable opening in the wall of reservoir 54 and communicates with the interior of bag 56. The entry or discharge of the fluid into or from nozzle 57 is controlled by a suitable valve 58.

To begin operation a predetermined pressure is applied within bag 56 by introducing or withdrawing fluid from the bag by any conventional means. As operation of the heater is begun and steam is generated within the internal arm, the pressure of the steam will force the electrolyte downwardly within the internal arm and cause the electrolyte to compress the fluid within bag 56 in reservoir 54. As in the case of the first embodiment, when the level of the electrolyte in the internal arm of tube 53 is lowered the current will decrease and steam generation will be reduced. Under these circumstances the fluid within bag 56 will be compressed as compared to its original pressure and the pressure of the fluid at this time will determine the boiling temperature of the electrolyte and hence the temperature to which the water in tank 4 will be heated.

As an equilibrium pressure of about 3 to 30 pounds per square inch absolute is desired within bag 56 so as to heat the water to the ordinary domestic range of 140° F. to 250° F., it is necessary to originally establish a pressure substantially beneath the desired equilibrium pressure within the bag because during operation the fluid is compressed by the electrolyte. In most instances the original pressure established in bag 56 will be below atmospheric pressure and when a water temperature in the lower portion of the aforementioned range is desired the original pressure will be substantially below atmospheric.

Fig. 5 illustrates a fourth embodiment of the invention. In this embodiment the heating chamber instead of being a tube, as shown by 14 in the first embodiment, is defined by a generally arcuate or annular channel member 60 which encircles the exterior surface of the lower portion of the body of tank 4. The flanged end portions of channel member 60 are secured by welding to tank 4. Channel member 60 may be either annular or arcuate in shape and may correspondingly encircle the tank 4 if annular or merely extend partially therearound, if arcuate.

The chamber 61 defined by the channel member 60 and tank 4 contains the electrolyte 62 and an electrode 63 similar in construction and function to that previously described in the prior embodiments. If desired, a plurality of electrodes may be circularly spaced within the chamber 61.

To balance the pressure of the steam generated within chamber 61 a tube 64 communicates with the lower portion of chamber 61. Tube 64 extends outwardly through a suitable opening in casing 1 and then upwardly along the exterior of the casing. To begin operation the electrolyte completely fills chamber 61 and tube 64.

In this embodiment the pressure of the electrolyte is balanced with atmospheric pressure and therefore the electrolyte will boil at a temperature corresponding to atmospheric pressure which would be somewhat above 212° F. at 14.7 pounds per square inch absolute pressure.

The upper end of tube 64 may be left open to the atmosphere or it may be sealed off by a pressure-re-

sponsive element. In either case the external pressure on the electrolyte will be atmospheric at all times. In the construction shown in Fig. 5, the upper end of the tube 64 is enlarged and covered by a cap 66. A flexible diaphragm 67 is secured between the flanged edge portions of tube 64 and cap 66 and serves to seal off the end of the tube. The chamber 68 defined by cap 66 and diaphragm 67 is subjected to atmospheric pressure due to the opening 69 in cap 66.

In operation the electrolyte is heated within chamber 61 causing steam to be generated. The pressure of the steam drives the electrolyte downwardly within chamber 61 and raises the level of the electrolyte in tube 64 causing diaphragm 67 to flex upwardly to balance the pressure on the electrolyte with the atmospheric pressure in chamber 68. The electrolyte will therefore boil at a temperature corresponding approximately to the atmospheric pressure.

The throttling action which occurs in this embodiment is similar to that of the previous embodiments with the current being automatically decreased as the steam pressure drives the level of the electrolyte within chamber 61 downwardly and the current being automatically increased when the pressure of the steam is reduced due to condensation.

Fig. 7 illustrates another modification of the invention. In this embodiment a generally curved circular plate 70 is disposed within the tank 4 and spaced upwardly from bottom head 6 to define a chamber 71. The peripheral edges of the plate 70 are secured in a fluid-tight manner, as by welding, to the inner wall of the tank.

A heating chamber is provided by welding a sealed tube 72 within an axial opening in plate 70. Tube 72 extends upwardly from plate 70 within tank 4 and the hollow interior of the tube communicates with chamber 71.

An electrolyte 73 is contained within tube 72 and chamber 71, and the electrolyte within tube 72 is adapted to be heated and vaporized by an electrode 74, similar in construction and function to electrode 21 of the first embodiment.

The throttling action which takes place in this embodiment is similar to that previously described with the current being automatically varied in inverse proportion to the pressure of the vapor in the tube 72.

To vary the pressure on the electrolyte within chamber 71 and thereby control the boiling temperature of the electrolyte, an annular flexible bag 75 is disposed within chamber 71. A fluid such as air is introduced into and withdrawn from bag 75 through conduit 76. The flow of fluid in conduit 76 is controlled by valve 77. The pressure of the fluid within bag 75 determines the boiling temperature of the electrolyte and thus the discharge temperature of the water in tank 4.

The present water heater does not require a conventional thermostat to control the temperature of the water being heated. The water is automatically heated to the predetermined boiling temperature of the electrolyte. The current will automatically decrease when the pressure of the steam drives the electrolyte from the heating chamber and the current will automatically increase when the pressure of the steam is reduced by condensation.

For ordinary domestic use the steam temperature within the heating chamber will be in the neighborhood of 160° F., and the water to be heated will not exceed this temperature and therefore will not boil. The mechanism thus serves as a low temperature heating element. As the heat transfer surfaces do not reach temperatures sufficient to decompose bicarbonates, scale formation does not take place.

The mechanism also serves as a temperature limiting safety device since the current is entirely shut-off should any external source of heat cause the temperature to rise

9

sufficiently to remove the electrolyte from electrical contact with the electrode.

By glass coating the exterior of the heating chamber it is possible to employ cathodic protection to defects in that coating. This construction overcomes present day difficulties with cathodic protection due to the conductive surface on heating elements.

Various embodiments of the invention may be employed within the scope of the following claims.

I claim:

1. A water heater comprising a tank to contain water to be heated and having a water inlet and a water outlet therein, a member associated with the tank and defining a heating chamber disposed in heat conductive relation with the water in said tank, an electrolyte contained within said heating chamber, heating means to pass an electric current through said electrolyte to heat and vaporize a portion of the same with heat being transferred to the water in said tank until the water is heated to a temperature approaching that of the temperature of the vapor, pressure means associated with said member and acting on said electrolyte for balancing the pressure of said vapor, the magnitude of the pressure exerted on said electrolyte by said pressure means increasing with an increase in the pressure of said vapor on said electrolyte to thereby control the vaporizing temperature of the electrolyte and the electrical energy input to said heating means, and means disposed within said member for converting any gases produced by electrolysis of said electrolyte into a stable compound.

2. A water heater comprising a tank to contain water to be heated and having a water inlet and a water outlet therein, a member associated with said tank and defining a heating chamber disposed in heat conductive relation with the water in said tank, a liquid contained within the heating chamber and capable of conducting an electric current, said liquid being subjected to the pressure of a compressible fluid, means to pass an electric current through said liquid to heat the liquid and vaporize a portion of the same with heat being transferred to the water in said tank, means associated with said member for effecting a compression of the compressible fluid and establishing an equilibrium liquid level in the heating chamber, means to vary the electrical energy input to said first named means in accordance with changes of the liquid level in the heating chamber, and means for raising the temperature of any gases produced by electrolysis of said liquid to the combustion temperature of said gases to convert the same to a stable compound.

3. A water heater comprising a tank to contain water to be heated and having a water inlet and a water outlet therein, a sealed metallic hollow member having a portion thereof disposed in heat conductive relation with the water in said tank, a liquid disposed within said hollow member and capable of conducting an electric current, an electrode disposed within said hollow member and out of physical contact therewith, means to pass an electric current through the liquid between said electrode and said hollow member to heat the liquid and to vaporize a portion of the same with heat being transferred to the water within said tank, pressure means associated with said hollow member and acting on the liquid for balancing the pressure of the vapor, the magnitude of the pressure exerted on the liquid by said pressure means increasing with an increase in the pressure of said vapor on the liquid to control the liquid level in the member and thereby the electrical energy input to said first named means, means associated with said pressure means for selectively varying the pressure on said liquid to correspondingly vary the vaporizing temperature thereof, and means disposed within said hollow member for converting any gases produced by electrolysis of said liquid into a stable compound.

4. A water heater comprising a tank to contain water to be heated and having a water inlet and a water outlet

10

therein, a sealed metallic hollow member having a section thereof disposed in heat conductive relation with the water in said tank, an electrolyte contained within said hollow member and subjected to the pressure of an external fluid, an electrode disposed within said section of the hollow member and out of direct electrical contact therewith, means to pass an electric current through the electrolyte between said electrode and said section to heat a portion of said electrolyte and generate a vapor with heat being transferred to the water within said tank, an increase in vapor pressure tending to drive the level of the electrolyte from the hollow member to compress the external fluid and to decrease the electrical energy input to said first named means, the level of said electrolyte tending to rise within said member as the vapor pressure decreases due to condensation of the steam by heat transfer to the water in the tank and the electrical energy input to said first named means being correspondingly increased, means for selectively changing the magnitude of the pressure of the external fluid on the electrolyte to correspondingly vary the vaporizing temperature of said electrolyte, and means disposed within said hollow member for converting any gases produced by electrolysis of said electrolyte into a stable compound.

5. A water heater comprising a tank to contain water to be heated and having a water inlet and a water outlet therein, a generally U-shaped hermetically sealed tube having a leg disposed within said tank in heat conductive relation with the water in said tank, an electrolyte contained within said tube and filling said leg, means to pass an electric current through said electrolyte contained within said leg to heat the same and generate a vapor, means responsive to the pressure of said vapor to decrease the electrical energy input to said first named means as the vapor pressure increases and to increase the electrical energy input to said first named means as the vapor pressure decreases due to condensation of said vapor resulting from heat transfer to the water in the tank, and means disposed within said leg for converting any gases produced by electrolysis of said electrolyte into a compound.

6. A water heater comprising a tank to contain water to be heated and having a water inlet and a water outlet therein, a generally U-shaped hermetically sealed tube having a leg disposed within said tank in heat conductive relation with the water in said tank, an electrolyte contained within said leg, means disposed within said leg to heat the electrolyte to the boiling temperature thereof and generate a vapor with heat being transferred to the water within said tank and said vapor tending to displace said electrolyte from said leg, means to decrease the electrical energy input to said first named means as said electrolyte is displaced and to increase the electrical energy input to said first named means when the electrolyte recedes from its displaced position as the vapor pressure decreases due to condensation of said vapor resulting from heat transfer to the water in the tank, and a heated filament member disposed within said leg for converting any gases produced by electrolysis of said electrolyte into a compound.

7. A water heater comprising a tank to contain water to be heated and having a water inlet and a water outlet therein, a generally U-shaped metallic tube having a sealed inner leg disposed within said tank in heat conductive relation with the water in said tank and a second outer leg disposed outside of said tank, an electrolyte contained within said tube and filling said first leg and extending within said outer leg, the electrolyte within said outer leg being subjected to an external pressure, an electrode disposed within said first leg and out of physical contact therewith, heating means to pass an electric current through said electrolyte between the portion of said electrode within said inner leg and said tube to heat said electrolyte and vaporize the same with heat being transferred to the water in said tank, means responsive to the pres-

11

sure of the vapor within said inner leg to decrease the electrical energy input to said first named means as the pressure of said vapor increases, means associated with the outer leg for varying the external pressure on said electrolyte to control the vaporizing temperature thereof should a resetting of the discharge water temperature be desired, and means disposed within the inner leg of said tube for converting any gases produced by electrolysis of said electrolyte into a stable compound.

8. A water heater comprising a tank to contain water to be heated and having a water inlet and a water outlet therein, a containing member secured to the outer surface of said tank adjacent the lower portion thereof, said member and the outer surface of said tank defining a heating chamber in heat conductive relation with the water in said tank, a tubular member communicating with the lower portion of said heating chamber and extending upwardly beyond the upper extremity of said chamber, an electrolyte contained within said tubular member and within said chamber and substantially filling said chamber with the electrolyte within said tubular member subjected to a predetermined pressure, means to pass an electric current through the electrolyte within said heating chamber to heat the same and generate a vapor with heat being transferred to the water in said tank, an increase in the pressure of said vapor tending to force said electrolyte out of said heating chamber and into said tubular member against the pressure of said external fluid, means responsive to the pressure of said vapor to decrease the electrical energy input to said first named means as the vapor pressure increases and to increase the electrical energy input to said first named means when the vapor pressure decreases due to condensation of said vapor resulting from heat transfer to the water in the tank, and means contained within said heating chamber for converting any gases produced by electrolysis into a stable compound.

9. A water heater comprising a tank to contain water to be heated and having a water inlet and a water outlet therein, a sealed hollow member associated with said tank and having a portion thereof defining a heating chamber disposed in heat conductive relation with the water in said tank, a liquid contained within said hollow member and capable of conducting an electric current, a sealed flexible member disposed within said hollow member, a compressible fluid under a predetermined pressure disposed within said flexible member, means to pass an electric current through the portion of said liquid disposed within said heating chamber to heat said liquid to the boiling temperature thereof with heat being transferred from the liquid to the water in said tank, said liquid boiling to generate a vapor with said vapor tending to displace said liquid from the heating chamber and effect a compression of said fluid within said flexible member, and means disposed within said hollow member for converting any gases produced by electrolysis of said liquid into a stable compound.

10. A water heater comprising a tank to contain water to be heated and having a water inlet and a water outlet therein, a generally U-shaped metallic tube having a sealed inner leg disposed within said tank in heat conductive relation with the water in said tank and a second outer leg disposed outside of said tank, an electrolyte contained within the tube and substantially filling the same, a flexible bag disposed within said outer leg, a compressible fluid contained within said bag, means to pass an electric current through the electrolyte contained within said internal leg to heat said electrolyte to the boiling temperature thereof with heat being transferred to the water in said tank, said electrolyte boiling to generate a vapor with said vapor tending to displace said electrolyte from the inner leg and effect a compression of said fluid within said bag, means to vary the pressure of the fluid within said bag to control the boiling temperature of said electrolyte, means for decreasing the electrical energy

12

input to said heating means as the pressure of said vapor increases and increasing the energy input to said heating means when the pressure of said vapor decreases due to condensation resulting from heat transfer to the water, and means for converting any gases produced by electrolysis of the electrolyte into a stable compound.

11. A water heater comprising a tank to contain water to be heated and having a water inlet and a water outlet therein, a hollow member associated with said tank and having a portion thereof defining a heating chamber disposed in heat conductive relation with the water in said tank, an electrolyte contained within said hollow member and filling said heating chamber, a flexible member to seal off the hollow member to the atmosphere, means to pass an electric current through the electrolyte contained within said heating chamber to heat the electrolyte to the boiling temperature thereof, said electrolyte boiling to generate a vapor with said vapor tending to displace said electrolyte from said heating chamber and effect a flexing of said flexible member, said flexible member serving to equalize the pressure of the vapor and the atmosphere and enable the electrolyte to boil at a temperature corresponding to atmospheric pressure, and means disposed within said hollow member for converting any gases produced by electrolysis of said electrolyte into a stable compound.

12. A water heater comprising a tank to contain water to be heated and having a water inlet and a water outlet therein, a sealed metallic hollow member associated with said tank and having a portion thereof defining a heating chamber disposed in heat conductive relation with the water in said tank, an expandable bellows communicating with said hollow member, an electrolyte contained within said hollow member and said bellows, an electrode disposed within said hollow member and out of physical contact therewith, heating means to pass an electric current through said electrolyte between said electrode and said hollow member to heat said electrolyte to the boiling temperature thereof, said electrolyte boiling and generating a vapor with the pressure of said vapor tending to displace the level of said electrolyte downwardly in said hollow member and effect an expansion of said bellows, means to exert an external force on said bellows to control the expansion thereof and regulate the position of the level of the electrolyte in said hollow member and thereby control the electrical energy input to said heating means, and means associated with said heating chamber for converting any gases produced by electrolysis of said electrolyte into a compound.

13. A water heater comprising a tank to contain water to be heated and having a water inlet and a water outlet therein, a generally U-shaped metallic tube having a sealed inner leg disposed within said tank in heat conductive relation with the water in said tank and a second outer leg disposed outside of said tank, an electrolyte contained within said tube and filling said first leg and extending within said outer leg, an electrode disposed within said first leg and out of physical contact therewith, means to pass an electric current through said electrolyte between the portion of said electrode within said inner leg and said tube to heat said electrolyte and vaporize the same with heat being transferred to the water in said tank, means responsive to the pressure of the vapor within said inner leg to decrease the electrical energy input to said first named means as the pressure of said vapor increases, a flexible member associated with the outer leg for sealing said outer leg to the atmosphere and spaced from the electrolyte therein to provide a clearance therebetween, a compressible fluid contained within said clearance and exerting a pressure on said electrolyte, means for varying the position of said flexible member in relation to said outer leg to vary the pressure of said compressible fluid and control the boiling temperature of said electrolyte, and means disposed within the inner leg of

13

said tube for converting any gases produced by electrolysis of said electrolyte into a stable compound.

14. A water heater comprising a tank to contain water to be heated and having a water inlet and a water outlet therein, said tank formed of a generally cylindrical shell enclosed at the ends by a top head and a bottom head, a hollow member associated with the bottom head and extending upwardly within the tank to define a heating chamber in heat conductive relation with the water in the tank, means associated with the tank for defining a compartment beneath said bottom head and in communicating relation with said heating chamber, an electrolyte contained within said chamber and said compartment, heating means for passing an electric current through the portion of the electrolyte contained within the heating chamber to heat the electrolyte to the boiling temperature thereof, said electrolyte boiling to generate a vapor with said vapor tending to displace said electrolyte from said heating chamber with the electrical energy input to said heating means being decreased as the pressure of the

14

vapor increases and the electrical energy input to said heating means being increased as the pressure of the vapor decreases, a hollow flexible member disposed within the compartment, means for introducing and withdrawing a fluid from the flexible member to vary the pressure on the electrolyte and correspondingly control the boiling temperature of the electrolyte and the discharge temperature of the water in the tank when resetting of the latter temperature, and means disposed within said heating chamber for converting any gases produced by electrolysis of the electrolyte into a stable compound.

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