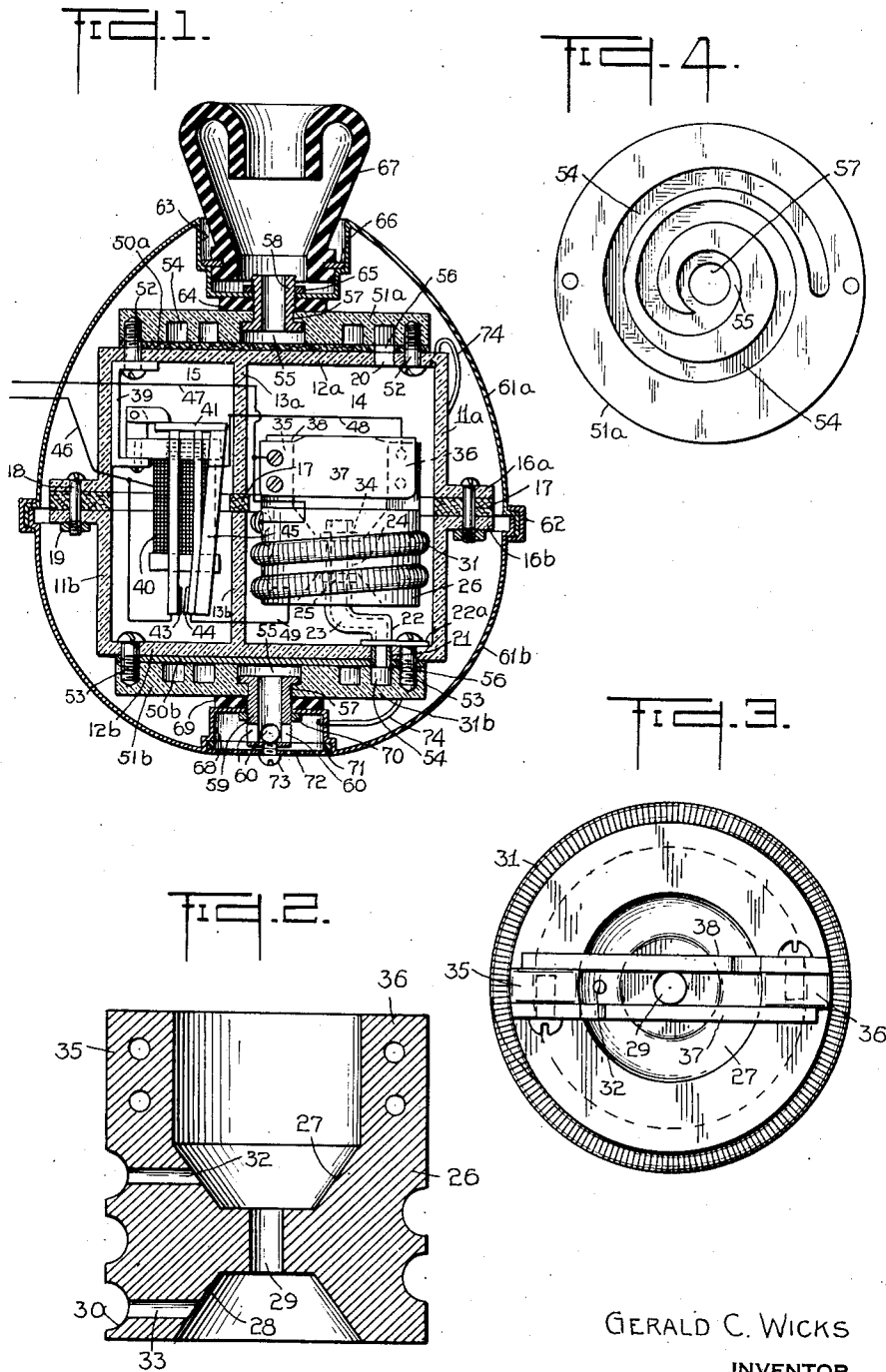


May 24, 1949.

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ELECTRIC WATER HEATER

2,471,133

Filed Jan. 18, 1946



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UNITED STATES PATENT OFFICE

2,471,133

ELECTRIC WATER HEATER

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Application January 18, 1946, Serial No. 641,911

2 Claims. (Cl. 219—39)

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The present invention relates to an electric water heater, and, more particularly, to an electric water heater of the type which can be connected to a cold water faucet to heat the water delivered from the faucet by means of an electric heating unit, such as a heating coil, disposed in a water heating compartment from which hot water is discharged in a continuous stream as long as cold water is fed to the heater.

One object of the invention is to provide in a water heater including a heating unit in the form of an electric resistance coil, electric means for automatically breaking the circuit through the heating coil when the level of the water in the water heating compartment falls below a predetermined height which is above the top of the heating coil and for automatically restoring the heating circuit when the level of the water reaches said predetermined height.

Another object of the invention is to provide an electric water heater including a heating coil in which substantially the entire heating coil remains submerged in the water to be heated whenever current flows through the coil, thus preventing an overheating of the coil.

A still further object of the invention is to arrange the water inlet and outlet passages of a continuous electric water heater in such a manner that no electric charges can be transmitted from the electric heating unit through the body of the water to conductors or semiconductors which may come in contact with the stream of water outside of the heater, so that a person touching the faucet through which the water is delivered to the heater or the stream of hot water discharged from the heater will be positively protected from electric shocks.

These and other objects, which will appear more clearly as the specification proceeds, are accomplished according to the present invention by the arrangement and combination of elements set forth in the following detailed description, defined in the appended claims and illustratively exemplified in the accompanying drawings in which:

Fig. 1 is an axial section through a water heater according to the invention, the internal equipment being shown in elevation and the circuit connections being diagrammatically indicated.

Fig. 2 is a vertical section through the bracket which supports the heating coil and control electrodes.

Fig. 3 is a separate top view of the heating coil and control electrode unit, and

Fig. 4 is a bottom elevational view of the upper

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disc-shaped element in which the water inlet passage is formed.

Referring now to the drawings, and first to Fig. 1, 11a and 11b are the upper and lower halves, respectively, of a substantially cylindrical container consisting of heat resisting glass and having an integral flat circular top wall 12a and an integral flat circular bottom wall 12b. A vertical partition wall is formed in two parts 13a and 13b integral with the two halves 11a, 11b, respectively of the container to divide the latter into a larger water heating compartment 14 and a smaller control unit compartment 15. The two halves 11a, 11b of the container are provided with outwardly projecting peripheral flanges 16a, 16b along their adjacent edges and are secured together with interposition of a suitably shaped gasket 17 by means of screws 18 passing through aligned holes in said flanges 16a, 16b and gasket 17, and nuts 19 cooperating with said screws 18.

The top wall 12a of the container is provided near its periphery with a water inlet port 20 leading into the water heating compartment 14, and the bottom wall 12b is provided, opposite the water inlet port 20, with a similar water outlet port 21. An overflow pipe of a flow cross-section slightly smaller than that of the inlet port 20 has its lower end 22 fitted into the outlet port 21 and includes a short horizontal portion 23 and a vertical portion 24 rising approximately centrally of the water heating compartment 14 to a level just below the upper edge of the lower half 11b of the container. The vertical pipe portion 24 is outwardly threaded and carries a nut 25. An insulating bracket (see Fig. 2) includes a lower cylindrical portion 26 provided in its two end faces with frustoconical recesses 27, 28 leaving between them a transverse web provided with an axial bore 29 traversed by the vertical portion 24 of the overflow pipe. A helical groove 30 is provided in the outer periphery of the cylindrical bracket portion 26 and a resistance heating coil 31 is mounted in the groove 30. Radial bores 32 and 33 lead from the recesses 27 and 28 to the beginning and the end, respectively, of the groove 30 to receive electric conductors connected to the opposite ends of the coil 31. The bracket is heated with the lower surface of the transverse web on the nut 25 and is secured in position by a nut 34 screwed onto the pipe portion 24 against the upper surface of the transverse web. The upper surface of the cylindrical bracket portion 26 is disposed at a level slightly higher than the open upper end of the pipe portion 24. Two lug shaped elements 35, 36 are integral parts of the

insulating bracket and project upwardly from the top of the cylindrical portion 26 thereof in diametrically opposite positions. A plate-shaped control electrode 37 is secured to one side of the lug 35 and projects across the cylindrical bracket portion 26, and a second plate shaped electrode 38 is secured to the opposite side of the lug 36 and extends parallel to said first electrode 37 at a distance from the latter corresponding to the thickness of the lugs 35, 36 which, in the example shown, is about one eighth of an inch.

The control unit compartment 15 contains an electromagnet carried by a bracket 39 secured to the top wall 12a of the container and including a winding 40 and a pivoted armature 41. A pair of normally open contacts 43, 44 is closed by an arm 45 of the armature 41 when the magnet is energized. The electrical connections are as follows: A first conductor 46 serves to connect one terminal of any suitable source of current (not shown) in parallel to one end of the winding 40 of the electromagnet and to one contact 43 of said pair. A second conductor 47 serves to connect the other terminal of the source of current in parallel to the control electrode 37 and to the upper end of the heating coil 31. A third conductor 48 connects the second electrode 38 with the other end of the magnet winding 40, and a fourth conductor 49 connects the second contact 44 of said pair with the lower end of the heating coil 31.

The water to be heated is fed to the inlet port 20 and the hot water is discharged from the outlet port 21 through insulating passages of relatively great length by means of the following arrangement: An assembly including a circular gasket 50a, 50b and a circular disc-shaped element of heat resisting glass 51a, 51b is applied to each of the outer flat surfaces of the top wall 12a and of the bottom wall 12b of the container. The top assembly 50a, 51a is secured to the top wall 12a by means of screws 52, one of which serves also to affix the bracket 39 to the top wall 12a. The bottom assembly 50b, 51b is secured to the bottom wall 12b by means of screws 53 one of which passes through a plate 22a traversed by and soldered to the lower portion 22 of the overflow pipe, said plate 22a being applied to the inner surface of the bottom wall 12b and holding the overflow pipe securely in place. Each disc-shaped element 51a, 51b is provided in the flat surface thereof directed toward the adjacent wall 12a, 12b of the container with a spiral groove 54, the inner end of which emerges from a central circular recess 55 formed in the disc-shaped element while its outer end registers with the port 21, 22 in the adjacent end wall 12a, 12b of the container and with a corresponding hole 56 provided in the gasket 50a, 50b interposed between the disc-shaped element 51a, 51b and the adjacent container wall 12a, 12b. Each disc-shaped element 51a, 51b is further provided with a central hole 57 opening into the recess 55 and having a smaller diameter than the latter.

An axially open inlet tube 58 having at its lower end an outwardly projecting peripheral flange fitting into the recess 55 of the upper disc-shaped element 51a passes through the central hole 57 of this element and is provided with an external screw thread at its upper end. An outlet tube 59 closed at its lower end is seated with an outwardly projecting peripheral flange provided at its upper end in the recess 55 of the lower disc-shaped element 51b. The lower end wall of the tube 59 is provided with a small threaded bore

and its peripheral wall is formed near the lower end of the tube with a number of radial apertures 60 and with an external screw thread extending from said lower end beyond the apertured portion of the tube.

The container assembly is supported in and protected by a substantially oval sheet metal shell comprising an upper shell portion 61a and a lower shell portion 61b provided at their adjacent edges with overlapping peripheral flanges and secured together by a clamping ring 62 of U-cross-section. The upper shell portion 61a is depressed at its top to form a stepped cup 63, the flat bottom of which is provided with a central aperture of a diameter substantially equal to that of the hole 57. The bottom of the cup 63 rests on an annular gasket 64 applied to the top surface of the disc-shaped element 51a, and the tube 58 passes upwardly through the gasket and through the aperture in the bottom of the cup 63 into the latter, the parts being secured together by means of a nut 65 screwed onto the upper threaded portion of the tube 58. A flat ring 66 is soldered to the step of the cup 63 to form an inwardly projecting flange. A substantially tubular mouthpiece 67 of an elastic material, such as rubber, is mounted on the flange 66 and serves to connect the heater to a cold water faucet. The mouthpiece 67 comprises a lower cylindrical portion provided with a peripheral groove, in which the flange 66 is seated, and an upwardly and outwardly projecting substantially frustoconical portion turned inwardly and downwardly upon itself at its upper edge to provide a substantially cylindrical depending lip which will apply itself with increasing force to a faucet as the pressure of water discharged from the faucet into the mouthpiece increases.

The lower shell portion 61b is formed at its bottom with a depression having the form of a small cylindrical cup 68 turned upside down and provided with a recess along its edge. The bottom of the cup 68 rests against an annular gasket 69 applied to the outer surface of the disc-shaped element 51b, and the tube 59 passes through a suitable central hole of the cup bottom to a plane near the outer edge of the cup 68. A nut 70 screwed on the tube 59 against the bottom of the cup 68 holds the parts together. An annular gasket 71 is seated in the recess at the edge of the cup 68, and the latter is closed by means of a perforated strainer and distributor plate 72 pressed in the recess to lie flush with the bottom surface of the shell portion 61b and secured to the tube 59 by means of a screw 73 passing through a central hole in the strainer plate 72 into the threaded bore provided in the end wall of the tube 59. A rubber venting tube 74 of small cross-section leads from the top of the heating compartment 14 into the cup 68 to prevent the formation of air or steam pockets in the upper part of compartment 14.

The device operates as follows: The mouthpiece 67 is pushed onto a faucet and the two conductors 46, 47 are connected to the opposite terminals, respectively, of a source of current. When water is admitted through the faucet it will pass through the tube 58, recess 55, spiral groove 54, and openings 56 and 20 into the water heating compartment 14 and fill the latter to the level of the upper open end of the overflow pipe 24 so that the heating coil 31 is substantially submerged. At this time, no current passes through the heating coil 31 because the contacts 43, 44 are open.

Thereafter, the water continues to rise in the

compartment 14, because the flow cross-section of the overflow pipe 24 is slightly smaller than that of the inlet port 20 and the air in the upper part of compartment 14 can escape through tube 74. When the water has sufficiently risen to fill at least partly the space between the two control electrodes 37, 38, an energizing circuit for the winding 40 of the electromagnet is closed through the water, as follows: Conductor 46, winding 40, conductor 48, control electrode 38, water, control electrode 37, conductor 47. The electromagnet operates and attracts its armature 41, whereupon the arm 45 of the latter closes the contacts 43, 44 and establishes the following heating circuit: Conductor 46, contact 43, contact 44, conductor 49, heating coil 31, conductor 47. The water surrounding the heating coil 31 is now heated and as additional cold water flows down along the peripheral wall of the heating compartment 14, the hot water rises continuously in the center of the compartment and is discharged through the overflow pipe 24, 23, 22, holes 21, 56, groove 54, recess 55, tube 59, apertures 60, cup 68 and strainer 72. Owing to the length and the small cross section of the spiral insulating paths traversed by the water in the grooves 54 before and after its contact with the exposed current carrying heating coil 31 no appreciable electric charges can be transmitted through the water to any conductor or semiconductor outside the heater.

When the faucet is closed and the supply of cold water ceases, the level of the water in the compartment 14 begins to fall, first slowly as air enters the heating compartment 14 through the tube 74 and then more rapidly as the water boils and the steam pressure increases. When the level of the water drops below the lower edge of the electrode plates 37, 38, the energizing circuit for the electromagnet is normally interrupted and the contacts 43, 44 open, thus breaking the heating circuit. Even if the breaking of the heating circuit should be delayed for a short period of time due to the accidental presence of some conductive material between the control electrodes 37, 38, the heating coil 31 will remain substantially submerged in the water because the opening of the overflow pipe is at approximately the same level as the top portion of the heating coil 31. However, steam rising from the boiling water tends to carry off any electro-conductive residue which may have remained between the electrodes 37, 38 and the heating circuit will be definitely broken. The heating circuit will then remain open until the gap between the electrodes 37, 38 becomes at least partially filled again upon admission of cold water to the heater.

It should be understood that the heater can be used for the heating of electro-conductive liquids other than water.

I claim:

1. An electric water heater, including two elements of insulating material, each having a surface provided with a recess at least part of which has the shape of a tortuous groove of considerable length, a connecting member provided with two sealing surfaces of insulating material in intimate contact with the recessed surfaces of said two elements, respectively, to form a sealing cover for at least the major portions of both said tortuous grooves, said connecting member providing a passage therethrough from one end of the tortuous groove in one of said elements to one end of the tortuous groove in the other element, means for supplying water to be heated continuously to the other end of the tortuous groove of said first element end and for discharging heated water continuously from the other end of the tortuous groove of said second element, whereby said two closed tortuous grooves and said passage through said intermediate member define a flow-path for the water through the heater, and an electric heating unit disposed in said flow-path remote from the supply end and from the discharge end thereof.

2. In an electric water heater having a closed heating compartment including a flat top wall provided with an inlet port, and a flat bottom wall provided with an outlet port, and an electric heating unit in said compartment which may transmit an electric charge to the water flowing past said heating unit, the combination of two disc-shaped elements of insulating material secured in a liquid tight manner to the top and bottom walls, respectively, of said compartment, each of said disc-shaped elements being provided in its face directed toward the adjacent wall of the compartment with a spiral groove one end of which registers with the port provided in said wall while it communicates at its other end with a hole through said disc-shaped element, said compartment and said disc-shaped elements consisting of heat resisting glass.

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