

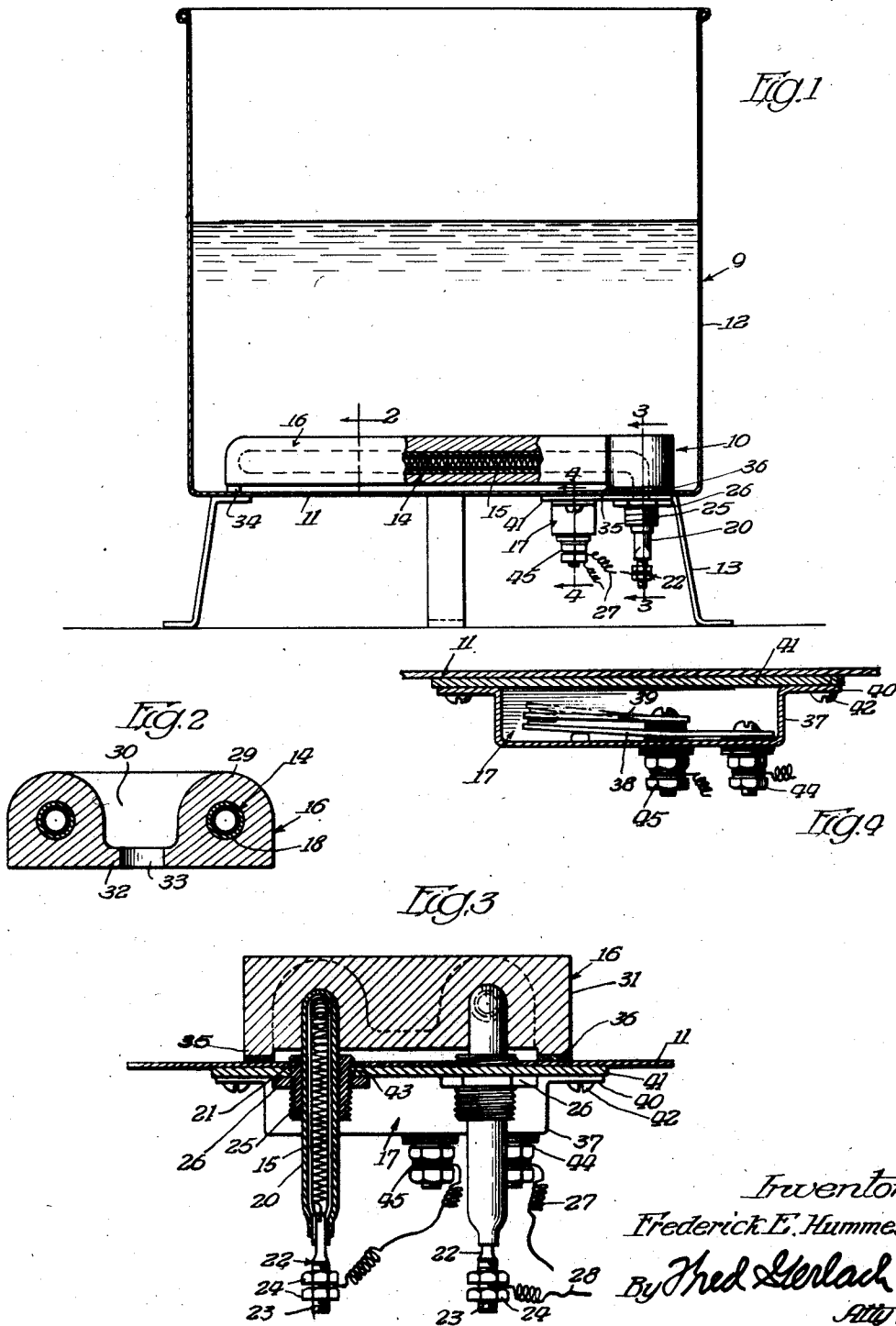
June 19, 1945.

F. E. HUMMEL
ELECTRIC WATER HEATER

2,378,772

Filed June 25, 1942

2 Sheets-Sheet 1



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Fig. 5

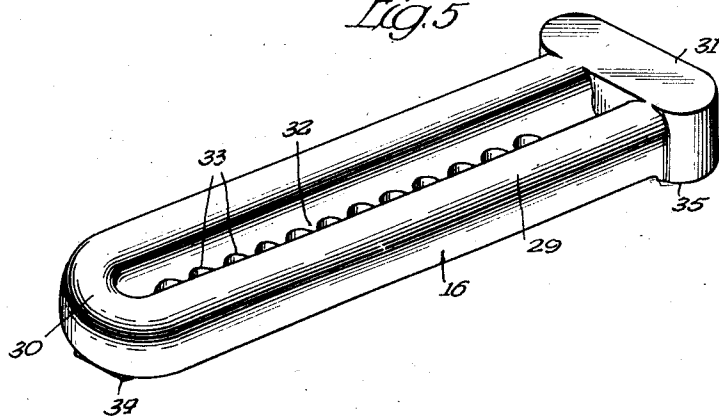


Fig. 6

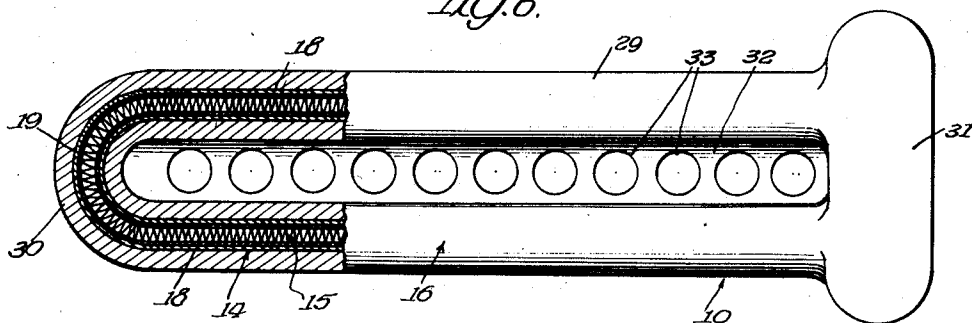


Fig. 7

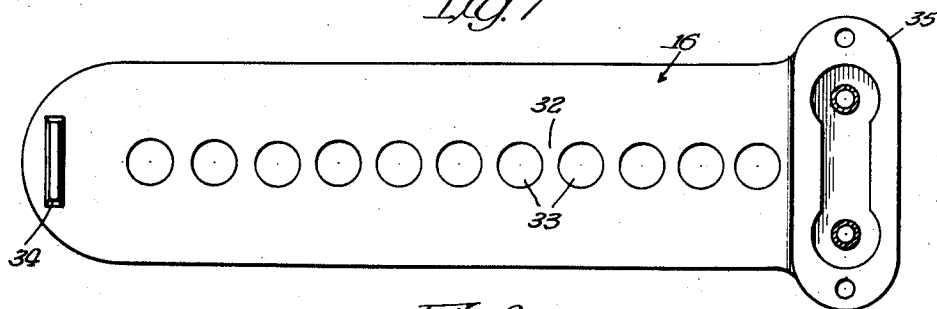
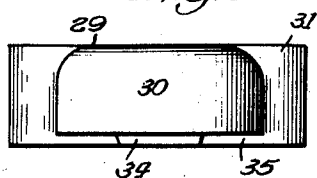


Fig. 8



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UNITED STATES PATENT OFFICE

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ELECTRIC WATER HEATER

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11 Claims. (Cl. 219—44)

The present invention relates generally to water heaters. More particularly the invention relates to that type of water heater which is of the electric variety and comprises a receptacle for the water to be heated and in addition an electric heating unit which is positioned for the most part in the receptacle directly over the bottom thereof, effects heating of the water when current is supplied to it and embodies a copper tube with down-turned ends extending through holes in the receptacle bottom and a resistance element extending longitudinally through the tube and having binding posts at its ends for connection to a pair of current conductors.

One object of the invention is to provide an electric water heater of this type which, due to the construction and design of the heating unit, is an improvement upon, and more efficient than, previously designed heaters.

Another object of the invention is to provide an electric water heater of the type under consideration in which the heating unit comprises in addition to the tube and resistance element a jacket-type casting which is formed of aluminum or like material having high heat conductivity, surrounds the portion of the tube that is disposed in the receptacle, and serves materially to increase the rate of heat transfer from the resistance element to the water in the receptacle to the end that the efficiency of the unit as a whole is increased and there is quick or rapid heating or boiling of the water in the receptacle when the unit is energized by the supply of current to the element.

Another object of the invention is to provide an electric water heater of the last mentioned character in which the casting around the tube is so arranged and designed that it permits the water in the receptacle to circulate readily past it and serves not only to increase the rate of transfer of heat from the resistance element to the water but also to protect the copper tube and prevent it from being distorted or improperly flexed in connection with installation of the unit or removal of the unit from the receptacle in connection with repair or replacement thereof.

A further object of the invention is to provide an electric water heater of the type under consideration in which the heating unit embodies as an auxiliary part thereof a thermostatic switch which is included in one of the conductors for the resistance element, serves automatically to interrupt the supply of current to the element when the water in the receptacle reaches a dangerously low level due to evaporation or boiling

thereof, and is disposed exteriorly of the receptacle and supported from the down-turned ends of the copper tube.

A still further object of the invention is to provide an electric water heater which is generally of new and improved construction, effectively and efficiently fulfills its intended purpose and is characterized by the fact that the heating unit is readily removable from the receptacle and may be installed with facility.

Other objects of the invention and the various advantages and characteristics of the present heater will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a vertical section of an electric water heater embodying the invention, parts of the heating unit being broken away and other parts being shown in section for illustrative purposes;

Figure 2 is an enlarged vertical transverse section taken on the line 2—2 of Figure 1 and showing in detail the cross-sectional design and construction of the casting of the heating unit;

Figure 3 is an enlarged vertical transverse section taken on the line 3—3 of Figure 1 and illustrating in detail the manner in which the heating unit is removably secured in place with respect to the receptacle bottom;

Figure 4 is an enlarged vertical transverse section taken on the line 4—4 of Figure 1 and illustrating the design, construction and arrangement of the thermostatic switch for interrupting the flow of current to the resistance element when the unit overheats as a result of dissipation of the body of water in the receptacle due to evaporation or boiling;

Figure 5 is a perspective of the casting constituting a part of the electric heating unit;

Figure 6 is a plan view of the unit, parts being broken away and other parts being shown in section in order to show the manner in which the casting surrounds the copper tube;

Figure 7 is a bottom view of the casting of the unit; and

Figure 8 is an end view of the casting.

The electric heater which is shown in the drawings constitutes the preferred form or em-

bodiment of the invention. It is designed primarily to heat water or other liquid and comprises a receptacle 9 and a heating unit 10.

The receptacle 9 is adapted to hold the body of water or other liquid to be heated and may be in any desired form. As illustrated in Figure 1, it comprises a bottom 11 and a continuous side wall 12 and has an open top. The side wall is suitably joined to, and extends upwardly from, the margin of the bottom and defines with the bottom a compartment or chamber for the water to be heated. The bottom 11 is substantially imperforate and has depending legs 13 whereby the receptacle 9 is held in an elevated position with respect to the support or surface over which it is disposed. If desired the receptacle and legs may be formed of sheet metal.

The heating unit 10 is disposed for the most part in the receptacle directly over the bottom 11 thereof and serves, when energized, to heat the water in the receptacle. It is in the form of a unit or unitary structure and comprises as the main parts thereof a tube 14, an electric resistance element 15, a casting 16 and a thermostatic switch 17. The tube 14 is formed of copper or like material having high heat conductivity and is bent centrally so that it is U-shaped so far as contour is concerned and comprises a pair of spaced apart, parallel arm-like part 18 and a semi-circular intermediate or connecting part 19 between certain ends of the parts 18. The parts 18 and 19 of the tube 14 extend horizontally, as shown in Figure 1, and are disposed over, and in spaced relation with, the receptacle bottom 11. The free ends of the arm-like parts 18 of the tube 14 are provided with down-turned extremities 20 and these extend through a pair of laterally spaced circular holes 21 in the bottom 11 of the receptacle. The lower ends of the down-turned extremities 20 of the tube 14 are of reduced diameter (see Figure 3) and surround a pair of binding posts 22. The latter are suitably insulated from the lower ends of the extremities 20 and are in the form of screw type rods 23 and clamping nuts 24 on the rods. The upper portions of the down-turned extremities 20 are provided with externally threaded copper or brass sleeves 25 and these are soldered or otherwise fixedly secured to said upper portions of the tube extremities 20 and extend through the holes 21, respectively. Nuts 26 are mounted on the sleeves 25 and together with the sleeves constitute means for removably securing the heating unit 10 in place.

The resistance element 15 of the heating unit 10 is in the form of a fine wire and extends longitudinally through the tube 14. It is suitably electrically insulated from the tube interior and has one end thereof connected to the upper end of the screw type rod of one of the binding posts 22 and its other end connected to the upper end of the rod of the other binding post. A pair of conductors 27 and 28 serve to connect the resistance element 15 to a source of electric current. The conductor 27 leads and is connected to one of the binding posts 22 and the other conductor, i. e., the conductor 28, is connected to the other binding post. When current is supplied to the resistance element 15 the latter becomes heated to a comparatively high degree and serves to heat the body of water in the receptacle 9. The tube 14 and the casting 16 function as heat transfer members and transfer the heat from the resistance element to the water. As hereinafter described, the thermostatic switch 17 is included in the conductor 27 and serves automatically to cut

off the flow of current through the resistance element when the water in the receptacle drops to a low level due to evaporation or boiling thereof.

The casting 16 constituting part of the unit 10 has a twofold purpose. In the first place it serves materially to increase the radiating surface of the unit; and secondly, it operates to protect the tube 14 and the resistance element 15 against bending or distortion during assembly or removal of the unit with respect to the receptacle bottom 11. Preferably the casting is formed of aluminum, although it is to be understood that instead of aluminum any other material having high heat conductivity may be employed. It is cast around the arm-like parts 18 and the semi-circular connecting part 19 of the tube 14 and comprises a pair of horizontally extending, laterally spaced, parallel arm-like parts 29, a semi-circular part 30, a head-like part 31 and a web 32. For practical purposes the casting 16 is of one-piece design. The arm-like parts 29 of the casting surround the arm-like parts 18 of the tube 14, respectively, and are approximately three times as thick as the tube. The semi-circular part 30 is disposed at one end of the casting 16. It serves to connect together the parts 29 and surrounds the semi-circular connecting part 19 of the tube. The head-like part 31 is located at the other end of the casting and surrounds the right angle bends between the free ends of the arm-like parts 18 of the tube 14 and the down-turned extremities 20. It is elongated transversely of the casting and preferably has a flat top surface. The sides and top portions of the parts 29 and 30 of the casting are curved or rounded whereas the bottom faces or portions are flat. The web 32 extends between the inner lower side portions of the arm-like parts 29 and at one end thereof joins the semi-circular part 30 and at its other end joins the head-like part 31. It is of reduced height and is coplanar with the flat bottom surfaces of said arm-like parts 29 of the casting. Holes 33 are formed in the web 32 and permit water in the receptacle to flow or circulate upwards therethrough and thence past the other portions or parts of the casting. The semi-circular part 30 of the casting is provided on the bottom surface thereof with a depending lug 34 and the head-like part 31 at the other end of the casting is provided with a depending marginal flange 35. The lug and flange are substantially of equal height and serve as legs for supporting the casting 16 in an elevated position with respect to the bottom 11 of the receptacle 9. When the heating unit 10 is energized the portion of the water that is in the immediate vicinity of the casting is heated by conduction and then rises to the top of the body of the water in the receptacle. This results in the cooler water circulating downwards into contact with the casting 16. The portion of the water that is directly over the hole equipped web 32 rises when heated and results in additional water circulating upwards through the casting via the holes 33. The head-like part 31 of the casting 16 overlies the portion of the receptacle bottom that defines the holes 21 and is supported therefrom by way of a gasket 36. The latter fits between said portion of the receptacle bottom and the lower surface of the marginal flange 35 on the head-like part 31 and operates when the nuts 26 are tightened to form a leakproof joint between the head-like part 31 and the receptacle bottom whereby leakage of water under the head-like part 31 and through the holes 21 is prevented.

Preferably the gasket 36 is shaped conformably to the flange 35.

The thermostatic switch 17 is disposed directly beneath the receptacle bottom 11 and comprises an elongated open top box-like housing 37 and a pair of vertically spaced, parallel, substantially horizontally extending contact strips 38 and 39 in the housing. The housing is in the form of a sheet metal stamping and is provided at the ends thereof with a pair of out-turned ears 40. Such ears abut against the bottom face of a horizontally extending metallic plate 41. Screws 42 extend through the ears 40 and the superjacent or superencumbent portions of the plate 41 and serve removably to secure the housing to the plate. The plate fits against the bottom of the receptacle and is provided with a pair of holes 43 for accommodating the metallic sleeves 25 around the upper portions of the down-turned tube extremities 20. The nuts 26 on the sleeves 25 bear against the hole-defining portions of the plate 41 and serve when tightened to urge the head-like part 31 of the casting downwards and thus compress the gasket 36 between the marginal flange 35 and the superjacent portion of the receptacle bottom 11. Tightening of the nuts 26 results in the heating unit 10 being firmly secured in place. When the nuts are removed from the sleeves 25 the unit may be removed from its operative position merely by lifting it out of the receptacle 9. The contact carrying strip 38 of the switch 17 extends directly above and is insulated from the bottom of the housing 37. It is disposed beneath the strip 39 and is provided at the end thereof that is opposite its contact with a binding post 44. The latter extends through a hole in the housing bottom and has attached thereto one part of the conductor 27. The contact equipped strip 39 is of the bimetallic variety and is supported above the strip 38 by way of a binding post 45 which extends through the bottom of the housing 37 and is connected to another portion of the conductor 27. The strips 38 and 39 of the switch are so arranged or positioned that the contacts thereof are in engagement with one another as long as normal temperatures are encountered. When the two contacts are in engagement, switch 17 is in its closed position with the result that current is permitted to flow through the resistance element 15. When the unit 10 starts to overheat as the result of substantially complete boiling away of the water in the receptacle the bimetallic strip 39 flexes away from the strip 38 and thus automatically opens the switch 17 and cuts off or stops the flow of current through the resistance element. The switch 17 is so adjusted that it only opens when the unit 10 starts to overheat. By reason of the fact that there is a metal to metal contact between the switch housing 37 and the plate 41 and a metal to metal contact between the plate and the sleeves 25 there is an effective conduction of heat from the resistance element to the interior of the switch housing 37 when overheating of the unit occurs. The switch 17 is essentially a safety device and prevents the unit 10 from overheating to the point where it is likely to burn out the receptacle bottom 11 in the event of complete or substantially complete boiling away of the water in the receptacle. By reason of the fact that the housing 37 of the switch is in heat exchange relation with the tube 14 around the resistance element 15 the switch responds quickly and readily to any overheating of the unit 10. Because the switch is disposed ex-

teriorly of the receptacle 9 it does not come into contact with the water in the receptacle and corrosion of the parts thereof is effectively avoided. It is contemplated that the thermostatic switch 17 will be employed in addition to a main switch (not shown).

In installing the unit 10 with respect to the receptacle the nuts 26 are first removed from the sleeves 25. Thereafter the unit is lowered into the receptacle and is so manipulated as to bring the sleeves through the holes 21 in the bottom 11 of the receptacle. When the unit is in place the switch carrying plate 41 is manipulated into place on the under side or face of the receptacle bottom and the nuts 26 are again applied to the sleeves 25 and then tightened. Tightening of the nuts, as previously pointed out, results in the head-like part 31 of the casting being drawn towards the receptacle bottom into a position wherein the gasket 36 is in a compressed or seal establishing position and the unit 10 is clamped or locked in place. After tightening of the nuts 26 the electrical conductors 27 and 28 are applied to the various binding posts so as to complete the electrical circuit for the resistance element 15 of the heating unit 10. When it is desired to heat the body of water or other liquid in the receptacle 9 the main switch is closed by the operator. This results in current flowing through the resistance element 15 and the resulting heat being transferred through the copper tube 14 and the aluminum casting 16 to the water. As soon as the unit starts to generate heat the water in the receptacle circulates around the casting in the manner heretofore described and becomes heated as the result of contact with the outer surface portions of the casting. A portion of the water in the receptacle circulates upward through the holes 33 in the web 32 whereas other portions circulate past the side faces of the parts 29 and 30. Should the water in the receptacle boil away or the level thereof drop to a dangerously low point in the receptacle the thermostatic switch 17, as hereinbefore pointed out, operates immediately upon overheating of the unit 10 to cut off the flow of current through the resistance element 15. Should it be desired to remove the unit 10 for inspection or replacement purposes it is only necessary to disconnect the conductors 27 and 28 and then remove the nuts 26 from the sleeves 25. As soon as the nuts are removed the unit may be removed from the receptacle by lifting it from the bottom 11.

The herein described water heater is extremely efficient and may be built at a comparatively low cost due to the simplicity of the heating unit 10. It has a comparatively long life and operates quickly to heat to the boiling point the water or other liquid in the receptacle by reason of the fact that the heating unit includes the aluminum casting 16 around the copper tube 14. In practice it has been found that a heater having a heating unit of the type hereinbefore specifically described will heat the body of water in the receptacle faster and with less current input than a heater wherein the heating unit includes no aluminum casting around the copper tube.

The invention is not to be understood as restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. A liquid heater comprising a receptacle for the liquid to be heated and a heating unit disposed for the most part in the receptacle and over the bottom thereof and embodying a U-shaped metallic tube having the ends thereof communicating with the receptacle exterior, an electric resistance element extending longitudinally through the tube and having its ends terminating exteriorly of the receptacle and provided with means for connection to current conductors, and an elongated separately formed jacket in the form of a casting of metal having high heat conductivity extending around and engaging the tube and having depending legs at its ends for supporting it in spaced relation with the receptacle bottom.

2. A liquid heater comprising a receptacle for the liquid to be heated, and a removable heating unit disposed for the most part in the receptacle and over the bottom thereof and embodying a metallic tube having separated downturned ends extending through the receptacle bottom, an electric resistance element extending through the tube and having its ends terminating adjacent the tube ends and provided with means for connection to current conductors, a separately formed jacket in the form of a casting of material having high heat conductivity extending around and engaging only the portion of the tube within the receptacle, and releasable clamping means carried by the downturned ends of the tube and serving to maintain the portion of the casting adjacent said downturned ends in clamped relation with the subjacent portion of the bottom of the receptacle.

3. A liquid heater comprising a receptacle for the liquid to be heated and a heating unit disposed for the most part in the receptacle and over the bottom thereof and embodying a U-shaped metallic tube having the ends thereof communicating with the receptacle exterior, an electric resistance element extending longitudinally through the tube and having its ends terminating exteriorly of the receptacle and adapted for connection to current conductors, and a casting of material of high heat conductivity spaced from the receptacle bottom and including a U-shaped part extending around and engaging the tube, and a web extending across said U-shaped part and having a longitudinal series of holes therein.

4. A liquid heater comprising a receptacle for the liquid to be heated and a heating unit disposed for the most part in the receptacle and over the bottom thereof and embodying a U-shaped metallic tube having the ends thereof communicating with the receptacle exterior, an electric resistance element extending longitudinally through the tube and having its ends terminating exteriorly of the receptacle and provided with means for connection to current conductors, and a separately formed jacket in the form of a one-piece casting of material having high heat conductivity cast around the tube and embodying a U-shaped part extending around the tube and having an opening in the central portion thereof and a head-like part connected to, and extending between, the ends of the U-shaped part and serving to cross connect the ends of the tube.

5. A liquid heater comprising a receptacle for the liquid to be heated and a heating unit disposed for the most part in the receptacle and over the bottom thereof and embodying a U-shaped metallic tube having the ends thereof communicating with the receptacle exterior, an electric resistance element extending longitudinally through the tube and having its ends terminating exteriorly

of the receptacle and provided with means for connection to current conductors, and a separately formed jacket in the form of a casting of metal having high heat conductivity and embodying a U-shaped part extending around and engaging the tube and having a depending leg for supporting it in spaced relation with the receptacle bottom and also having an opening in the central portion thereof, and a head-like part extending between, and connected to, the ends of the U-shaped part, serving to cross connect the tube ends and having a depending leg for supporting it in spaced relation with the receptacle bottom.

6. A liquid heater comprising a receptacle for the liquid to be heated and a heating unit disposed for the most part in the receptacle and over the bottom thereof and embodying a U-shaped metallic tube having the ends thereof communicating with the receptacle exterior, an electric resistance element extending longitudinally through the tube and having its ends terminating exteriorly of the receptacle and provided with means for connection to current conductors, and a jacket in the form of a casting of metal having high heat conductivity embodying a U-shaped part extending around and engaging the tube, a head-like part adjacent the tube ends and a web extending across the U-shaped part and provided with a longitudinal series of holes therein, and also embodying depending legs on the U-shaped part and the head-like part for supporting it in spaced relation with the receptacle bottom.

7. A liquid heater comprising a receptacle for the liquid to be heated and a removable heating unit disposed for the most part in the receptacle and over the bottom thereof and embodying a U-shaped metallic tube disposed in a substantially horizontal position in the receptacle and having down-turned extremities aligned with, and extending through, holes in the receptacle bottom, an electric resistance element extending longitudinally through the tube and having its ends extending through the holes in, and terminating exteriorly of, the receptacle bottom and adapted for connection to current conductors, a separately formed jacket in the form of a casting of metal having high heat conductivity, embodying a U-shaped part extending around and engaging the tube and having an opening in the central portion thereof and a head-like part between, and connected to, the ends of the U-shaped part and extending around, and serving to cross connect, the bent portions of the downturned extremities of the tube, and releasable clamping means disposed exteriorly of the receptacle and carried by said down-turned extremities for urging said head-like part of the jacket into clamped relation with the subjacent portion of the receptacle bottom.

8. A liquid heater comprising a receptacle for the liquid to be heated and a removable heating unit disposed for the most part in the receptacle and over the bottom thereof and embodying a metallic U-shaped tube disposed in a substantially horizontal position in the receptacle and having down-turned extremities extending through holes in the receptacle bottom, an electric resistance element extending longitudinally through the tube and having its ends terminating adjacent the ends of the tube extremities and provided with means for connection to current conductors, a jacket for the tube in the form of an elongated horizontally extending casting of metal having high heat conductivity embodying a U-shaped part extending around and engaging the tube, a

head-like part extending around the bent upper ends of the tube extremities and a marginal depending flange-like leg on the head-like part for spacing the head-like part and the U-shaped part from the receptacle bottom, and releasable clamping means carried by the down-turned extremities of the tube at a point beneath the receptacle bottom for urging the head-like part and leg of the casting in clamped relation with the sub-jacent portion of the receptacle bottom.

9. A liquid heater comprising a receptacle for the liquid to be heated, a heating unit disposed for the most part in the receptacle and over the bottom thereof and embodying a metallic tube having down-turned ends extending through the receptacle bottom, and an electric resistance element extending longitudinally through the tube and having its ends terminating adjacent the tube ends, a metallic plate mounted beneath the receptacle bottom and on the ends of the tube and in direct contact with the tube ends, and means for supplying current to the resistance element comprising a pair of conductors connected to the ends of the resistance element, respectively, and a thermostatic switch included in one of the conductors and mounted on the plate.

10. An electric heating unit adapted for use

in connection with a liquid heater and comprising a one-piece casting formed of metal having high heat conductivity and embodying a U-shaped part, a head-like cross part at the open end of the U-shaped part, and an intermediate web within said U-shaped part and provided with a longitudinally extending series of holes, and an electric resistance element extending longitudinally through the U-shaped part of the casting and having the ends thereof leading through the head-like part.

11. An electric heating unit adapted for use in connection with a liquid heater and comprising a U-shaped metallic tube having the end extremities thereof angularly disposed, an electric resistance element extending longitudinally through the tube, and a separately formed jacket in the form of a casting of metal having high heat conductivity and embodying a U-shaped part extending around and engaging the tube, a head-like cross part extending across the free end of the U-shaped part and around the bends adjacent the inner ends of the angularly disposed end extremities of the tube, and an intermediate web within said U-shaped part and provided with a longitudinal series of holes.

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