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ELECTRIC WATER HEATER

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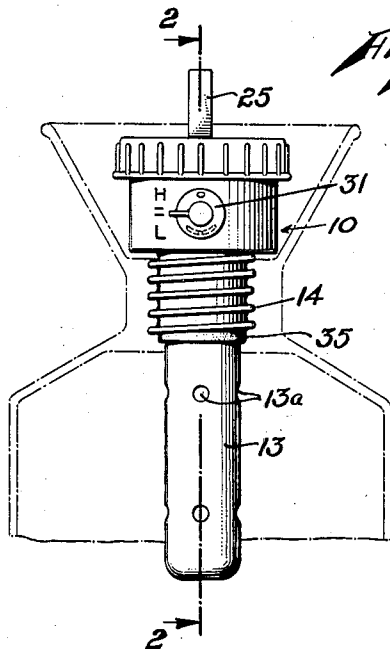


Fig. 1.

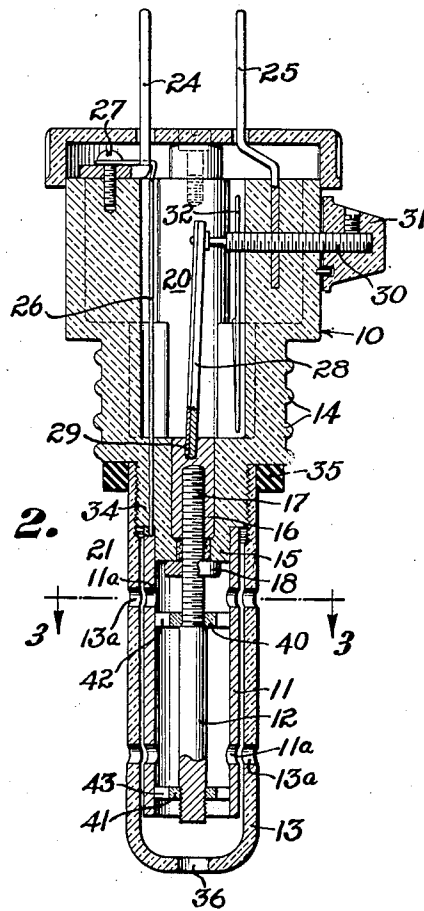


Fig. 2.

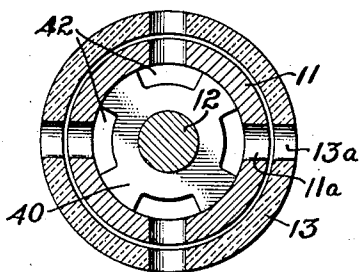


Fig. 3.

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ELECTRIC WATER HEATER

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9 Claims. (Cl. 219—40)

This invention relates to electric water heaters of the immersion type, and more particularly to the type employed to heat water in closed containers such as hot water bottles and the like.

Heaters of this type employ a pair of electrodes arranged in spaced relation one within the other. The water in which the electrodes are immersed serves as a medium for conducting current between the electrodes, and the resistance of the water to the passage of current causes the water to become heated.

The use of metallic electrodes in heaters of the above type has proved more or less unsatisfactory because of their tendency to become coated with insoluble substances in the water being heated and eventually become insulated, thereby reducing the efficiency of the heater and finally rendering it inoperative. Accordingly, electrodes of carbon or graphite have been employed, but due to the fragility of these materials, the center electrode, which is in the form of a comparatively thin rod, is relatively easily broken if the device is dropped or jarred unduly. Fracturing of this electrode often results in a bridging of the annulus between the electrodes by a piece of the broken electrode, resulting in a shorting of the device and explosion. Attempts have been made to prevent this by connecting the center electrode with the insulating housing in which the electrodes are contained. However, this construction interferes with the circulation of water through the device when it is in use and also interferes with the drainage of water from the device when it is removed from the liquid. Furthermore, mechanical shocks accidentally imparted to the outer housing are transmitted to the center electrode, often causing it to break and produce the deleterious effects above mentioned.

It is accordingly an object of the present invention to provide an electric water heater of the character referred to in which the danger of the electrodes breaking is reduced to a minimum, and which will not short circuit in the event an electrode becomes broken.

A further object of the invention is the provision of means for accomplishing the above object which will not interfere with the circulation of fluid through the device when in use, nor with the drainage of fluid therefrom when the device is removed from the fluid.

Another object of the invention is the provision of an electric water heater of the character referred to in which the center electrode is supported in such a manner that mechanical shocks

on the exterior of the device will not be transmitted to the center electrode.

This invention possesses many other advantages and has other objects which may be made more easily apparent from a consideration of one embodiment of the invention. For this purpose there is shown a form in the drawing accompanying and forming part of the present specification. This form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawing:

Figure 1 is a side elevation of an electric water heater embodying the present invention, shown in place in a hot water bag;

Figure 2 is an enlarged vertical sectional view through the device, taken on line 2—2 of Figure 1; and,

Figure 3 is a transverse sectional view taken as indicated by line 3—3 of Figure 2.

In general, the heating unit comprises a body 10 formed of Bakelite or other suitable insulating material, supporting a pair of electrodes 11 and 12 and an insulating housing 13 in which the electrodes are contained. As shown in Figure 1, the electrode and housing assembly is adapted to be inserted through an opening of a hot water bottle or other vessel, and immersed in the fluid contained therein. The body 10 provides a closure for the container opening and is secured therein by the engagement of its reduced threaded portion 14 with a threaded portion of the opening.

For reasons heretofore given, it is desirable to form the electrodes of non-metallic substances, such as carbon, graphite, or the like. The electrode 11 is preferably tubular in cross sectional configuration, and is secured at its upper end to a reduced portion 15 of the plug 16, which has a press fit in the end of the electrode. The lower end of this electrode is open and it is provided with a plurality of longitudinally spaced openings 11a for facilitating the circulation of fluid through the device and drainage of fluid therefrom. The electrode 12 is positioned within the tubular electrode 11 and is in the form of a rod secured at its upper end to a metal plug or insert 18 contained in a socket in the lowermost end of the insulating body 10. The metal plug is provided with a threaded opening for receiving the upper threaded end 17 of the electrode 11. The plug and its containing socket are pref-

erably non-circular in cross-sectional configuration to restrain the plug against rotation when the electrode is being secured to or removed from the plug. A circumferential fluid tight seal is provided between the plug and its containing socket to prevent the passage of fluid from the annular space between the electrodes to the hollow portion 20 of the insulating body 10, which contains part of the electrical control hereinafter described. The seal may be produced by coating the complementary surfaces of the plug and socket with Bakelite cement prior to the insertion of the plug into the socket. If desired, an additional circumferential seal 21 may be provided between the end of the plug 16 and the lowermost end of the body 10. The engagement of a nut 18 on the inner electrode with the end of the body 10 serves to secure the electrode in place after it has been screwed into the plug 16.

The electrodes 11 and 12 are connected electrically with a pair of terminals 24 and 25, which are adapted to be inserted in the ordinary electrical plug. The outer tubular electrode 11 is connected to the terminal 24 by a conductor wire 26, one end of which is soldered to a metallic surface provided on the upper end of said electrode, and the other end of which is secured to a screw 27 passing through the base of the terminal 24 into the insulating body 10.

The means for conducting current between the terminal 25 and the inner electrode 12 includes a thermostatic element 28 of the well-known type comprising a pair of metallic elements having different coefficients of expansion. The lower end of the thermostatic element 28 is rigidly secured to the metallic plug 16 as at 29, and its upper end is engageable with the inner end of an adjustable contact screw 30. The contact screw is threaded through both the insulating body 10 and the lower end of the terminal 25 embedded therein. Thus, current is conducted between the terminal 25 and the inner electrode 12 through the screw 30, the thermostat 28 and the plug 16. The outer end of the contact screw carries a knob 31 by which the screw can be adjusted with relation to the upper end of the thermostatic element for regulating the degree of heat. A spring wire 32 having one end secured to the body 10 and its other end bearing against the contact screw serves to hold the screw in adjusted position.

In order to protect the electrodes from mechanical injury and eliminate the possibility of electrical shock to a user of the device, the electrodes are enclosed in the housing 13 as mentioned above. The upper end of the housing is threadedly secured to a portion 34 of the insulating body 10 immediately below the threaded portion 14. A rubber gasket 35 surrounding the upper end of the housing 13 adjacent the end of the reduced threaded portion 14 of the body 10, serves to prevent leakage of fluid from the vessel to which the device is applied. The lower end of the housing 13 is closed except for a small opening 36, which facilitates the circulation of water through the device during use and drainage of water therefrom when the device is removed from the water. By enclosing the ends of the electrodes as well as the sides, all danger of the user becoming shocked is removed. Furthermore, there is no opportunity for electrical conducting objects to enter the space between the electrodes and short the device. The housing 13 is also provided with a plurality of longitudinally spaced openings 13a, which cooperatively with the open-

ings 11a in the inner electrode, define transverse passages for the circulation of fluid between the exterior of the device and the annulus between the electrodes.

As the electrodes 11 and 12 are made of carbon, graphite, or the like, they are comparatively fragile, and the center rod-like electrode is especially weak. The present invention concerns itself primarily with the provision of means for supporting this center electrode in such a manner as to minimize any likelihood of its becoming fractured by mechanical shocks imparted to the device, and to prevent bridging of the annular space between the electrodes by a piece of the inner electrode in the event it accidentally becomes fractured. This is accomplished by the provision of mechanical connections between the inner and outer electrodes, mutually supporting said electrodes independent of any connection with the housing 13. These connections are shown as being in the form of insulating spacers 40 and 41 positioned at spaced intervals along said electrodes and bridging the annular space between the electrodes. The spacers are preferably threaded onto the center electrode to positions near its effective outer ends, and have a relatively tight fit with the interior surface of the tubular electrode 11. It is to be noted that the spacer 41 adjacent the outer ends of the electrodes is wholly within the outer electrode 11 and entirely free of housing 13. Thus, the outer or tubular electrode 11 serves to shield the spacer from mechanical shocks which would be transmitted to the inner electrode 12 and might damage it. Openings 42 and 43 in the bridges 40 and 41, permit the free circulation of fluid from the exterior of the housing through the annulus between the electrodes both in a longitudinal and transverse direction, regardless of the position of the vessel in which the device is contained.

In the drawing, a considerable space is shown between the outer tubular electrode 11 and the housing 13. However, due to its rigidity, this electrode can actually be positioned immediately adjacent the housing without danger of its becoming fractured by mechanical shocks of the type normally imposed upon the housing during handling and use of the device. The rigidity of this tubular electrode serves as an ideal support for the relatively fragile internal electrode.

In addition to reducing the possibility of the inner electrode becoming fractured, the spacers 40 and 41 perform the important added function of preventing a portion of the inner electrode from bridging the space between a remaining portion and the outer electrode in the event that the center electrode is accidentally broken by dropping the device or otherwise mistreating it. It can be seen that if the center electrode is broken, it will merely part between the spacers, which will support the broken portions and prevent one broken portion from bridging the space between the remaining broken portion and the outer electrode, which if permitted, would cause short circuiting and a resultant explosion. About the only way bridging could occur would be for the center electrode to break into three or more pieces, an almost impossible fortuity. The lack of mechanical support between the inner electrode and the housing, permits the housing to be removed and replaced without straining the inner electrode, thus facilitating the problem of original assembly, inspection and replacement.

Although the inner electrode is shown as being supported at both ends by the insulating spacers

40 and 41, the rigid support provided by the outer tubular electrode makes possible the utilization of a single spacer between the electrodes at their outer ends. In any event, the number of spacers and their relative positions on the electrode is dictated by the length of the electrode and its physical characteristics.

I claim:

1. An electric water heater of the immersion type comprising a plug formed of electrical insulating material, a tubular electrode secured at one end to said plug, a second electrode within said tubular electrode secured at one end to said plug, a housing of insulating material enclosing said electrodes and supported from the plug free from any connection with said second electrode, and an insulating spacer forming a bridge between said electrodes near their outer ends.

2. An electric water heater of the immersion type comprising a plug formed of electrical insulating material, a tubular electrode secured at one end to said plug, a second electrode within said tubular electrode secured at one end to said plug, a housing of insulating material enclosing said electrodes and supported from the plug free from any connection with said second electrode, and a plurality of insulating spacers positioned at spaced intervals along said electrodes to form bridges.

3. An electric water heater of the immersion type comprising a plug formed of electrical insulating material, a tubular electrode secured at one end to said plug, a second electrode within said tubular electrode secured at one end to said plug, a housing of insulating material enclosing said electrodes and supported from the plug, said housing and tubular electrode each having longitudinally spaced openings therethrough to establish communication between the exterior of said housing and the annulus between said electrodes, and an insulating spacer forming a bridge between said electrodes near their outer ends, said spacer having an opening permitting passage of fluid therethrough to and from said annulus.

4. An electric water heater of the immersion type comprising a plug formed of electrical insulating material, a tubular electrode secured at one end to said plug, a second electrode within said tubular electrode secured at one end to said plug, a housing of insulating material enclosing said electrode and supported from the plug free from any connection with said second electrode, and an insulating spacer mounted on said second electrode near its outer end and having a press fit in said tubular electrode.

5. An electric water heater of the immersion type comprising a plug formed of electrical insulating material, a tubular electrode secured at one end to said plug, a second electrode spaced within said tubular electrode and secured at one

end to said plug, a housing surrounding said electrodes and supported from the plug, said housing and tubular electrode having openings therethrough to establish communication between the exterior of said housing and the space between said electrodes, and an insulating spacer forming a bridge between said electrodes beyond their ends of attachment to said plug, said spacer being located wholly within said tubular electrode and shielded thereby against shocks.

6. An electric water heater of the immersion type comprising a plug formed of electrical insulating material, a tubular electrode secured at one end to said plug, a second electrode spaced within said tubular electrode and secured at one end to said plug, a housing surrounding said electrodes and supported from the plug, said housing and tubular electrode having openings therethrough to establish communication between the exterior of said housing and the space between said electrodes, and an insulating spacer forming a bridge between said electrodes beyond their ends of attachment to said plug, said spacer having an opening therethrough permitting flow of fluid longitudinally of the space between the electrodes.

7. An electric water heater of the immersion type comprising a plug formed of electrical insulating material, a tubular electrode secured at one end to said plug, a second electrode within said tubular electrode secured at one end to said plug, a housing of insulating material surrounding said electrodes and supported from the plug, and an insulating spacer forming a bridge between said electrodes near their outer ends, said spacer being located wholly within said tubular electrode and shielded thereby against shocks.

8. An electric water heater of the immersion type comprising a plug formed of electrical insulating material, a tubular electrode secured at one end to said plug, a second electrode within said tubular electrode secured at one end to said plug, a housing of insulating material surrounding said electrodes and supported from the plug, and an insulating spacer forming a bridge between said electrodes near their outer ends and entirely free of the housing.

9. An electric water heater of the immersion type comprising a plug formed of electrical insulating material, a tubular electrode secured at one end to said plug, a second electrode spaced within said tubular electrode and secured at one end to said plug, a housing surrounding said electrodes and supported from the plug, a plurality of insulating spacers positioned at spaced intervals along said electrodes to form bridges therebetween, there being openings to establish communication between the exterior of the housing and the space between the electrodes.

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