April 3, 1951 M. W. HANKS 2,547,865

LIQUID CONDUCTOR HEATER

Filed May 17, 1947 3 Sheets-Sheet 1

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Filed May 17, 1947 3 Sheets-Sheet 2

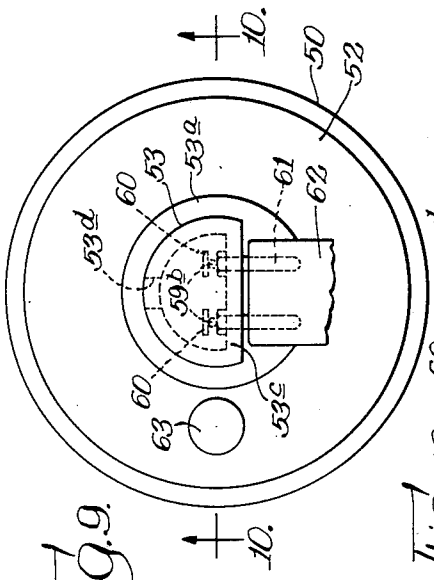


Fig. 9.

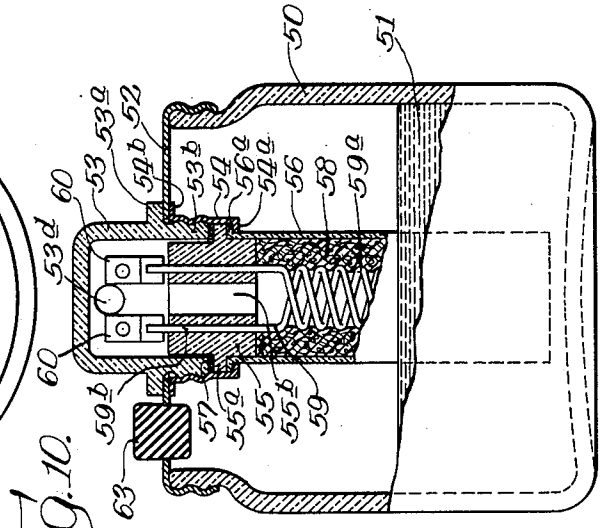


Fig. 10.

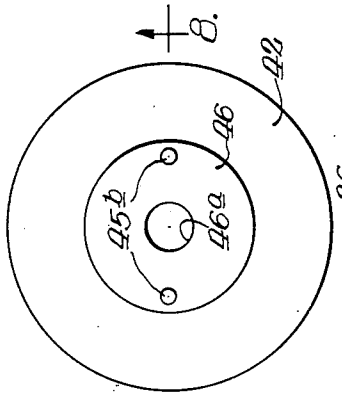


Fig. 7.

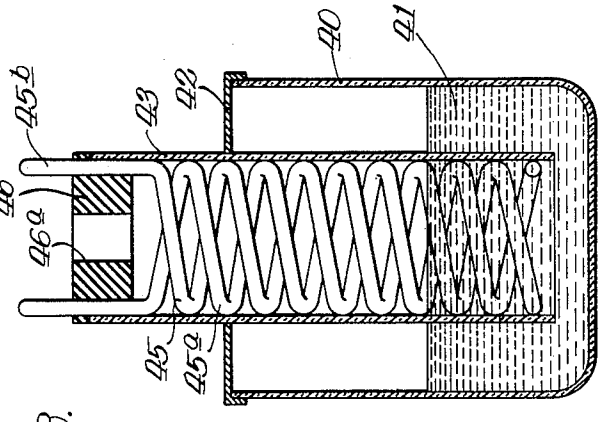


Fig. 8.

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April 3, 1951 M. W. HANKS 2,547,865

LIQUID CONDUCTOR HEATER

Filed May 17, 1947 3 Sheets-Sheet 3

Fig. 11.

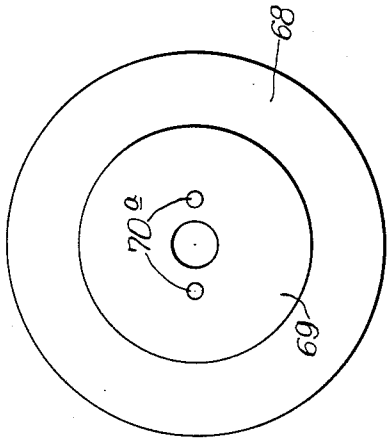
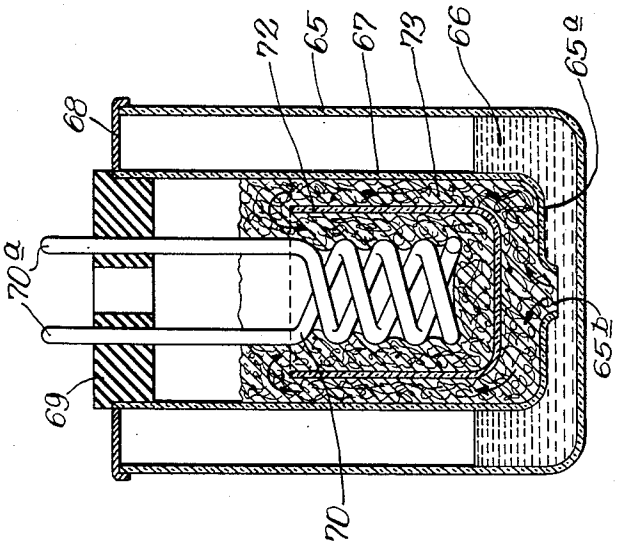


Fig. 12.



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LIQUID CONDUCTOR HEATER

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12 Claims. (Cl. 219—40)

1

This invention relates to improvements in liquid conductor heaters of the type in which a pair of spaced electrodes connected in an electric circuit are located in a vessel formed of insulating material and are adapted to be connected by a quantity of water or other vaporizable liquid which is adapted to be heated and evaporated by the passage of electric current therethrough. If a measured quantity of liquid is placed in the vessel, it will then have a substantially definite time period of operation. Devices of this type have been described and claimed in numerous Letters Patent of the United States taken out by me including, for example, No. 1,683,069, dated September 8, 1928, No. 2,061,337, dated November 24, 1936, and No. 2,300,891, dated November 3, 1942.

Liquid conductor heaters of this type have been highly successful in practical use but have had the disadvantage of slow starting because it has been necessary to heat the entire body of water in the vessel before vaporiaztion begins. Further, the steam generated at the electrodes condenses and imparts its heat to the adjoining liquid by which it is transmitted to the main body of liquid so that there is some loss of efficiency. Also, in most devices of the type referred to there is a tendency for the development of a large starting current which continues until the resistance of the liquid is increased by the formation of a bubble structure between the electrodes.

The principal object of the present invention is to improve upon prior devices of this type in the foregoing respects, and others, by providing apparatus in which evaporation is started and maintained by heating only a small portion of the total quantity of water in the vessel and in which the condensate returns directly to the electrodes for re-evaporation without circulating through the main body of liquid, thus providing a quick acting and more efficient operation. A further object is to provide a liquid conductor heater in which the spaced electrodes are located partially or wholly outside the body of liquid in the vessel and liquid is conveyed to the electrode portions outside of the liquid body by capillary action through a porous body or wick formed preferably of non-conducting, non-carbonaceous material, such as glass wool, asbestos or the like, whereby a quick acting vaporization is initiated and maintained, without directly heating the many body of liquid at all or without directly heating any substantial portion thereof. Still another object of the invention is to provide a

2

liquid conductor heater comprising an insulating vessel adapted to contain a body of liquid and having mounted therein a tubular insulating member containing a body of capillary insulating material extending into said liquid and contacting with two upwardly extending spaced electrodes formed preferably as intermeshing coaxial helices of conducting material having their upper ends arranged for connection in an electric circuit. Other objects relate to various features of construction and arrangement which will appear more fully hereinafter.

The nature of the invention will be understood from the following specification taken with the accompanying drawings in which several embodiments of the invention are illustrated. In the drawings,

Figure 1 shows a top plan view of one form of liquid conductor heater embodying the features of the present invention;

Fig. 2 shows a vertical section taken on the line 2—2 of Fig. 1;

Fig. 3 shows a top plan view of a second form of the invention;

Fig. 4 shows a vertical section taken on the line 4—4 of Fig. 3;

Fig. 5 shows a top plan view of a third form of the invention;

Fig. 6 shows a vertical section taken on the line 6—6 of Fig. 5;

Fig. 7 shows a top plan view of a fourth form of the invention;

Fig. 8 shows a vertical section taken on the line 8—8 of Fig. 7;

Fig. 9 shows a top plan view of still another form of the invention;

Fig. 10 shows a vertical section taken on the line 10—10 of Fig. 9;

Fig. 11 shows a top plan view of another form of the invention; and

Fig. 12 shows a vertical section through the form of the invention shown in Fig. 11.

The invention is illustrated in Figs. 1 and 2 as being embodied in a liquid conductor heater comprising a vessel 10 formed of insulating material, such as porcelain or the like, and containing a body of water or other liquid 11 which is to be vaporized when the device is in operation. The vessel 10 has a cover 12 in which there is mounted a tubular member 13 formed of insulating material and having positioned therein a body 14 of capillary material such as glass wool, asbestos, or the like, which is non-conductive and non-carbonaceous, through which the water 11 is conveyed upwardly by capillary action into contact

with the metallic electrodes 15, each of which is formed as a helix intertwining with the convolutions of the other electrode, so that the two electrodes are spaced apart throughout. The upper ends of the electrodes 15 are formed as terminal posts 15a which project through a cap member 16 of insulating material which fits within the upper end of the tube 13. The cap member 16 is provided with a central aperture 16a through which the vapor produced by the passage of current between the convolutions of the electrodes escapes to the atmosphere. The terminal posts 15a are adapted to be connected in an electric circuit by means of the usual plug and electric cord and when they are connected in the circuit the portions of the liquid which are in the body of the capillary material 14 are vaporized by the passage of the electric current therethrough. In the form of the invention shown in Figs. 1 and 2, the capillary material 14 is arranged in tubular fashion around the convolutions of the two electrodes 15 which are coaxial with each other and coextensive with the walls of the tube 13. Both the tube 13 and the capillary material 14 extend downwardly into the body of water 11 and the tubular formation of the capillary material 14 provides a passages 14a at the bottom of the tube through which the water extends upwardly to a point in proximity to the electrodes, from which point the liquid is conveyed by capillary action to the portions of the electrodes which contact with the material 14. With this arrangement of the parts, there is an instant starting of the device when it is connected in the electric circuit and the vapor condensate in the upper part of the tube falls back into contact with the convolutions of the electrodes or spatters onto the adjacent walls by the action of the bursting bubbles so that it is again immediately vaporized without returning to the main body of liquid 11 in the bottom of the vessel. The vaporization of the liquid may be continued for a substantial period of time without replacing the body of liquid in the vessel and without the necessity of heating the entire body of liquid. It has been found in practice that the electrodes 15 have a longer life if the convolutions of the electrodes have a gradually increasing spaced relation from their lower ends upwardly and that arrangement is therefore preferred. Although illustrated as embodied in a vaporizer which may be used for medicinal purposes, it will be apparent that the principles of this invention may be embodied in liquid conductor heaters used for cooking, bottle warming, and other like purposes.

In the form of the invention shown in Figs. 3 and 4, a vessel 20 contains a body of water or other liquid 21 and is provided with a cover 22 arranged to carry a depending tube 23, formed preferably of insulating material, in which there is mounted a body of capillary material 24 such as glass wool, asbestos or the like, The upper part of the body of capillary material 24 has a tubular formation, thus providing an inner cavity in which there are located the concentric convolutions of two helical electrodes 25. These electrodes extend upwardly and form terminal posts 25a which project in parallel relationship through the cap member 26 of insulating material which fits into the upper end of the tube 23. This cap member 26 has a central aperture 26a to allow the escape of the vapor which is produced by the passage of current between the convolutions of the electrodes when the terminal posts 25a are plugged into an electric circuit.

In the form of the invention shown in Figs. 3 and 4, the tube 23 is restricted at its lower end as shown at 23a and the capillary material is correspondingly compressed to form a solid body 24a of this material within the restricted part of the tube. The part 23 of the tube and the material 24a contained therein extend downwardly into the body of the liquid 21 to a point adjacent the bottom of the vessel. The operation of this form of the invention is generally similar to that previously described except that there is no open body of water within the tube adjacent the lower parts of the electrodes. It has been found in practice that the device will operate successfully even though the lower ends of the electrodes are spaced substantial distances above the level of the liquid in the vessel, the distance depending largely upon the capillary action of the particular material employed in contact with the electrodes. In this form, the restricted tube 23a may not be occupied by capillary material but the small short tube serves to cut down leakage current and thereby minimize the danger of shock in case the fingers of the operator come in contact with the tube when the entire unit is removed from the vessel 20 with the electric cord still attached.

The form of the invention shown in Figs. 5 and 6 is generally similar to those previously described except that the body of capillary material is enclosed within the convolutions of the electrodes instead of surrounding them. In this form, the insulating vessel 30 is adapted to contain a body of water or other liquid 31 and is provided with a cover 32 which is arranged to support a tube 33, formed preferably of insulating material, which extends downwardly into the liquid 31 and terminates slightly above the bottom of the vessel. The tube 33 contains a body of capillary material 34, such as glass wool, asbestos or the like, which occupies the entire area of the lower part of the tube below the surface of the liquid 31 but which has its upper portion restricted or compressed in cross section to provide a cylindrical extension 34a which is surrounded and fitted by the convolutions 35a of the two helical electrodes 35 which have their convolutions spaced apart and which terminate in posts 35b arranged to extend through the insulating cap 36 which fits within the upper end of the tube 33. This cap has a central aperture 36a so that when the terminal posts 35b are connected in an electric circuit, the vapor produced by the passage of current between the convolutions of the electrodes through the portions of the liquid which are conveyed thereto by capillary action, will escape through the aperture 36a to the atmosphere, so that it may be employed for medicinal purposes or the like. As in the two forms of the invention previously illustrated, the convolutions of the electrodes may preferably have an increasing spaced relation as the upper end of the device is approached.

Another form of the invention is shown in Figs. 7 and 8 and it differs primarily from those previously described in that the capillary material is preferably omitted and the convolutions of the electrodes extend downwardly into the body of the liquid. As there illustrated, this form of the invention comprises a vessel 40 formed of insulating material and containing a body of water or other liquid 41. The vessel has a cover 42 which is arranged to support a tube 43 formed of insulating material and extending downwardly into the body of liquid 41 with its ends spaced slightly above the bottom of the vessel. In the

tube 43 there are mounted two metallic electrodes 45 having helical convolutions 45a which intermesh with each other and are spaced apart so that adjacent convolutions are of opposite polarity. These electrodes have their upper ends formed as terminal posts 45b which project through the insulating cap 46 fitting within the upper end of the tube 43 and having a central aperture 46a for the escape of vapor. In this form of the invention, the starting of the vaporization and the continuance thereof are not dependent upon capillary action. When the terminal posts 45b are plugged into an electric circuit, the passage of current through the body of liquid within the lower end of the tube 43 between the convolutions of the electrodes which are immersed in this portion of the liquid will cause the vaporization thereof with a resulting bubble formation which will extend upwardly within the tube and thus cause electric connections to be formed between the upper convolutions of the electrodes. In this way, the zone of activity is increased in height so that the vaporization of the liquid will be carried on at an increased rate after the initial starting has been effected, which is in contrast with the operation of the usual liquid conductor heater where the starting current tends to be larger than the running current. As in the forms of the invention previously described, the condensate which forms in the upper part of the tube falls downwardly and is again evaporated by contact with spaced convolutions of the electrodes without returning to the body of liquid in the vessel.

The form of the invention illustrated in Figs. 9 and 10 embodies the features heretofore described but the structure is somewhat more commercial in form and comprises an arrangement where the spaced helical electrodes have their lower ends immersed in the body of liquid in the vessel and have liquid conveyed to the upper convolutions thereof by capillary action. As there illustrated, this last embodiment of the invention comprises a vessel 50 formed of insulating material and arranged and arranged to contain a body of water or other liquid 51 which is to be vaporized. The upper end of the vessel 50 is restricted in size and is externally threaded for engagement by a member 52. The member 52 is centrally apertured to receive a hollow inverted cap member 53 formed of porcelain, Bakelite, or other insulating material and having an outwardly extending flange 53a which engages the upper surface of the cover 52 around its central aperture. Within the cover member, the lower externally threaded portion 53b of the cap member 53 is engaged by an annular clamping ring 54 which secures in place an insulating sleeve 55 and also a tube 56. The insulating sleeve 55 is provided with an outwardly extending annular flange 55a and a ring 57 of rubber or other packing material is positioned between the flange 55a and the lower end of the part 53b of the cap member. The upper end of the tube 56 surrounds the lower end of the insulating sleeve 55 and is provided with an outwardly turned annular flange 56a which is engaged on its under side by the inwardly directed annular flange 54a which is formed on the lower end of the clamping ring 54. When the member 54 is screwed to its normal position shown in Fig. 10, the annular flange 54b on the upper end thereof clamps the cover member 52 against the flange 53a of the cap member and at the same time the flange 54a clamps the members 53b and 55a together to effect a compression of the intervening gasket 57.

The tube 56 extends downwardly into the body of liquid 51, terminating adjacent the bottom of the vessel, and it contains a tubular body 58 of capillary material such as glass wool, asbestos, or the like, which has mounted therein the intermeshing helical convolutions 59a of the electrodes 59. These electrodes terminate at their upper ends in straight portions 59b which extend through the insulating sleeve 55 and are secured at their upper ends to terminal fittings 60 which are mounted within the hollow cap member 53. These fittings are provided with terminal posts 61 which extend downwardly through the vertical wall 53c of the cap member for engagement with the plug 62 of an electric circuit. The insulating sleeve 55 has formed therein a central aperture 55b to permit the escape of vapor from the region of the convolutions of the electrodes. This aperture 55b communicates with the internal chamber of the cap member 53 and one wall of this cap member is provided with an aperture 53d through which the vapor escapes to the atmosphere. The cover member 52 is provided at one side with an aperture normally closed by a removable insulating plug 63 so that the supply of medicant or other liquid within the vessel 50 may be replenished without removing the cover 52.

In the operation of the form of the invention shown in Figs. 9 and 10, the vaporization is initiated by the passage of current between the lower convolutions of the electrodes which are immersed in the body of the liquid 51 and is continued and maintained not only by this vaporization but also by the vaporization of liquid which connects the upper convolutions of the electrodes after passing by capillary action through the material 58 and by the bubble formation which arises within the convolutions due to the boiling of the liquid within the lower convolutions of the electrodes. The condensate which is formed in the upper part of the heating device and in the passages leading to the orifice 53d returns to the chamber in which the convolutions of the electrodes are located and is vaporized without again intermingling with the body of the liquid in the lower part of the vessel.

It has been found that the form of the invention shown in Figs. 11 and 12 tends to minimize any danger of the electrodes burning out at the top of the coils, a tendency which sometimes develops in devices of this kind. This is accomplished by feeding the water to the electrodes at their tops instead of at their lower ends through the use of an inner vessel in which the electrodes are located. In this form the outer insulating vessel 65 is adapted to contain a body of liquid 66 in which is partially immersed the lower end of a tube 67 which is suspended from the cover 68.

An insulating plug 69 is inserted in the upper end of the tube 67 and has mounted therein the terminal portions 70a of two spaced electrodes 70. The lower parts of these electrodes are helical in form and intermesh with each other in spaced relation within an inner vessel 72. The vessel 72 is surrounded and supported by a body of capillary material 73 which rests on the lower wall 65a of the tube 67 which restricts the tube so that it has a comparatively small bottom opening 65b. The capillary material 73 extends over the top edge of the vessel 72 and downwardly within this vessel around and below the helical

electrodes. Thus, the liquid 66 which finds its way upwardly through the capillary material finds its way first to the upper parts of the electrodes and passes progressively downward within the vessel 72.

Although certain forms of the invention have been shown and described by way of illustration, it will be understood that it may be constructed in various other embodiments which come within the scope of the appended claims.

I claim:

1. In a liquid conductor heater, an insulating vessel adapted to contain a quantity of liquid, spaced electrodes mounted in said vessel above the body of liquid therein, means for conveying a part of said liquid to said electrodes by capillary action, and means forming an unobstructed passage for the escape of vapor from said electrodes.

2. In a liquid conductor heater, an insulating vessel adapted to contain a quantity of liquid, spaced electrodes mounted in said vessel above the body of liquid therein, a non-conducting member extending into said liquid and adapted to convey liquid to said electrodes by capillary action, and means forming an unobstructed passage for the escape of vapor from said electrodes.

3. In a liquid conductor heater, an insulating vessel adapted to contain a quantity of liquid, spaced electrodes mounted in said vessel and comprising helical convolutions intermeshing with each other in spaced relation, and a body of non-conductive material extending into said liquid and arranged to convey liquid to convolutions of opposite electrodes by capillary action, said non-conducting material and said convolutions being arranged to provide an unobstructed passage from said electrodes to permit the escape of vapor.

4. In a liquid conductor heater, an insulating vessel adapted to contain a quantity of liquid, spaced electrodes mounted in said vessel and comprising helical convolutions intermeshing with each other in spaced relation, and a body of non-conductive material extending into said liquid and arranged to convey liquid to convolutions of opposite electrodes by capillary action, said convolutions having an increasing spaced relation as their distance from the body of liquid increases.

5. In a liquid conductor heater, an insulating vessel adapted to contain a quantity of liquid, a tube located in said vessel and extending downwardly into said liquid, a pair of upwardly extending spaced electrodes mounted in said tube, and a body of non-conductive material mounted in said tube and adapted to convey liquid to said electrodes by capillary action, said tube and said material being arranged to form an unobstructed passage for the escape of vapor directly from said electrodes.

6. In a liquid conductor heater, an insulating vessel adapted to contain a quantity of liquid, a tube located in said vessel and extending downwardly into said liquid, a pair of upwardly extending helical electrodes mounted in said tube with their convolutions intermeshing and spaced apart, and a body of non-conductive material mounted in said tube and extending into said liquid and adapted to convey liquid to said electrodes by capillary action, said convolutions having an increasing spaced relation as their upper ends are approached.

7. In a liquid conductor heater, an insulating vessel adapted to contain a quantity of liquid, a tube located in said vessel and extending downwardly into said liquid, a pair of upwardly extending helical electrodes mounted in said tube with their convolutions intermeshing and spaced apart, and a body of non-conductive material mounted in said tube and extending into said liquid and adapted to convey liquid to said electrodes by capillary action, said tube being provided at its upper end with means for permitting the escape of vapor, said tube and said material being arranged to form an unobstructed passage for the escape of vapor directly from said electrodes.

8. In a liquid conductor heater, an insulating vessel adapted to contain a quantity of liquid, a cover for said vessel having an aperture therein, a hollow cap member engaging said aperture and having a flange overlying said cover, an insulating sleeve engaging the lower part of said cap member and having a flange underlying the lower end of said cap member, a tube extending downwardly into said liquid and having a flange underlying said flange on said sleeve, and a clamping member for securing said cap member to said cover and for securing said sleeve and said tube to said cap member.

9. In a liquid conductor heater, an insulating vessel adapted to contain a quantity of liquid, a cover for said vessel having an aperture therein, a hollow cap member engaging said aperture and having a flange overlying said cover, an insulating sleeve engaging the lower part of said cap member and having a flange underlying the lower end of said cap member, a tube extending downwardly into said liquid and having a flange underlying said flange on said sleeve, a clamping member for securing said cap member to said cover and for securing said sleeve and said tube to said cap member, spaced electrodes carried by said sleeve and extending downwardly into said tube, and non-conductive material for conveying liquid upwardly by capillary action to said electrodes.

10. In a liquid conductor, an insulating vessel adapted to contain a quantity of liquid, a tube mounted in said vessel and extending downwardly into said liquid, a pair of spaced electrodes mounted within said tube, a body of non-conductive capillary material mounted in said tube and extending into said liquid, and means for causing the liquid passing through said capillary material to find access first to the upper ends of said electrodes.

11. In a liquid conductor, an insulating vessel adapted to contain a quantity of liquid, a tube mounted in said vessel and extending downwardly into said liquid, a pair of spaced electrodes mounted within said tube, a body of non-conductive capillary material mounted in said tube and extending into said liquid, and a second vessel mounted in said tube and containing said electrodes, said capillary material extending into said second vessel over the upper end thereof whereby said liquid is caused to connect said electrodes progressively downward from the upper ends thereof.

12. In a liquid conductor heater, an insulating vessel adapted to contain a quantity of liquid, a tube mounted in said vessel and extending downwardly into the body of liquid therein, a pair of spaced electrodes located in said vessel above the level of said liquid, and a body of non-conductive material mounted in said tube in contact with said electrodes and extending downwardly into said liquid to convey said liquid to said elec-

trodes by capillary action, the portions of said tube and of said non-conductive material within said liquid being reduced in cross section as compared with the parts thereof above said liquid.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,685,266	Baum	Sept. 25, 1928
1,782,069	Henning	Nov. 18, 1930
1,806,729	Aitken	May 26, 1931
1,977,232	Ginder	Oct. 16, 1934
1,994,331	Ziskin et al.	Mar. 12, 1935
2,140,516	Cowan	Dec. 20, 1938
2,429,112	Warren	Oct. 14, 1947