

Dec. 7, 1965

P. CONLIN ET AL
LIQUID CONDUCTOR HEATER

3,222,499

Filed March 26, 1962

3 Sheets-Sheet 1

FIG. 1

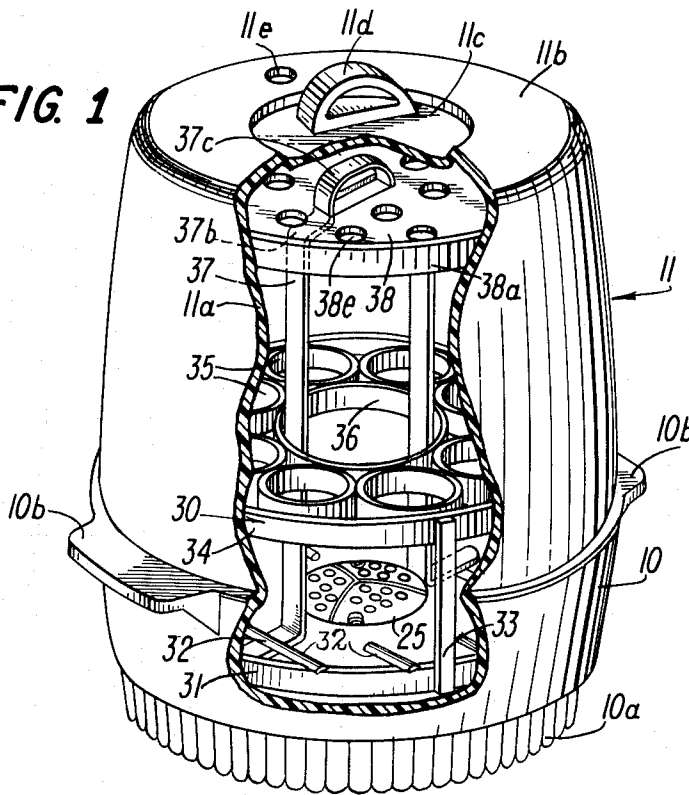
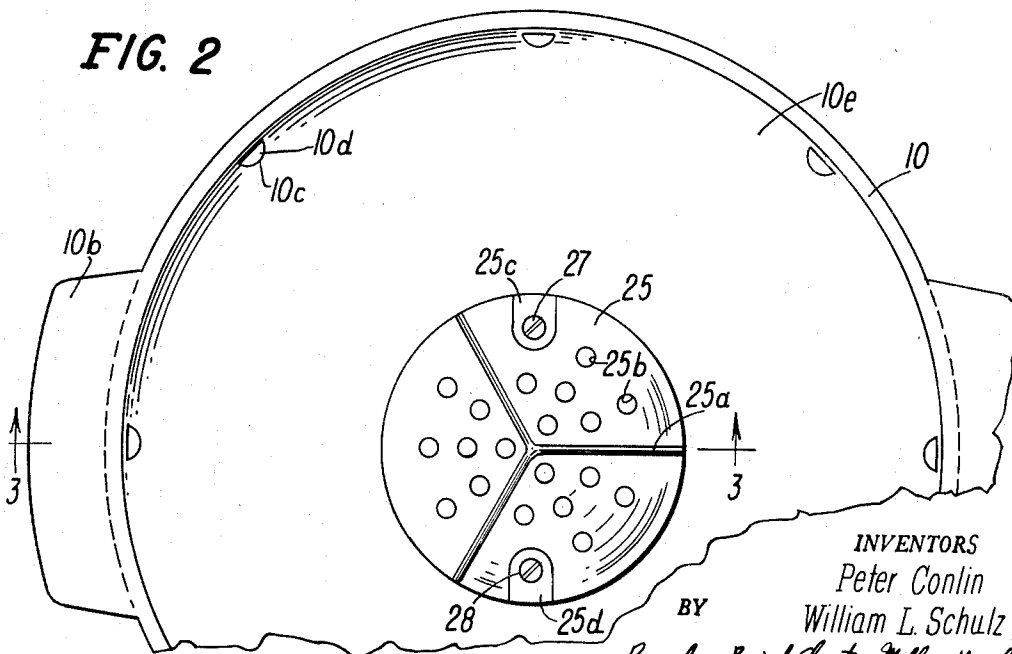


FIG. 2



INVENTORS
Peter Conlin
William L. Schulz
BY
Prangley, Baird, Clayton, Miller & Vogel
Attys.

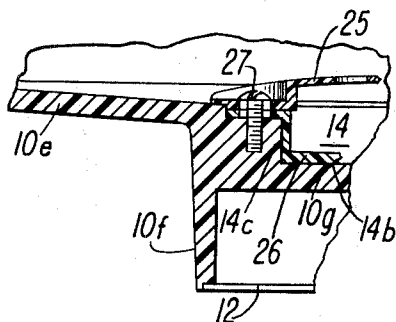
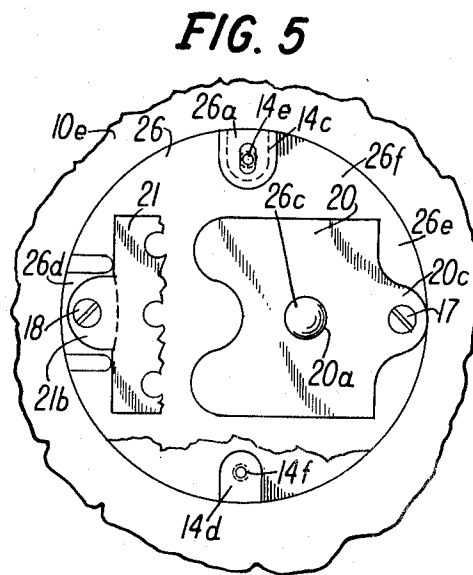
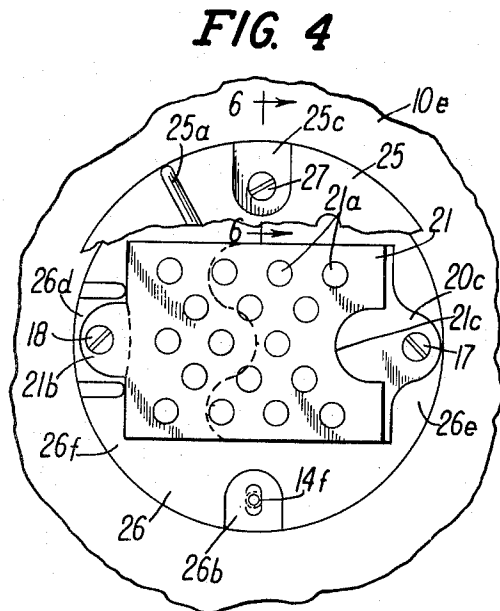
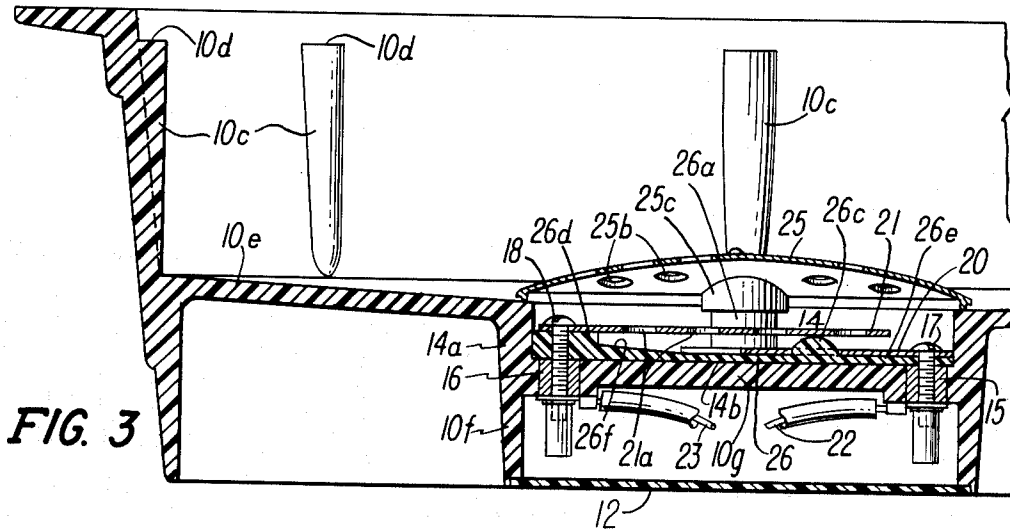
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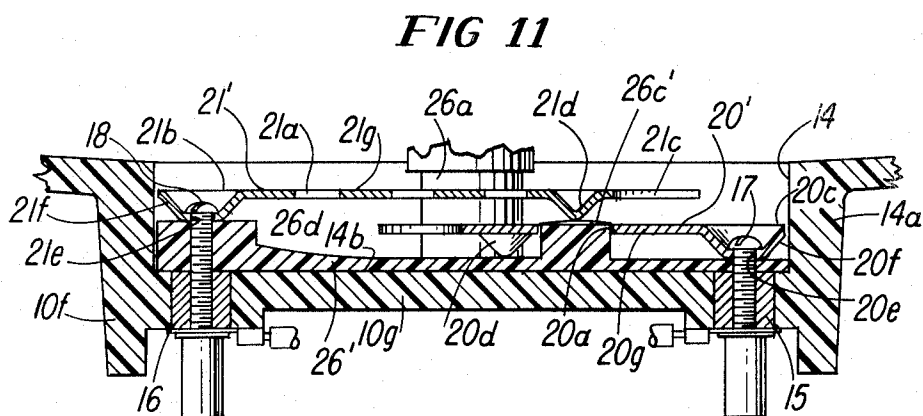
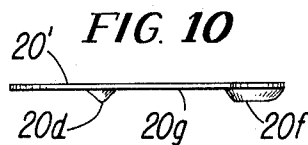
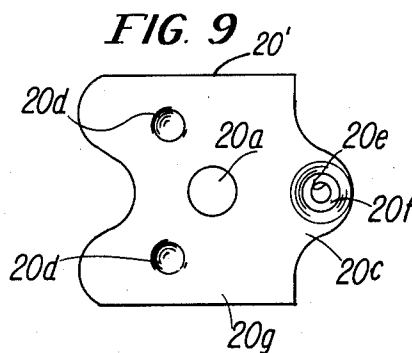
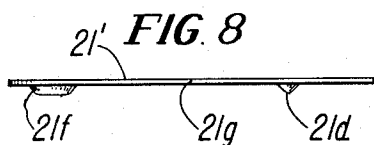
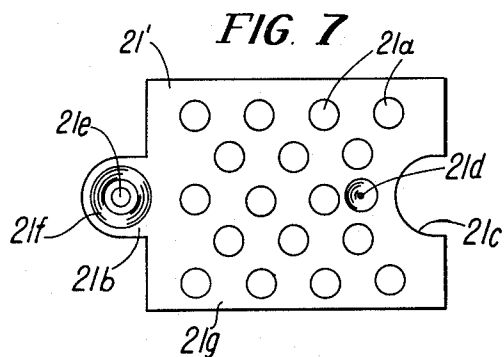
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LIQUID CONDUCTOR HEATER

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3 Sheets-Sheet 3



INVENTORS

Peter Conlin

William L. Schulz

BY

Pringle, Baird, Clayton, Miller & Vogel
Attys.

Atty's.

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3,222,499

LIQUID CONDUCTOR HEATER

Peter Conlin and William L. Schulz, Reedsburg, Wis.,
assignors to Hanksraft Company, Reedsburg, Wis., a
corporation of Wisconsin

Filed Mar. 26, 1962, Ser. No. 182,513

4 Claims. (Cl. 219-289)

This invention relates to improvements in liquid conductor heaters of the general type disclosed in United States Letters Patent 2,837,625 owned by the assignee of the present invention. Heaters of this broad type are well known and easily may be adapted for use as sterilizers, egg cookers, bottle warmers, etc.

This application is a continuation-in-part of our copending application Serial No. 36,306, filed June 15, 1960, now abandoned.

In general, a liquid conductor heater of the type referred to comprises a vessel having therein two spaced-apart electrodes of comparatively large exposed surface area. Heat is generated by adding a conductive liquid to the vessel until, at least, the gap between the electrodes is bridged, and then applying across the electrodes an electrical potential great enough to cause an electrical current to flow through the liquid. It is customary to design heaters of this type so that vaporization will occur when they are used with water containing normal amounts of impurities and a standard 110 volt source of electric power, both of which are readily available to most consumers in the United States.

In the past, thermoset plastics have been used in manufacturing liquid conductor heaters. These materials are suitable especially for parts of the vessel which are subjected to higher temperatures, such as, for example, the base where the electrodes ordinarily are mounted. One thermoset plastic which has been used extensively for bases is phenol-formaldehyde resin containing woodflour or cotton flock filler. This material is comparatively inexpensive and is characterized by its heat insulating qualities, durability, resistance to chipping and breakage, beauty of finish, and ease of processing. Although this material and those like it have these desirable properties, they are subject to tracking, a phenomenon involving the progressive formation of electrical current-conductive paths on or within the surface layer of an insulator, caused, ostensibly, by the combined action of a tangential electric field and the agent overlying and in contact with the surface affected. Inasmuch as the tracks established in the plastic between the electrodes carry some of the current which otherwise would flow through the liquid, vaporization does not occur and the heater is rendered inoperative. Indeed, in some instances, the tracking paths may constitute a damaging short circuit between the electrodes.

It should be apparent, therefore, that the many advantages of a thermoset plastic such as phenol-formaldehyde resin cannot be made available unless some means is provided for overcoming the tracking problem. Efforts to resolve this difficulty already have achieved some measure of success, but not without the use of disproportionately expensive, fragile, and sometimes unwieldy electrode-mounting structures. For example, the electrode-mounting structure disclosed in the above cited Patent No. 2,837,625 achieves this result through the use of a heating unit made up of a hollow porcelain molding and perforated cover plate which surround and effectively insulate two flat, horizontally-oriented, vertically-spaced electrodes from the inner cylindrical wall surface of a recess or well provided therefor in the bottom of a plastic base. In effect, the porcelain structure of the heater unit prevents tracking by separating the electrodes and elec-

2

trical terminals from the surface of the plastic, thereby minimizing the strength of any electric field tangential thereto and insuring that none of the current-conducting liquid comes into contact therewith.

Although a structure of this type provides a satisfactory safeguard against tracking, it is subject to the disadvantages of high cost, difficulty of assembly during production, difficulty of disassembly, and likelihood of breakage during maintenance.

It is among the objects of this invention to provide a liquid conductor heater wherein:

(1) Tracking is prevented through the use of a novel electrode-mounting structure;

(2) A liquid-tight container wall forms an integral part of a novel electrode-mounting structure;

(3) The wall of a liquid-tight vessel made of a comparatively inexpensive thermoset plastic highly susceptible to tracking forms an integral part of a novel, tracking-inhibitive, electrode-mounting structure of optimum simplicity;

(4) The wall of a lightweight, fracture and scratch resistant, easily-molded liquid-tight vessel made of a phenol-formaldehyde resin, or like material highly susceptible to tracking, is an integral and indispensable part of an improved, inexpensive, lightweight, arcproof, leak-proof, durable, reliable, easily-disassembled, and tracking-inhibitive electrode-mounting structure of optimum simplicity;

(5) A lightweight, fracture and scratch resistant, easily molded, liquid-tight vessel made of a plastic material susceptible to tracking comprises an integral and indispensable part of a novel electrode-mounting structure characterized by optimum simplicity, low cost, ease of disassembly, lightweight, durability, high resistance to breakage, and freedom from tracking and arcing;

(6) An insulating element made of a thermoset plastic material resistant to tracking may be conjoined with at least part of a fracture and scratch resistant, easily-molded, liquid-tight vessel molded of a thermoset plastic material highly susceptible to tracking to form a novel electrode-mounting structure characterized by optimum simplicity, low cost, ease of disassembly, lightweight, durability, reliability, high resistance to breakage, and freedom from tracking and arcing.

Another known structure used in overcoming the tracking problem is described in United States Letters Patent No. 2,433,750. In that instance, however, the spaced-apart electrodes lie side by side in a common horizontal plane, and tracking is inhibited by placing a flat porcelain plate between the lower surface of the electrodes and the bottom wall of their plastic container. The disadvantages of this arrangement are at least two fold. First, the porcelain plate, if made thick, is disproportionately expensive, and if made thin, is easily broken during normal use and disassembly for maintenance; and second, the relationship of the electrodes results in the deposition of impurities and eventual arcing between their adjacent edges, thereby necessitating frequent disassembly and cleaning and increasing the likelihood that the porcelain plate will be broken.

In accordance with the present invention, a liquid conductor heater may comprise a liquid-tight vessel made of a thermoset plastic such as phenol-formaldehyde resin, and having a bottom wall provided with a centrally-disposed recess or well with a flat bottom and cylindrical walls; two diametrically-opposite electrical terminals mounted in the bottom wall of said recess; two diametrically-opposite lugs integral with the cylindrical and bottom walls of said recess and extending inwardly from locations displaced 90 degrees from said terminals; a circular insulator plate coextensive with the bottom of said recess and made of a plastic material such as melamine formaldehyde resin

with a filler of cellulose or asbestos, said plate having diametrically-opposed indentations in its edge forming pockets for receiving said inwardly-extending lugs, first and second holes mating with said two terminals, an integral mounting ledge surrounding said first hole, and an integral spacing boss; a flat lower electrode disposed on the upper surface of said plate, one end of said lower electrode and a corresponding side of said plate being removably secured to the bottom wall of said recess by a current-conductive fastener extending through said second hole to the terminal mating therewith, and the other end of said electrode being held in position by engagement of a hole therein with the base of said spacing boss; a perforated upper electrode supported in spaced relation above said lower electrode by said mounting ledge and spacing boss of said plate, and having one end removably secured to the bottom wall of said recess by a current-conductive fastener extending through said first hole to the other of said two terminals and the other end supported upon the upper end of said spacing boss; and a perforated plastic cover for said recess overlying said indented sides of said plate and removably secured to said lugs, thereby eliminating the possibility that the electrode spacing may be altered as the result of warpage of the insulator plate.

The foregoing paragraphs are intended to summarize and explain the significance of this invention in relation to the problems which it resolves, and should not be construed to narrow the scope of protection delimited by the claims set forth hereinafter. For a more complete understanding of the structure, operation, and novel features of a preferred embodiment, consider the following description with reference to the drawings wherein:

FIGURE 1 is a perspective view of a bottle sterilizer embodying the features of the present invention;

FIG. 2 shows a partial enlarged horizontal section through the liquid containing vessel of the sterilizer illustrated in FIG. 1, showing a top plan view of the heating unit shown in FIG. 1;

FIG. 3 shows a vertical section taken on the line 3—3 of FIG. 2;

FIG. 4 is a plan view of the electrode-mounting structure with a portion of protective cover plate removed;

FIG. 5 is a plan view of the electrode-mounting structure with the protective cover plate and a portion of the upper electrode removed;

FIG. 6 is a cross-sectional view through the lug-mounting structure along plane 6—6 of FIG. 4;

FIG. 7 is a plan view of another embodiment of one of the electrodes;

FIG. 8 is a side elevational view thereof;

FIG. 9 is a plan view of another embodiment of the other electrode;

FIG. 10 is a side elevational view thereof; and

FIG. 11 is a fragmentary vertical sectional view like FIG. 3 and further enlarged, showing a modified electrode-mounting structure with the electrodes of FIGS. 7-10 employed therein.

As illustrated in the drawings, particularly FIGS. 1-6, the invention comprises a water containing vessel or base 10 which is formed preferably of plastic material highly susceptible to tracking such a phenol-formaldehyde resin with a wood flour or cotton flock filler and which is slightly bowed outwardly between its top and lower edges with a horizontal row of vertical ribs 10a extending about the lower edge thereof for ornamental purposes. On opposite sides, the vessel 10 is provided with integral projecting handles 10b by which the entire sterilizer may be conveniently moved about. The vessel 10 is provided on its inner side with a series of integral projections 10c terminating at their top ends in horizontal shoulders 10d which are adapted to be engaged by the lower edge of the metal shell or cover 11 adapted to form the chamber in which the major portion of the sterilizing operation takes place. This cover or shell comprises an annular wall 11a which bulges slightly in an outward direction and which is

united at its top edge with a flat top wall 11b having formed therein a depression 11c in which there is secured a handle 11d. The top wall 11b is further provided with an aperture 11e through which the steam or vapor escapes.

The vessel 10 has a bottom wall 10e sloping toward its center where it is provided with a tubular downwardly-extending projection 10f. A transverse integral partition 10g in tubular projection 10f forms a recess or well 14 opening into the center of bottom wall 10e. The recess 14 has a cylindrical wall 14a comprised of the upper section of tubular projection 10f and a bottom surface 14b provided by the upper surface of partition 10g. The lower end of tubular projection 10f is closed by a circular cover 12 made preferably of plastic removably secured in position by screws (not shown) or by any other suitable fastening device or method.

Elongated electrical terminals 15 and 16, embedded in diametrically-opposite locations in partition 10g, have upper ends flush with the bottom wall surface 14b of recess 14, and are provided with internally-threaded holes for accommodating the mounting screws 17 and 18 of lower electrode 20 and upper electrode 21, respectively. The lower ends of terminals 15 and 16 extend below partition 10g for a short distance to facilitate the connection of conductors 22 and 23 from an electrical power source (not shown). The cover 12 constitutes a safeguard against electrical shocks and short circuits which otherwise might result from accidental touching or bridging of terminals 15 and 16.

The recess 14 shelters the vertically-spaced electrodes 20 and 21, respectively, from bumps and jolts by articles placed in vessel 10 from time to time during use of the heater, and further provides means for collecting within the interelectrode gap substantially all of the conductive liquid introduced into vessel 10. The recess 14 is provided with two diametrically-opposite mounting lugs 14c and 14d (FIGS. 5 and 6) displaced through an angle of 90 degrees from electrical terminals 15 and 16 and formed integrally with cylindrical wall 14a and partition 10g. The upper surfaces of lugs 14c and 14d are slightly below the upper rim of the tubular projection 10f. Internally-threaded holes 14e and 14f extend downwardly in lugs 14c and 14d, respectively, for accommodating the mounting screws 27 and 28 which removably secure protective cover 25 and insulator plate 26 thereto.

To prevent the occurrence of tracking on or within the highly susceptible plastic material of bottom surface 14b, the insulating plate 26 made, for example, of a thermoset plastic having a relatively long tracking response characteristic is disposed thereover. A plastic found to be suitable for this purpose is melamine formaldehyde resin which has a tracking response characteristic on the order of 85-110 seconds. Two convex indentations 26a and 26b at diametrically-opposite locations on the rim of plate 26 enclose mounting lugs 14c and 14d and are provided with elongated openings mating with holes 14e and 14f to accommodate mounting screws 27 and 28. Positioned on a diameter of plate 26 displaced through an angle of 90 degrees from indentations 26a and 26b are integral spacing boss 26c and an integral mounting ledge 26d for supporting upper electrode 21 above lower electrode 20. A hole is provided through mounting ledge 26d to accommodate screw 18 which engages the internally-threaded hole of terminal 16 to removably secure upper electrode 21 and the adjacent side of plate 26 to partition 10g. The plate 26 is provided with another hole diametrically opposite mounting ledge 26d and above terminal 15 for accommodating the mounting screw 17 which effectively and removably secures lower electrode 20 and the adjacent side of plate 26 to partition 10g. The upper surface of plate 26 has a flat area 26e underlying lower electrode 20 substantially parallel to bottom surface 14b, and an area 26f sloping downwardly from the rim toward flat area 26e

to insure that a maximum amount of the conductive liquid placed in vessel 10 will drain into the gap between electrodes 20 and 21. It should be noticed that the electrode mounting screws 17 and 18 together with the mounting screws 27 and 28 effectively secure insulator plate 26 in position against the bottom surface 14b at four points equally spaced around its periphery. This arrangement eliminates any possibility that plate 26 may deform and cause harmful arcing or other malfunction as the result of a diversion of liquid or an alteration in the critical spacing between electrodes 20 and 21.

The upper electrode 21 comprises a flat, generally rectangular metal plate having a plurality of perforations or apertures 21a to facilitate the ascent of hot vapors from the confines of the interelectrode gap. One end of electrode 21 is provided with an integral semi-circular extension 21b having a hole for accommodating the mounting screw 18 which, in turn, removably secures and couples electrode 21 electrically to terminal 16. Extension 21b insures that the adjacent edges of electrode 21 are spaced far enough from the surface of cylindrical wall 14a to prevent the occurrence of tracking therein. The other end of electrode 21 rests on spacing boss 26c to insure that the required interelectrode gap is established and maintained. To make certain that the gap between electrode 21 and the head of the mounting screw 17 of lower electrode 20 is wide enough to avoid arcing, the adjacent end edge of electrode 21 is provided with a semicircular notch 21c.

The lower electrode 20 comprises a flat metal plate having a single aperture 20a through which spacing boss 26c may project. Inasmuch as the adjacent surfaces of electrodes should be equal in area and the lower electrode 20 does not have a multiplicity of apertures as does the upper electrode 21, it is somewhat shorter in length than the latter. One end of lower electrode 20 has an integral semicircular extension 20c provided with a hole for accommodating mounting screw 17 which removably secures and couples electrode 20 electrically to terminal 15. The extension 20c also insures that the adjacent edges of the electrode 20 are spaced sufficiently from the surface of cylindrical wall 14a to prevent the occurrence of tracking therein.

FIGS. 7-11 illustrate additional embodiments of the electrodes which function to make the structure even more immune to tracking. In these views, the electrodes are identified by the respective prime numerals 20' and 21', and the insulator plate by the prime numeral 26', corresponding to the numbering of the first-described embodiments. The components common to the respective parts are identified by the same reference symbols.

The structures of the electrodes 20' and 21' embody the discovery that the possibility of tracking is further minimized by minimizing contact between the electrodes and the insulator plate 26', preferably reducing the contact to point contact. The contact is limited in the illustrative embodiments by the provision of projections on the electrodes, which extend between them and the insulator plate, and space the bodies of the electrodes and the plate apart from each other. Alternatively, corresponding projections (not illustrated) may be provided on the insulator plate 26'.

Referring to FIG. 3, the susceptibility to tracking is greatest where the lower electrode 20 lies on the surface of the insulator plate 26. The electrode 20' of FIGS. 9 and 10 reduces this susceptibility by minimizing contact with the insulator. Two like integral depending spacing projections 20d are formed on the electrode, by indenting or dimpling the opposite surface. The projections are generally conical and are located in spaced relation to each other, and in spaced relation to the mounting opening 20e in the extension 20c. As seen in FIG. 11, the projections are disposed over the insulator plate 26', and they provide supports or spacers for the electrode which

limit contact with the insulator substantially to point contact.

Similarly, an integral depending mounting projection 20f is formed on the extension 20c, with the mounting opening 20e centrally thereof. The mounting projection is generally frusto-conical and extends for the same distance as the spacing projections 20d. The mounting projection limits contact with the insulator 26' to a small annulus around the opening 20e, where the electrode 20' and the insulator are secured together on the recess surface 14b by the screw 17. By this construction, the body 20g of the electrode is spaced above the insulator, and contact of the two members is minimized.

Additional immunity to tracking is provided by the provision of an integral depending spacing projection 21d on the upper electrode 21', as seen in FIGS. 7 and 8, the projection being formed by indenting the upper surface. This projection is generally conical and is located adjacent the notch 21c and in spaced relation to the mounting opening 21e in the extension 21b. As seen in FIG. 11, the projection is disposed over the spacing boss 26c' on the insulator plate 26', and the projection provides a support or spacer for the electrode which limits contact with the insulator substantially to point contact. The spacing boss 26c' extends upwardly for a greater distance than the boss 26c on the first-described plate 26, to correspond to the raised position of the electrode body 20g.

An integral depending mounting projection 21f is formed by indenting the upper electrode extension 21b, with the mounting opening 21e centrally thereof. The mounting projection is generally frusto-conical and extends for the same distance as the spacing projection 21d. The mounting projection limits contact with the mounting ledge 26d of the insulator 26' to a small annulus around the opening 21e, where the electrode 21' and the insulator are secured together on the recess surface 14b by the screw 18. By this construction, the body 21g of the electrode is spaced above the ledge 26d and above the boss 26c' of the insulator, and contact of the electrode and insulator is minimized.

Referring once more to FIGS. 1-6, the opening of recess 14 in the bottom wall 10e of the vessel is provided with a protective cover 25 made of plastic for safeguarding users from burn or electrical shock, and for protecting the electrode-mounting structure from accidental damage as the result of bumps or other contact with articles placed or inadvertently dropped into vessel 10. The protective cover 25 is slightly convex and is provided with three radially-extending reinforcing ribs 25a, a plurality of apertures 25b to facilitate the escape of hot vapors from recess 14, two diametrically-opposite concave indentations 25c and 25d provided with elongated holes mating with the internally threaded holes 14e and 14f of mounting lugs 14c and 14d, respectively. The mounting screws 27 and 28 removably secure the indented sides of plate 26 and protective cover 25 in their respective positions in recess 14 and over the opening thereof in the bottom wall 10e. It should be noticed that the concave indentations 25c and 25d provide convenient receptacles for the heads of mounting screws 27 and 28, thereby insuring that they will not scratch or be subjected to blows from articles placed in vessel 10.

From the foregoing paragraphs, it should be apparent that an electrode-mounting structure in accordance with the invention is characterized by structural simplicity, high reliability, and economy of materials, fabrication and assembly. Simplicity of structure is achieved through the elimination of unnecessary insulating and mounting devices heretofore required by prior art structures; high reliability is achieved by eliminating all fragile items such as porcelain insulators used heretofore and by providing a leakproof recess 14 integral with the main body of vessel 10; and increased economy is achieved by an electrode design which enables them to be sheared or stamped

from flat metal strips without waste except for the material removed for the apertures and holes required therein, by the use of a single insulating member 26 easily molded from a plastic having a tracking characteristic substantially higher than that of the relatively inexpensive plastic material used for vessel 10, by a design which makes it possible for the same two screws to mount two sides of the insulating plate 26 or 26', and the electrodes 20 and 21, or 20' and 21' while two other screws mount two other sides of the insulating plate and the protective cover 25 in their respective positions relative to recess 14, and by a consequent minimization of the number of separate components to be assembled during production.

The bottles or other vessels to be sterilized are carried by a rack 30 which rests upon the bottom wall 10e and extends upwardly within the metal shell or cover 11. The rack 30 comprises an annular bottom ring 31 which rests upon the bottom wall of the vessel and which has opposite portions of its upper edges connected by transversely extending parallel rods 32. The ring 31 is connected by upwardly extending legs 33 with an annular ring 34 within which there is secured an annular series of small rings 35 which act as guides for bottles which are supported in inverted position on the rods 32. The bottle supporting rings 35 are soldered or otherwise secured to the ring 34 and they are also secured to a central ring 36 by which they are held securely in assembled relationship.

The ring 36 is attached to two upwardly extending bars 37 which are provided at their lower ends with transversely extending supporting flanges 37a. These bars are provided at their upper ends with inwardly extending flanges 37b which are united by a U-shaped upwardly extending handle 37c. These flanges 37b serve as a support for a disk 38 which serves as a removable nipple support. This disk 38 has an outer flange 38a, a central rectangular aperture 38b to receive the handle 37c and apertures 38c.

Although one form of the invention has 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.

We claim:

1. A liquid conductor heater comprising: a vessel made of a thermoset plastic material highly susceptible to tracking, said vessel having a bottom wall provided with in integral recess; first and second flat electrodes; an insulator plate effectively disposed on and coextensive with one surface of said recess and having a mounting ledge and spacing boss projecting from a surface of said plate for supporting said second electrode, said plate being made of a thermoset plastic material effectively immune to tracking; first and second electrical terminals extending through the walls of said recess; first means electrically coupling said first terminal to said first electrode and effectively securing the latter and one side of said insulator plate in stacked relation to said one surface of the recess; second means for electrically coupling said second terminal to said second electrode and for securing the latter and a side of said insulator plate opposite said one side in mutually spaced-apart and overlying relation to the wall of said recess; an apertured cover for the opening of said recess; means for effectively securing said cover and opposite sides of said insulator plate ninety degrees removed in each direction from said first means to the wall of said recess; and means for applying a source of electrical power to said first and second terminals.

2. A liquid conductor heater comprising a vessel having a bottom wall provided with a liquid-tight recess made of plastic material highly susceptible to tracking an apertured cover for said recess, and an electrode mounting structure substantially free from tracking although

utilizing said recess as an indispensable and integral part thereof, said electrode-mounting structure comprising: first and second plate electrodes; an insulator plate made of plastic material effectively immune to tracking and provided with a mounting ledge and spacing boss for supporting said second electrode in overlying and spaced-apart relationship with respect to said first electrode; means including first and second electrical terminals mounted in and extending through the wall of said recess at spaced-apart locations for securing in stacked relation to the surface of said recess wall, the insulator plate, first electrode, and second electrode, in the order named; means for securing said cover in position over said recess and for securing the sides of said insulator plate on each side of a line between said terminals whereby said insulator plate is restrained from deformations which would alter the interelectrode gap or divert liquid therefrom and cause arcing or other malfunctions; and means for applying a source of electrical power to said terminals.

3. The combination set forth in claim 2, wherein said insulator plate is formed of melamine formaldehyde resin.

4. A liquid conductor heater comprising: a vessel having a bottom wall made of plastic material highly susceptible to tracking, said bottom wall having an integral recess therein, said recess being entirely closed at its lower end by a substantially planar second wall integral with said bottom wall and disposed well below the level thereof; an insulator plate of thermoset plastic material effectively immune to tracking disposed entirely within said recess and resting upon and substantially covering the entirety of said second wall, said insulator plate having a mounting ledge and a spaced apart boss projecting therefrom; a first plate electrode mounted on said insulator plate to extend thereover, said first electrode having a mounting projection and a spaced apart spacing projection thereon for supporting the electrode on said insulator plate in limited contact therewith, said contact with said spacing projection being limited substantially to point contact; a second plate electrode mounted on said insulator plate to extend thereover and over said first electrode in spaced apart relation to the latter, said second electrode having a mounting projection and a spaced apart spacing projection thereon for respectively supporting the electrode on said mounting ledge and said boss of said insulator plate in limited contact therewith, said contact of said spacing projection and said boss being limited substantially to point contact; means including a first terminal coupled electrically to said first electrode mounting projection and securing the latter to one side of said insulator plate, and also securing the first electrode mounting projection and the insulator plate to said recess surface; and means including a second terminal coupled electrically to said second electrode mounting projection and securing the latter to said mounting ledge on the opposite side of said insulator plate, and also securing the second electrode mounting projection and the insulator plate to said recess surface.

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RICHARD M. WOOD, *Primary Examiner.*