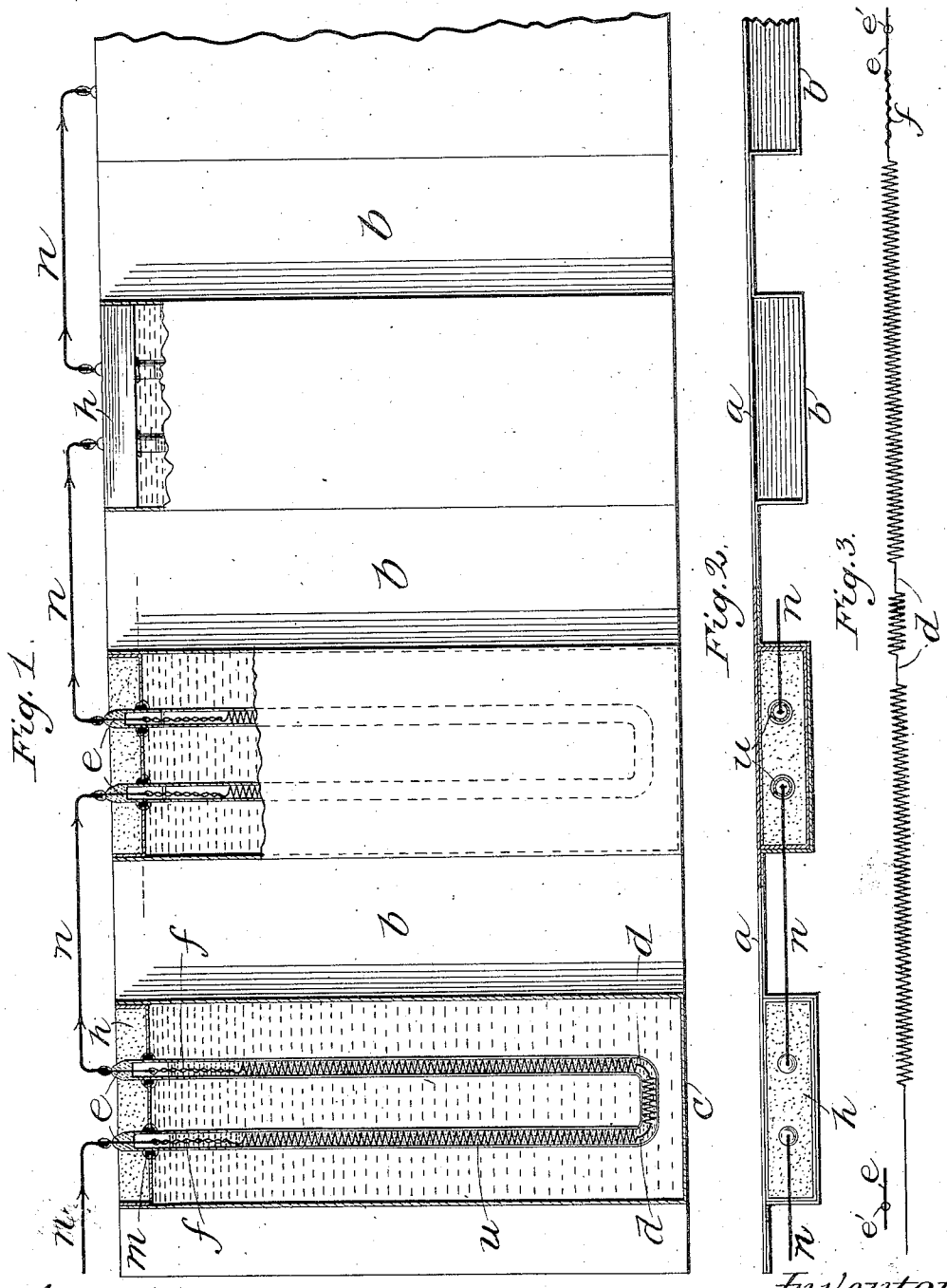
(No Model.) 2 Sheets—Sheet 1.

H. L. TYLER.

ELECTRIC HEATER.

No. 573,629. Patented Dec. 22, 1896.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 4.

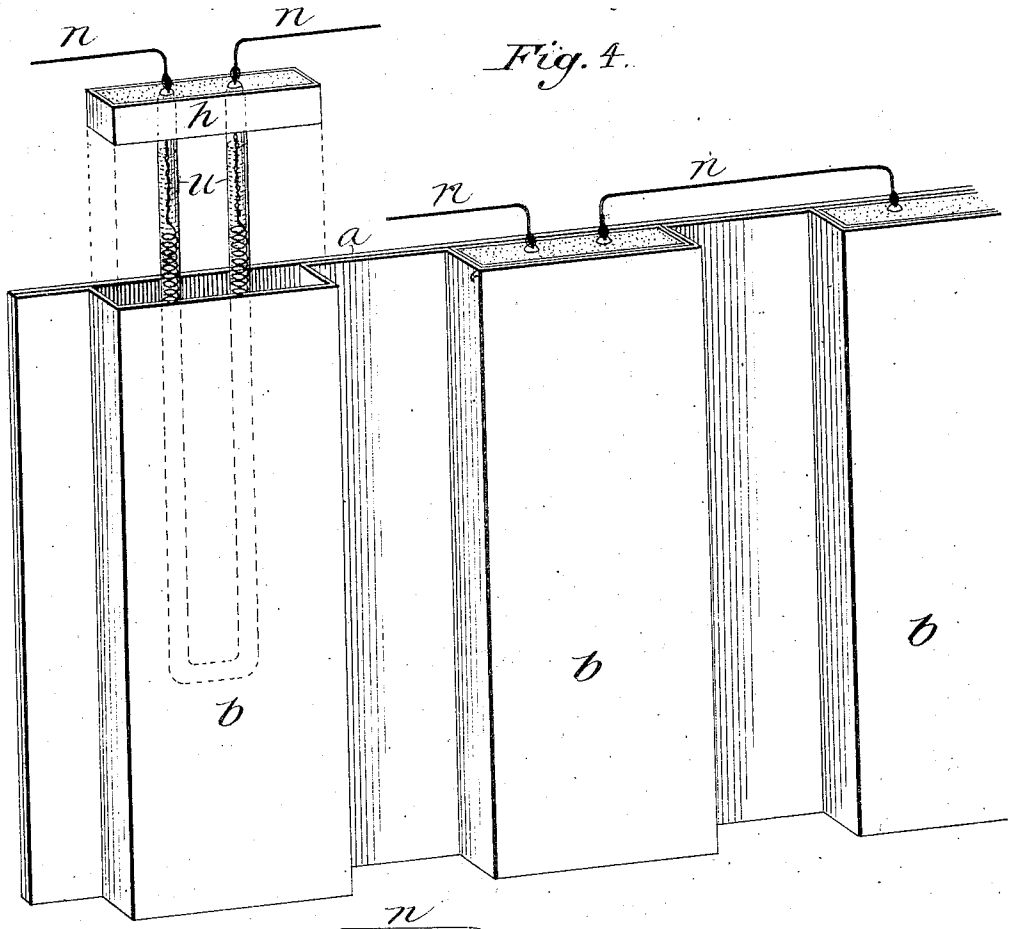
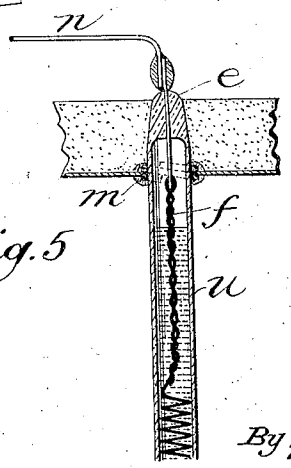


Fig. 5.



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UNITED STATES PATENT OFFICE.

HARRY L. TYLER, OF CORNING, NEW YORK.

ELECTRIC HEATER.

SPECIFICATION forming part of Letters Patent No. 573,629, dated December 22, 1896.

Application filed August 6, 1896. Serial No. 601,914. (No model.)

To all whom it may concern:

Be it known that I, HARRY L. TYLER, a citizen of the United States, residing at Corning, in the county of Steuben and State of New York, have invented certain new and useful Improvements in Electric Heaters; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to certain new and useful improvements in electric heaters, and is designed to render available the calorific effect due to the passage of an electric current through a conductor of high resistance as means for the heating of cars and rooms or compartments generally.

In the accompanying drawings, Figure 1 represents a front elevation, partly in section and partly broken away, of an electric heater embodying my invention. Fig. 2 represents a corresponding top plan view, partly in section. Fig. 3 represents a plan view of my preferred form of high-resistance conductor prior to its incorporation in the apparatus. Fig. 4 represents an isometric view, the closure of one of the heating compartments being shown as disassembled from the compartment itself, so as the better to illustrate its relation thereto. Fig. 5 represents, on a larger scale, my preferred manner of forming a liquid and air proof joint between the metallic bottom of the closure and the glass wall of the tube which incases the conductor.

Similar letters of reference indicate similar parts throughout the several views.

Referring to the drawings, *a* indicates a sheet of metal, preferably copper, constituting the back wall of a series of compartments whose front wall is formed by bending into appropriate shape a second copper sheet *b*. The bottom *c* of each of the compartments is soldered in place, and the outer peripheral edges of the wall-plates *a* and *b* are soldered together. The compartments thereupon become stanch liquid-receptacles, although liquid communication exists between them through the interval existing between the adjacent surfaces of those portions of the walls *a b* intermediate of the compartments proper.

As the filling liquid for the compartments I employ glycerin, which, while possessing a high capacity for the absorption and transmission of heat to radiating-surfaces, has a comparatively slight coefficient of expansion, whereby the retaining-receptacle may be practically filled to its complete capacity without fear of producing such internal pressure as would endanger the integrity of the receptacle itself. These qualities render the glycerin especially appropriate for the purposes of the invention, inasmuch as the containing vessel or receptacle may be substantially filled with the liquid, thereby not only utilizing its full capacity, but also increasing the radiating-surface by reason of the fact that all of the parts of the receptacle are brought into actual contact with the liquid.

In my early experiments I observed the fact that glycerin was of such high resistance at ordinary temperatures as to prevent electrolysis, and I was led to believe from this fact that it would be feasible to employ bare or naked conductors for the transmission of the heating-current, said conductors being immersed directly in the glycerin. I have ascertained, however, that when glycerin or any hydrocarbon is raised to a higher temperature, and especially to the temperature incident to the passage of the electric current as employed in the practice of my invention, its electrical resistance is greatly lowered, in consequence whereof the receptacle becomes virtually a battery-cell wherein cross-currents are set up within the liquid, with the result that the metal of the conductor is deposited electrolytically upon the inner walls of the compartments or from one portion of the conductor upon another portion. In either case the integrity of the conductor is soon destroyed and the apparatus becomes useless. To avoid this difficulty, I insert the conductor within a glass tube of such small cross-sectional area as to inclose within itself a body of glycerin which will offer so much resistance to the passage of the current that it will be unable to bridge over from one point of the conductor to another through the liquid and set up electrolytic action destructive to the conductor. The interposition of the glass tube, moreover, between the naked conductor within it and the outer body of glycerin in the main body

of the compartment entirely cuts off any possible electrolytic action between the conductor and the inner walls of the compartment, while at the same time the heat is freely transmitted from the conductor to the body of glycerin within the tube and thence through the tube-walls to the glycerin within the main body portion of the compartment and thence to the radiating-surfaces. In actual practice I have found that an apparatus constructed after this plan maintains its efficiency after long-continued use.

I may employ as the conductor any suitable solid material of sufficient resistance, such as graphite or the like. I prefer, however, to employ a metallic wire or filament, and for this purpose I have found it convenient to make use of a German-silver wire of, say, No. 30 gage in those instances where the incasing tubes are glass one-quarter of an inch in diameter, and where the individual compartments are eight and one-quarter inches in height, five-eighths of an inch in width, and three inches in breadth, although it will be understood that these particular dimensions are not of the essence of the invention, but illustrate merely its application to a particular use. In imparting a suitable form to the German-silver wire I first wind it in tight spirals about a forming-mandrel of about the size of an ordinary knitting-needle, but leaving the end portions in their original straight condition. I thereupon pull the convolutions apart, as indicated in Fig. 3, so as to make a looser coil, and at the points *d d* of said figure I straighten out certain of the convolutions to correspond to the location of the bends of the glass tube, as indicated in Fig. 1. Each end of the German-silver wire is thereupon twisted upon itself, as indicated at *f*, and at the bend of this returning twist is soldered a platinum wire *e*, which may be of No. 24 gage, and which is preferably provided with a glass bead *e'*, whose function is to assist the subsequent operation of sealing the platinum wires in the ends of the glass tube. The conductor as thus constructed is then placed within a straight glass tube, which is thereupon heated at the appropriate place and bent into U shape, as shown in the drawings. The tube thereupon receives a filling of glycerin, as shown, and its ends are sealed upon the platinum wire by the aid of the blowpipe, the glass beads upon the platinum wires becoming amalgamated with the fused ends of the glass tubes, and a small portion of the platinum wire projects from the said fused ends, as indicated more clearly in Fig. 5.

I do not completely fill the tubes with glycerin, for mechanical reasons only. If the tube is filled within less than an inch or so of the ends to be fused together, the heat is conducted through the glass to the glycerin while the glass is fusing, the glycerin is raised above its boiling-point, and the steam therefrom tends to blow the glass into a bulb, which is not wanted and which would break to let the steam escape. Therefore it is not easy to fuse the glass with such outward pressure exerting against it. So to prevent this difficulty in fusing the ends of the tube I leave the liquid far enough below the ends to prevent its reaching a boiling-point while fusing the glass.

The top of each compartment is sealed by a metallic cover consisting of a shallow metallic vessel *h*, preferably of copper. The bottom of this vessel is provided with suitable orifices for the passage of the ends of the tube *u*, and in order to provide an air and liquid tight joint between the tube ends and the said bottom I first coil about the tube end a few convolutions of platinum wire *m* and fuse them to the outer surface of the glass. I then solder the platinum-wire convolutions to the metal surrounding the openings through which they pass, thereby forming a substantial joint between the glass-tube ends and the bottom of the shallow cover *h*. In most instances this joint may be relied upon as sufficient, but as a further precaution and to protect the ends of the glass tubes from injury I preferably fill the shallow cover with plaster-of-paris or similar composition which sets when cold. Electrical connections are then established between the platinum leading-in wires by means of copper wire *n* of, say, No. 20 gage, soldered to the proximate ends of the platinum wires, as indicated in the drawings.

For car-heating, where the commercial five-hundred-volt current is employed, I preferably employ enough German-silver wire to give a resistance of about eight ohms in each compartment, and I preferably construct the heater with fifteen compartments connected in series and employ two heaters on each side of the car, extending practically the entire length thereof. This arrangement insures the distribution of the heating effect along the entire length of the car, rather than its localization at widely-separated intervals. Moreover, as the radiation is substantially uniform at every point of the heater the calorific effect is evenly distributed to the uniform comfort and convenience of the passengers.

Having thus described my invention, what I claim is—

1. An electric heater, comprising an electric conductor, an insulating-inclosure within which the conductor is contained, a body of practically non-conducting liquid within the inclosure, and an outer heat-radiating body; substantially as described.

2. An electric heater, comprising an electric conductor, an insulating-inclosure within which the conductor is contained, a body of practically non-expansive non-conducting material within said inclosure, and an outer receptacle containing heat-transmitting material and having heat-radiating walls; substantially as described.

3. An electric heater, comprising an electric conductor, an insulating-inclosure there-

for containing glycerin, and an outer receptacle containing a body of heat-conducting material and having heat-radiating walls; substantially as described.

4. An electric heater, comprising an electric conductor, an insulating-inclosure within which the conductor is contained, a body of practically non-conducting liquid within said inclosure, and an outer receptacle containing a body of liquid and having heat-radiating walls; substantially as described.

5. An electric heater, comprising an electric conductor, an insulating-inclosure within which the conductor is contained, a body of practically non-expansive liquid within said inclosure, and an outer receptacle containing a body of practically non-expansive liquid and having heat-radiating walls; substantially as described.

6. An electric heater, comprising an electric conductor, an insulating-inclosure therefor containing glycerin, and an outer receptacle containing glycerin and having heat-radiating walls; substantially as described.

7. An electric heater, comprising an electric conductor, an inclosure therefor containing a body of glycerin of such small cross-sectional area as to prevent electrolysis from one part of the conductor to another, and an outer receptacle containing glycerin and having heat-radiating walls; substantially as described.

8. An electric heater, comprising an electric conductor consisting of a spiral wire, a tube containing glycerin and of diameter substantially equal to the diameter of the coils of the spiral, and an outer receptacle containing glycerin and having heat-radiating walls; substantially as described.

9. In an electric heater, an inclosure containing a body of practically non-conducting liquid, and an electric conductor within said liquid, the cross-sectional area of the liquid being such as to prevent electrolysis between different portions of the conductor; substantially as described.

10. In an electric heater, a tube containing glycerin, and an electric conductor within said glycerin, the tube being bent in U form and having sealed ends and leading-in wires; substantially as described.

11. In an electric heater, an outer receptacle, a tube containing a liquid and an electric conductor, and a top or cover for the outer receptacle and from which the tube depends; said cover consisting of a shallow receptacle above whose bottom the tube ends project and containing a plaster-of-paris setting; substantially as described.

12. An electric heater, comprising a series of compartments, whose front wall consists of a sheet of metal bent to form said compartments, and whose rear wall is common to all the compartments, in combination with electric conductors entering the several compartments and in electric connection with each other; substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

HARRY L. TYLER.

Witnesses:
WM. F. MCNAMARA,
FRANK H. FERRIS.