

Dec. 16, 1952

T. W. GLYNN

2,622,178

ELECTRIC HEATING ELEMENT AND METHOD OF PRODUCING THE SAME

Filed April 22, 1946

6 Sheets-Sheet 1

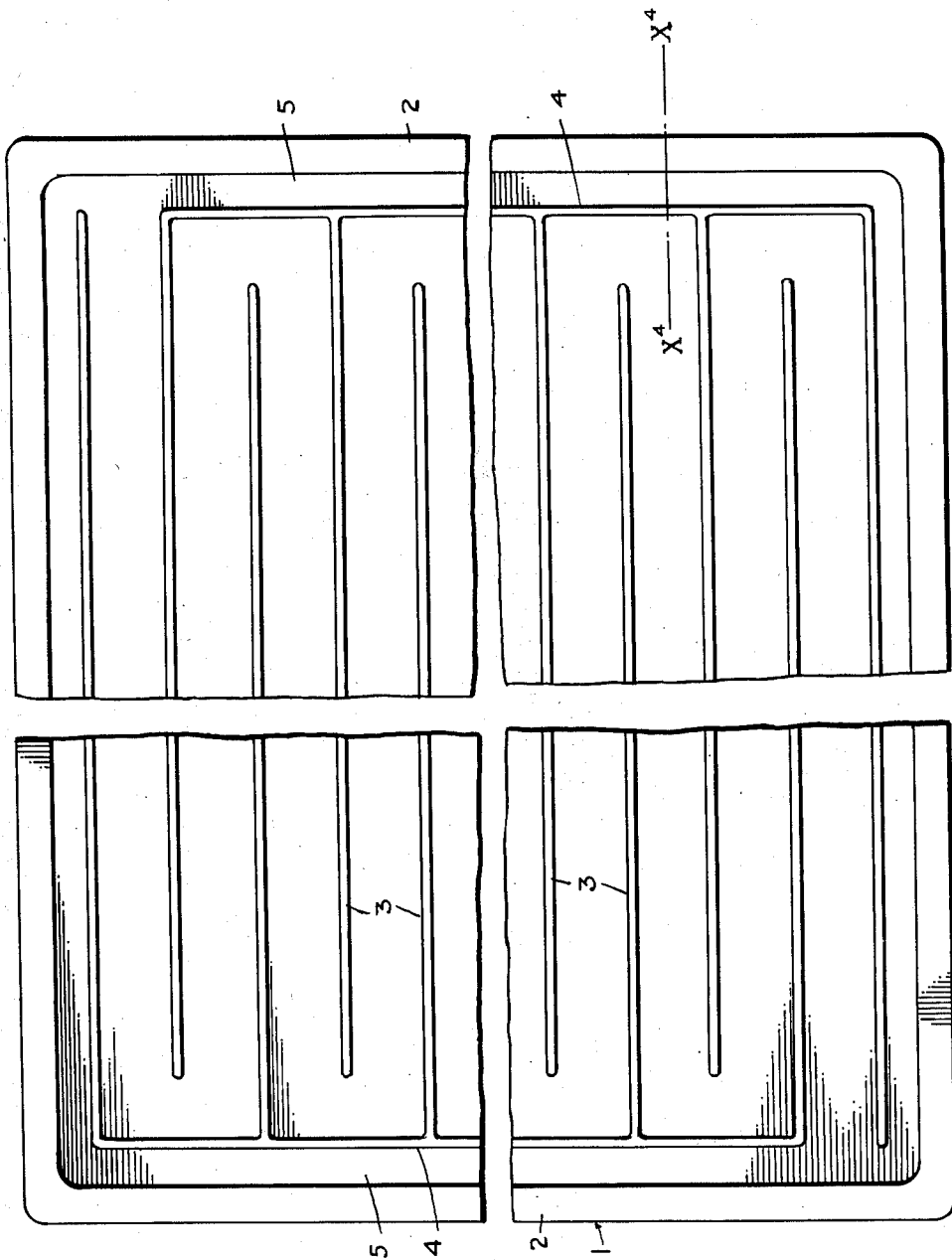


FIG. 1.

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FIG. 2.

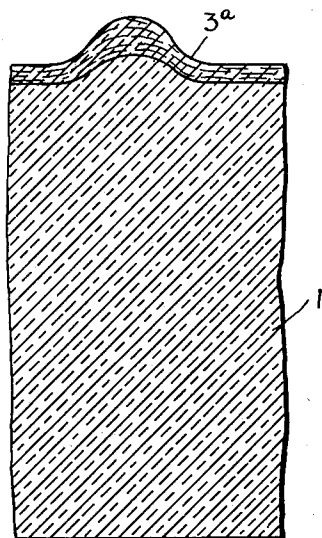


FIG. 3.

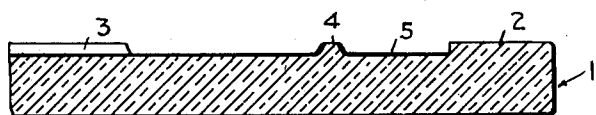
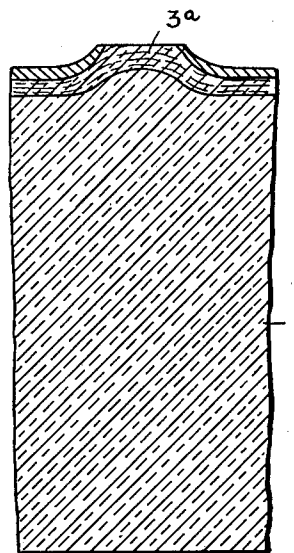
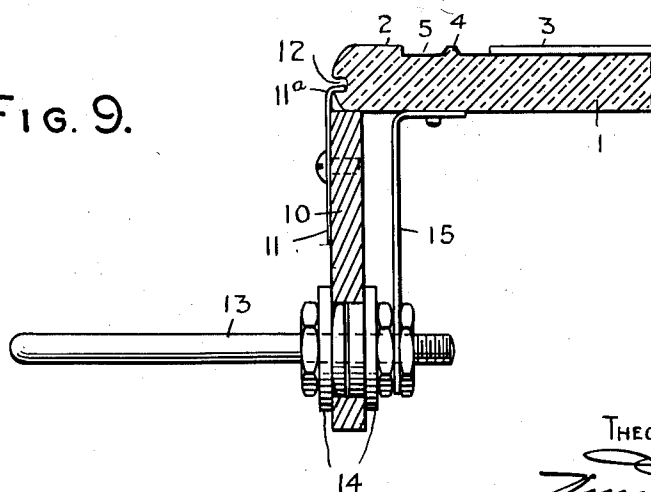


FIG. 4.

FIG. 9.



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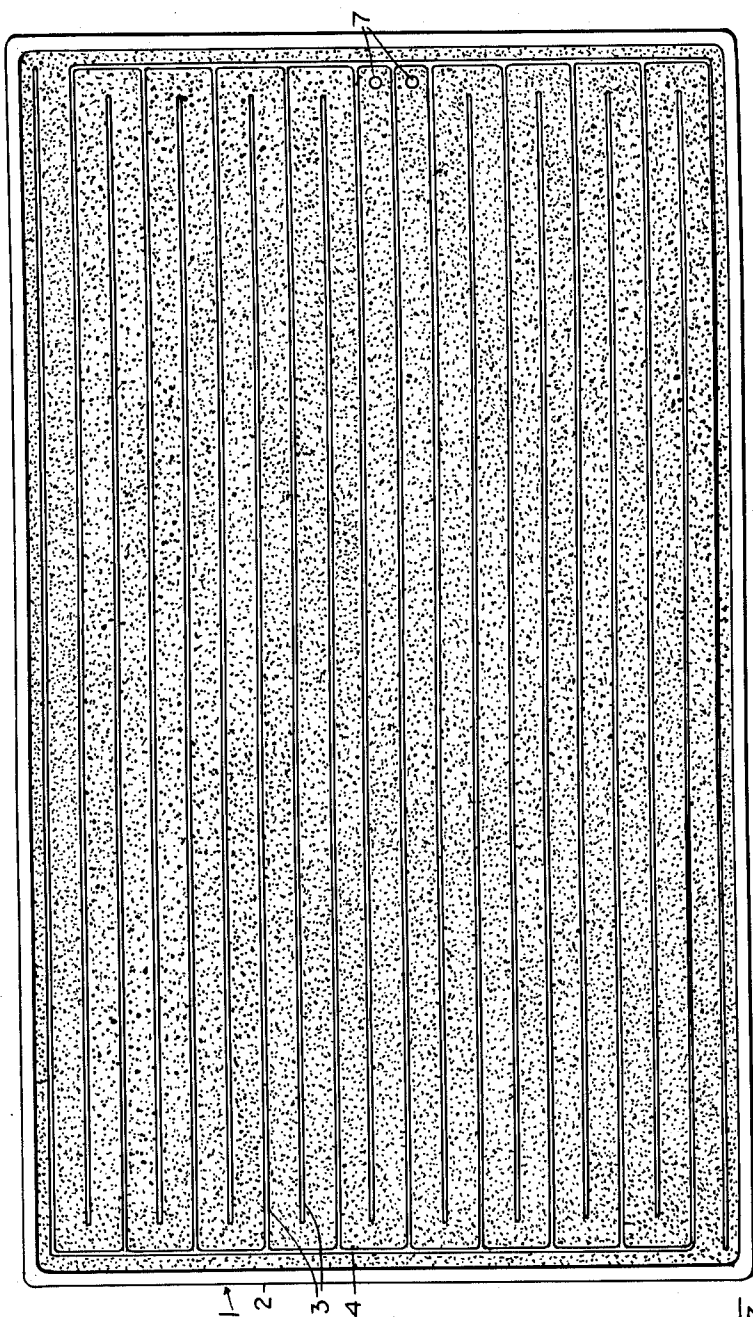
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FIG. 5.



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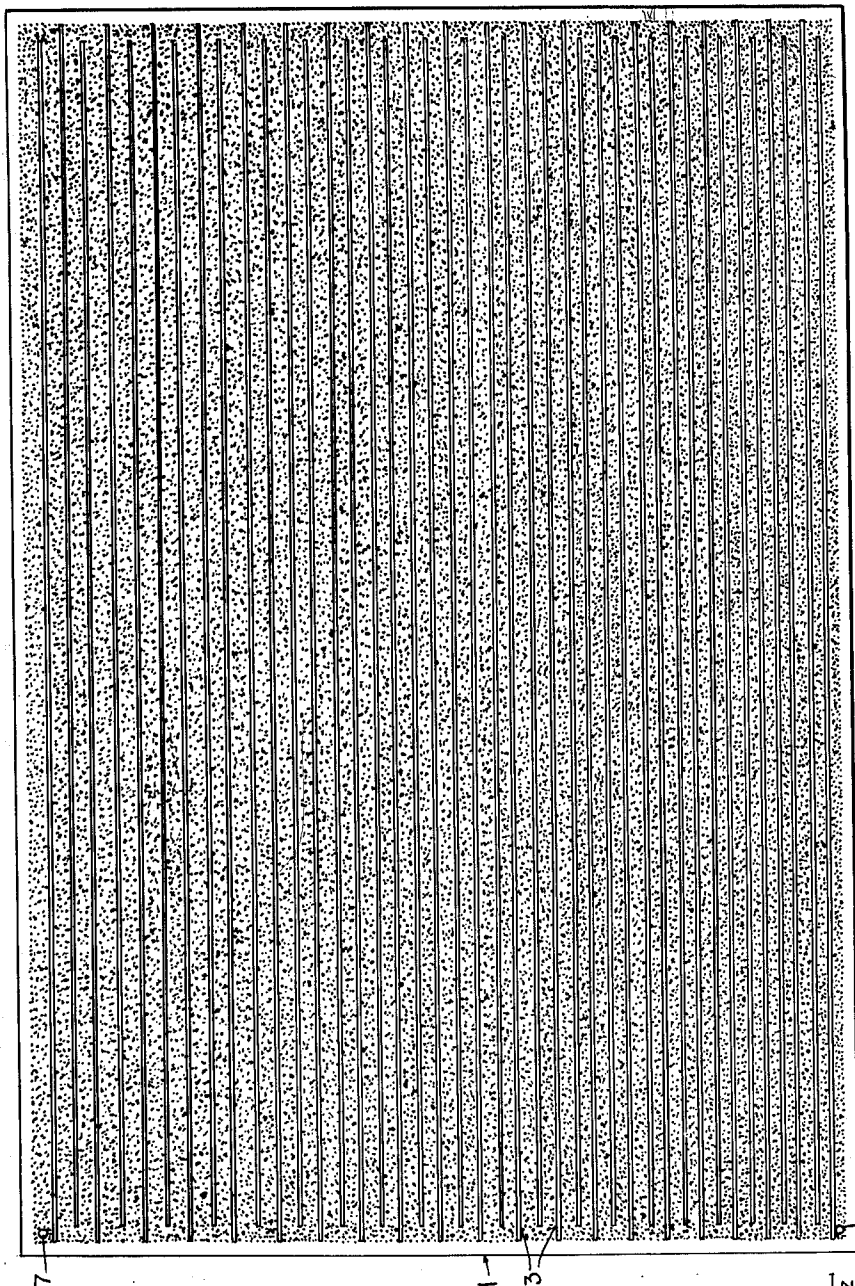
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FIG. 6.



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FIG. 7.

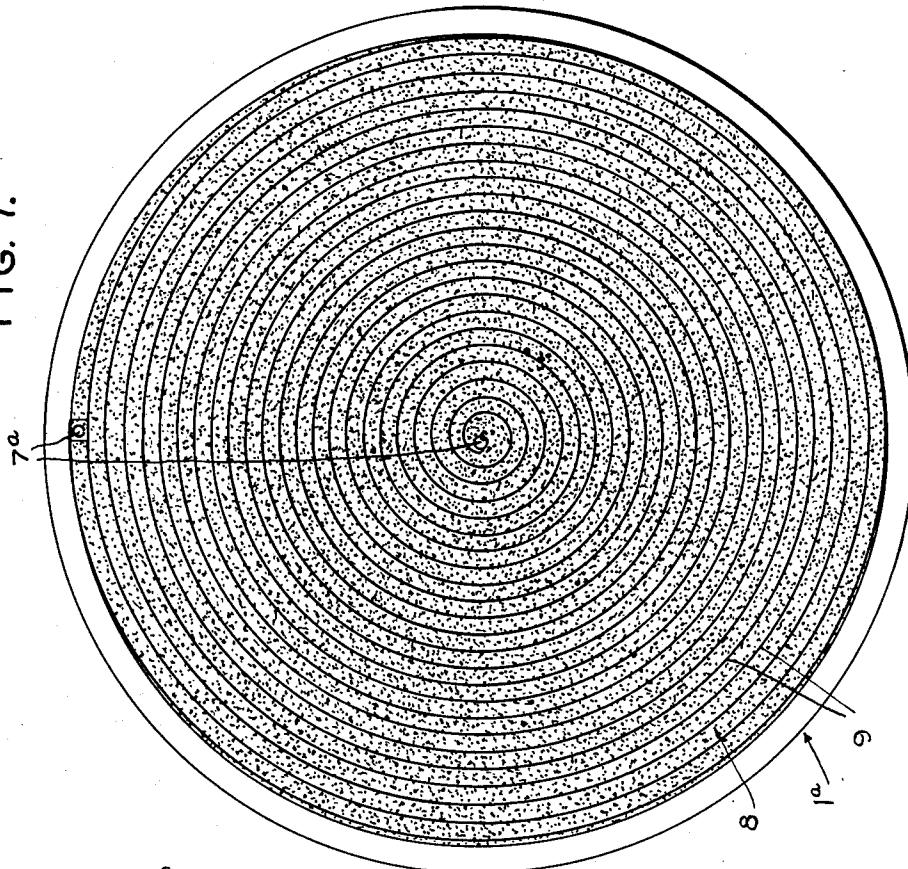


FIG. 10.

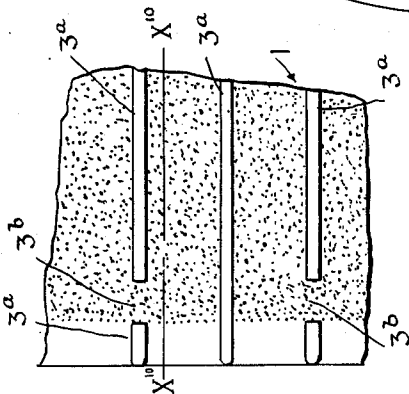
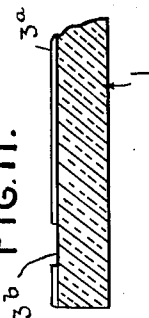


FIG. 11.



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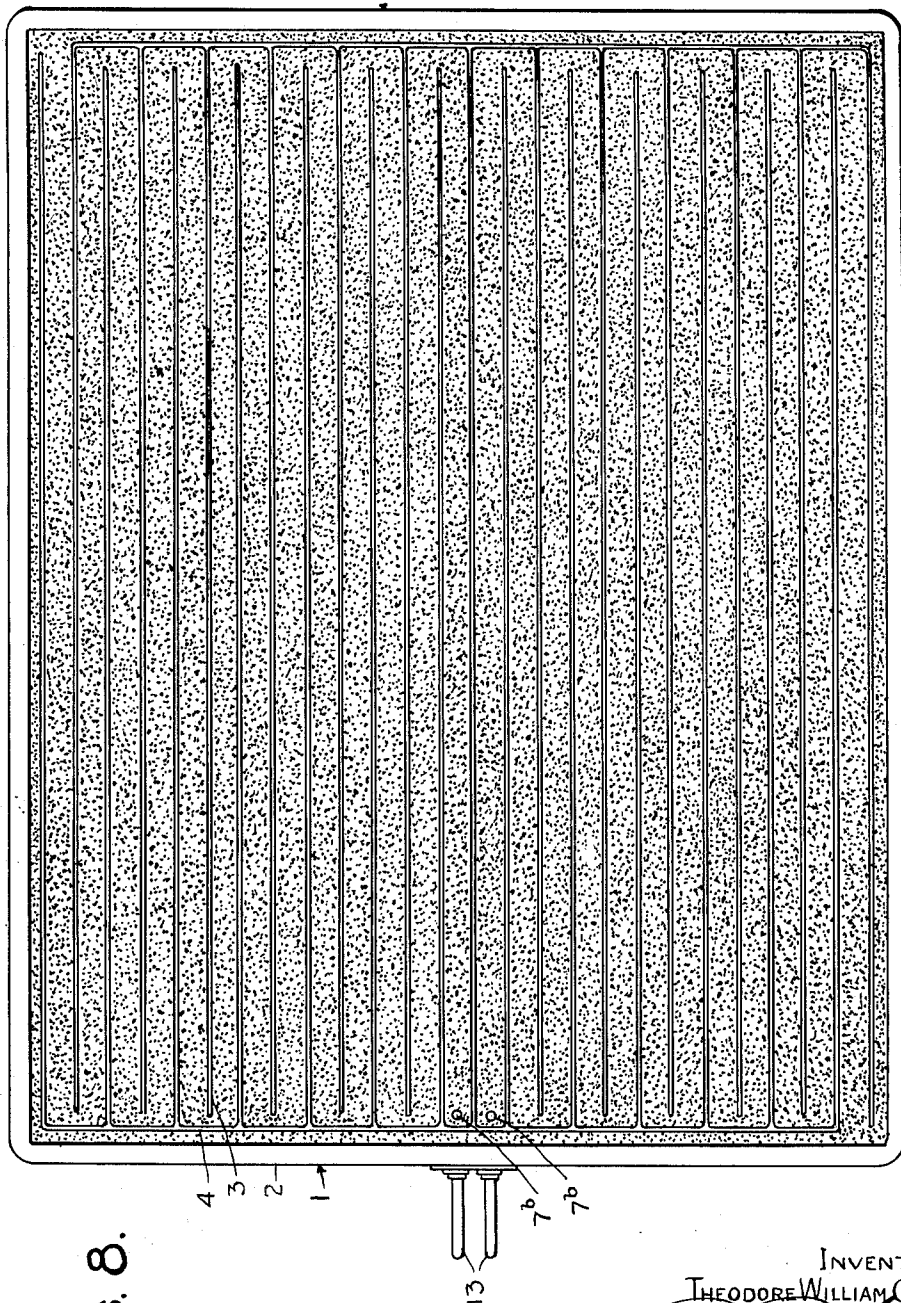


FIG. 8.

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UNITED STATES PATENT OFFICE

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ELECTRIC HEATING ELEMENT AND METHOD
OF PRODUCING THE SAME

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Application April 22, 1946; Serial No. 663,811

5 Claims. (Cl. 201—73)

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The object of this invention is to provide an improved construction of an electric heater comprising a refractory plate having deposited thereon a tortuous metallic conducting coating and to provide a method of producing the same.

It has been the practice in the past, in manufacturing such elements, to sometimes deposit the metal by a gun on the plate through a mask, or stencil, adapted to shield portions of the plate so that the deposit is in the form of a continuous convolution or grid. This procedure is not satisfactory in that the shielding does not result in the sharp delimitation of the deposit that is desirable to reduce the spacing between adjacent runs of the conductor. As an alternative, it has been proposed to make a uniform deposit on a smooth plate and to then remove, by an abrading operation, the metal at selected points to form the convolution or grid. While this operation may result in a conducting element having sharp definition, it is expensive and is commercially impracticable if the plate is of tempered glass, as in removing the deposit the chilled skin of the tempered glass is generally removed to such an extent that the plate is weakened and is no longer able to resist the expansive forces present in the interior of the plate so that fracture occurs.

By this invention the plate is formed with raised lands on one surface thereof, the lands being arranged so as to leave a continuous groove on, by far, the major portion of the surface. The sheet is then coated with the metal deposit and the metal on the top of the lands removed by abrasive action. This is particularly of value when the sheet is tempered, as I have found that when the cross section of the lands is properly selected the chilled skin formed thereon by tempering is sufficiently thick at the top of the lands to permit a part thereof to be removed by the abrading without undue weakening of the tempered sheet.

Furthermore, I have discovered that the destruction of the heating elements of the kind referred to when used in an upright position can be much reduced if the generation of heat in the element is controlled in such manner that it is greater at the bottom of the element than at the upper portion thereof.

For these purposes my improved heater is constructed in accordance with the following specification.

Referring to the accompanying drawings, in which corresponding parts are designated by corresponding marks of reference,

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Figure 1 is a side view of a glass plate, such as is contemplated by this invention, the central portions thereof being broken away.

Figure 2 is a greatly enlarged fragmental section of such a plate taken across a rib after tempering.

Figure 3 is a similar view after the plate has been coated and ground.

Figure 4 is an enlarged fragmental section taken on the line X⁴—X⁴ of Figure 1.

Figure 5 is a side view of a complete heater element embodying the plate shown in Figure 1.

Figure 6 is an elevation on a different scale of a complete heater element, also according to this invention, embodying means for equalizing the temperature of various portions of a vertical panel in use.

Figure 7 is a plan view of a heater element adapted for use as a hot plate, also embodying my invention.

Figure 8 is a plan view of a rectangular hot plate embodying my invention.

Figure 9 is a vertical marginal section thereof.

Figure 10 is a fragmental plan view of a modified form of a heating element.

Figure 11 is a fragmental section on lines X¹¹—X¹¹ of Figure 10.

In the production of a heater, such as is shown in Figures 1 to 6, I form a sheet of glass of the desired size either by rolling or pressing. As shown in Figure 1, sheet 1 has a continuous raised marginal flange 2. Inside of the marginal flange the plate has a plurality of longitudinal ribs 3 extending nearly across the length of the plate but staggered in respect to each other. The one end of each alternate rib 3 is united with one or the other of two transverse ribs 4 on the plate located inside of the adjacent vertical marginal flange 2, while the opposite end of each of the intermediate ribs is separated from the vertical rib 4 on the opposite end of the plate by a proper distance. The opposite ends of the top and bottom longitudinal ribs 3 are each connected with one of the transverse ribs 4. This arrangement results in a continuous channel 5 near the four edges of the plate, the channels 5 near the ends of the plates being formed by the vertical flanges 2 and the transverse ribs 4 adjacent thereto and the channels at the top and bottom being formed by the top and bottom flanges and the top and bottom longitudinal ribs 3, each of the two vertical members of this channel 5 being in connection at one end with the marginal top or bottom channels formed by the longitudinal external ribs 3. Likewise, a continuous tortuous channel is formed

by the longitudinal ribs, which serve as lands between such channels.

The plate 1 may be of any glass having high thermal endurance and this endurance may either be due to composition or may be given to the plate by tempering in any of the well known ways. If it is tempered it will be found that the chilled skin (shown as 3* in Figures 2 and 3) on which its strength depends is thicker at the ribs or lands than is normally obtainable with a flat surface. This is represented on an enlarged scale in Figures 2 and 3.

The sheet having a surface of the above-described figure is now coated by depositing on the figured side thereof a conducting metallic layer. This may be done in any of the well known ways but I prefer to use a Schoop gun to deposit a layer of aluminum of between .001 and .002 of an inch thickness. As the deposit is made on the whole surface of the sheet inside of the marginal flange, accuracy in depositing is not essential. The marginal flanges 2 may be masked by a holding frame.

The coated sheet is now subjected to abrading operation of such kind that the abrading action is restricted to the apexes of the lands. This may be accomplished by a portable sandpapering element or by a sandpaper hand pad. This results in removing the metallic coating on such apexes together with some of the underlying glass but if the contour of the lands is proper for the end in view and the plate has been subjected to proper tempering, the chilled skin at the points subjected to abrasion will be sufficiently thicker than the skin normally formed on a flat surface to permit such removal without exploding the plate.

A further statement as to my preferred construction is that the ribs, or lands, after the grinding operation, have the cross section of a frustrum of a triangle or of a segment with a flattened top, the base of which may be about .06", the height of which may be about .016" and the top of which across may be about .04" and are spaced .625" apart center to center. This will result, after the coating and grinding, in a conducting grid, the several runs or bars of which are slightly under .625" in width and of .001 to .002" in thickness, the several runs thereof being separated by the insulation afforded by the lands, the space between the runs being the width of the lands at the top, to wit: .04". The plate if of glass may be .22" thick. If the marginal channel 5 is of less width than the bars, there will be an increased heating effect adjacent to the margins of the plate.

The several operations above described will result in a plate having on one surface thereof, inside of the marginal flanges 2, a conducting coating broken up by the several ribs into a grid through which electricity will flow in a tortuous path, if proper connections are made at the points indicated by 7.

Under these conditions, heat will be generated in the grid in quantities determined for each portion of the grid by the electrical resistance of such portions. Obviously, the amount of such resistance may be given a selected value by selecting a metal of desired conductivity and by properly selecting the thickness and width of the portions of the conductor under consideration. I take advantage of this ability to control the heat generation at different portions of the plate, especially where one side of the plate is higher

than the other in operation, as is the case with a wall panel.

As shown in Figure 6 in such case, I give the conducting bars along the lower portion of the plate greater resistance per unit area of the plate adjacent thereto than those along the upper portion of the plate. This may be done by reducing the width of the conducting bars at desired portions, as is shown. I have found that this results in equalizing the temperature of the top and between portions of the plate, and hence in reducing breakage. Thus, as shown, the top bar across the plate may have a width of .45" and the width of each lower bar decreases at such rate that the lower bar has a width of .29".

In Figure 7 I have shown an embodiment of my invention for use as a hot plate. In this form the disc 1-A of tempered glass had a convoluted depression 8 in the surface thereof formed by the spiral wall or lands 9. Here, as before, the desired surface is sprayed and then subjected to abrading to remove the coating on the top of the lands. The circuit connections may be made at the end of the outer convolution and at the center, at the point 7a, 7a.

In Figure 8 and in Figure 9 I have shown an embodiment of my invention in another form of hot plate. Here the plate is rectangular as in the form shown in Figure 1 and has the grid arrangement of that figure with the bar slightly narrower. The plate 1 is mounted on a rectangular flange 10 to which it is secured by the clamp pieces 11 fastened to the outer surface of the frame and having inturned ends 11a entering a groove 12 formed in the edges of the plate. The terminal plugs 13 pass through the frame in bushings 14 and are connected with the grid at the points 7b, 7b by the conducting strips 15.

The heating element having been made in any of the ways before described may then have a second sheet of glass 10 laid over the coated surface of the element to protect such surface from contact with external objects.

In the construction shown in Figure 10 the transverse ribs 4 are dispensed with and the plate as rolled has the longitudinal ribs 3a extending from end to end. The adjacent longitudinal channels formed by these ribs are then connected by grinding off the alternate longitudinal ribs, as at 3b, for a proper length near, but not at, the opposite ends of the plate. The plate is then sprayed with metal, the extreme marginal portions thereof being suitably masked, after which the tops of the ribs are submitted to grinding as before. Thus, the alternate channels are connected inside of the masked margin by the metal deposited in the ground out portions 3b.

Having thus described my invention what I claim as new and desire to secure by United States Letters Patent, is:

1. The hereinbefore described method of producing a heating element which comprises forming a glass plate with depressions in the surface thereof, tempering said plate, depositing a metallic conducting coating on the surface of the plate and removing the coating from the top of the lands separating adjacent portions of the depressions by abrasive action.

2. In a heating element, the combination with a refractory plate having a conducting strip thereon and a channeled edge, of a metallic base for the plate, clamps secured to the sides of the base and having inturned ends entering the channel in the edges of the plate, terminal plugs car-

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ried by the base and insulated therefrom, and connections between the plug and the conducting strip.

3. The hereinbefore described method of producing a heating element which comprises forming a glass plate with depressions in the surface thereof, said depressions being separated from each other by ridges whose width at the base is greater than four times the height thereof, tempering said plate, depositing a metallic conducting coating on the surface of the plate and removing the coating from the top of the lands separating adjacent portions of the depressions by abrasive action.

4. An upright heating element comprising a glass plate pre-shaped to form a surface including a series of ridges extending lengthwise of the plate in alternate staggered relation terminating short of the ends of the plate thereby establishing between said ridges a series of grooves, said ridges being spaced closer together below the center of the plate than those above the center of the plate, a metallic conductor lying within said grooves in adherence therewith and extending around the ends of alternate ridges with that portion of the conductor below the center of the plate having higher resistance per unit length than the portion above such center.

5. An upright heating element comprising a glass plate pre-shaped to form a surface including a series of ridges having side and outer faces extending lengthwise of the plate in alternate

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staggered relation terminating short of the ends of the plate thereby establishing between said ridges a series of grooves, said ridges being spaced closer together below the center of the plate than those above the center of the plate, a metallic conductor lying within said grooves in adherence therewith with the outer face of the ridges exposed and extending around the ends of alternate ridges with that portion of the conductor below the center of the plate having higher resistance per unit length than the portion above such center.

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