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T. W. GLYNN ET AL
ELECTRIC RESISTANCE HEATER

2,780,708

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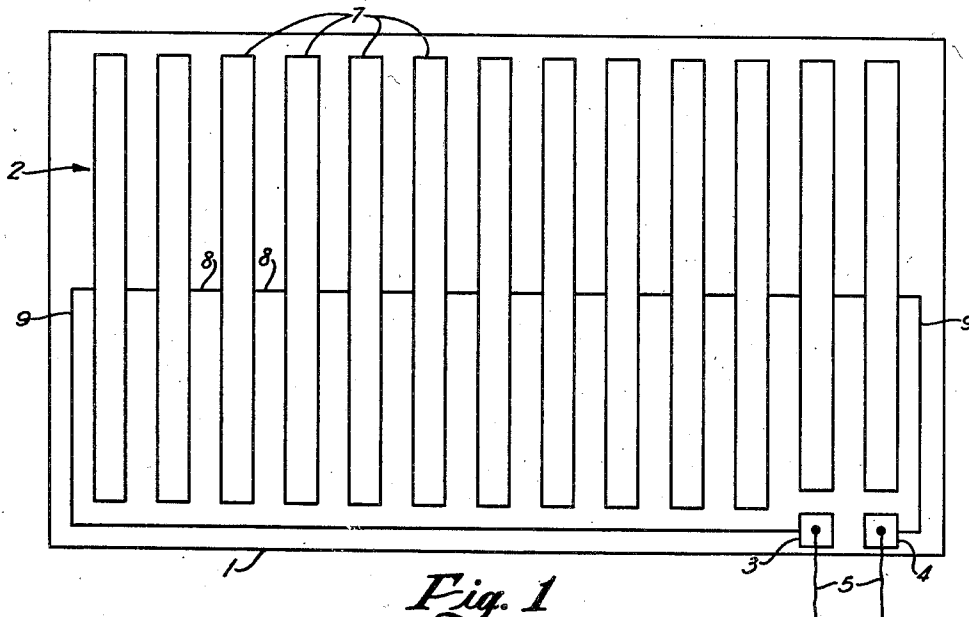


Fig. 1

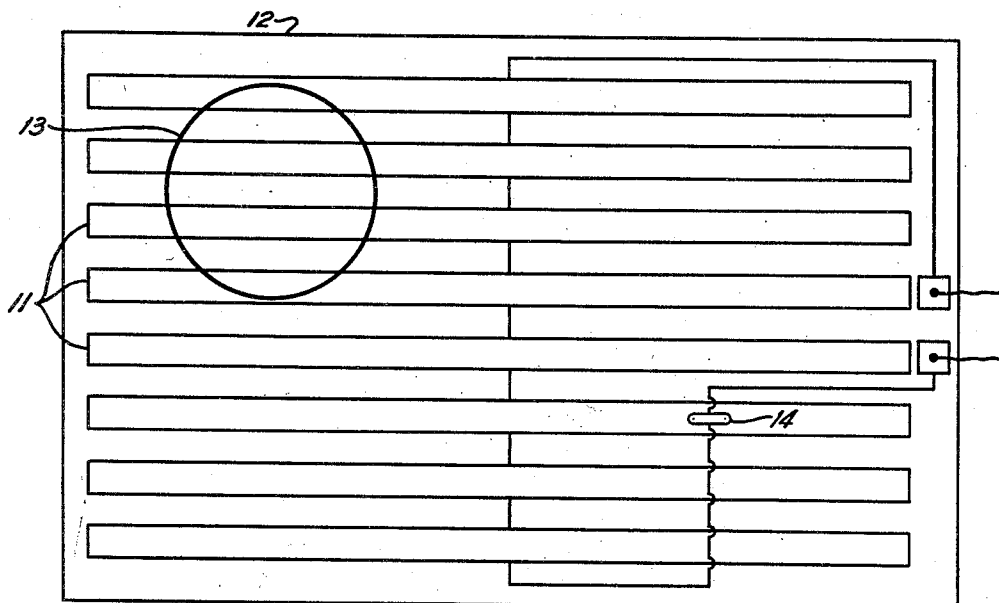


Fig. 2

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ELECTRIC RESISTANCE HEATER

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1 Claim. (Cl. 219—19)

This invention relates to electric resistance heaters, and more particularly to those in which a resistance element covers most of one side of a glass plate. Such a heater is shown in my Patent No. 2,623,971.

In heaters of the type shown in that patent, aluminum or aluminum alloy is sprayed onto the surface of a glass plate, which may or may not be tempered, in a predetermined pattern to form an electrical resistance element. Aluminum and aluminum alloy offer greatly increased resistance to flow of electricity when they are hot. Therefore, if a section of the heating element is heated by an adjoining heated object, the resistance of that section will increase materially. Also, difficulties in applying the resistance material with absolute uniformity result in the resistance of the conductor not being uniform throughout its length. In a series circuit, a spot where the conductor has a higher resistance will become hotter than the adjoining portions of the conductor, with the result that the resistance of that spot will be increased as the spot becomes hotter. Development of hot spots in this manner shortens the life of the heater, either by causing the conductor to burn out or causing the glass plate to break due to straining of the tempered glass because of the overheating. When the heater is used in upright position, hot spots always occur in the upper area of the plate because that area always runs hotter due to the heat rising from the lower area of the heater.

It is among the objects of this invention to provide an electric heating plate, in which any increase in the electrical resistance of any part of the resistance element will divert current from that part into and through another part to prevent an excessive rise in temperature of the part first mentioned, and in which hot spots are substantially eliminated.

In accordance with this invention a resistance heating element, covering most of one side of a glass plate, is in the form of a row of laterally spaced closed loops connected to one another in series near their centers so as to divide each loop into two sections. Preferably, the heating element is formed from a material, the resistance of which increases greatly when hot. Any increase in resistance, regardless of its cause, in one section of one of the heating element loops will divert current from that section into the other section of the loop and, thereby, reduce the wattage input of the first section to prevent an excessive rise of temperature therein.

The invention is illustrated diagrammatically in the accompanying drawings, in which

Fig. 1 is a view of one side of an upright electric resistance heater; and

Fig. 2 is a bottom view of a horizontal heater.

Referring to Fig. 1 of the drawings, a vertical rectangular glass panel or plate 1, of the type generally used for an electric resistance type of space heater, is adapted to be mounted in a frame or other support of well known form which can be set on the floor or hung on a wall. The frame forms no part of the invention, so it is not disclosed. Mounted on one side of the plate, which generally is tempered glass, is an electric heating element.

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It is formed from an electric conductor band 2 connected to a pair of terminals 3 and 4 disposed at the bottom of the plate most suitably near one of its corners. Fastened to these terminals are wires 5 for connecting the heating element in an electric circuit, such as the usual 110 volt household circuit.

The conductor is formed from electrical resistance material, the resistance of which increases greatly when it is heated. Aluminum and aluminum alloy have this characteristic and may be sprayed onto the surface of the plate in a pattern about to be described. The pattern consists principally of a row of closed loops 7. Each loop extends from top to bottom of the plate and has substantially parallel sides. Between each pair of adjacent loops there is a short horizontal piece 8 of the conductor that integrally connects the sides of the two loops about halfway between the top and bottom of the plate. Each outermost loop has its outer side connected centrally to a part 9 of the conductor that leads to one of the terminals 3 or 4. As a result of this arrangement, the loops are connected in series and each one is divided into upper and lower sections through which the current flows from the short length of conductor at one side to the short length of conductor at the opposite side of the loop.

When this heater is plugged into an electric circuit, the top half of the plate will tend to become hotter than the lower half, due to convection. The higher temperature upper portion of the plate will increase the resistance of the upper section of each loop over the resistance of its lower section. Accordingly, the current will follow the line of less resistance and more of it will flow through the lower sections of the loops. This reduces the heat in the upper area of the plate and counteracts the convection effect which tends to make the upper area run hotter. In other words, since the current enters and leaves each loop centrally of its sides, it will divide at that point and the current flow in each half of the loop will be inversely proportional to the resistance of the half loops. The same thing occurs, but to a greater extent, when any of the loops has an area of greater resistance in its upper half due to non-uniform application of the resistance material. Such a high resistance spot will cause current to be diverted from the upper half of that loop to the lower half to prevent an excessive rise of temperature in the upper half. In any case, this particular circuit, which actually is a multiplicity of series parallel circuits, prevents hot spots from developing, which might cause the conductor to burn out or the glass to strain and break.

The heater shown in Fig. 2 can be used as a food warming tray. The loops 11 on the glass plate 12 of this tray are arranged in the same general way as those first described, but they may extend lengthwise of the plate if desired. The temperature of conventional series circuit trays is controlled as far as possible by a thermostat connected in one of the terminal wires. The thermostat is mounted below the plate and is affected by the plate's temperature. It prevents the plate from overheating and the food from drying out, but it does not guarantee accurate control of the temperature of the entire plate, but only of the area where the thermostat is mounted. Consequently, if a hot dish, such as a pot of beans, is set on the opposite end of the plate, the thermostat will not be affected very much by the hot area beneath the pot, with the result that that area may be considerably overheated, due to increase in resistance of the heating element caused by the added heat of the bean pot. Such overheating, if repeated over a period of time, would be likely to result in deterioration in the temper of the glass at the hot spot and eventual breakage of the glass plate. The overheating also would prevent the bean pot from cooling down to serving temperature. Such localized overheating is prevented by this invention, because the increase in resistance at the ends of the loops heated by the bean pot

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13, represented by the circle in Fig. 2, will divert current through the opposite ends of the loops and thereby reduce the wattage input to the area beneath the bean pot. The overall temperature of the plate is controlled by the thermostat 14.

In some cases, outside heat may not be applied to the heating element in the manner just described, but nevertheless an area of the plate may tend to become overheated because heat cannot escape from it as rapidly as from the rest of the plate. Such a condition can exist when the heater is used in a clothes closet or the like for controlling mildew. A piece of clothing might partially cover an area of the plate, so as to permit heat to accumulate in that area. With my heater the rising temperature will increase the resistance of the loops in that location and the current, therefore, will be diverted through the opposite ends of the loops to keep the temperature over the entire plate substantially uniform.

According to the provisions of the patent statutes, we have explained the principle of my invention and have illustrated and described what we now consider to represent its best embodiment. However, we desire to have it understood that, within the scope of the appended claim, the invention may be practiced otherwise than as specifically illustrated and described.

We claim:

An electric resistance heater comprising an upright glass plate and a sprayed aluminum heating element of uniform width covering most of one side of the plate, the

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electric resistance of said element increasing greatly as its temperature is increased the heating element being in the form of a single row of laterally spaced closed narrow loops, the loops extending vertically across the plate and being connected to one another in series at points located only about halfway between the top and bottom of each loop to divide each loop into upper and lower sections, whereby the great increase in resistance in the upper section of each loop due to heat rising from the lower section of the loop diverts electric current from the upper section into the lower section and thereby materially reduces the wattage input to said upper sections in order to maintain substantially uniform temperature in the top and bottom halves of the plate.

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