

- [54] CERAMIC COOKTOP WITH A SPIRALLED HEATING COIL ELEMENT ASSEMBLY

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- [58] **Field of Search** ..... 219/213, 455, 457, 459,  
219/463, 464, 465, 467, 552; 338/217, 218,  
282, 285, 286, 293, 294, 297, 301, 141

[56] **References Cited**

## UNITED STATES PATENTS

|           |         |                     |           |
|-----------|---------|---------------------|-----------|
| 563,032   | 6/1896  | Hadaway, Jr. ....   | 338/218 X |
| 918,535   | 6/1908  | Hadaway, Jr. ....   | 338/217 X |
| 2,918,642 | 12/1959 | Webster et al. .... | 338/218 X |
| 3,345,498 | 10/1967 | Siegla .....        | 219/464   |
| 3,346,720 | 10/1967 | Siegla .....        | 219/464   |
| 3,612,828 | 10/1971 | Siegla .....        | 219/464   |
| 3,627,986 | 12/1971 | Anderson .....      | 219/460   |

|           |        |                      |           |
|-----------|--------|----------------------|-----------|
| 3,680,207 | 8/1972 | Belmonte et al,..... | 338/285 X |
| 3,710,076 | 1/1973 | Frazier.....         | 219/449   |

FOREIGN PATENTS OR APPLICATIONS

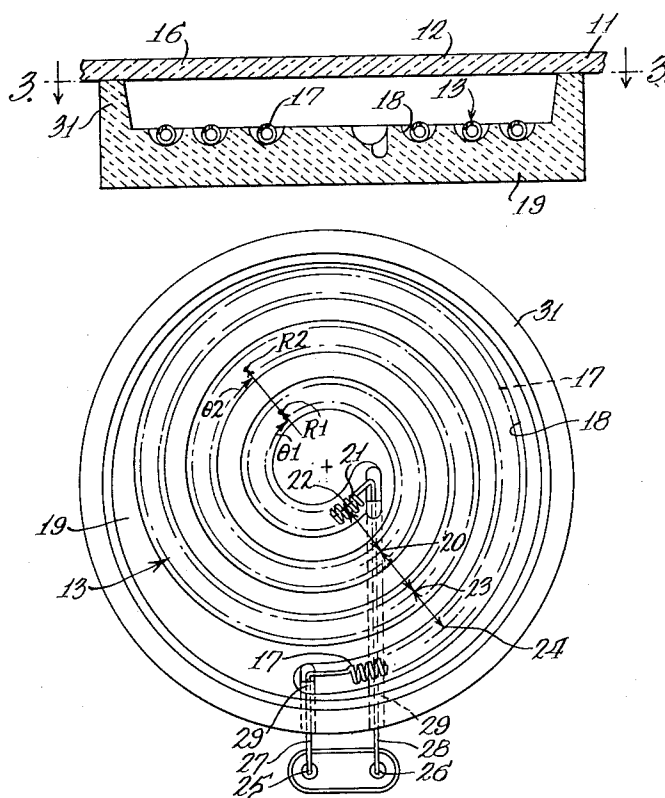
|         |         |               |         |
|---------|---------|---------------|---------|
| 162,984 | 4/1949  | Austria ..... | 219/464 |
| 647,110 | 6/1937  | Germany ..... | 219/464 |
| 653,432 | 11/1937 | Germany ..... | 219/464 |

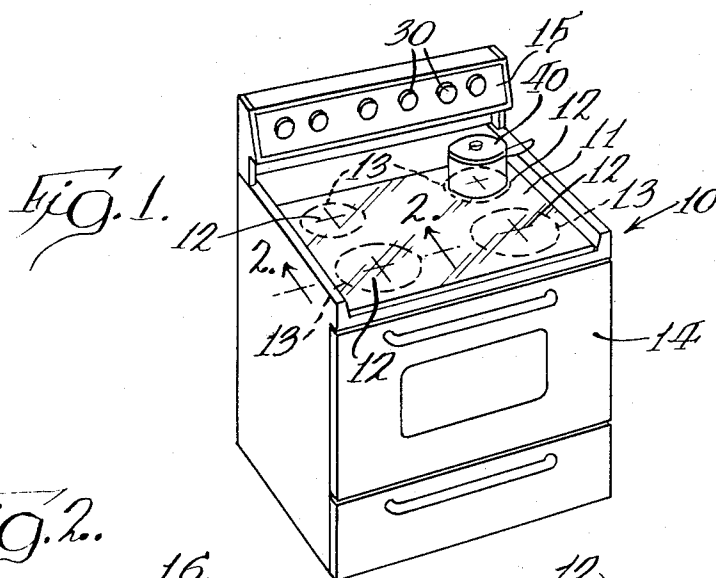
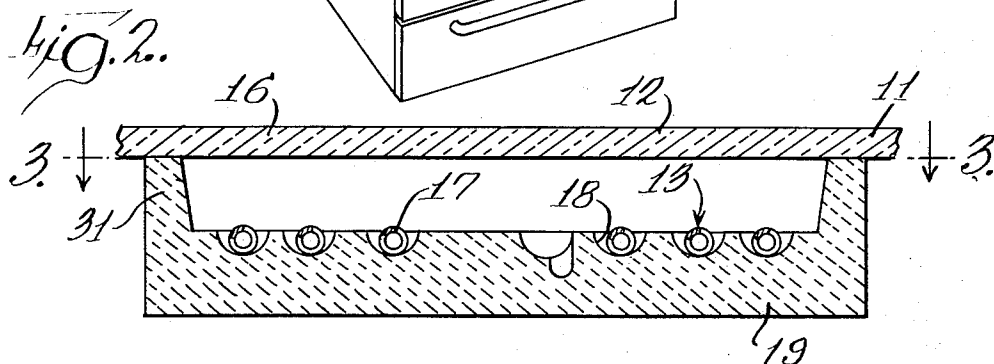
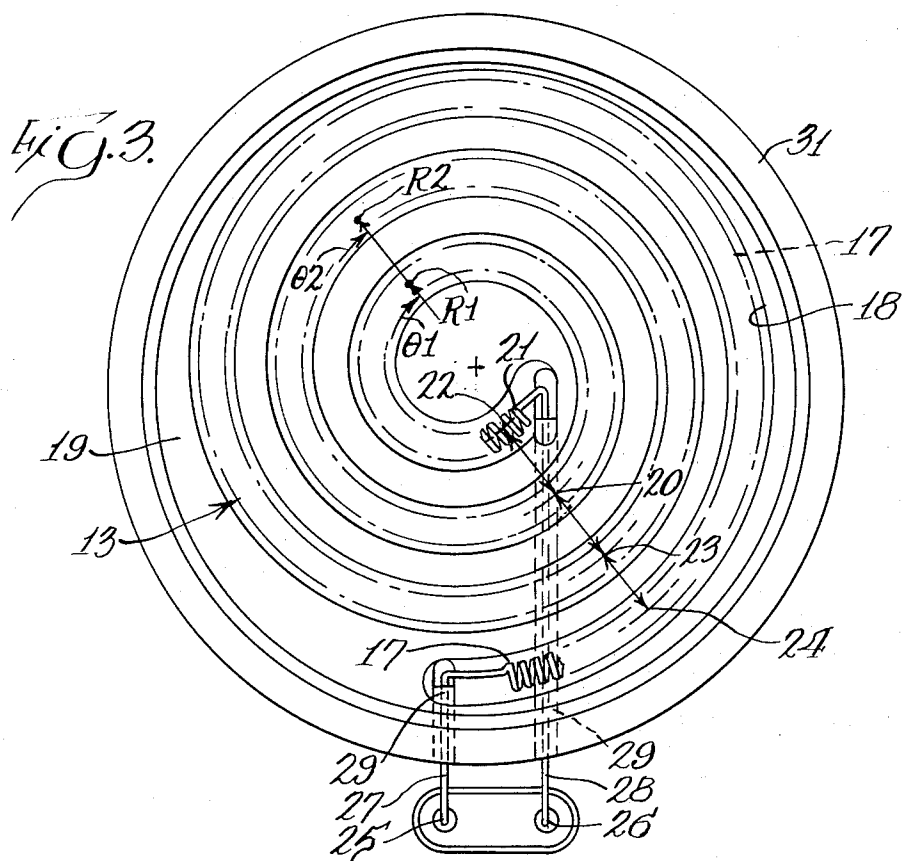
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Stellman & McCord

[57] **ABSTRACT**

A smooth glass-ceramic cooktop for ranges and the like having one or more heating elements disposed below the cooktop for heating cooking utensils and the like supported on the cooktop. Each one of the heating elements is arranged in a unique spiral configuration providing substantially uniform heating of the cooktop surface area disposed superjacent thereto. The spacing between the spiral coil turns of the respective heating elements decreases as a function of the angle thereof from the inner end of the spiral in a novel manner to provide the desired uniform heating effect.

**7 Claims, 3 Drawing Figures**





# CERAMIC COOKTOP WITH A SPIRALLED HEATING COIL ELEMENT ASSEMBLY

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

This invention relates to glass-ceramic cooktops, and in particular to heating element assemblies for use with glass top ranges and the like.

An electric cooktop is usually provided with a plurality of metal sheathed electrical resistance heating elements which are each wound in the form of a spiral coil and positioned in an opening formed in the cooktop. Each heating element is adapted to support a cooking utensil thereon. These metal sheathed heating elements are self-cleaning of food soil due to the high temperatures they reach once they are energized, but it is possible for spillovers to drain through the heating element and accumulate in a collecting pan located beneath the cooktop.

In order to reduce this cleaning problem, cooktops or solid plate surface units have been proposed in which the exposed surface is formed of a glass-ceramic panel. In particular, a generally milk-white, opaque glass-ceramic material has been suggested for this use. Examples of such material are the crystalline glass sold under the trademarks "Pyroceram," "Cer-Vit," and "Hercuvit." The opaque crystalline glass, because of its smooth surface not only presents a pleasing appearance but it is also readily cleanable. There has been a problem, however, in these glass-ceramic heating units in obtaining satisfactory heating rates as compared with those available from the traditional, exposed, metal sheathed electrical resistance heating units.

### 2. Description of the Prior Art

Another problem has arisen in the prior art ranges of this type in that the heating of the glass-ceramic panel in the desired area has not been satisfactorily uniform.

In United States Letters Patent to Hadaway, Jr. Ser. No. 563,032, a heating coil is disclosed in which the cross section of the resistance wire turns increases in diameter from the radial outer portion of the heater to the inner portion while the spacing between coil turns remains substantially constant to provide improved uniformity in heating. However, the Hadaway, Jr. structure has the obvious disadvantage of requiring a special coil which is nonuniform throughout its length and which, therefore, would be more expensive to manufacture than a coil with turns of uniform diameter and would present a serious problem in interchangeability and replacement.

United States Letters Patent Ser. No. 842,849 to Anderson shows an electric, coiled wire heater which follows the broad concept of Hadaway, Jr. in providing a heating coil wherein the coil turns are evenly spaced from each other but the coiled resistance wire turns are made tighter at the outer portion of the coil as compared to those at the inner portion.

In Dills United States Letters Patent No. 3,586,826, the patentee discloses a spiral surface heater with the turns thereof spaced equally radially throughout.

## SUMMARY OF THE INVENTION

The present invention comprehends an improved form of glass-ceramic panel range construction wherein the heating of the desired localized area of the

range surface panel is effectively uniform, providing an improved heating rate for this type of construction and avoiding the above discussed problems of the prior art.

5 More specifically, the present invention comprehends a range construction wherein a heating coil is arranged in a unique spiral configuration in a plane spaced from and parallel to the glass-ceramic surface panel to provide uniform heating of the surface panel area. The heating coil is arranged in a spiral configuration having decreasing radial spacing between the centerlines of successive coil turn portions of the spiral.

10 In the preferred embodiment, the spiral configuration of the heating coil is one wherein the spacing between coil turn decreases as a function of the angle of the point along the spiral at which the spacing is measured.

15 One improved construction of the present invention employs a spiral heating element constructed in accordance with the following mathematical formulation for the spiral configuration:

$$R = C1 + C2\theta - C3\theta^2$$

20 where  $\theta$  is the angle of the coil turn expressed in radians, the angle being measured from a starting point by tracing along the center line of the coil spiral;  $C1$ ,  $C2$  and  $C3$  are constants, and  $R$  is the radial distance in inches from the coil center to the coil turn centerline. Thus, the radial spacing,  $R2-R1$ , between the centerlines of successive coil turn portions at angles  $\theta2$  and  $\theta1$ , with the relationship ( $\theta2 = \theta1 + 2\rho$ ), would decrease as the angle increases in accordance with the following:

$$35 \quad R2 - R1 = K1 - K2\theta$$

or

$$R2 - R1 = K3 - K2\theta$$

where  $K1$ ,  $K2$ , and  $K3$  are constants.

40 In the illustrated embodiment, the glass top range employs a heating element which comprises a flexible elongated coil element which is caused to have the desired spiral configuration by its reception in a correspondingly constructed groove in the upper surface of an insulator support mounted subjacent the glass-ceramic surface panel of the range.

45 Thus, the present glass top range invention comprehends structure providing an improved heating rate by eliminating the undesirable nonuniform heating effect of conventional coil resistance heaters in a novel and simple manner. The heating element assembly is extremely simple and economical of construction while yet providing the above-discussed, highly desirable advantages.

## BRIEF DESCRIPTION OF THE DRAWING

50 Other features and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

FIG. 1 is a perspective view of a range having a glass-ceramic cooktop provided with heating element assemblies embodying the invention;

65 FIG. 2 is an enlarged vertical section taken substantially along the line 2—2 of FIG. 1 illustrating one of the heating element assemblies in association with the cooktop; and

FIG. 3 is a horizontal section taken substantially along the line 3—3 of FIG. 2.

### DESCRIPTION OF THE PREFERRED EMBODIMENT

In the exemplary embodiment of the invention as disclosed in the drawings, a range generally designated 10 is shown to be provided with a glass-ceramic cooktop 11 which is heated at selected areas 12 by a plurality of heating element assemblies 13 embodying the invention.

It should be noted that while the instant invention will be described in conjunction with a free standing range shown in FIG. 1, it is to be understood that the present invention is not intended to be so limited and that the heating element assemblies could be used, for example, with counter or "drop-in" type cooking arrangements without departing from the scope of the invention. Furthermore, the invention contemplates a single heating assembly having a cover plate located in a range top or counter providing one or more heating areas.

In the illustrated embodiment, range 10 comprises a free standing range having an open portion 14 and a control console 15. The present invention is concerned primarily with the construction of the glass-ceramic cooktop 11 and the heating element assemblies 13 thereof so as to provide substantially uniform heating of the surface areas 12 of the glass-ceramic cooktop 11. As illustrated in FIG. 2, the cooktop 11 defines a relatively thin panel 11a of a refractory glass-ceramic material which is capable of being heated to high temperatures without distortion thereof and which effectively transmits the heat from the subjacent heating coil to objects such as a cooking utensil 40 placed on the upper surface 16 of the panel at one of the heated localized areas 12.

The utensil-supporting panel or cover plate 11a is preferably formed of a high-strength infrared transmissive material such as recrystallized glass-ceramic sold under the trade name Herculit by Pittsburgh Plate Glass or Cervit by Owens-Illinois. It will be appreciated, however, that other infrared transmissive material, such as high silica glass, for example, could be used with the invention without departing from the scope thereof. The panel 11a is shown in a preferred embodiment having a rectangular configuration with a length of approximately 27 inches, a width of approximately 19 inches and a thickness of approximately 3/16 inch providing a smooth top cooking surface that will accommodate four radiant heating areas in a manner similar to a conventional four surface unit electric range.

The heating element assembly 13 includes a helically wound heating coil 17 received in a spiral groove 18 of a support 19 comprising an insulator support mounted subjacent the panel 11a for positioning the heating coil 17 closely subjacent the panel.

The present invention comprehends an improved spiral configuration of the heating element coil preventing an effectively uniform heating of the area 12 associated with the heating element assembly. To this end, the heating coil is constructed to have a radial spacing between the centerline of successive coil turn portions (the distance measured along a radius from one turn to the next) which decreases as a function of the angle of the coil turn portion, the angle being measured by trac-

ing along the centerline of the spiral coil from the inner starting portion. Thus, as illustrated in FIG. 3, the radial spacing between centerline point 20 (defining the turn portion radially outwardly of the start portion 21 of the heating element coil) and the centerline point 22 of the start portion is greater than the radial spacing between point 20 and the point 23 at the centerline of the next coil turn radially outwardly of point 20. Similarly, the radial spacing between point 24 (comprising the centerline point of the heating element coil turn radially outwardly of point 23) and point 23 is less than the spacing between points 23 and 20.

It has been found that by decreasing the spacing between the successive radially related coil turn portions as a function of the angle of the portions from the start portion 21, an improved uniform heating of the panel portion 12 is obtained. Thus, assuming that the angular position of point 22 represents a 0° angle, point 20 would be disposed at an angle of 2 pi radians, point 23 would be disposed at an angle of 4 pi radians, and point 24 would be disposed at an angle of 6 pi radians from the initial start point 22. Illustratively, an improved heating element formed in accordance with the present invention has a spacing between points 20 and 22 of 0.876 inch, a spacing between points 23 and 20 of 0.75 inch, and a spacing between points 24 and 23 of 0.687 inch where the heating element coil is a normal 6 inch diameter heating element assembly.

More specifically, the arrangement of heating coil 17 may be in accordance with the following mathematical equation:

$$R = .65 + .1454 \theta - .00089 \theta^2$$

where  $\theta$  is the angle expressed in radians of the coil turn measured from a starting portion by tracing along the centerline of the coil turn spiral, and R equals the radial distance in inches from the spiral center to the coil turn center. It has been found that this equation is applicable to heating element assemblies having nominal diameters in the range of from 6 to 9 inches and where the outermost heating coil portion is up to 9 pi radians.

Utilizing the above equation, the radial spacing ( $R_1 - R_2$ ) between successive coil turn portions can be determined. Because the angles,  $\theta_2$  and  $\theta_1$ , for the radii,  $R_2$  and  $R_1$ , differ by  $2\theta$ , the radial spacing,  $R_2 - R_1$  can be defined in terms of  $\theta_1$  as follows:

$$R_2 - R_1 = .8785 - .01118 \theta_1$$

It can, therefore, be seen that the radial spacing,  $R_2 - R_1$ , between successive coil turn portions decreases as a function of the angle measured from the inner starting portion 21 of the coil spiral.

As discussed above, the improved uniform heating effect is obtained by arranging the heating coil in the disclosed spiral configuration. The disposition of the coil in this configuration may be effected by using a flexible resistance wire heating coil which is laid in a groove 18 of support 19 having the corresponding desired spiral configuration so that the groove, in effect, determines the configuration of the heating coil. Thus, any conventional flexible heating coil having the proper length and resistance may be utilized in replacement of the heating coil of the range 10 as the groove will automatically cause the replacement coil to be disposed in the novel spiral configuration. The resistance wire heating element illustrated in FIG. 3 preferably

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has a uniform density of resistance wire turns per inch to provide the desired uniform heating of the panel portion 12 as discussed above.

As shown in FIG. 3, the heating element is connected to a suitable source of electrical power through connectors 25 and 26 connected respectively to the outer end 27 of the heating coil and the inner end 28 of the heating coil. The end wires may be brought out to the connectors 25 and 26 through suitable porcelain insulators 29 in the conventional manner. Energization of the different heating coils 17 may be effected by suitable manipulation of control knobs 30 on control console 15.

Further uniformity in the heating of panel 11a at a selected area 12 is effected by means of the upturned rim portion 31 of support 19 which serves to reflect and concentrate radiant heat and to space the heating coil 17 at a preselected distance below the panel 11a, as shown in FIG. 2.

The spiral arrangement of heating coil 17 simulates an arrangement of concentric circular heating elements having a decreasing radial spacing between the elements. BY providing a spiral arrangement, however, the manufacturing cost of the structure is effectively minimized while yet heating coil 17 provides the highly desirable heating effect discussed above.

The present invention permits the use of a uniformly wound heating coil construction while yet providing a variation in the heating effect as a function of the radial spacing of the heating element-portion from the center of the element so as to provide a uniform heating of the superjacent panel for an improved heating rate. Thus, the present invention avoids the costly specially formed heater constructions of the prior art therefore provided relative to the problem of heating uniformity.

The foregoing disclosure of a specific embodiment is illustrative of the broad inventive concepts comprehended by the invention.

I claim:

1. In a range structure having a glass-ceramic cooktop for surface cooking operations, a surface heating

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element assembly mounted below said cooktop for heating a utensil placed on said cooktop, said element comprising: an insulative heater support having a top surface spaced adjacent said cooktop; a groove in the heater support top surface defining a spiral, said spiral having an inner end, an outer end and a plurality of turns between the inner end and the outer end; and a uniformly coiled resistance wire heating coil element positioned in said groove to extend from said inner end to said outer end, said element being arranged for connection to a source of power for producing heat energy, the radial spacing between successive turn portions of the groove and coil decreasing from the inner end to the outer end.

2. The range structure as claimed in claim 1 wherein said cooktop comprises a glass cooktop.

3. The range structure as claimed in claim 1 wherein said radial spacing uniformly decreases.

4. The range structure as claimed in claim 3 wherein said radial spacing decreases as a function of the angle of said turn portions.

5. The range structure as claimed in claim 1 wherein said spiral groove has a radius defined by the following formula:  $R = C1 - C2\theta - C3\theta^2 \dots$  where  $\theta$  is the angle of the coil turn expressed in radians, the angle being measured from a starting point by tracing along the centerline of the coil spiral; C1, C2 and C3 are constants; and R is the radial distance in inches from the coil center to the coil turn centerline.

6. The range structure as claimed in claim 1 wherein said spacing along a preselected radius decreases in the following steps: (a) .875 inch, (b) .750 inches, and (c) .687 inch.

7. The range structure as claimed in claim 1 wherein the spiral groove has a radius defining the centerline of the groove constructed as a function of a constant, plus a constant times the angle of the point from the start of the spiral, minus a constant times the square of said angle of the point.

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