

- [54] **ELECTRIC BROILER HEATING UNIT**
 [72] Inventor: **Mitchell D. Charneski**, Southfield, Mich.
 [73] Assignee: **The Detroit Edison Company**, Detroit, Mich.
 [22] Filed: **April 8, 1971**
 [21] Appl. No.: **132,279**

- [52] U.S. Cl. **219/537**, 13/25, 219/347, 219/397, 219/405, 219/546, 219/552, 338/217
 [51] Int. Cl. **H05b 3/06**
 [58] Field of Search.....219/405, 408, 461, 347, 524-525, 219/552-553, 390, 397, 530, 540, 538, 464; 338/217-218, 287-288, 319; 13/22, 25, 31

[56] References Cited

UNITED STATES PATENTS

- | | | | |
|-----------|--------|----------------------|-----------|
| 3,327,094 | 6/1967 | Martin et al. | 219/405 X |
| 3,316,390 | 4/1967 | Gaugler et al. | 219/464 |
| 3,569,672 | 3/1971 | Hurko | 219/464 |
| 2,668,896 | 2/1954 | Husaczka et al. | 219/538 X |
| 2,777,300 | 1/1957 | Palmer..... | 219/530 X |
| 918,535 | 4/1909 | Hadaway, Jr. | 338/217 X |

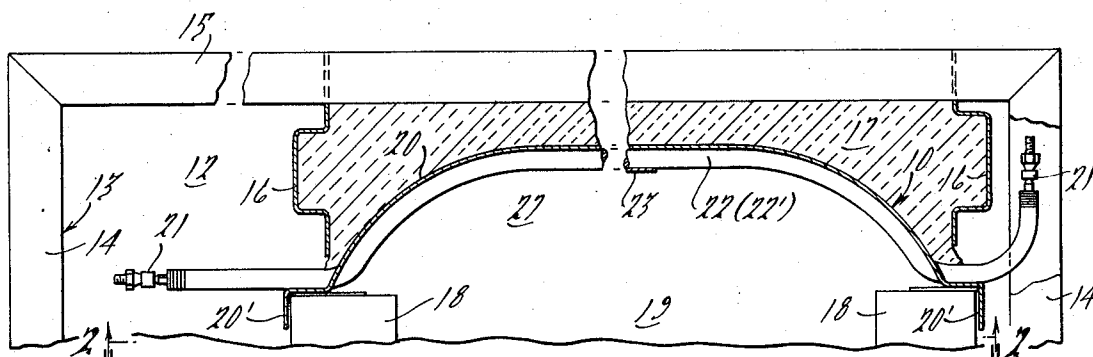
- | | | | |
|-----------|---------|--------------------|-----------|
| 3,161,755 | 12/1964 | Tilus..... | 219/405 X |
| 3,036,191 | 5/1962 | Aitken et al. | 219/347 X |
| 3,336,465 | 8/1967 | Hurko | 219/397 |
| 3,342,977 | 9/1967 | Anderson | 338/217 X |
| 3,385,953 | 5/1968 | Henneberger..... | 219/390 |

Primary Examiner—Volodymyr Y. Mayewski
 Attorney—Whittemore, Hulbert & Belknap

[57] ABSTRACT

A composite radiating plate and rod heating unit for an electric-heated broiler compartment has a generally flat but arcuate-sided ceiling panel in the form of a rectangular metal sheet whose bottom bears a series of parallel passes of "Calrod" electric heating rod components. These, whether represented by individual lengths electrically jumper-connected at their opposite ends, or as arranged in sets of two or more in a serpentine outline, are non-uniformly spaced from one another in at least some of the successive components of the units, generally increasing in spacing starting at a front or rear pass. They and the thermally conductive sheet panels to which they are fixedly secured are curved downwardly adjacent opposite side margins of the latter to afford a warm dead air ceiling or dome space as installed at the top of a broiler chamber.

2 Claims, 3 Drawing Figures



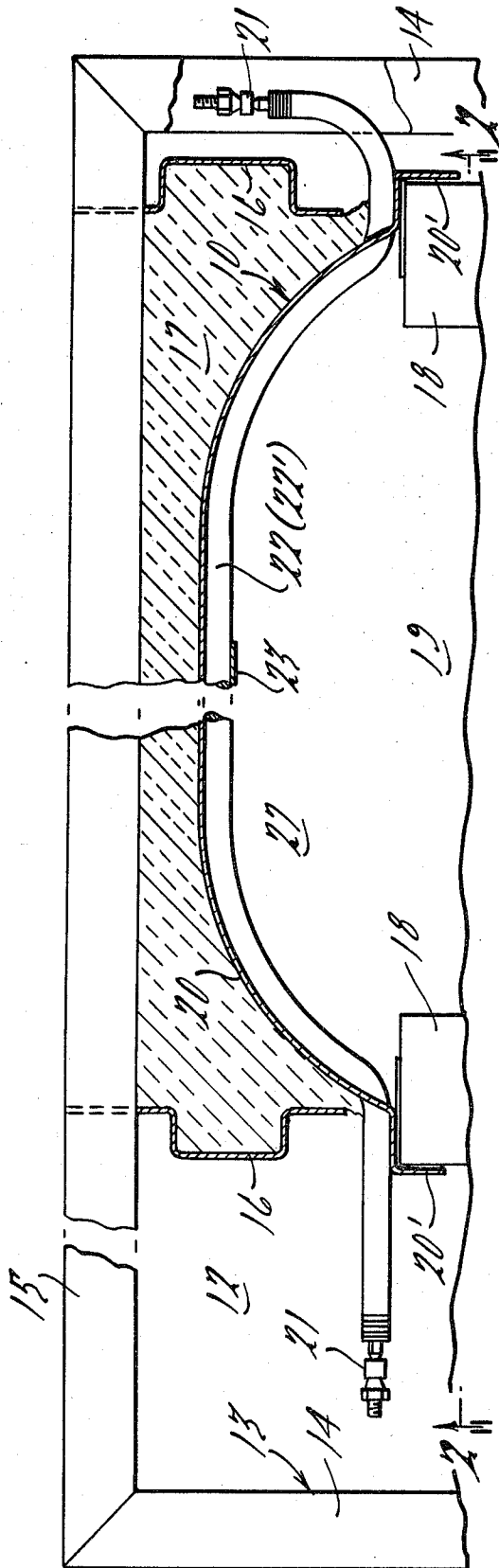


FIG. 1.

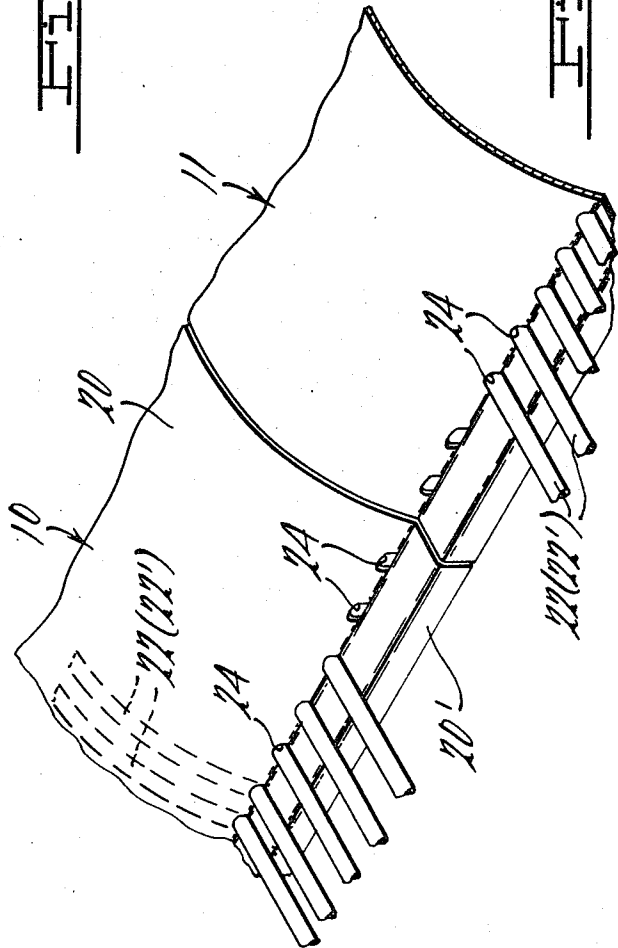


FIG. 2.

INVENTOR.
 Mitchell D. Charneski.
 BY *Whittmore, Kellogg & Bell*
 ATTORNEYS

ELECTRIC BROILER HEATING UNIT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The heating units of the invention are particularly intended for installation in company cafeterias or like food preparational or dispensing facilities at which large scale broiling, baking, heat-maintaining or like cooking operations are the normal order of the day. However, the application of the invention is by no means limited to such fields, since it may well have wide-spread use in domestic broiler type ovens.

2. Description of the Prior Art

The most pertinent prior art patent of which I am aware is that to Anderson, U.S. Pat. No. 3,342,977 of Sept. 19, 1967, relating to an electric broiler heating element essentially comprised of a corrugated, resistance heating sheet structure.

SUMMARY OF THE INVENTION

An objective of the invention is to provide an improved electric broiler heating unit whose direct and primary heating source, as energized electrically from an appropriate voltage supply, is in the form of a so-called "Calrod" type heater, i.e., constituted of a tubular metal sheath encasing an elongated resistance heating conductor and its magnesium oxide electrical insulation. It is a fact that in conventional electric broilers in which such heating rod components are arranged in a symmetric or uniform distribution of parallel lengths, a useful cooking area of about only half of the total exposed lower heater rack area is in effect available, the expression "useful cooking area" being empirically determined as a function of combined temperature rise, time and area factors. This is due in considerable measure to a loss of space heating efficiency characteristic of passes or lengths of the heater rods adjacent the front, rear and sides of the broiler chamber, coupled with the air insulation of the rods from one another. On the other hand, if such lengths are spaced more closely together in perimetral zones where heating losses are greatest, then their life is inevitably shortened.

Accordingly, the invention proposes to fixedly connect such rod lengths in good heat transfer relation to the bottom of a generally flat thermally conductive metal sheet or panel, with ends of the rods and sides of the sheets curved for an intended dome outline, all of which contributes to a useful cooking area increased to the order of 80 percent, as compared with the prior figure of a bit more than 50 percent. The individual heating rods themselves are kept cooler for a long life, since a large measure of radiative capacity is contributed by the supporting sheet or panel, acting in effect as an extension of the rod capacity. Considering each set or pair of rod components as operating at 240 volts a.c., 6 kw., the combined rod and sheet broiler unit presents an increase in watt density up to 14 watts per square inch of the broiler rack, as compared with a prior available density of about 9 w./in².

Assuming, for example, that as many as 100 steaks are to be broiled simultaneously, the improvements mentioned above make possible a shorter cooking time and an increased usable space, representing about 25 percent at marginal areas. Substantially doubled cooking capacity and greatly lessened operating cost are the result.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view, partially broken, in transverse vertical section on line 1—1 of FIG. 2, showing the improved unit as typically installed in a broiler compartment;

FIG. 2 is a fragmentary plan view, also partially broken, from the line 2—2 of FIG. 1, being in larger scale; and

FIG. 3 is a fragmentary top perspective view of a schematic nature, further illustrating the general arrangement of the heating plate and rod parts.

DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. 1 shows a typical installation of one or more (as dictated by the size of the installation) of the improved combined metal sheet and rod type heating units of the invention. Typically there are two of these, front and rear, as generally designated by the respective reference numerals 10, 11, mounted within the broiler chamber or compartment 12 of a commercial oven. This compartment has an outer casing 13 including mitered outer side wall members 14 and a connecting top wall member 15, and stamped sheet metal panels 16 are fixedly secured in depending relation to top wall member 15 to in part define a space 17 bottomed by a ceiling or dome portion (later described) of the improved heating unit. Space 17 is occupied by a high temperature insulation, such as blanket aluminum silicate, to preserve efficiency. The units 10 and 11 are identical but oppositely oriented, with the rear of the former adjacent the front of the latter to reverse the progression of spacing of certain heating rods, as will appear; and they are fixedly supported appropriately upon the top of insulated inner side walls 18 of the broiler space 19 proper within the general space 12 of outer broiler casing 13.

Referring to FIG. 2 in conjunction with FIG. 1, each of the heating units 10, 11 comprises a sheet metal rod-supporting and heat radiating plate 20 of rectangular cross section, relatively elongated in the side-to-side direction of the broiler space 19. An area of 15 inches by 28 inches would be typical. While the material of the plate or sheet 20 is, of course, subject to selection, I find a 20 gauge stainless steel sheet of, say, No. 304 having 8 percent nickel-18 percent chrome composition, to be very satisfactory. It has sufficient rigidity for the purpose, coupled with an acceptable heat-up time factor.

This sheet or plate 20 has a plurality of "Calrod" type heating rod components 22 appropriately secured rigidly to its lower surface in good heat-conducting relation to the plate. This may be effected by spot weld connections; however, I find that for the purpose of the invention, and as shown in FIG. 2, that an appropriate number of aligned stainless steel tabs 23 (of which only a relatively few are shown) spot welded to the sheet 20, with the rod lengths 22 received in bights of the tabs, afford a very satisfactory connection, particularly in view of the cost consideration. This is so, moreover, in view of the fact that heat build-up time in the units 10, 11 at the commencement of a daily operation in a commercial kitchen is a negligible operating factor; the rods and sheets are brought to heat in a very reasonable time, and are normally kept heated during a daily run.

By preference, the rod-type heating elements or components 22 are of, say, $\frac{1}{4}$ " or $\frac{3}{8}$ " outer diameter having an Incoloy or stainless steel sheath part within which an electrical resistance heating component, as embedded in magnesium oxide electrical insulation, is disposed. The rod components are of themselves conventional and readily available on the market, being readily shaped for the purpose of the invention.

Options are available in regard to the specific configuration of the several rod components, as non-uniformly or non-symmetrically related to one another in regard to their front-to-rear spacing, as will later be described. This, FIG. 1 shows, for each sheet 20, a total of 12 such individual rods, although the number may be less or more, which are each 120 volt-rated straight elements. They are electrically coupled as pairs at the left-hand end thereof by conventional jumpers 21, thus rating each coupled pair for a 240 volt alternating current supply, and the right-hand ends thereof (FIG. 2) are connected in parallel in a conventional way to such voltage source. At their left and right hand ends the rods 22 are terminated in relatively cool zones, at which they extend through openings 24 (FIG. 3) of the plates or sheets 20, and beneath the insulation-enclosing panels 16. These terminal rod portions are appropriately configured as required by space limitations within the outer broiler casing walls 14 and the inner walls 18.

As an alternative contouring of the pairs of rod lengths or passes 22, and as indicated in dotted line in FIG. 2, they may be of a loop-like or U-shaped configuration, joined at an end thereof by an arcuate connecting bight or loop formation 25, integral component pairs as thus joined being specially designated 22' in FIG. 2. As a still further available alternative, more than two heating rod lengths or passes may be arranged in a serpentine or zig-zag configuration, with successive lengths integrally joined as opposite sides or ends, as by bights or loops similar to the loops 25. In such case, the un-looped ends of the individual serpentine configuration will be appropriately connected electrically to a 240 volt source, just as the U-shaped pairs 22' will be connected to a similar source at the un-looped right-hand ends thereof (FIG. 2).

Pursuant to the invention, and for obtaining a maximum usable cooking area (as arbitrarily defined above) which contributes along with the combined heating rod and sheet construction feature to a faster cooking time and generally improved thermal efficiency, the spacing of the parallel rod components 22 or 22' from one another in the front-to-rear direction will vary at several zones transverse of that direction, thus normalizing or rendering uniform the radiant heating effect upon the rack or grid area throughout the entire dimension of the rod-sheet construction, i.e., offsetting or compensating for the radiative loss normally characteristic of heating components at the extreme front, rear and side margins of the broiler space.

Thus, reference being had to FIG. 2, and always bearing in mind that dimensional variations are contemplated, the front and rear-most component lengths

or passes of the combined panels 10, 11 may be positioned $\frac{1}{4}$ inch from the front and rear margins of the combination, hence correspondingly related dimensionwise to the food-supporting rack (not shown) in the broiler chamber 19. Succeeding pairs of similar components may then be spaced successively from one another distances increasing progressively, as shown in FIG. 2, from $\frac{1}{2}$ inch to 1 inch, with a spacing of the front-most pass of, say, $\frac{1}{2}$ inch in a zone in which adjacent edges of the units 10 and 11 adjoin one another. It will be understood that the progression of variable spacings of the front unit 11 will be the reverse of that of rear unit 10, so that the spacings diminish outwardly from the mid-point of the two.

The plate or sheet units 10, 11 are fixedly mounted atop the inner broiling chamber walls 18 at angled side flange extensions 20' of the respective sheets or plates 20, which downwardly straddle those walls.

The domed space 27 directly beneath the units 10, 11 serves as an accumulator pocket and continuous reservoir extending from the front zone of the broiler and trapping hot air surrounding the rods 22 and beneath the sheet 20. This materially reduces convection losses.

It is seen that the invention affords an electrical broiler heating unit of great simplicity and low production cost in which there are combined in fixed relation to one another, a sheet-like thermally conductive and electrically non-conducting means, and a relatively localized, but non-uniformly distributed, electrically and thermally energized means disposed in direct and thermally conductive relation to said sheet-like means, this combination affording the various advantages in point of thermal and electrical efficiency discussed above at some length.

What is claimed is:

1. An electrical heating unit comprising the combination, in relatively fixed relation to one another, of a thermally conductive sheet which is electrically non-conducting in the operation of the unit, and sets of elongated, relatively localized, but non-uniformly distributed, electrically and thermally energized heating elements arranged in a generally parallel relation to one another and disposed in direct and thermally conductive contact with said sheet, said sheet having angularly offset and downwardly angled side margins, said heating elements being conformed to and fixedly secured in nesting contact with said offset sheet side margins, the transverse spacing of certain of the respective heating elements differing in a generally progressive way from an element of one set to an element of another in a direction transverse of the length of said elements, elements of the respective sets being electrically connected in series with one another and the sets being electrically connected in parallel.

2. The unit of claim 1, in which said sheet and heating elements are contoured in the direction of the length of the latter to provide a hot air trapping dome space directly beneath the unit which extends in a front-rear direction transversely of the element length.

* * * * *