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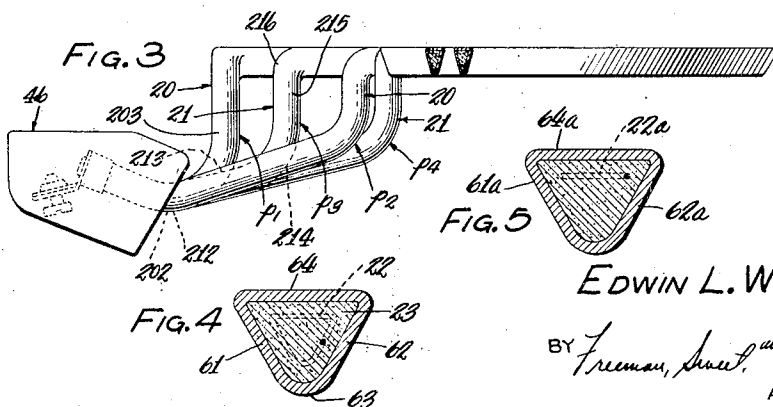
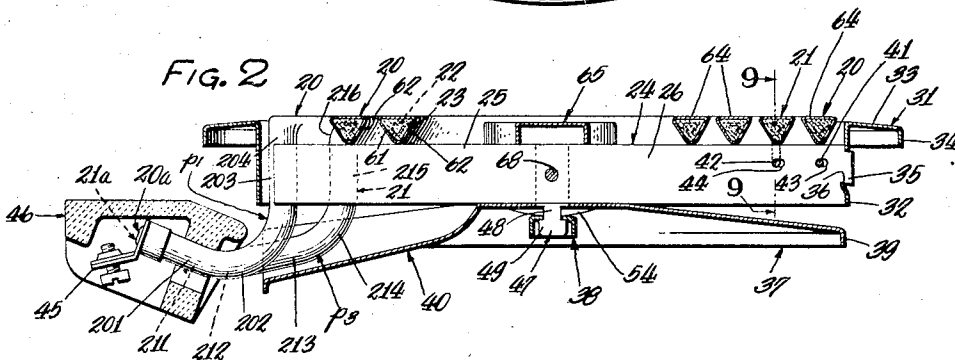
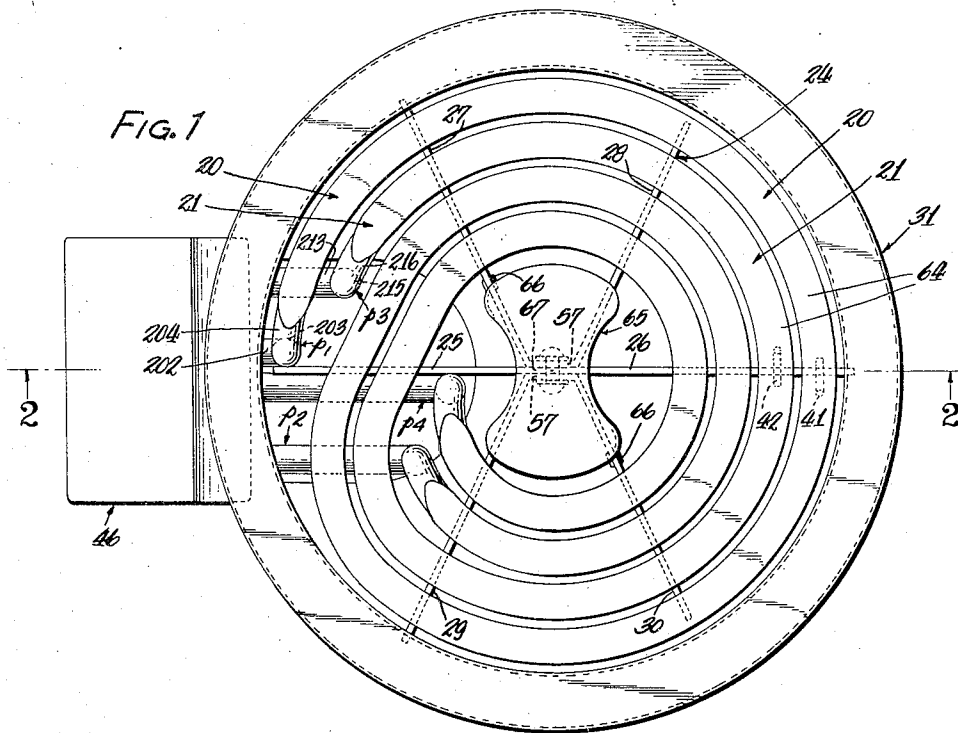
E. L. WIEGAND

2,413,477

ELECTRIC HOT PLATE UNIT

Filed Dec. 5, 1940

2 Sheets-Sheet 1



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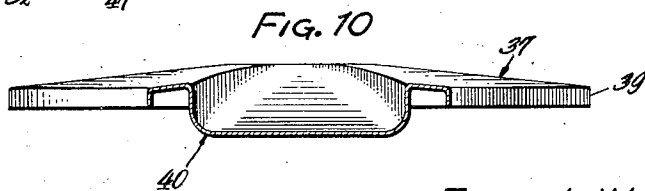
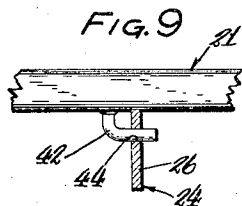
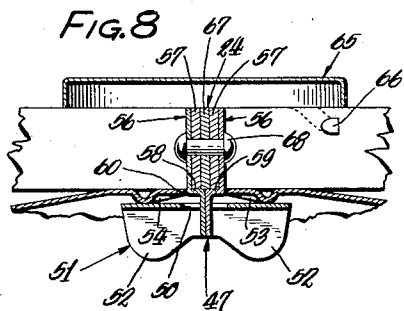
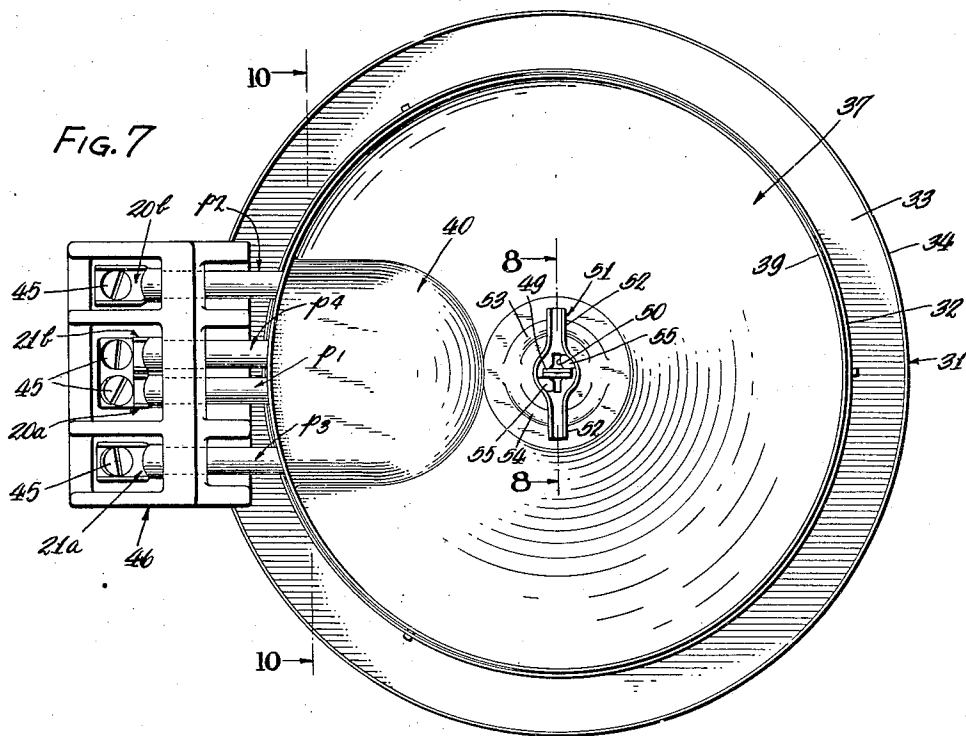
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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ELECTRIC HOT-PLATE UNIT

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Application December 5, 1940, Serial No. 368,633

13 Claims. (Cl. 219—37)

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My invention relates to electric heaters, and more particularly to electric range units embodying one or more electrical resistance heating elements of desired types comprising a resistor disposed within and insulated from a metal sheath. The principal object of my invention is to provide new and improved electric heaters or range units of these types.

In the drawings accompanying this specification, and forming a part of this application, I have shown, for purposes of illustration, several forms which my invention may assume, and in these drawings:

Figure 1 is a plan view of an electric range unit illustrating an embodiment of the invention,

Figure 2 is a vertical sectional view corresponding generally to the line 2—2 of Figure 1,

Figure 3 is a side elevational view, partly fragmentary, of the electrical heating means embodied in the range unit shown in Figures 1 and 2, along with an associated connection housing,

Figure 4 is an enlarged sectional view of an active portion of the heating means,

Figure 5 is a cross-sectional view similar to Figure 4 but of another embodiment,

Figure 6 is a fragmentary plan view of a resistor which may be utilized in the embodiment of Figure 5,

Figure 7 is a bottom view of the range unit shown in Figure 1,

Figure 8 is a fragmentary section taken along the line 8—8 of Figure 7,

Figure 9 is a fragmentary section taken along the line 9—9 of Figure 2, and

Figure 10 is a section of a reflector embodied in the range unit shown in Figure 7, taken along the line 10—10 of Figure 7.

The heating means of a range unit embodying my invention may comprise one or more heating elements, in this instance two elements 20, 21. Each element comprises a tubular metal sheath within which is disposed electrical resistance heating means 22 embedded in refractory electrical-insulating heat-conducting material 23. The insulating material 23 may be in the form of suitable granular, comminuted, or powdered refractory material, preferably compacted to a dense hard condition. The active portions of the elements define a general plane and as here shown the active portion of each element is of generally spiral form. The active portions of the elements are of generally triangular cross-sectional outline, as will more fully appear, and the construction and arrangement is such that sides of these outlines define the upper side of the heating means,

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which upper side is engageable by an object, such as a cooking vessel, to be heated. The apexes of these outlines define the under side of the active portion of the heating means, and this under side is mounted upon a supporting means 24 which may be a grating or grid comprising a plurality of radially disposed arms 25 to 30 inclusive.

In this instance the supporting means 24 comprises a straight sheet-metal member, providing the arms 25, 26, to the approximate central portion 67 of which are suitably fastened on opposite sides thereof bights 57 of two generally V-shaped sheet-metal members, one of these members providing the arms 27, 28, and the other the arms 29, 30.

Circumscribing the outer ends of the arms of the supporting means 24 is a ring 31 having a cylindrical portion 32 merging with an annular portion 33 in turn merging with a downwardly extending cylindrical flange 34 adapted to engage a range top (not shown).

The arms 26, 27, and 29 are longer than the other arms and the longer arms are provided with projections or shoulders 35 adapted to engage respectively in apertures 36, one of which may be seen in Figure 2, so that the ring 31 is adapted to support the supporting means 24.

Disposed beneath the supporting means 24 is a reflector 37 of generally conical form, the reflector being held in engagement with the lower side of the supporting means 24 by holding means 38. The flanged outer periphery 39 of the reflector is spaced from the cylindrical portion 32 of the ring 31 so that air may enter this space radially inwardly and proceed upwardly through the grating and heating element assembly. The reflector 37 has a pocket 40 of generally U-shaped cross-section, as may be seen in Figure 10, the bottom of the pocket slanting upwardly radially inwardly so that the depth of the pocket decreases radially inwardly as may be seen in Figure 2.

The pocket 40 in the reflector accommodates end portions p_1 , p_2 of the heating element 20, and end portions p_3 , p_4 of the heating element 21, these end portions being bent out of the plane of the active portions of the heating elements. The extremities of the end portions of the element 20 are provided with insulated terminals 20a, 20b, and the extremities of the end portions of the element 21 are provided with insulated terminals 21a, 21b (see Figures 2 and 7), the terminals 20a, 20b being electrically suitably connected, within the sheath of the element 20, to the ends of the resistance means 22 of that element, and the terminals 21a, 21b being similarly connected to the

resistance means 22 of the element 21. The terminals 20a, 20b, 21a, 21b may be connected to suitable connectors 45 in a desired well understood way. The connectors 45 may be housed in a suitable insulating block or housing 46 and are connectable to a source of electricity (not shown).

Starting with the terminal 20a and tracing the end portion p_1 of the element 20, the portion p_1 , in the embodiment shown, comprises a portion 201 slanting downwardly slightly and merging with an arcuate portion 202 in turn merging with a vertical portion 203 in turn merging with an arcuate portion 204, the latter turning into the plane of and merging with one end of the spiral active portion of the element 20. In like manner, starting with the terminal 21a of the element 21, the portion p_3 of this element comprises a portion 211 slanting downwardly slightly and merging with an arcuate portion 212 in turn merging with a slightly upwardly slanting portion 213 in turn merging with an arcuate portion 214 in turn merging with a vertical portion 215 in turn merging with an arcuate portion 216, the latter turning into the plane of and merging with one end of the spiral active portion of the element 21. The other end of the spiral portion of the element 20 merges with the portion p_2 , and the other end of the spiral portion of the element 21 merges with the portion p_4 , the portions p_2 and p_4 being analogous to the portion p_3 . An advantage of the described construction and arrangement is that the terminal end portions of the heating elements may be brought together at one place so that external electrical connection thereto is facilitated. Another advantage is that terminals 20a, 20b, and 21a, 21b are not disposed where cooking material may be spilled upon them through the aperture defined by the ring 31. Also, any cooking material that may be spilled upon the portions 203, 215 of the end portions p_1 , p_3 may flow down along these end portions until it reaches the downwardly directed arcuate bends 202, 212 where it will drip off and hence will not reach the terminals 20a, 21a. The terminals 20b, 21b of course are protected in like manner by the downwardly directed arcuate bends of the end portions p_2 and p_4 , corresponding to the bends 202, 212. A further advantage is that the reflector 37 need not be perforated to pass end portions of the heating elements, and assembly and removal of the reflector are made easier.

The end portions p_1 , p_2 , p_3 , p_4 are all of substantially circular or rounded section, to facilitate bending, only the spiral portions being of triangular section.

Means may be provided to hold the heating means comprising the elements 20, 21 in desired assembly with the supporting means 24. In the embodiment shown this means comprises L-shaped rods 41, 42 welded or otherwise suitably fastened to the elements 20, 21 respectively, the free ends of the rods 41, 42 extending freely through apertures 43, 44 in the arm 26. Desirably the apertures 43, 44 are elongated in the radial direction of the arm 26, to allow for relative movement of the rods when the respective elements 20, 21 expand and contract. It will be noted that the portion of the element 21 shown in Figure 9 is free to move cross-wise of the arm 26, and this portion is also free to move radially with respect to the arm 26 as will be apparent from Figure 2. The element 20 has similar freedom of movement. Thus the elements 20, 21 are held in desired assembly with the supporting means 24 without interfering with free expansion

and contraction of the spiral portions of the elements.

The means for holding the reflector 37 assembled with the supporting means 24 comprises a key-like member 47 depending from the supporting means 24, the key-like member 47 having a reduced portion 48 and a pair of wings 49. The key-like member 47 is adapted to cooperate with a key slot 50 in a central portion of a sheet-metal lock member 51 formed with wings 52 to facilitate rotation thereof. The key slot 50 has an enlarged central part to accommodate the portion 48 when the lock member 51 is turned. The reflector 37 is formed, as by embossing, with a pair of arcuate cam tracks 53, 54 spaced from each other at diametrically opposite points in alignment with the plane of key-like member 47, so that when the slot 50 of the lock member 51 is passed over the key-like member and then rotated the surface of the lock member engages and rides up on the cam tracks and the reflector 37 and supporting means 24 are drawn into engagement with each other. Parts 55 of the central portion of the lock member 51 margining the enlarged part of the slot 50 may be embossed to form stops so that when the lock member is rotated clockwise to the position shown in Figure 7 these stops engage the wings 49 respectively and stop further rotation.

The key-like member 47 may be provided by a pair of sheet-metal members 56 the upper portions of which are oppositely offset so that they engage the surfaces of the bights 57 of the V-shaped members forming the arms 27, 28, and 29, 30 respectively. Shoulder portions 58, 59 are thus also provided which together serve as a projection extending below the under side of the parts 57, 67 into a complementary aperture 60 in the reflector 37 thereby preventing rotation of the reflector. If desired the parts 56, 57, 67 may be fastened together by a single rivet 68.

If desired a central medallion 65 or the like, to cover a desired amount of the space at the center of the heating means, may be provided, and fastened as by clinched parts 66 to arms 27, 30, or in any other desired suitable way to the supporting means 24.

Referring now more particularly to the cross-sectional form of an active portion of a heating element, one-desirable form of triangular section is shown in Figure 4. In this instance the tubular sheath has two walls 61, 62, the major portions of which are flat and make between them an angle of 60°, these walls merging in a rounded apex 63. The upper wall 64 is substantially entirely flat and makes with the walls 61, 62 angles of 60° respectively, the defined triangle then being of course equi-angular, but the flat surfaces are not equi-lateral. Thus in this embodiment the flat portions of the walls 61, 62 are respectively of less cross-sectional extent than the substantially entirely flat upper wall 64. This construction provides for a greater area of heating surface of the wall 64 and is the reason the section is formed with a rounded apex 63. The radius of the rounded apex 63 may however be greater thereby to increase the area of the upper wall 64, or if desired, the walls 61, 62, 64 may have equi-lateral flat portions, or the generally triangular cross-sectional outline may be of any other suitable form consistent with the desired results. The resistance means 22 is in this instance in the form of a resistor of generally helically wound wire, the cross-section outline of the resistor being triangular and substantially similar

to and uniformly spaced from the outline of the inner wall of the sheath.

If an object, such as a cooking vessel, is placed upon the heating means comprising the heating elements 20, 21, the vessel will be in contact with the flat upper walls 64 of the heating elements these walls being in a plane defining the upper side of the heating means. The vessel, accordingly, is in excellent heat-conducting relation with respect to a relatively large area of the heating means and is heated mainly by conduction from the wall 64 of the element 20 or of the element 21, or of both elements. The generally downwardly facing lower walls 61, 62 of each heating element radiate some heat diagonally downwardly in respectively opposite directions, considering any given portion of an element, and this heat is reflected upwardly by the reflector 37. By reason of the diagonally downward direction of the heat radiated from walls 61, 62, the surfaces of opposed lower walls of adjacent portions of the intercalated heating elements 20, 21 do not directly inter-radiate to any great extent and inter-radiate much less than if these walls were not inclined downwardly and away from each other. This reduction of inter-radiation reduces the possibility of overheating of adjacent elements, under all circumstances of operation, and accordingly the life of an element is greatly prolonged. It will of course be apparent that what has been hereinbefore stated with respect to reduced inter-radiation between adjacent portions of two intercalated spirally formed elements such as the elements 20, 21, applies also with respect to adjacent portions of separate elements whether the longitudinal axes of the elements are spiral, rectilinear, or any other form, and applies also with respect to adjacent portions of a single element of spiral form, or any other form having adjacent portions between which there might otherwise be substantial undesired inter-radiation.

An electric heating element such as may be embodied in a range unit in accordance with my invention may initially comprise a tubular sheath of substantially circular cross-section into which the resistor and insulating material have been introduced endwise, and may be side-pressed in suitable dies to a desired triangular cross-sectional outline, and the element may be pressed as set forth in my co-pending application Serial Number 361 997, filed October 21, 1940.

The insulating material in an electrical heating element side-pressed to triangular cross-sectional outline is of great density, thereby improving its heat-conducting properties. In general, a triangular section element provides the optimum combination of rigidity and strength with a greater ratio of sheath area to element volume and weight. Or stated in another way, it provides a greater ratio of perimeter to sectional area and what is more important, when embodied in an electric range unit as herein disclosed, it provides a much larger percentage of perimeter and sheath area which may be brought into efficient heat-conducting contact with a cooking vessel seated on the element, the general efficiency being further increased by the reduction in inter-radiation hereinbefore described. Furthermore the path of conduction to the upper wall 64 from the opposite extreme point on the sheath is considerably reduced from what it is in, for example, a round section merely pressed somewhat flat on one or both sides. For any one or more of these reasons, heat is more quickly conducted from the

resistor to the sheath, and efficiently transmitted from the sheath to the cooking vessel. I have found that in a heating means embodying my invention, starting with the heating means cold, the speed and efficiency of heat transfer from the heating means to the object to be heated is much improved.

An element of triangular cross-section is not only of great rigidity and strength but is particularly advantageously embodied in an electric range unit, as a spiral for example, because the plane form of the spiral is maintained, the element freely expanding and contracting on its support without warping.

The resistor of a heating element may be constructed and arranged so that it is non-symmetrical with respect to the cross-section of the heating element. By way of example, and referring to Figure 5, a heating element is here shown in cross-section, this element being similar to an element such as shown in Figure 4, but the resistor 22 is non-symmetrical. In this instance the resistor 22a is of sinuously formed wire, as shown in plan in Figure 6, and defines a surface collateral with the inside surface of the wall 64a. This construction may be utilized if it is desired that the wall 64a be directly heated more than the walls 61a, 62a.

A heating element embodied in my invention is preferably side-pressed to its final triangular cross-sectional outline because thereby the insulating material is re-distributed, re-compacted and highly densified so as to close up any discontinuities or voids which may have been present therein by reason of the bending of the element to spiral or other non-rectilinear form, or due to any other cause. This is particularly desirable where the heating element is designed so that the energy input is such that the element operates at a desired external temperature of from 1200° or 1400° F. to 1600° F. or higher, temperatures at which such elements are capable of operation. It is of course understood that the sheath of the element may be made of nickel, or a metal alloy, for example, nickel chrome, or "inconel" or of any material capable of withstanding such temperatures or whatever temperature of operation may be selected.

It will be understood that the resistor may be made of any desired suitable material, and of any desired suitable form; that the refractory insulating material may be, or may include, for example, silica, or silicates, or magnesium oxide, or aluminum oxide, or any refractory oxide or combination of refractory oxides, or any other suitable refractory material, desirably of a mineral character; that such refractory material may be mixed, if desired, with a bonding or cementing material, or mixed with a clay, or with any other suitable binder; that a sheath of desired suitable initial form, a resistor and insulating material may be assembled in any desired suitable way and in any desired suitable sequence; and that such assembly may be brought to final form in any desired suitable way.

From the foregoing it will be apparent to those skilled in the art that the illustrated embodiments of my invention provide new and improved electric heaters and new and improved electric range units, and accordingly, accomplish the principal object of my invention. On the other hand, it also will be obvious to those skilled in the art that electric heaters and electric range units embodying my invention may be variously changed and modified, or features thereof, singly

or collectively, embodied in electric heaters or electric range units or combinations other than those illustrated, without departing from the spirit of my invention, or sacrificing all of the advantages thereof, and that accordingly, the disclosure herein is illustrative only, and my invention is not limited thereto.

I claim:

1. An electric heater, comprising: supporting means; electrical heating means mounted upon said supporting means; a reflector having an aperture, disposed below said supporting means; and means for holding said reflector in position comprising a key-like flat member depending from said supporting means and extending through said reflector aperture, a rotatable lock member having a slot cooperable with said key-like member, and means, including cooperating parts of said reflector and said lock member, so constructed and arranged that rotation of said lock member causes said reflector and supporting means to be drawn together.

2. An electric heater, comprising: supporting means; electrical heating means mounted upon said supporting means; a reflector having an aperture, disposed below said supporting means; and means for holding said reflector in position comprising a key-like flat member depending from said supporting means and extending through said reflector aperture, a rotatable lock member having a slot cooperable with said key-like member, and means, including cam track means on said reflector engageable by said lock member, so constructed and arranged that rotation of said lock member causes said reflector and supporting means to be drawn together.

3. An electric heater, comprising: supporting means; electrical heating means mounted on said supporting means; said supporting means including an arm having an upwardly facing flat supporting surface portion slidably engaged by a portion of said heating means; said arm having a transverse aperture providing a downwardly facing surface portion spaced below said upwardly facing surface portion; a member carried by and extending downwardly from said heating means adjacent said arm; and said member having lateral extension means extending freely through said aperture and adapted slidably to engage said downwardly facing surface portion.

4. An electric heater, comprising: supporting means; electrical heating means mounted on said supporting means; said supporting means including an arm having an upwardly facing flat supporting surface portion slidably engaged by a portion of said heating means; said arm having a slot therethrough the upper margin of which provides a downwardly facing surface portion spaced below and extending approximately parallel to said upwardly facing surface portion; a member carried by and extending downwardly from said heating means adjacent said arm; and said member having lateral extension means extending freely through said slot and adapted slidably to engage said downwardly facing surface portion.

5. An electric heater, comprising: supporting means; electrical heating means mounted upon said supporting means; a reflector disposed below said supporting means, said reflector having a slot; means for holding said reflector in position comprising a member having a key-like flat part depending from said supporting means and extending through said reflector slot, said member having a flat portion cooperating with

said reflector slot to prevent relative rotation of said reflector and said supporting means, and a lock member having a slot cooperable with said key-like part.

6. An electric heater, comprising: supporting means comprising a plurality of sheet-metal parts forming radiating arms; electrical heating means mounted upon said supporting means; a reflector disposed below said supporting means, said reflector having a slot; means for holding said reflector in position comprising a member having a key-like flat part depending from said supporting means and extending through said reflector slot, said member having a flat portion cooperating with said reflector slot to prevent relative rotation of said reflector and said supporting means, and a lock member having a slot cooperable with said key-like flat part; said sheet-metal arms and said member having portions in mutually overlapping relation; and means fastening together said mutually overlapping portions.

7. An electric heater, comprising: supporting means having upper supporting surfaces defining a general plane; electric heating means resting freely on said supporting means and having surfaces engaging said supporting surfaces and slidable thereon; and holding means holding said heating means assembled with said supporting means, said holding means including generally vertically abutting interlocking lost motion connection means, between said heating means and said supporting means, so constructed and arranged that substantial movement of said heating means away from said supporting means at said lost motion connection means is prevented while sliding of said engaging surfaces on said supporting surfaces is permitted for expansion and contraction of said heating means.

8. An electric heater, comprising: supporting means having upper supporting surfaces defining a general plane; electric heating means having a sheathed active portion defining a general plane and having sheathed terminal portions extending downwardly out of said plane and then laterally outwardly, the active portion of said heating means resting freely on said supporting means, and said heating means along with said terminal portions being shiftable with respect to said supporting means in a general plane parallel to the general plane of said supporting means, the active portion of said heating means having surfaces engaging said supporting surfaces and slidable thereon; and holding means holding said heating means assembled with said supporting means, said holding means including generally vertically abutting interlocking lost motion connection means, between said active portion and said supporting means, so constructed and arranged that substantial movement of said active portion away from said supporting means at said lost motion connection means is prevented while sliding of said engaging surfaces on said supporting surfaces is permitted to accommodate for expansion and contraction of said heating means.

9. An electric heater, comprising: supporting means comprising a grid having radial arms and having upper supporting surfaces defining a general plane; ring means connected to and circumscribing said grid; electric heating means having an active portion defining a general plane and having terminal portions extending downwardly out of said plane and then laterally outwardly

under the lower margin of said ring means and approximately diametrically opposite one of said arms, the active portion of said heating means resting freely on said supporting means, and said heating means along with said terminal portions being shiftable with respect to said supporting means in a general plane parallel to the general plane of said supporting means, the active portion of said heating means having surfaces engaging said supporting surfaces and slidable thereon; and holding means holding said heating means assembled with said one of said arms, said holding means including generally vertically abutting interlocking lost motion connection means, between said active portion and at least said one of said arms, so constructed and arranged that substantial movement of said active portion away from said grid at said lost motion connection means is prevented while sliding of said engaging surfaces on said supporting surfaces is permitted to accommodate for expansion and contraction of said heating means.

10. An electric range or hot-plate surface unit comprising an embedded-resistor electric heating element having substantially its active portion arranged in a pattern indicating an approximately flat plate having approximately parallel inner and outer faces, supporting means supporting said element, and holding means holding said element assembled with said supporting means, said active portion having its external surface constituted by sheathing closely embracing said embedding material and substantially throughout its length approximately triangular in cross-section with an apex disposed at least approximately in one of said faces and the opposite side disposed at least approximately in the other of said faces, said portion thereby being highly resistant to deformation out of the contour of said plate, and said supporting means supporting said element freely movable relative to said supporting means both laterally and perpendicularly, and said holding means comprising relatively movable interlocking parts holding said element assembled with said supporting means with said active portion movable laterally of said supporting means freely expansible and contractible under change in temperature.

11. An electric range or hot-plate surface unit comprising an embedded-resistor electric heating element having substantially its active portion arranged in a pattern indicating an approximately flat plate having approximately parallel inner and outer faces, supporting means supporting said element, and holding means holding said element assembled with said supporting means, said active portion having its external surface constituted by sheathing closely embracing said embedding material and substantially throughout its length approximately triangular in cross-section with an apex disposed at least approximately in one of said faces and the opposite side disposed at least approximately in the other of said faces, said portion thereby being highly resistant to deformation out of the contour of said plate,

and said supporting means supporting said element freely movable relative to said supporting means both laterally and perpendicularly, and said holding means comprising relatively movable interlocking parts holding said element to said supporting means at one or more places so positioned and arranged that said active portion is movable laterally of said supporting means freely expansible and contractible under change in temperature.

12. An electric range or hot-plate surface unit comprising a plurality of embedded-resistor electric heating elements having substantially their active portions arranged in a pattern indicating an approximately flat plate having approximately parallel inner and outer faces, supporting means supporting said elements, and holding means holding said elements assembled with said supporting means, said active portions having their external surfaces constituted by sheathing closely embracing said embedding material and substantially throughout their lengths approximately triangular in cross-section with an apex disposed at least approximately in one of said faces and the opposite side disposed at least approximately in the other of said faces, each of said portions thereby being highly resistant to deformation out of the contour of said plate, and said supporting means supporting said elements freely movable relative to said supporting means both laterally and perpendicularly, and said holding means comprising relatively movable interlocking parts holding said elements assembled with said supporting means with said active portions movable laterally of said supporting means freely expansible and contractible under change in temperature.

13. An electric range or hot-plate surface unit comprising a plurality of embedded-resistor electric heating elements having substantially their active portions arranged in a pattern indicating an approximately flat plate having approximately parallel inner and outer faces, supporting means supporting said elements, and holding means holding said elements assembled with said supporting means, said active portions having their external surfaces constituted by sheathing closely embracing said embedding material and substantially throughout their lengths approximately triangular in cross-section with an apex disposed at least approximately in one of said faces and the opposite side disposed at least approximately in the other of said faces, each of said portions thereby being highly resistant to deformation out of the contour of said plate, and said supporting means supporting said elements freely movable relative to said supporting means both laterally and perpendicularly, and said holding means comprising relatively movable interlocking parts holding said elements to said supporting means each at one or more places so positioned and arranged that said active portions are movable laterally of said supporting means freely expansible and contractible under change in temperature.

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