Nov. 4, 1941. S. S. VINEBERG 2,261,533

ELECTRIC HEATING DEVICE

Filed Feb. 4, 1939 2 Sheets-Sheet 1

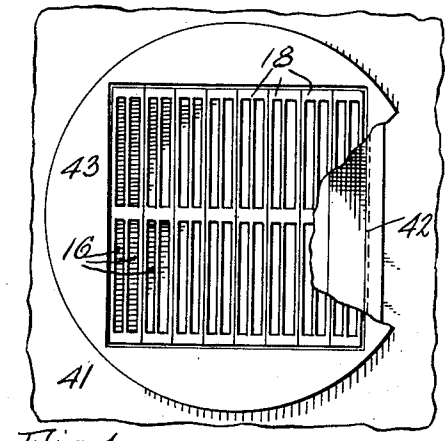



Fig. 1.

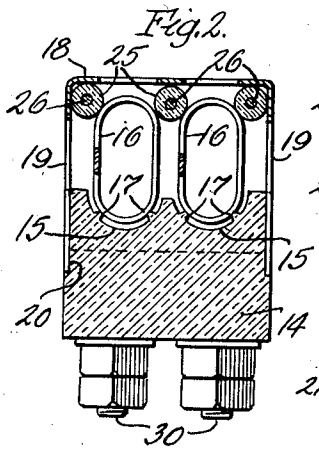



Fig. 2.

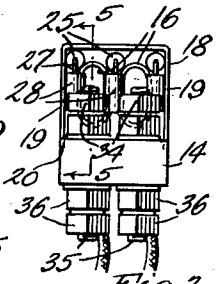



Fig. 3.

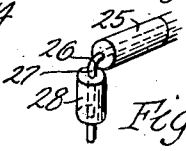



Fig. 7.

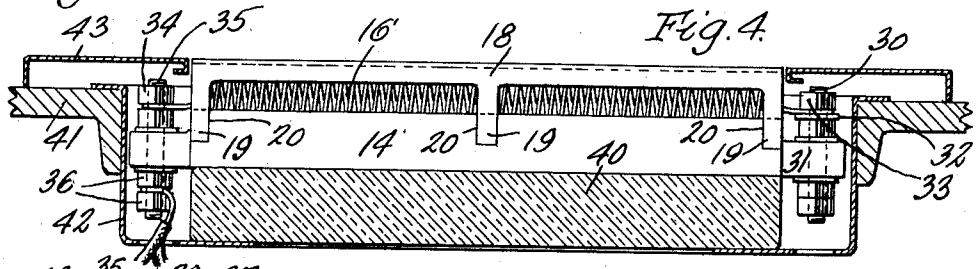



Fig. 4.

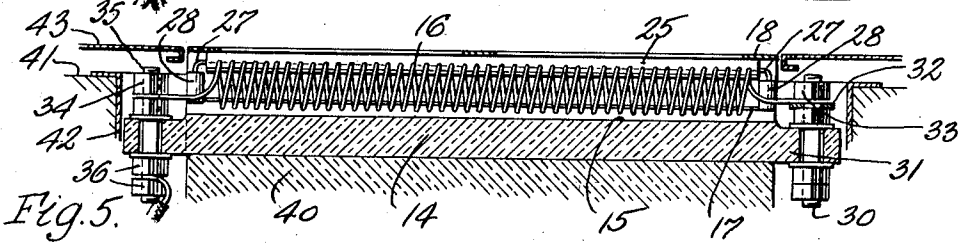



Fig. 5.

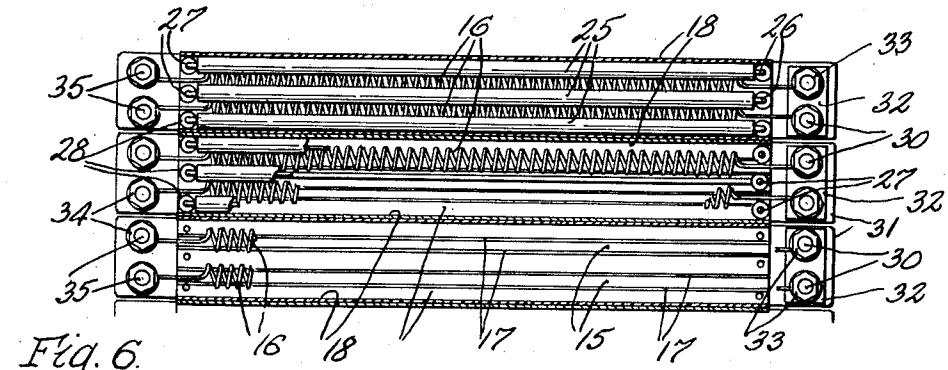



Fig. 6.

INVENTOR.
Samuel S. Vineberg
By Parker, Prichard & Farmer.
ATTORNEYS.

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ELECTRIC HEATING DEVICE

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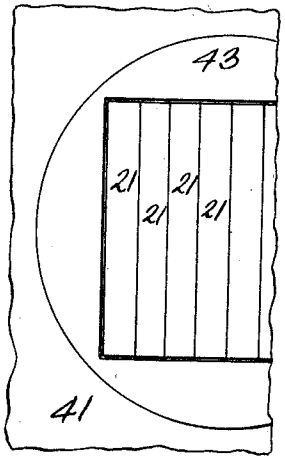
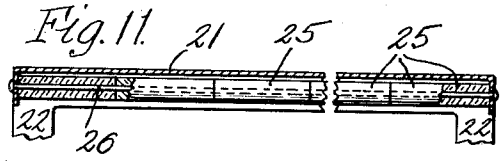



Fig. 8.

Fig. 11.



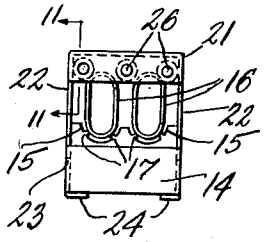




Fig. 9.

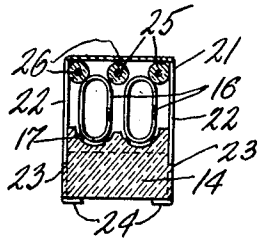



Fig. 10.

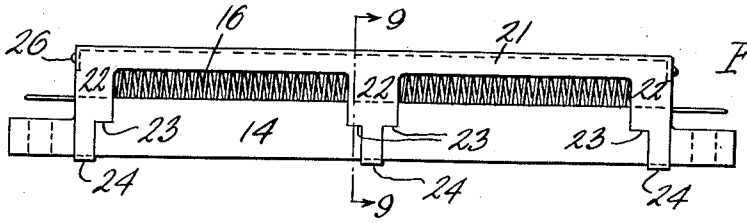



Fig. 12.

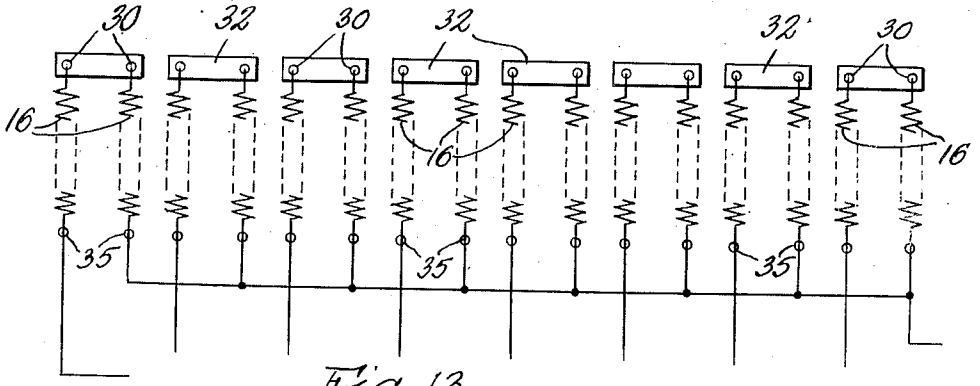



Fig. 13.

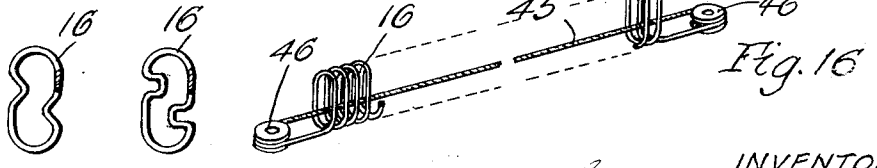



Fig. 16.

Fig. 14. Fig. 15.

INVENTOR.
Samuel S. Vineberg
By Parker, Prochnow & Farmer.
ATTORNEYS.

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2,261,533

# UNITED STATES PATENT OFFICE

2,261,533

## ELECTRIC HEATING DEVICE

Samuel S. Vineberg, Buffalo, N. Y.

Application February 4, 1939, Serial No. 254,678

11 Claims. (Cl. 219—37)

This invention relates to electric heating devices and more particularly to improvements in electric heating units or burners of the open or surface type used in electric ranges and hot plates.

In the early days of the electric range, there were several obstacles to its sale in competition with other fuel type ranges that made merchandising progress slow. However, sales were made because the public wanted a type of cooking equipment that was clean, healthful, safe and practically automatic. But objections to the electric range appeared as it came into more general use and became obstacles to future mass sales. The principal objections were that electric surface burners were slow as compared with other fuel burners; and the element wire did not last long; and cost of maintenance of early ranges was high. These early ranges used spirally wound, open wire coils made of nickel-chromium alloy which to this day is standard in the electrical heating appliance industry, although today's alloy is superior in quality.

During these early days of the electric range, many engineering minds turned to the problem of making the electric range trouble-free, and burners were developed in which the wire heating elements were enclosed in a metallic sheath from which it was insulated by magnesium oxide powder or other material of suitable character.

Ranges equipped with these enclosed element burners had some desirable characteristics, and their sales increased. Although there was the demand, especially by designers and manufacturers, for the open coil-equipped ranges, because they are faster, cheaper and less expensive to repair than the enclosed type, nevertheless the problem of overcoming their recognized objections remained unsolved.

Among the objections to range and hot plate burners as constructed up to the present time, may be mentioned the following:

First referring to open type burners: wattages are low because there isn't sufficient surface on a standard 8½ inch burner to put enough heating element wire of the types now available to build up the desired wattage and at the same time keep the element temperature low enough to guarantee sufficiently long life of element and leave sufficient room for thick and strong separating or supporting ribs on the porcelain element base block between the coil grooves; burnouts are frequent, and when this happens, one-half of the whole burner is rendered inoperative; replacements are expensive and must be made by a qualified service man; open elements are hazardous. Second, referring to enclosed type burners: they are slow to heat up because heat passes from the heating wire through insulating material and the metal enclosure, as distinguished from the open burner in which the wire is not enclosed in solid material and all heat is above the porcelain base block; they are expensive to build; are expensive to replace, and expert service is required; wattages are limited; and due to the blind method of assembly, waste at the test table is high, due to a considerable percentage of completed units not being satisfactory.

Reference to accepted tables of heating element alloys shows that with the conventional circular form of spiral coil element, there is a safe maximum wattage which can be placed in a surface burner of a given size.

For practical purposes, consider a standard range burner which is 8½ inches in diameter, or has a total area of 56.8 square inches. Part of the surface is grooved to receive spiral coils of heating element wire and part is used as separators between adjacent coils for insulation purposes, and to keep the cooking utensils from falling down and touching the elements. In use, these separators must have sufficient strength and that necessitates thickness to withstand the knocking which a range element gets from cooking utensils being put on and taken off the burner. Thus, in practice, the area of a burner taken up by grooves, which is the area available for the element coils, is less than half the total area, and for practical reasons, cannot be increased without making the burner structurally weak. If it could be increased, still the limit would be considerably short of the full area of the burner.

Since the length of wire in a circular spiral coil is equal to 3.1416×mean diameter of the coil×the turns per linear inch×the length of the spiral coil in inches, then the possible length of wire in a surface burner using the circular coil is fixed by the groove area available and the closeness with which the wire can be wound, or the number of turns per inch, which latter factor, according to best practice, is dependent upon the gage of the wire.

One object of my invention is to overcome these deficiencies and provide an electric heating device of the open or surface range burner type but of a novel and improved construction, which will ensure an efficient and fast heating but economical heater. Other objects are to provide a heating device in which a sufficient amount of heating element wire of proper size

can be used to obtain increased wattages or capacity in a burner of given size with a low wattage dissipation per unit of wire surface, while nevertheless the burner is of strong, desirable and practical construction; which is of cheaper and simpler construction enabling safe repairs by the housewife or unskilled persons, and with cheap repair parts; in which the electric heating elements are longer-lived, insuring fewer burnouts; which can be visibly assembled in the factory by unskilled hands and will result in less waste of completed product when finally put on the test table; which can be more efficiently used with less waste of heat when heating utensils of smaller diameter than the burner; which comprises a plurality of full voltage units which can be operated separately or in different multiples, so as to regulate the heat and enable ready replacement of burnt-out units, or the use of the device even with one or more units burned out; in which the heating element coils are protected by guards or covers which also serve to support the cooking utensils; which, like a gas burner, will give heat immediately after it is turned on, and will stop heating promptly after it is turned off; in which increased capacity and efficiency is obtained by a novel form and arrangement of heating coil; in which the heating coil is wound and disposed so as to increase the length of heating wire in a burner of given area, whereby greater surface area of the heating element is obtained, the radiation temperature of the heating wire is reduced, and its life before burnouts occur is increased.

Further objects and advantages of my invention will appear from the following description thereof and the novel features of the invention will be set forth in the appended claims.

The heating device or burner hereinafter described as an embodiment of my invention is preferably made up of a plurality of units, each of which can burn out without affecting the operation of the remainder, and which units are individually complete, compact, and when placed side by side, form a burner of approximately square shape in plan. Because the heating element coils are of elliptical or substantially elliptical form, being of greater diameter vertically than horizontally, and preferably arranged parallel in straight lines, a sufficient amount of proper sized wire can be used to obtain adequate wattages or capacity for heat generation with low wattage dissipation per square inch of wire surface.

The accompanying drawings illustrate somewhat differing constructions embodying the invention. In said drawings:

Fig. 1 is a plan view on a reduced scale, with parts broken away, showing an electric heating device or burner of one form embodying my invention.

Fig. 2 is a transverse sectional elevation, on an enlarged scale, of one of the burner units.

Fig. 3 is an end view thereof, approximately actual size.

Fig. 4 is a longitudinal, sectional view showing one of the units in side elevation.

Fig. 5 is a longitudinal, sectional elevation on line 5—5, Fig. 3.

Fig. 6 is a plan view of three burner units with the guards shown in section and showing parts of two of the units broken away.

Fig. 7 is a fragmentary, perspective view of an end of one of the spacing or retaining devices for the heating coils.

Fig. 8 is a fragmentary, plan view, on a reduced scale, of a slightly modified embodiment of the invention.

Fig. 9 is an end elevation of one burner unit thereof.

Fig. 10 is a transverse, sectional elevation thereof.

Fig. 11 is a longitudinal, sectional elevation thereof on line 11—11, Fig. 9.

Fig. 12 is a side elevation of the unit.

Fig. 13 is a diagrammatic view showing one system of electrically connecting the heating elements.

Figs. 14 and 15 are sections showing two modified forms of element coils.

Fig. 16 is a broken perspective view of a heating coil with means to prevent stretching of the coil.

In the preferred construction, as illustrated in the drawings, the heating device or burner is composed of a plurality, preferably eight, of separate units, which are of narrow, rectangular shape in plan, and of such size that when placed side by side, they form an approximately square composite burner or heating device, and preferably the burner is approximately 6 inches in diameter, so that the square burner will occupy a circular space of 8½ in. diameter, which is the standard size for electric range burners.

Each of the burner units comprises a base block 14 of porcelain or other suitable insulating material which is of narrow, preferably rectangular, shape in plan, and made with two spaced, parallel grooves or channels 15 in its top face, in each of which grooves a heating element 16 in the form of a wire coil is secured with the coils spaced apart in parallel relation. Each groove 15, as shown, is formed with raised, narrow, spaced ribs 17 on which the coils rest, whereby the bottoms of the coils are held up off of the bottoms of the grooves, so as to be out of line contact with the bottom of the groove, thereby allowing air to circulate below the wire, keep it cooler, and at the same time, reduce the heat conducted to the porcelain base. This will also speed up the heating of the cooking surface. Supported by the base block 14 is a guard, cover or protector 18 which overlies the tops of the heating coils so as to protect the coils from being struck or injured by cooking utensils or other objects.

As illustrated in Figs. 1–5, this guard is in the form of a slotted, inverted channel or grid made of suitable metal, such as steel or Monel metal, and is provided at its opposite, long sides with supporting legs 19 which straddle the block and enter vertical notches 20 in its sides, with the lower ends of the legs resting on the bottoms of the notches, so that the guard is supported by the base block and held in position over the heating coils, but is adapted to be readily lifted off or removed. This guard overlies and protects the coils of the unit, but in one form shown, the guard leaves open spaces at opposite sides of and above the coils through which the heat from the coils can pass freely to reduce the amount of heat absorbing material and speed up initial heating. However, for some purposes, it may be preferable not to leave the sides open. When the several units are placed side by side, the guards mutually support each other by side contact, and together form a strong, rigid structure on which a cooking utensil or object to be heated can rest and be supported over the burner coils. Nevertheless, in one form, as in Fig. 2, the guards

can be individually removed to expose or afford ready access to the coils of any one or more units.

Instead of being of this slotted or grid form, the guard may, if desired, be of other form. For instance, it may be made as shown in Figs. 8–12, in the form of a non-slotted or solid, inverted channel 21, and may be removably fastened in place on the block 14. As shown in these Figs. 8–12, the guard 21 is made with shouldered side legs 22 which are seated in correspondingly shouldered notches in the sides of the base block 14, with the shoulders of the legs resting on the shoulders 23 of the notches and the projecting lower ends 24 of the legs bent under the bottom of base block to secure the guard in place. The guard in this form leaves open spaces at the opposite sides of the heating coils between the depending side flanges of the guard channel and the top of the base block for the passage of the heat. With this form of guard, when access is desired to the coils of a unit, as for replacing a burnt-out coil, the unit is lifted out of its place and the guard then can be readily removed by straightening out the inbent lower ends 24 of the legs and lifting the guard off the block. These guards, like those first described, when the units are placed side by side to form the complete burner, mutually support each other and form a strong support for the utensil or object to be heated.

In order to prevent possible displacement or deformation of the coils from causing contact between the two coils of a unit, spacing or retaining devices are provided which are arranged at opposite sides of the upper portion of each coil. These retaining devices may consist of slender tubes or beads 25 of insulating material threaded on supporting wires 26. As shown in Figs. 2–7, the supporting wires 26 are made with down-bent ends 27 supported in vertical holes in the end portions of the base block with insulating beads 28 surrounding the down-bent ends to prevent possible contact of the same with the heating element wires. With this construction, when the guard 18 is removed, the retaining devices can be readily removed by pulling their bent ends out of the holes in the base block, so as to be out of the way and permit ready removal of the heating coils.

As shown in Fig. 11, the supporting wires for the retaining beads or tubes 25, instead of having downbent ends removably seated in holes in the base block, are secured at their ends to the ends of the guard 21, so that the retaining devices are mounted directly on and removable with the guard. The coil spacing or retaining device 25 could be mounted in either of the ways described, or in any other suitable way, when using either the guard constructed and mounted as shown in Figs. 1–5, or as shown in Figs. 8–12.

The two heating coils of each unit are preferably electrically connected in series and are removably fastened on the base block 14 in any suitable way which will enable any coil or coils to be readily removed and replaced without removal of the burner or the base blocks. For instance, as shown in Figs. 4–6, two binding posts or screws 30 pass vertically through and are secured in a lug or projection 31 at one end of each base block, and the adjacent ends of the two wire coils on the base block are secured to the binding posts, in contact with a metal connecting plate 32, by nuts 33 screwed on the upper ends of the binding posts so as to electrically connect the two coils at this end of the unit. At the opposite end of the unit, the end of each wire coil may be secured by a nut 34 to one of a pair of binding posts 35 which pass through and are secured in a lug or projection at this end of the base block. The binding posts 35 are electrically insulated from each other, and the conducting wires for supplying current to the coils may be separately connected to the two binding posts 35, as by nuts 36 screwed on the lower ends of the binding posts, which project downwardly from the base block lug. Thus, any heating coil can be quickly and easily removed while its base block remains in place in the burner, simply by unscrewing the upper nuts to release the coil, and a new coil can be secured in its place by tightening the upper nuts.

The several units, constructed as described, may be mounted side by side in the range or hot plate to form the square burner in any suitable way, as for example, on a bed plate 40 of porcelain or other suitable insulating material, supported below the range top 41 on the bottom of a flanged metal holder 42 which is seated in a hole in the range top. As shown, the upper face of the burner is exposed through a square opening in a circular ring 43, which rests on the range top with its inner rim overlying and covering the coil connections at the ends of the burner units.

The described square form of the burner is more efficient for most cooking operations with a variety of kettle sizes. For example, an 8½ in. kettle on a 6 in. square burner covers the burner entirely. A 6½ in. kettle covers all except the corners of the burner, leaving less than 2 sq. in. of burner surface uncovered, while a 6½ in. kettle on an 8½ in. standard circular burner leaves a complete annulus 1 in. wide and 8 in. in diameter uncovered, or about 25 square inches. Because the wire is not embedded in an electrical insulating and heat conducting material which has first to be heated before surface of burner gets hot enough to cook with, this element heats faster. Wattage for wattage, it is as fast or faster than the standard open coil burner now in use, and because, as presently explained, higher wattages can be obtained in the described burner, its speed improvement is virtually limitless. The best results obtained in present practice with open type range burners is 1500 watts in an 8½ in. diameter surface burner using #19 wire. The surface dissipation in this case is 18.5 watts per square inch of wire surface. On the other hand, in a burner according to my invention, employing heating coils of elliptical or analogous form arranged with their greater diameters vertical, it is possible to construct a 6 in. square burner, made up of eight 250 watt units, having 2000 watts capacity, and yet keep the surface dissipation of the element wire down to 9.55 watts per square inch.

The fundamental problem with which my novel elliptical form and disposition of the heating coils is concerned is that of increasing the wattage which can be radiated from a range burner and stay within the practical limits of the material we have to work with.

The most general practice today is to use nickel-chromium alloy wire composed of 80% nickel, 20% chromium. This alloy has a resistivity of 650 ohms per mil-ft., at 68° F. Industrial heating engineers claim that this alloy should not be used to radiate heat at a rate greater than 34 B. t. u. per sq. inch of wire surface. If this factor were adhered to the most wattage which

could be obtained from a standard 8½ in. range surface burner would be about 1000 watts.

Electrical heating authorities claim that wattage dissipation per square inch of wire surface should not exceed ten watts per square inch. They call this the safe emissivity rate, and it is used constantly in the design of electric annealing and hardening furnaces and similar industrial applications. With my improved elliptical winding, it is not only possible to increase the wattage above that now employed, namely 1500, but at the same time keep the wattage dissipation below 10 watts per sq. inch of wire surface.

The following illustrates the improvement of my device over present day burners. One of the leading 1500 watt range burners used at this time is composed of two 110 volt elements, each of 750 watt capacity. Said burner uses #19 gage wire, the largest that can be squeezed into the space (using a circular coil), but even this design using 29.9 feet of wire has only 40.5 square inches of surface. The watts per square inch are 18.5. If my described elliptical coils were employed 46.7 feet of #17 wire could be used, which gives a dissipation of only 9.5 watts per square inch. To get this increased length of wire into the available groove space, the vertical axis of the coil is increased, making an elliptical coil. The length of each turn of the elliptical coil is actually longer than the corresponding circular coil in a greater proportion than 46.7 is to 29.9, which is the relative lengths of wire of the same resistance but different diameter. The ellipse needs to be of greater proportionate length to the circle than the relative lengths of the wire to take up the loss due to the reduced number of turns per inch in the larger size wire because the manufacturer recommends that the pitch of the winding should not be less than one and one-half times the wire diameter.

This example illustrates how elliptical winding can reduce the emissivity rate, thereby increasing the life of the element and similarly increasing the wattage in the same area, if that is desired. By increasing the area of wire dissipating a fixed wattage, we reduce the emissivity rate, reduce the burning temperature of the element wire, yet liberate the same number of B. t. u over the total length of wire.

As will be apparent from the Fig. 13 diagram, the two heating coils of each unit, while being individually removable, are connected in series so as to form, in effect, a single double length coil, and these coils of the several units may be electrically connected in parallel, as shown, or otherwise, so that any one or more coils may burn out or be cut out without affecting the operation of the remainder. In use, by employing appropriate switch means well known in the art, the heating units can be operated singly or in any desired combinations, such as two units, three units, etc., in multiple up to their full number.

Modified forms of the elliptical coils may be found advantageous where it is desired to obtain even more wire length per turn of element wire without increasing the coil depth and width beyond a predetermined amount. In such case modifications of my elliptical winding, such as shown in Figs. 14 and 15, may be adopted. These coils, in which the sides of the convolutions have inbent portions increasing the length of wire in each convolution, come within the spirit of my invention.

The heating coil element as shown in Fig. 16 is equipped with a non-extensible, combustible cord or member extending lengthwise of and attached to the ends of the coil, for accomplishing another object of my invention, i. e., to definitely determine the length of the coil and prevent it from being stretched when being assembled in the burner or unit. Each heating coil, as here illustrated, has a cord **45** of cotton or other suitable combustible material which will not stretch, extending axially through the coil and attached at its ends to the ends of the coil, so as to prevent the stretching of the coil beyond its normal intended length, and thereby making it possible, even for an unskilled person, to properly place the coil in position. As shown, the ends of the coil wire and cord are secured to eyelets **46** adapted to be secured on the binding posts fixed at opposite ends of the heater unit, but other means for securing the ends of the cord and coil wire to each other and to the binding posts or other terminal fixtures could be employed. The cord is made of material such that, when the element is first heated, it will carbonize and turn to gaseous form, being thus removed from the heating coil. While I have shown and described the non-extensible cord applied to a straight, short coil of the sort used in the units hereinbefore described, it is obvious that this novel feature is also applicable to short coil units of other form, and to the usual heating coils of single-piece length of either circular, elliptical or other cross sectional form.

This application is a continuation in part of my copending application for Heating units for electrical cooking devices, Serial No. 100,507, filed Sept. 12, 1936.

I claim as my invention:

1. An electric heating device, comprising a plurality of separate removably supported units of rectangular shape in plan arranged side by side and forming a burner of approximately square shape in plan, each of said units comprising a rectangular base block of insulating material, a spirally wound heating wire coil supported on said base block, and a separate guard removably supported by each said base block over said coil, said guards being of rectangular shape and arranged side by side and cooperating with each other to form a broad utensil support over said coils, said units being separately removable and each guard being removable from its base block independently of the coil and leaving the coil in place on the block and exposed to give access to said coil.

2. An electric heating unit, for use in side by side association with other similar units to form a burner, said unit comprising a base block of insulating material of narrow elongated shape in plan, a spirally wound heating wire coil removably secured on top of said base block by electric terminal fastening means operable at the upper side of the block for removal and replacement of the coil, and a guard of narrow elongated shape in plan supported from said base block over said coil by legs which straddle the base block and are seated in notches in the sides of said block, said guard forming a support over said coil for an utensil, and said guard being removable from the base block independently of the coil and leaving the coil in place on the block and exposed to make said coil accessible for removal.

3. An electric heating unit as set forth in claim 2 in which said base block has coil-spacing grooves in its upper side in which plural coils are removably seated and above which the coils pro-

ject, and said removable guard carries retaining means which cooperate with said coils to retain them in spaced relation in said grooves.

4. An electric heating device comprising a base of insulating material, spirally wound open coreless heating wire coils on top of and supported by said base with substantially their entire surfaces exposed to air circulation, said coils being of oblong cross-sectional form disposed with their greater diameters vertical, means for so retaining the coils in spaced side by side relation on the base, said base being provided with coil-spacing grooves in which said coils are seated and above which the coils project, and said retaining means being removably supported by the device and having point contacts with the coil turns at the projecting upper portions of the coils for retaining the coils in position in said grooves.

5. An electric heating device comprising a plurality of separate narrow elongated units arranged side by side, each of said units comprising a base of insulating material having coil-spacing parallel grooves in its upper side, spirally wound open, coreless heating coils of oblong cross sectional form removably seated in said grooves with their greater diameters vertical and substantially their entire surfaces exposed to air circulation, and means for removably retaining the coils so positioned in said grooves.

6. An electric heating device as set forth in claim 5 in which the coils project up out of said grooves and are retained in position by removable retaining devices supported by the unit and having point contacts with the coil turns at opposite sides of the upper portion of each coil.

7. An electric heating device comprising a base of insulating material having a plurality of coil-spacing grooves in its upper side, spirally wound open coreless heating wire coils separately secured removably on said base with one coil seated in each groove, said coils being of oblong cross-sectional form disposed with their greater diameters vertical and the coils projecting up out of and above the tops of the grooves, and removable means supported by the base and having point contacts with the coil turns at the projecting upper portions of said coils to retain them in position in said grooves.

8. An electric heating device comprising a plurality of separate narrow elongated units arranged and supported side by side, for individual removal, each of said units comprising a base block of insulating material, a spirally wound open coreless heating wire coil removably secured on the upper side of said base block, said coil being of oblong cross-sectional form with its greater diameter vertical and having substantially its entire surface exposed to air circulation, and a narrow elongated guard removably supported on said base block over said coil, said guards being arranged side by side and cooperating with each other to form a broad support over said coils for an utensil.

9. An electric heating device comprising a plurality of separate narrow elongated units arranged side by side, each of said units comprising a base of insulating material having coil-spacing parts on its upper side, spirally wound open, coreless heating coils of oblong cross sectional form supported on top of said base between and separated by said parts, said coils being positioned with their greater diameters vertical and having substantially their entire surfaces exposed to air circulation, and means for removably retaining the coils so positioned.

10. An electrical heating device comprising a body of insulating material, and a spirally wound open coreless heating wire coil supported externally on said body at the outer side thereof which faces toward the object to be heated by the device, said coil being of non-circular elongated cross-sectional form disposed with its greater diameter substantially perpendicular to said side of said body and having substantially its entire surface exposed to air circulation, and a guard which is supported by said body over said coil leaving an air circulating space between the guard and coil.

11. An electrical heating device comprising a body of insulating material, and a spirally wound open coreless heating wire coil supported externally on said body at the outer side thereof which faces toward the object to be heated by the device, said coil being of non-circular elongated cross-sectional form disposed with its greater diameter substantially perpendicular to said side of said body and having substantially its entire surface exposed to air circulation, said coil being seated in a shallow groove in said side of the body with a substantial portion of the coil projecting out of the groove, and retaining means supported by the device and having point contacts with the coil turns at the projecting outer portion of the coil to retain the coil in place.

SAMUEL S. VINEBERG.