Dec. 8, 1931. A. J. KERCHER ET AL 1,835,602

ELECTRICAL HEATING DEVICE

Original Filed Sept. 20, 1926 3 Sheets-Sheet 1

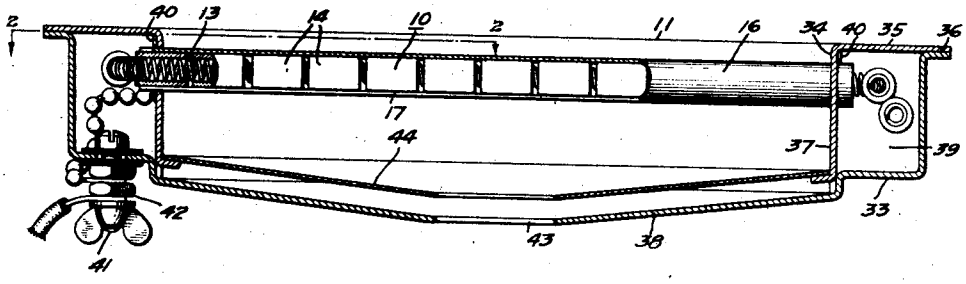

FIG. 1.

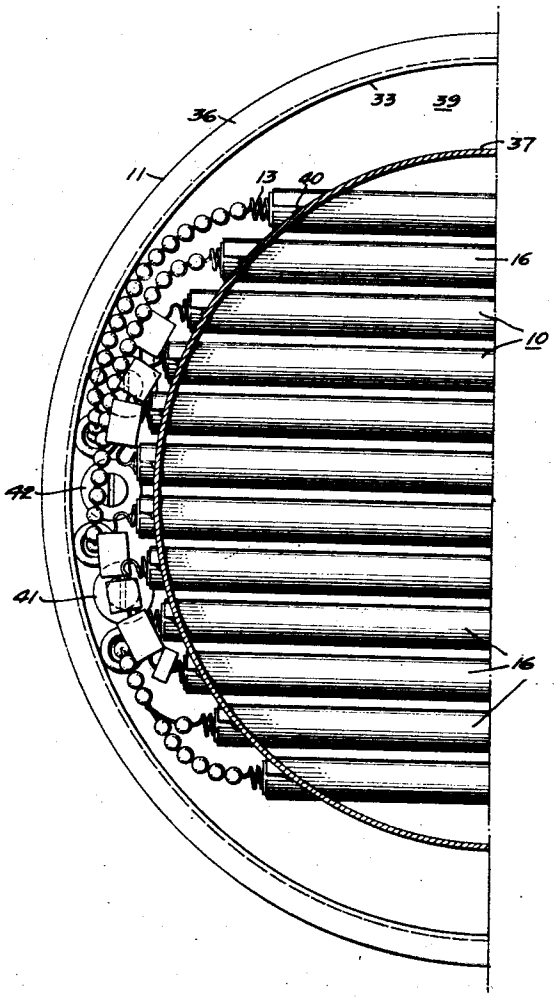

FIG. 2.

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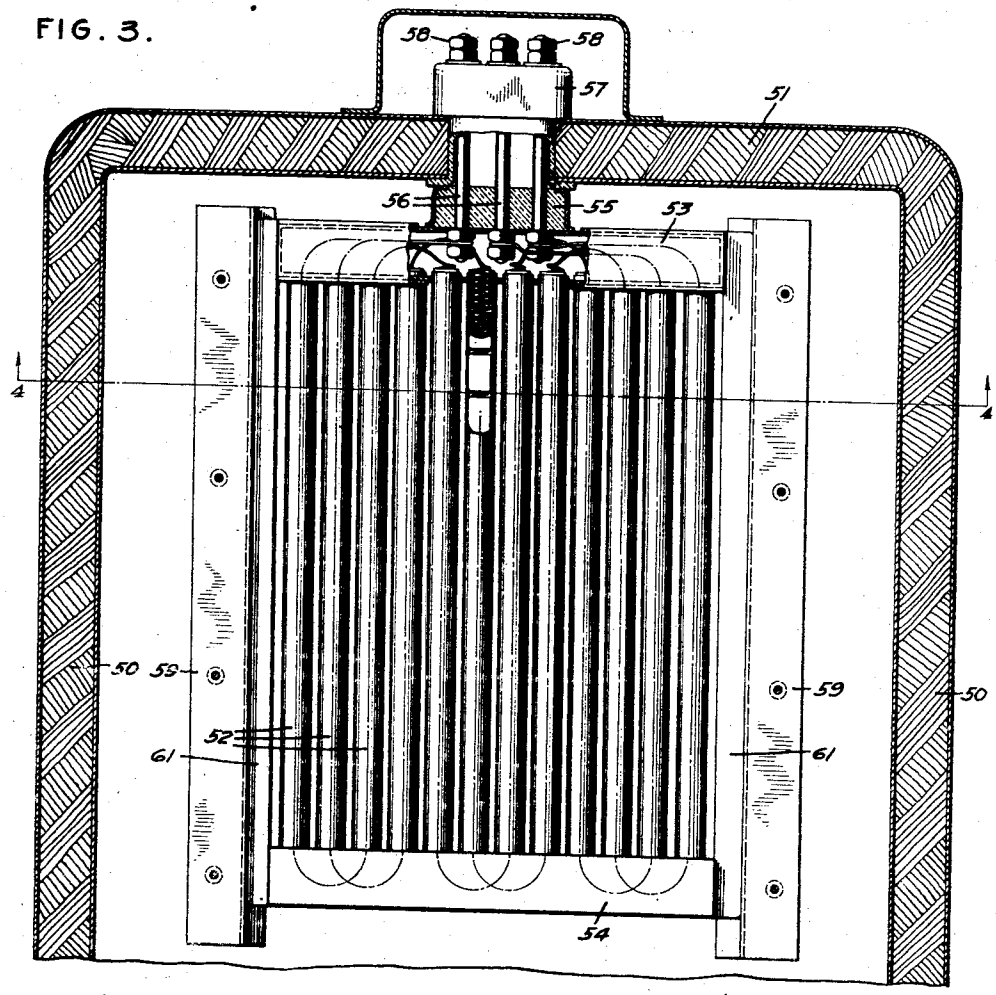
FIG. 3.



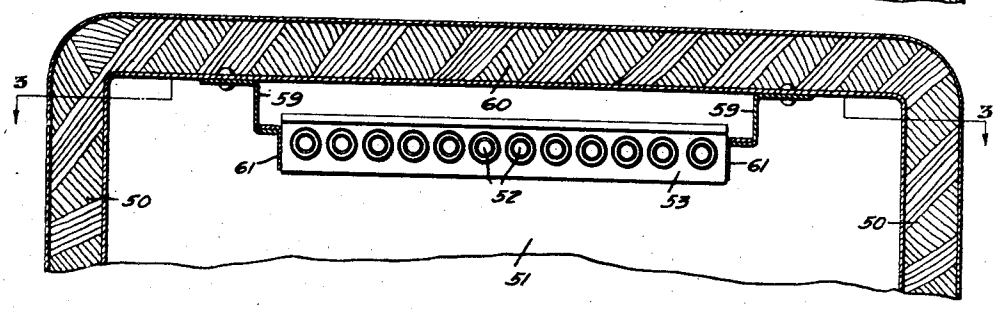


FIG. 4.

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ELECTRICAL HEATING DEVICE

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FIG. 6.

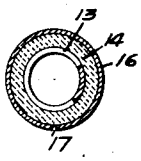


FIG. 5.

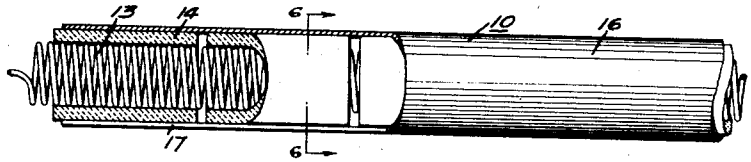


FIG. 7.

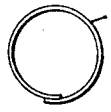
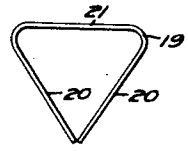


FIG. 10.



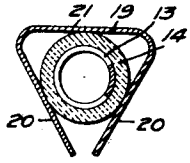


FIG. 9.

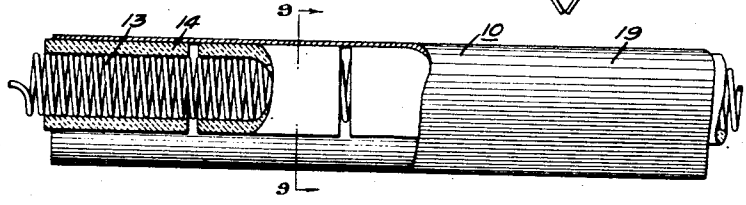


FIG. 8.

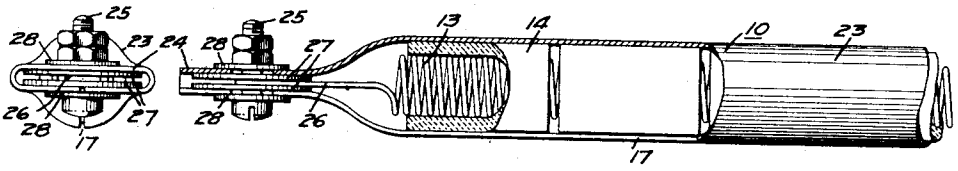


FIG. 12.

FIG. 11.

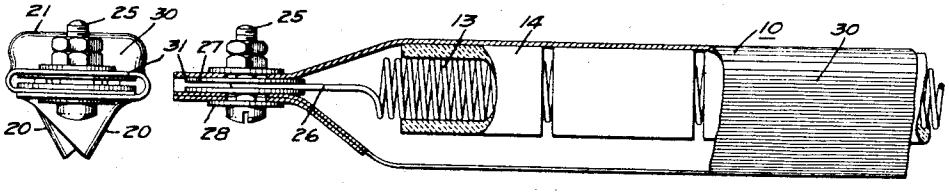


FIG. 14.

FIG. 13.

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UNITED STATES PATENT OFFICE

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ELECTRICAL HEATING DEVICE

Application filed September 20, 1926, Serial No. 136,444. Renewed November 15, 1929.

This invention relates generally to devices for producing a supply of heat from electrical energy.

Electrical heating devices for domestic or commercial use generally utilize a resistance conductor provided with a suitable insulating mounting. It is common practice in such heating elements to protect the conductor by a suitable casing, such for example as a metal sheath which may dissipate the heat by radiation, by imparting the same to convection currents of air or by direct conduction to a heat absorbing body. For example, it has been proposed to employ a sheet metal casing enclosing one or more resistance wires, the wires being insulated as by means of a refractory cement. Such elements have a relatively high heat lag, and due to expansion and contraction of the sheath, the cement or other refractory insulating material readily breaks down, with the result that the resistance element either fails or becomes grounded upon the sheath. A somewhat similar heating element utilizes a sheath in the form of a metal tube which is likewise filled with a refractory material, the sheath being frequently swaged to a reduced diameter to pack the refractory material about the wire. While elements of the latter type may have a comparatively long life, they are expensive to manufacture and are difficult to incorporate in heating appliances.

It is an object of this invention to devise an electrical heating element of simple construction which will have a long operative life and a relatively low heat lag.

It is a further object of this invention to devise a heating element which may be readily adapted to form a part of an electrical heating appliance.

It is a further object of this invention to construct a heating element having a sheath of such material that it may be operated at high temperatures without injury or deterioration.

It is another object of this invention to devise a heating appliance incorporating a heating element constructed of resilient sheet metal.

Further objects of this invention will appear from the following description in which we have set forth the preferred embodiment of our invention. It is to be understood that the invention is to be accorded a range of equivalents consistent with the state of the prior art.

Referring to the drawings:

Figure 1 is a cross sectional view of a heating appliance incorporating certain principles of this invention.

Fig. 2 is a plan view showing one half of the device illustrated in Fig. 1.

Fig. 3 is a cross sectional view of an oven construction illustrating another form of electrical heating device incorporating certain principles of this invention.

Fig. 4 is a cross sectional view taken along the line 4—4 of Fig. 3.

Fig. 5 is a side elevational view partly in section illsutrating one form of heating element incorporated in the heating devices shown in Figs. 1 to 4 inclusive.

Fig. 6 is a cross sectional view taken along the line 6—6 of Fig. 5.

Fig. 7 is a cross sectional view of the metal sheathing incorporated in the heating elements shown in Figs. 5 and 6.

Figs. 8, 9 and 10 are views similar to Figs. 5, 6 and 7, showing a modified form of heating element.

Fig. 11 is a side elevational view shown partly in section showing one form of heating element provided with terminal connectors mounted upon the sheath.

Fig. 12 is an end view of the elements shown in Fig. 11.

Figs. 13 and 14 are views similar to Figs. 11 and 12 but showing a modified form of heating element with the terminal connectors mounted upon the sheath.

The invention involves a number of novel features one of which is a heating element which is applicable to any form of electrical appliance or other heating device. The novelty in the heating element resides in the use of a metal sheath of chrome nickel alloy which has been found to possess properties making it especially adaptable for this purpose. Instead of constructing this sheath in the form of a rigid casing or tube,

it is made of relatively thin sheet material which is preferably positioned upon the insulated resistance element in such a way as to press against the same by its own inherent resilience, thus being at all times in close thermal contact with the same. In devising an electrical heating device to incorporate such a heating element, the elements have been positioned in spaced relationship and supported adjacent their ends, suitable provision being made for electrically connecting adjacent elements. The heating device shown in Figs. 1 and 2 is of the type commonly known as an electric grill or hot plate. It includes a plurality of heating elements 10 which are mounted in spaced relationship upon a suitable frame designated generally at 11.

Several possible embodiments of the heating element are shown in Figs 5 to 14 inclusive. For example, in Figs. 5 to 7 inclusive which illustrate the element shown as incorporated with the heater of Figs. 1 and 2, there is provided a resistance conductor 13 preferably in the form of a helical or coiled wire of suitable metal such as a chrome nickel alloy. This resistance wire is insulated by means of a plurality of refractory beads or tubes 14 which are preferably strung upon the resistance wire in contiguous relationship so as to form an articulated resistance element. About the insulator 14 there is disposed a sheath 16 of relatively thin resilient sheet metal which is preferably adapted to normally resiliently press against the outer surfaces of the insulators 14. In forming this sheath the sheet metal is first bent or rolled into the form shown in Fig. 7 and the insulated resistance element is then inserted into the sheath to expand the same to the form shown in Fig. 6. This expansion of the sheath is of course within its elastic limit so that it always tends to resiliently press against the insulators 14. The edges of the metal strip are not secured together to form a closed tube but are preferably allowed to overlap or to form a slot 17 extending longitudinally of the element. The particular metal used to form the sheath is preferably a chrome nickel alloy which we have found to have certain peculiar properties which make it especially adaptable for this use. For example, a chrome nickel alloy will not loose its natural resilience when heated to even a glowing temperature and under similar conditions will not oxidize or corrode.

Another form of element is shown in Figs. 8 to 10 inclusive in which the sheath instead of being tubular in shape is formed triangular. Thus the sheath 19 has been shown as being bent to form two inclined side portions 20 and a top portion 21. As in case of the element previously described the sheath is bent so that when the insulators 14 are inserted they serve to expand the sheath so that it will press against the insulators along three lines of contact. With this construction the top portion 21 forms a relatively large flat surface for transmitting heat by conduction to an absorbing body.

In Figs. 11 to 14 inclusive we have illustrated how terminal connectors may be mounted directly upon the ends of the metal sheath. Thus for example, as shown in Figs. 11 and 12, the metal sheath 23 which is tubular in shape has been shown as formed with a flat end portion 24 which is apertured to receive a terminal connector 25. The terminal 26 of the resistance wire 13 is extended into electrical contact with the terminal connector 25, suitable insulating members 26 being inserted between the flattened sides of the sheath for preventing grounding of this wire. The terminal connector 25 is of course insulated from the sheath by suitable means such as insulating washers 28. Heating elements of this kind may be made up in standard sizes for incorporation in various types of electrical appliances. In the construction shown in Figs. 13 and 14 a heating element having a triangular shaped metal sheath 30 has been shown as provided with a flattened end portion 31 for mounting a terminal connector 25, the end portion being formed for example by overlapping the side portions 20.

Referring again to Figs. 1 and 2 for a detailed description of the heating device illustrated therein, the mounting for the heating elements 10 includes a casing 33 within which is disposed a ring 34 which is preferably L-shaped in cross section. The upper portion 35 of this L has been shown as extended into contact with and secured to the upper rim of the casing 33 so as to form a peripheral flange 36. The other portion 37 has been shown as depending into contact with the bottom 38 of the casing so as to inclose a ring-shaped space 39 for making necessary electrical connections between the heating elements. The ends of the element 10 are extended through apertures provided in the ring 34, these apertures being spaced so as to arrange the elements in spaced parallel relationship to form a planar top for supporting a cooking utensil or other body which it is desired to heat. For retaining the elements within their respective apertures the ends of each casing may be slotted to provide bent-out tongues 40. The slot 17 is preferably arranged at the bottom of each elements in order to prevent the entrance of foreign substances. The electrical connections have been indicated at 41 and preferably serve to connect alternate elements so as to form two groups which may be either operated independently, in series, or in parallel. Suitable terminal connectors 42 are mounted upon the casing for making the necessary connections to a control switch and current supply line.

Since liquids may be spilled through the spaces between the heating element the bottom 38 of the casing is preferably inclined downwardly toward the center of the same and is provided with a central aperture 43. The inner space of this bottom wall may be covered by suitable heat insulating material or may be provided with a false bottom 44 having a smooth upper surface serving to reflect heat radiated from the heating elements.

In Figs. 3 and 4 a heating device has been shown as incorporated with an electric oven construction, the side and rear walls of the oven being indicated at 50 and 51 respectively. The heating device has been shown as comprising a plurality of heating elements 52 supported adjacent their ends in a pair of spaced metal headers 53 and 54. The elements are secured within apertures provided in the headers in a manner similar to that described previously with respect to Figs. 1 and 2, these headers serving to provide spaces for interconnecting the wires of the different elements. As indicated, alternate elements are connected to form two groups of heating elements which may be either energized separately, in series or in parallel to secure different degrees of heat. The header 53 is provided with a suitable connection block 55 carrying the bayonet connectors 56 which are adapted to cooperate with a suitable electrical connection block 57. The terminal connectors 58 carried by this block are for making electrical connections to a control switch and current supply lines. The device may be removably supported within the oven by providing a pair of guides 59 mounted for example upon the top 60 of the oven and adapted to engage a pair of L-shaped side brackets 61 secured to the ends of the headers 53 and 54, these brackets 61 preferably running between the ends of the headers in order to reinforce the same.

The efficiency of the heating elements may be increased and all danger of short circuiting obviated by providing the convoluted resistance wire with a thin coating of refractory material, such as alundum. In applying this coating the insulators are first strung upon the coiled wire and then the assembly is stretched or elongated and dipped in an alundum wash. The stretching of the wire provides spaces between the insulators to permit the wash to flow through the same to effectively cover the entire surface of the wire. When removed from the wash it is permitted to return to its original length and the excess material is allowed to drain away. A thin coating of the refractory material remains upon the wire, thus facilitating conduction of heat to the insulators and preventing short circuiting of adjacent convolutions.

The heating devices described above have high electrical efficiency due principally to the novel construction of the heating element. Because of the use of a thin sheet metal sheath, the heat lag is reduced to a minimum. The heat developed by the resistance wire is uniformly conducted to the sheath as all of the insulators 14 have positive thermal contact with the same, due to the resilience of the metal. Because of the articulated nature of the insulation, contraction and expansion of the sheath will not injure the element.

If desired the heating device may be constructed so as to utilize the metal sheath as a return conductor. Thus the resistance wire at one end of the element can be connected with the adjacent end of the sheath so that the element can be connected to the line by connections made at the other end of the element to the resistance wire terminal and sheath. In this case the elements must be provided with an insulating mounting to prevent grounding upon frame of the device.

We claim:

1. An electrical heating element comprising a convoluted resistance conductor, circular refractory insulating tubes strung upon said conductor, and a longitudinally split resilient metal sheath enclosing said tubes, said sheath being normally stressed in an expanded position to press upon the sides of said tubes thereby forming an effective heat transferring contact between the tubes and said sheath.

2. An electrical heating element comprising a resistance conductor, refractory insulating tubes strung upon said conductor, an elongated resilient sheet metal sheath bent to encompass said tubes, said sheath having its sides normally sprung outwardly by the encompassed insulating tubes and having free longitudinal edges.

3. An electrical heating element comprising a bead insulated conductor, and a resilient sheet metal sheath of chromium nickel alloy bent to encompass said conductor, said sheath having its sides normally sprung outwardly by the encompassed insulation of said conductor and having free opposed edges to permit expansion and contraction of the sheath.

4. An electrical heating element comprising an elongated resistance conductor, round insulation surrounding said conductor, and an elongated resilient metal sheath enclosing said conductor and insulation, said sheath being formed of a single sheet metal strip bent about said conductor and insulation to form a longitudinally split casing, said sheath being normally expanded within its elastic limit to press against the sides of said insulation and forming the sole metal sheathing material for the same.

5. An electrical heating element comprising a resistance conductor, insulation surrounding said resistance conductor, an elongated resilient sheet metal sheath initially formed to provide an enclosing space hav-

ing a cross sectional area which is smaller than the corresponding area of the insulation adapted to encompass said insulation, said sheath being normally under internal stress and extended within its elastic limit to exert pressure upon said insulation.

6. An electrical heating element comprising a resistance conductor, refractory insulation surrounding said conductor, an elongated resilient sheet metal sheath initially formed to provide an enclosing space having a cross sectional area which is smaller than the corresponding area of the insulation adapted to encompass said insulation, said sheath having its sides normally sprung outwardly by the encompassed insulation and said sheath having free longitudinal edges.

7. An electrical heating element comprising a resistance conductor, insulation surrounding said resistance conductor, an elongated resilient sheet metal sheath being initially formed to provide an enclosing space bent to encompass said insulation, said sheath having a cross section of discontinuous triangular outline the area of which is smaller than the corresponding area of said insulation, the discontinuity allowing expansion and contraction of the sheath.

8. An electrical heating element comprising a resistance conductor, insulation surrounding said resistance conductor, an elongated resilient sheet metal sheath bent to encompass said insulation, said sheath being initially formed to provide an enclosing space having a cross section of discontinuous triangular outline the area of which is smaller than the corresponding area of said insulation, the discontinuity allowing expansion and contraction of the sheath and said sheath being normally expanded within its elastic limit to exert pressure upon said insulation.

9. The method of manufacturing an electrical heating element having an insulated resistance conductor enclosed within a metal sheath, which method comprises placing the insulation about the conductor, initially forming the sheath so that its cross section is too small to encompass the insulation, thereafter expanding the sheath and placing it about the insulation and then allowing the sheath to contract about the insulation under the influence of its own internal stresses.

In testimony whereof, we have hereunto set our hands.

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