

May 22, 1951

J. GYURIS  
ELECTRICAL HEATING ELEMENT AND METHOD  
OF MAKING THE SAME

2,553,762

Original Filed Nov. 1, 1946

2 Sheets-Sheet 1

*Fig. 1*

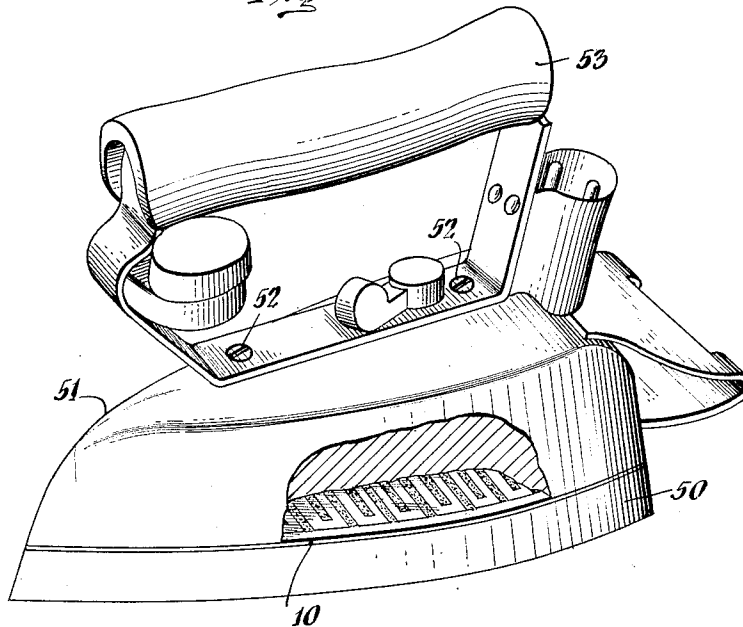


*Fig. 10*

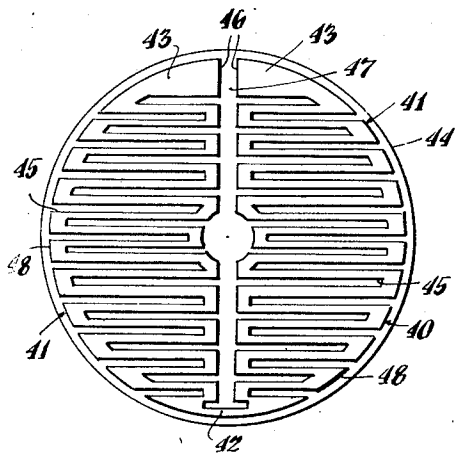
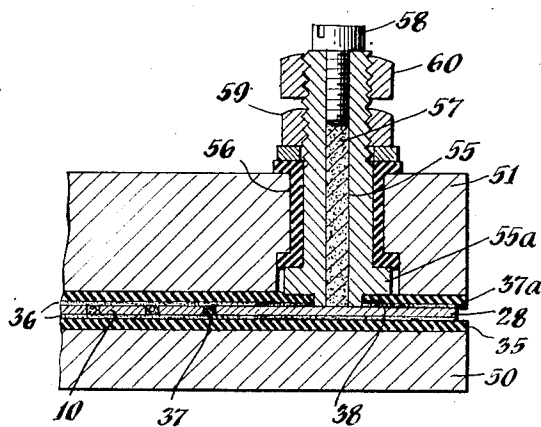


*Fig. 11*



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2 Sheets-Sheet 2

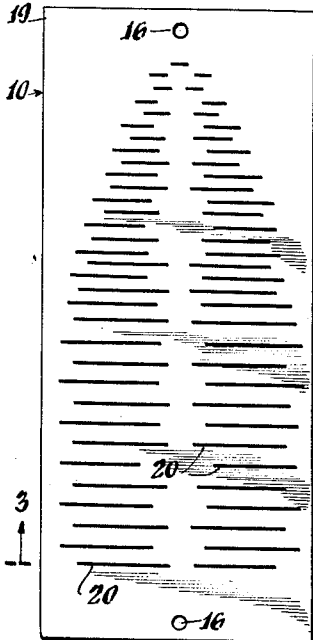


Fig. 2

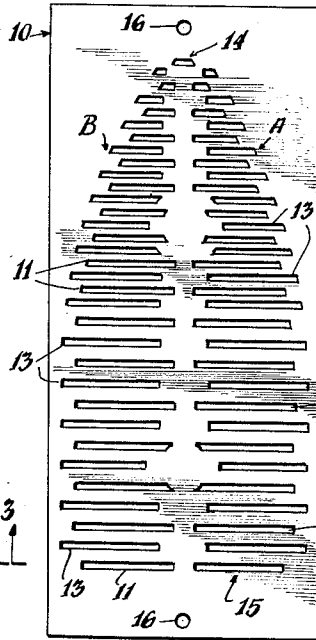


Fig. 4

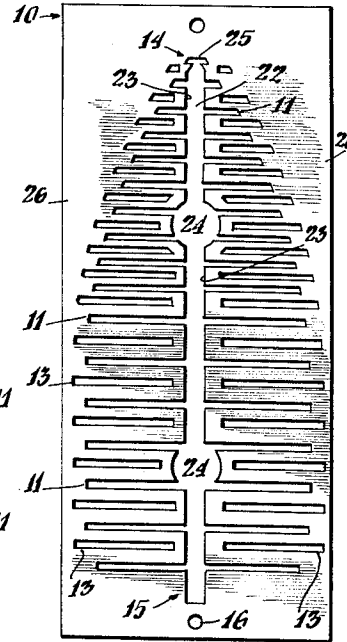


Fig. 5



Fig. 3

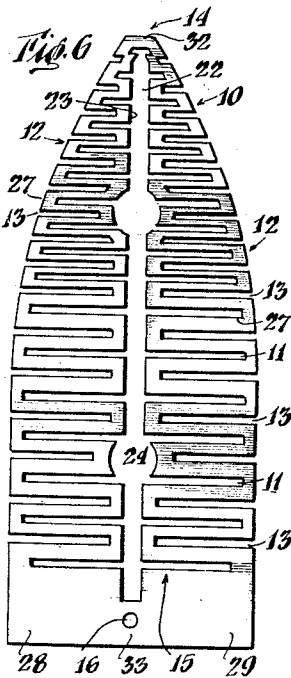


Fig. 6

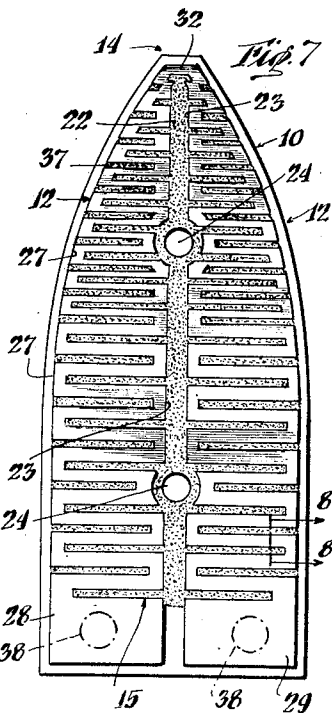


Fig. 7

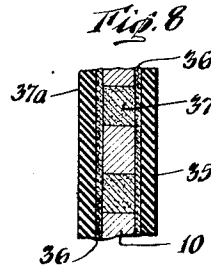


Fig. 8

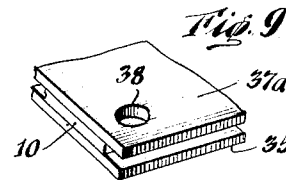


Fig. 9

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## UNITED STATES PATENT OFFICE

2,553,762

ELECTRICAL HEATING ELEMENT AND  
METHOD OF MAKING THE SAME

John Gyuris, New York, N. Y.

Original application November 1, 1946, Serial No.  
707,106. Divided and this application March  
19, 1948, Serial No. 15,856

8 Claims. (Cl. 201-69)

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This invention relates to a heating element adapted for use in an electric iron or other electrical appliance and to a method for making such a heating element.

The present application is a division of my co-pending application Serial No. 707,106, filed November 1, 1946.

This invention further relates to a terminal construction which is particularly adapted to make contact with a flat, conductive portion of a heating element.

This invention has further reference to a die constructed and arranged to form a heating element in a single operation and to a method for making the same.

This invention also embraces the construction of an electric iron or appliance embodying the novel heating element or terminal structure, alone or in combination.

Heretofore, heating elements for electric irons and other electrical appliances have ordinarily consisted of a ribbon or spiral of resistive material embedded in a mass of insulating material, this element being secured between two metal plates constituting the body of the iron. Aside from the inherent difficulties of constructing and assembling such a structure, the prime disadvantage of this type of heating element resides in the poor heat conduction between the heating element and the body of the iron. This arises from the thickness of the insulating material which is necessary to enclose a spiral or ribbon of resistance material and adequately insulate it from the body of the iron, such insulating materials normally being poor conductors of heat. As a result, the heating element is ordinarily operated at a temperature of several hundred degrees above the operating temperature of the iron, resulting in rapid deterioration of the heating element and formation of an oxide film thereon which is in itself a poor heat conductor, thus causing a further increase in the temperature differential between the heating element and the body of the iron.

It has been proposed to substantially minimize this temperature differential by utilizing a substantially flat heating element in which a number of slots are punched to define the respective segments of a heating element. However, difficulties have been encountered with such struc-

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tures in that it is extremely difficult to provide an element with sufficient rigidity and mechanical strength to prevent buckling and the contacting of adjacent resistance segments. In addition, difficulty is also experienced in the manufacture of such elements in that a large number of closely-spaced slots must be formed in the heating element, usually by cutting one slot at a time, with the result that the process is quite expensive and difficult to perform.

In accordance with my invention, a heating element is provided in which both the resistance portions and the terminal portions lie in a single plane and in which the resistance portions are bonded to a sheet of heat resistant insulating material to provide the requisite mechanical strength and rigidity. In manufacturing my novel heating element, gridlike resistance elements are formed by suitable cutting or etching operations from a thin plate of resistance metal. The resistance elements are interconnected, during the initial stages of the process, by portions of the plate of sufficient size to provide enough mechanical strength and rigidity to prevent buckling. While in this stage, the resistance elements are bonded to a thin sheet of heat resistant insulating material, such as, for example, mica, to positively retain the respective segments of the resistance element in their proper relation. Thereafter, the interconnecting portions are severed to provide a resistance element bonded to the sheet of insulating material with flat plate-like terminal member extending from the respective ends thereof. I may then complete the resistance unit by bonding a second insulating sheet to the exposed surface of the plate.

In this manner, I eliminate the difficulties arising from an excessive temperature differential between the heating element and the metal plates associated therewith. This is explicable on the basis that my heating element is entirely flat throughout and free from buckling so that it may be placed in intimate contact with the adjacent metal plates, separated therefrom only by extremely thin sheets of heat resistant insulating material. The advantages resulting from the use of such thin sheets of insulating material may be better understood by reference to the following tabulation which compares the temperature differential with the thickness of

the interposed insulating material where the operating temperature is maintained constant at 250° C.

| Thickness of Insulating Material (Mica) in Inches | Temperature of Heating Element | Temperature Differential between Heating Element and Body of Iron |
|---------------------------------------------------|--------------------------------|-------------------------------------------------------------------|
|                                                   | °C.                            | °C.                                                               |
| 0.001                                             | 251                            | 1                                                                 |
| 0.002                                             | 253                            | 3                                                                 |
| 0.003                                             | 256                            | 6                                                                 |
| 0.004                                             | 263                            | 13                                                                |
| 0.005                                             | 275                            | 25                                                                |
| 0.006                                             | 296                            | 46                                                                |
| 0.007                                             | 328                            | 78                                                                |
| 0.008                                             | 375                            | 125                                                               |
| 0.009                                             | 436                            | 186                                                               |
| 0.010                                             | 494                            | 244                                                               |
| 0.011                                             | 547                            | 297                                                               |
| 0.012                                             | 598                            | 348                                                               |
| 0.013                                             | 648                            | 398                                                               |
| 0.014                                             | 696                            | 446                                                               |
| 0.015                                             | 742                            | 492                                                               |
| 0.016                                             | 787                            | 537                                                               |

Conventional heating elements utilize insulating plates ranging from about 0.013 inch to about 0.016 inch in thickness and the temperature differential, which is an index of the heat transfer efficiency between the heating element and the iron, varies from about 400° C. to about 550° C. It will be observed that the heating elements of such irons are operated at temperatures on the order of 650° C. to 787° C. which approaches red heat for Nichrome wire. This results in rapid deterioration and oxidation of the heater structure. When the novel heating elements of this invention are utilized, the thickness of the insulating material may be reduced to a thickness in the range from 0.001 inch to 0.010 inch with a temperature differential of as little as 1° to 244° C. Preferably, I utilize insulating material having a thickness of 0.004 inch to 0.005 inch with a temperature differential of 13° C. to 25° C. It will be noted that the element may be operated, in accordance with the invention, at temperatures of about 250° C. to 300° C. which is insufficient to cause deterioration or excessive oxidation of the heater element even when it is used for extended periods. I have verified these facts by extensive life tests and found that the novel heating elements of this invention, after prolonged operation, show no signs of deterioration and preserve a bright untarnished surface. These results may be attributed to the fact that the heater element is under the protection of the heated body as a result of the intimate heat exchange relation therebetween.

Another factor contributing to the low temperature differential and increased efficiency of my heating units is the novel terminal construction therefor. By the use of this structure, the terminal portions of the heating element may consist of plate-like members integrally formed with and lying in the same plane as the grid-like resistance structure. I have found that the use of such terminal portions contribute substantially to the low temperature differential of the heating element and I have devised a terminal structure for making efficient contact with such flat plate-like terminal members.

In view of the foregoing discussion, it will be seen that I have provided an efficacious solution to many of the problems confronting the manufacturer of electrical appliances, such as electric irons and heating units.

It is an object of this invention to improve the construction and operation of heating elements.

It is a further object of the invention to set forth a novel method of making a heating element.

It is still a further object of the invention to provide an improved terminal structure for a heating element.

The invention further aims to provide an electrical appliance, such as an iron, embodying the novel heating element from a plate of resistance metal in a single punching operation.

Other objects of the invention will be apparent from the following description and accompanying drawings taken in connection with the appended claims.

The invention accordingly comprises the features of construction, combination of elements, arrangement of parts, and methods of manufacture referred to above or which will be brought out and exemplified in the disclosure hereinafter set forth, including the illustrations in the drawings, the scope of the invention being indicated in the appended claims.

For a fuller understanding of the nature and objects of the invention as well as for specific fulfillment thereof, reference should be had to the following detailed description taken in connection with the accompanying drawing, in which:

Figure 1 is a perspective view of an electric iron embodying the novel heater element and terminal structure;

Figure 2 is a plan view showing a metal plate prepared for an etching operation;

Figure 3 is an end view of the plate shown in Figure 2;

Figure 4 is a plan view of a metal plate having a series of slots formed therein by a punching or etching operation;

Figures 5 and 6 are plan views of partially completed heating element;

Figure 7 is a plan view illustrating the resistance unit bonded to a sheet of heat resistant insulating material;

Figure 8 is a sectional view taken along the line 8-8 of Figure 7;

Figure 9 is a fragmentary perspective view of the completed resistance unit;

Figure 10 is a plan view of a completed heating element of modified structure; and

Figure 11 is a vertical sectional view of the novel terminal construction.

In each figure, the size of the slots shown therein is greatly exaggerated for clarity.

While a preferred embodiment of the invention is described, it is contemplated that considerable variation may be made in the method of procedure and the construction of parts without departing from the spirit of the invention. In the following description and in the claims, parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar parts as the art will permit.

Referring now to the drawings in detail, Figures 2 to 9 illustrate successive steps in the method of making my novel heating element. In Figure 4, a thin plate 10 of resistance metal, such as Nichrome, is shown having two rows of slots A, B formed therein in the manner to be hereinafter explained. Each row comprises a series of parallel, closely spaced slots which are arranged in staggered formation so that each slot is laterally offset from the two slots adjacent

thereto. Accordingly, each row may be said to consist of a group of slots 11, the inner ends of which define the inner edge of a grid-like resistance element 12, Figure 6, together with a group of slots 13, laterally offset from slots 11, the outer ends of which define the outer edge of grid-like resistance element 12.

It will be observed that the outer ends of the respective groups of slots 13 define substantially the outline of an electric iron, the slots being shorter and more closely spaced adjacent the tip portion 14 than the slots adjacent the other end portion 15. Closer spacing of the slots will increase the electrical resistance of the grid portions defined thereby and thus will increase the temperature of the electric iron in such regions. If it is desired to manufacture a heating element adapted for use in an appliance other than an electric iron, the slots may be formed to define any desired shape of heating element, as will become clearly apparent from the following description. For the purpose of supporting and aligning the element with the die during successive stages of the manufacturing operations, I may provide holes or openings 16 at the respective opposite ends of the plate 10 for cooperating with suitable guide pins to accurately locate the plate during subsequent stamping operations. Where the slots are formed by a stamping operation, the holes 16 may be formed in the same step as the slots.

In accordance with the invention, the slotted plate depicted in Figure 4 may be formed either by a stamping operation or by an etching process. In a preferred embodiment of the invention, the slots are stamped in the plate by a single operation of my novel die disclosed and claimed in my aforesaid co-pending application. However, the method of making a heating element in accordance with the invention contemplates the formation of the slots in any suitable manner such as, for example, by punching out the slots one at a time or in groups, or by utilizing the etching process now to be described in connection with Figures 2 and 3.

In forming the slots by etching, the plate 10 is coated on one or both sides thereof by a layer of masking material 19. A plurality of slits 20 corresponding, respectively, to the slots 11, 13 are formed in the masking layer in any suitable manner, as by scratching the masking layer with a sharp instrument. The plate is then immersed in a bath of a suitable acid reagent which corrodes the unmasked portions of the plate forming the slots 11 and 13. In order to carry out the etching in a quick and efficient manner, it is preferred to make the resistance plate the anode in an etching solution which may be a strong mineral acid, such as sulphuric, nitric or hydrochloric acid of the desired concentration and to apply a voltage of 50-60 volts to the anode and cathode. I have found that in this manner a Nichrome plate having a thickness of 0.003 may be etched through in about 5 to 6 seconds. Instead of providing a continuous coating of the masking material on the resistance plate, it is also possible to apply the masking material in the form of a waxy film having the desired configuration by means of a printing or lithographic process which eliminates the necessity of scratching in the slots by a separate operation. The masking material is then removed leaving the plate in the condition shown by Figure 4.

The slotted plate of Figure 4, whether produced by etching or stamping, is then placed in a suit-

able die and a central channel 22, Figure 5, is formed therein, the longitudinal edges 23 of which define the respective inner edges of the grid-like resistance elements 12, Figure 6. Preferably, the edges 23 are formed along the extreme inner ends of the slots 11 but some tolerance is permissible in the width of channel 22, the essential feature being that each slot 11 communicates with the channel 22 to prevent a short circuit being formed between adjacent segments of the resistance grids. It will be observed that the slots and the channel are shaped to form circular passages 24 constituting openings for receiving supporting bolts to secure the heating element in proper position with respect to the structure associated therewith. The end of channel 22 may terminate at a short slot 25 at the tip portion 14 to provide uniform thickness of the heating element in this region.

The structure of the grid-like resistance units 12 is then completed by cutting away portions 26 of the plate, thus defining the outer edges 27, Figure 6, of grid-like resistance structures 12. The edges 27 are preferably formed along the extreme outer ends of slots 13 but may extend inwardly a short distance beyond such outer ends, the essential feature being that the slots 13 separate and prevent a short circuit between adjoining outer ends of the segments of grid-like resistance elements 12. It will be observed that the ends 15 of resistance elements 12 terminate in integral flat plate-like portions 28, 29 constituting terminals for the heater element, such terminals lying in the same plane as resistance elements 12.

The structure shown in Figure 6 has sufficient mechanical strength and rigidity to prevent buckling and bending of the resistance segments into short circuiting contact with each other. This is due to the fact that the grid-like resistance element is interconnected at the end 14 thereof by a plate portion 32 which serves to connect elements 12 in series. The mechanical strength and rigidity is also due to the interconnection of terminal members 28 and 29 by plate portion 33. It will be understood, however, that plate portion 33 forms a short circuit between portions of the grid-like structure at this time and, accordingly, must be subsequently removed.

In accordance with the invention, while the grid-like structure is still interconnected in this manner, I bond it to a sheet of heat resistant insulating material, such as mica. Referring to Figure 7, the element is shown with the grid-like resistance elements 12 secured to a mica sheet 35 by bonding material 36, Figure 8. More specifically, the grid-like elements 12 may be bonded or heatsealed to the surface of mica sheet 35 by means of a layer 36, Figures 8 and 11, of thermoplastic resin. This may be accomplished by coating the mica surface with a suitable thermoplastic resin, such as vinylseal, placing the resistance grid thereon and then applying heat and pressure to the said plate by means of a metal surface, such as steel, which is heated to a temperature of 180°-220° C. Preferably, the application of heat and pressure stops short of the terminal regions of the plate, which are initially integrally connected so that such regions are not bonded to the insulating surface. This permits the terminal regions to be slightly lifted up so that the short portion 33 of the metal plate bridging the terminal portions may be cut out. Thereupon heat and pressure may be applied to the entire surface of the resistance plate so that the terminal regions are also firmly bonded to

the mica plate by the layer 36. The bonding material serves to afford sufficient strength and rigidity to preserve the flatness and configuration of the heater element, at least until it is rigidly mounted in an iron or other electrical appliance. Once the element is mounted in this fashion, it is immaterial whether the bond between the heating element and insulating sheet 35 persists or whether the bonding material is decomposed during operation of the iron.

After the bonding has been completed, I fill the slots 11, 13 with a semi-refractory insulating compound or mass 37, Figures 8 and 11, which remains in position after assembly and at all times, positively insulates adjoining segments of the resistance elements from each other. A suitable compound for this purpose is an oxide paste prepared from a refractory metal oxide, such as aluminum, calcium, or magnesium oxide, a filler such as water glass or uncalcined borax and water.

After the slots are filled, a second sheet 37a, Figure 9, of heat resistant insulating material, such as mica, is bonded or otherwise suitably secured to the exposed surface of plate 10, this second sheet having openings 38 therein permitting access to the respective terminal portions 28 and 29.

Alternatively, the bonding operation may be performed at any stage of the process so long as the grid-like resistance elements are interconnected before the bonding in such fashion that the structure has sufficient mechanical strength and rigidity to prevent buckling and contact of adjacent resistance elements. After bonding, the interconnecting portions are severed to define the heater element. Thus, for example, the plate 10 of Figure 2 may be coated, on one side only, with masking material after which the other side thereof may be bonded to insulating sheet 35, Figure 7. The masking material is then removed from the coated face to define the finished heater element of Figure 7 after which the assembly is etched electrolytically, a potential being applied to a number of points at the same time. In this manner, the interconnecting portions are severed or removed by the etching and the complete resistance element is formed in a single etching operation. Thereupon the interspaces between the slots may be filled, as described, with an oxide paste and a second insulating sheet bonded to the exposed surface of the metal plate to form a completed heater element.

Accordingly, the completed resistance element comprises a metal plate of resistance material 10 having grid-like resistance elements 12, 12 defined therein by the slots 11 and 13, inner edges 23 and outer edges 27. The elongated grid-like resistance elements 12 are connected in series by plate portion 32 and terminate, respectively, in flat integral plate-like terminal portions 28, 29 which lie in the same plane as grid-like resistance elements 12. The grid-like portions of the element are bonded to heat resistant insulating sheet 35 to secure the desirable mechanical strength and rigidity, and the insulating compound 37 fills the slots 11, 13 to effectively insulate the respective resistance segments from each other. A second sheet of insulating material, such as mica, is applied or bonded to the exposed surface of the plate, this second sheet having openings 38 therein for effecting connection to the terminals 28 and 29. In its completed form, the heater element is of uniform thickness throughout and free from bonds, folds, soldered

or welded joints. The insulating layers are likewise completely plane and of uniform thickness throughout so that they can be pressed against the plane heater element substantially in the complete absence of any interposed or entrapped air spaces or films. This is of critical importance as even an air film or gap of 0.0001" may very appreciably reduce the efficiency of heat transfer. In this manner, the concentration of heat in definite regions, which is characteristic of conventional wire or ribbon-wound heater elements, and the resulting presence of "hot spots" is completely avoided. Preferably, the two insulating sheets, with the grid-like resistance element therebetween, are compressed between a pair of plane metal plates. These plates are in intimate heat exchange relation with the resistance element and are also instrumental in protecting the element from injury.

Suitable dimensions for the component parts of the novel heating element are a thickness of about 0.001 to 0.004 inch for the plate 10 and a thickness of about 0.004 to 0.005 inch for the insulating sheets 35 and 37a. I prefer to utilize about 80 to 150 slots on each side of the channel 22, the width of the slots varying from about 0.002 to 0.01 inch and the length thereof being determined by the particular zigzag pattern desired for the heater element. The width of the grid-like portions defined by the slots may vary from about  $\frac{1}{16}$  to  $\frac{1}{8}$  inch, this dimension being adjusted in accordance with the heating effect desired in particular regions.

A modified form of resistance element, which is suitable for use in a hot plate, is shown by Figure 10. This element is formed in accordance with the principles of the present invention and comprises a plate 40 of resistance metal having generally semicircular grid-like resistance elements 41 connected, at one end, by a plate portion 42 and terminating, at the other end, in integral, flat terminal members 43. The grid-like portions are bonded to a sheet 44 of heat resistant insulating material and, prior to the bonding operation, the terminals were interconnected by a metal plate portion giving sufficient mechanical strength to prevent buckling, this interconnecting portion being severed after the bonding step. The resistance elements are defined, as in the case of the element shown in Figure 7, by slots 45, the inner edges 46 of a channel 47, and outer edges 48. The slots 45 are filled by a suitable insulating compound or paste thus insulating adjacent segments of the grid-like resistance elements. A sheet of insulating material similar to sheet 44 may be placed on top of the resistance element and the two sheets with the grid-like resistance element therebetween may be compressed between a pair of plane metal plates of similar shape.

Referring now to Figures 1 and 7, an electric iron is shown embodying the heating element of the present invention. The heating element is mounted between a pair of metal plates or bodies 50, 51 which are held together by bolts 52 extending through the respective openings 24 in the heating element and also carrying a handle 53.

In accordance with the invention, I provide terminals of novel construction for making connection to the respective plate-like terminal portions 28 and 29, these terminals making an efficient electrical connection to the plate portions 28 and 29 while permitting them to remain in the plane of the heater element.

Each terminal, as shown in detail in Figure 11, may comprise a metal sleeve or container member 55 having a lower flanged portion 55a resting on insulating sheet 37a and disposed in a cavity formed in the upper iron member 51. Sleeve member 55 may be insulated from metal plate 51 by a bushing or grommet 56 which is lapped over the top of plate 51. A solid body or rod 57 of compressed, conductive, powdered material, such as graphite, is disposed within the container member 55 and a portion of this material extends through the opening 38 into contact with the flat terminal portion 28. In preparing the terminal rod, pure graphite powder of high electrical conductivity is glowd while in powder form and compressed into desired cylindrical shape generally without any binder. The resulting pressed graphite body is characterized by high mechanical strength, is unaffected by elevated temperatures, and has some elasticity to apply resilient pressure to the resistance plate. The compressed body of powdered material or rod is forced into contact with the terminal portion in any suitable manner, such for example, as by a set screw 58 which is disposed on interior threads located at the top of sleeve member 55. The set screw 58 should be formed of material which is non-oxidizing at moderately high temperatures, such as nickel, monel metal, or silver plated brass.

The member 55 also carries external means for making electrical connection through the sleeve and compressed conductive material 57 to the flat terminal portion 28. This external means may comprise a pair of nuts 59, 60 threaded to the exterior of the sleeve. The nut 59 may be forced into engagement with grommet 56 and the top of plate member 51 to hold the terminal firmly in assembled position thereon. The nut 60 may be utilized to hold a lead or conductor in contact with sleeve 55 and nut 59 to afford an electrical connection to the terminal portion 28. It is also possible, of course, to clamp or otherwise attach a conventional contactor pin to the terminal which is adapted to cooperate with a conventional connector at the end of a flexible cord.

It will be apparent that the entire heating element, including the grid-like resistance elements 12 and the terminal portions 28, 29 is held in a perfectly flat position between the metal plates 50, 51 and the insulating sheets 35, 37a. Accordingly, the insulating sheets may be greatly reduced in thickness, as compared with prior art structures, thus reducing the operating temperature of the heater element and decreasing the temperature differential between the heater element and the body of the iron. As a result, the heater element is placed under the protection of the body of the iron due to the intimate heat exchange relation therebetween. Furthermore, the heating element is absolutely plane, a uniform thickness throughout and free from bonds, folds, soldered or welded joints. Also, practically the entire available surface is effectively utilized for the generation of heat. The terminals, one of which is provided for each terminal portion 28 and 29, cooperate with the associated structure to maintain a perfectly flat position for the entire heating element and to afford an efficient electrical connection thereto.

While the present invention, as to its objects and advantages, has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby but it is intended to cover the invention broadly within the

spirit and scope of the appended claims. For example, instead of concentrating the heat at the tip of the iron by decreasing the width of the element adjacent the tip regions, it is also within the scope of the invention to slightly roll down the tip portion of the heater element blank, thereby increasing the specific resistance of the element in this region.

What is claimed is:

1. A heater element including the combination, with a flat sheet of mica, of a flat plate of electrically resistant metal having a plurality of generally parallel staggered slots forming the plate into an elongated resistance element comprising a plurality of sections and disposed with one side thereof on the mica sheet; a pair of flat plate-like terminal portions integral with two end portions of the plate or resistance element and disposed substantially in the same plane therewith; insulating material located in the staggered slots to prevent accidental contact between the sections of the plate; a second flat sheet of mica disposed on the other side of said plate and having a plurality of apertures therein giving direct access exclusively therethrough to the two plate-like terminal portions of said resistance element; a pair of hollow binding posts mounted in upstanding position with openings to the interiors thereof directed to said terminal plate-like portions; and a quantity of comminuted conducting material occupying the hollow interiors of said hollow binding posts under pressure and making direct pressure contact with said flat plate-like terminal portions through said openings.

2. A heater element including the combination, with a flat sheet of mica, of a flat plate of electrically resistant metal having a plurality of generally parallel staggered slots forming the plate into an elongated resistance element comprising a plurality of sections and disposed with one side thereof on the mica sheet; a pair of flat-like terminal portions integral with two end portions of the plate or resistance element and disposed substantially in the same plane therewith; insulating material located in the staggered slots to prevent accidental contact between the sections of the plate; a second flat sheet of mica disposed on the other side of said plate and having a plurality of apertures therein giving direct access exclusively therethrough to the two plate-like terminal portions of said resistance element; a pair of hollow binding posts mounted in upstanding position with openings to the interiors thereof directed to said terminal plate-like portions; said hollow binding posts having further openings which are internally threaded and lead to the hollow interiors thereof; adjusting screws engaging in the interiors of the threaded openings; and a quantity of comminuted conducting material filling the hollow interiors of said binding posts and being compressed between the inner ends of said adjusting screws and said plate-like terminal portions in such fashion as to make electrical contact between the latter and said binding posts.

3. A heater element including the combination, with a flat sheet of mica, of a flat plate of electrically resistant metal having a plurality of generally parallel staggered slots forming the plate into an elongated resistance element comprising a plurality of sections and disposed with one side thereof on the mica sheet; a pair of flat plate-like terminal portions integral with two end portions of the plate or resistance element and disposed substantially in the same plane therewith;

insulating material located in the staggered slots to prevent accidental contact between the sections of the plate; a second flat sheet of mica disposed on the other side of said plate and having a plurality of apertures therein giving direct access exclusively therethrough to the two plate-like terminal portions of said resistance element; a pair of hollow binding posts mounted in up-standing position with open lower ends directed to said plate-like terminal portions and having internally threaded upper hollow ends communicating through the hollow interiors of said binding posts with the open lower ends thereof; means for securing the binding posts individually in position upon said terminal portions; adjusting screws engaging in the internally threaded hollow upper ends of said binding posts; and a quantity of comminuted graphite filling the hollow interiors of said binding posts in compressed condition between the inner ends of said adjusting screws and said plate-like terminal portions and making electrical contact between the latter and said binding posts.

4. The method of making a heating element for an iron or the like, which consists in simultaneously stamping a predetermined number of substantially parallel staggered slots through a flat plate of electrically resistant metal and also stamping an intermediate channel slot subdividing the plate into a plurality of flat sections connected together at one end and terminating at the other end in a pair of flat plate-like terminals inter-connected by a bridge portion; insulating the stamped plate in flat condition while retaining said bridge portion intact to facilitate handling said stamped plate and also exposing part of said plate-like terminal portions; fixing the stamped and insulated plate in position and disposing it to form an elongated resistance element; cutting through the bridge portion to separate the flat plate-like terminal portions; and connecting the exposed parts of said flat plate-like terminal portions to a pair of binding posts.

5. The method of making a heating element for an iron or the like, which consists in simultaneously stamping a predetermined number of substantially parallel staggered slots through a flat plate of electrically resistant metal and also stamping an intermediate channel slot subdividing the plate into a plurality of flat sections connected together at one end and terminating at the other end in a pair of flat plate-like terminals inter-connected by a bridge portion; insulating the stamped plate in flat condition while retaining said bridge portion intact to facilitate handling said stamped plate and also exposing part of said plate-like terminal portions; fixing the stamped and insulated plate in position; cutting out said bridge portion subsequently to the stamping operation; and connecting the exposed part of the flat terminal portions to a pair of binding posts.

6. The method of making a heating element for an iron or the like, which consists in simultaneously stamping a predetermined number of

substantially parallel staggered slots through a flat plate of electrically resistant metal and also stamping an intermediate channel slot subdividing the plate into a plurality of flat sections connected together at one end and terminating at the other end in a pair of flat plate-like terminals inter-connected by a bridge portion; insulating the stamped plate in flat condition while retaining said bridge portion intact to facilitate handling said stamped plate and also exposing part of said plate-like terminal portions; fixing the stamped and insulated plate in position; cutting out said bridge portions subsequently to the stamping operation; and making electrical contact with said flat plate-like terminal portions by individually disposing a pair of metal contact members adjacent to the exposed part of said terminal portions compressing comminuted conducting material between said terminal portions and portions of said pair of metal contact members.

7. The method of making a heating element having an elongated conductive path for electric current which consists in producing a flat resistance element from a sheet of electrically resistant metal with a pair of terminals thereon and leaving a short-circuiting portion which short circuits said terminals; securing the resistance element in position in flat supported position; and finally cutting out the short-circuiting portions and conditioning said terminals for connection to a pair of binding posts.

8. The method of making a heating element for an iron or the like, which consists in stamping a predetermined number of substantially parallel staggered slots through a flat plate of electrically resistant metal and also stamping an intermediate channel slot subdividing the plate into a plurality of flat sections connected together at one end and terminating at the other end in a pair of flat plate-like terminals inter-connected by a bridge portion; fixing the stamped plate in position and disposing it to form an elongated resistance element; cutting through the bridge portion to separate the flat plate-like terminal portions; and connecting the exposed parts of said flat plate-like terminal portions to a pair of electrical conductors.

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#### REFERENCES CITED

The following references are of record in the file of this patent:

#### UNITED STATES PATENTS

| Number     | Name               | Date          |
|------------|--------------------|---------------|
| Re. 21,611 | Reichold .....     | Oct. 29, 1940 |
| 953,393    | Parkhurst .....    | Mar. 29, 1910 |
| 1,158,487  | Hadaway .....      | Nov. 2, 1915  |
| 1,848,759  | Wiegand .....      | Mar. 8, 1932  |
| 1,909,247  | Benkleman .....    | May 6, 1933   |
| 2,009,732  | Harper et al. .... | July 30, 1935 |
| 2,162,918  | Marvin .....       | June 20, 1939 |
| 2,432,800  | Reichold .....     | Dec. 16, 1947 |