June 24, 1930. H. V. LECKIE ET AL 1,767,249

ELECTRIC HEATER

Original Filed Aug. 9, 1920 3 Sheets-Sheet 1

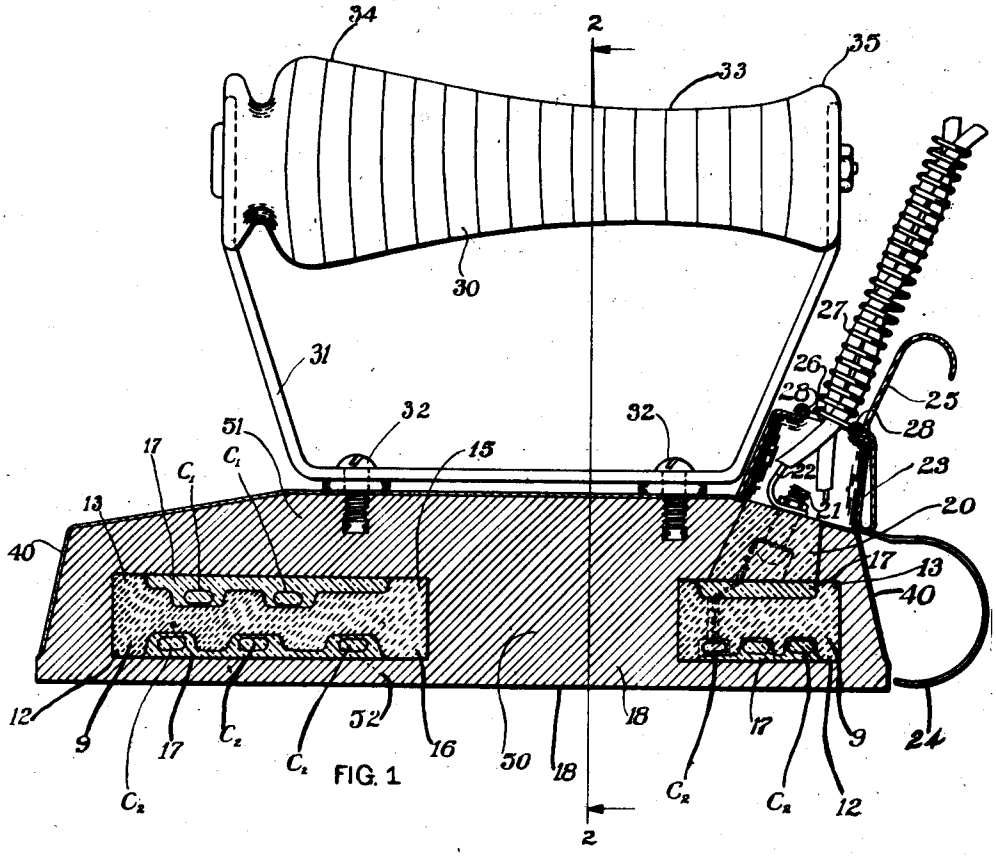


FIG. 1

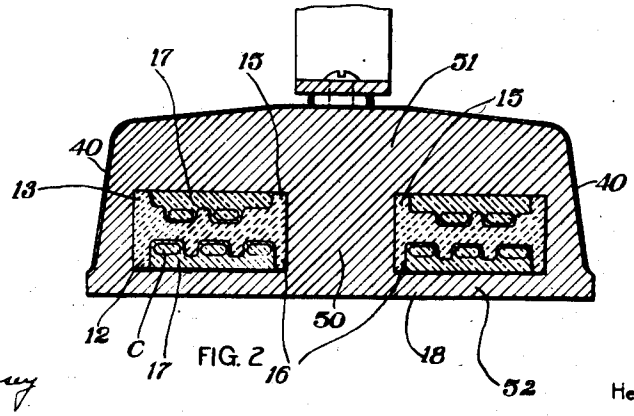


FIG. 2

WITNESS
Vera C. Ramsey

INVENTORS
Herbert V. Leckie
AND
Watson H. Woodford

BY A. A. Hicke
ATTORNEY

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FIG. 3

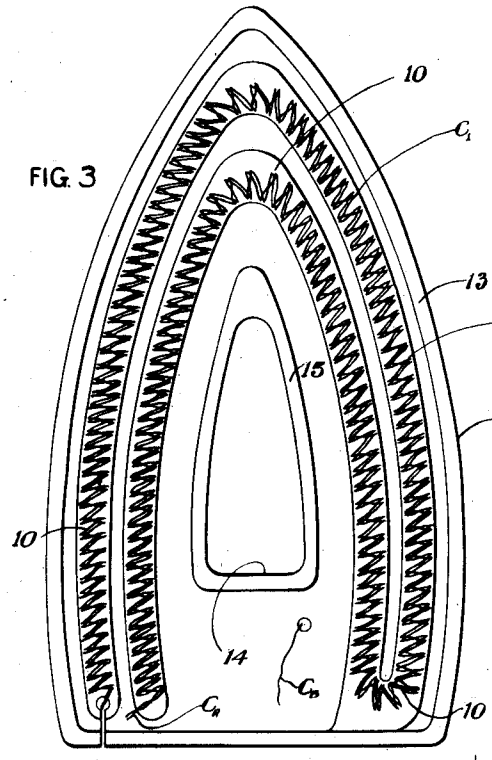
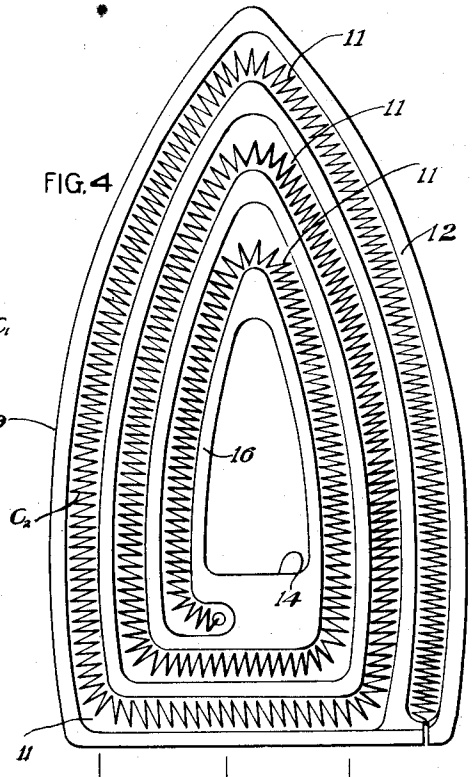


FIG. 4



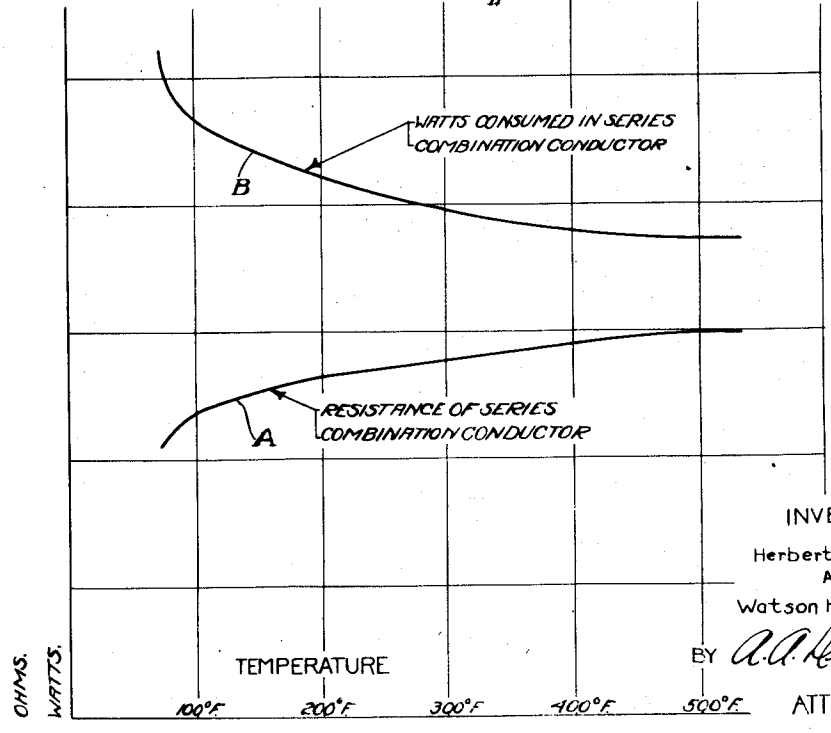


FIG. 5

INVENTORS

Herbert V. Leckie

AND

Watson H. Woodford

BY A. A. Hicke

ATTORNEY

June 24, 1930. H. V. LECKIE ET AL 1,767,249

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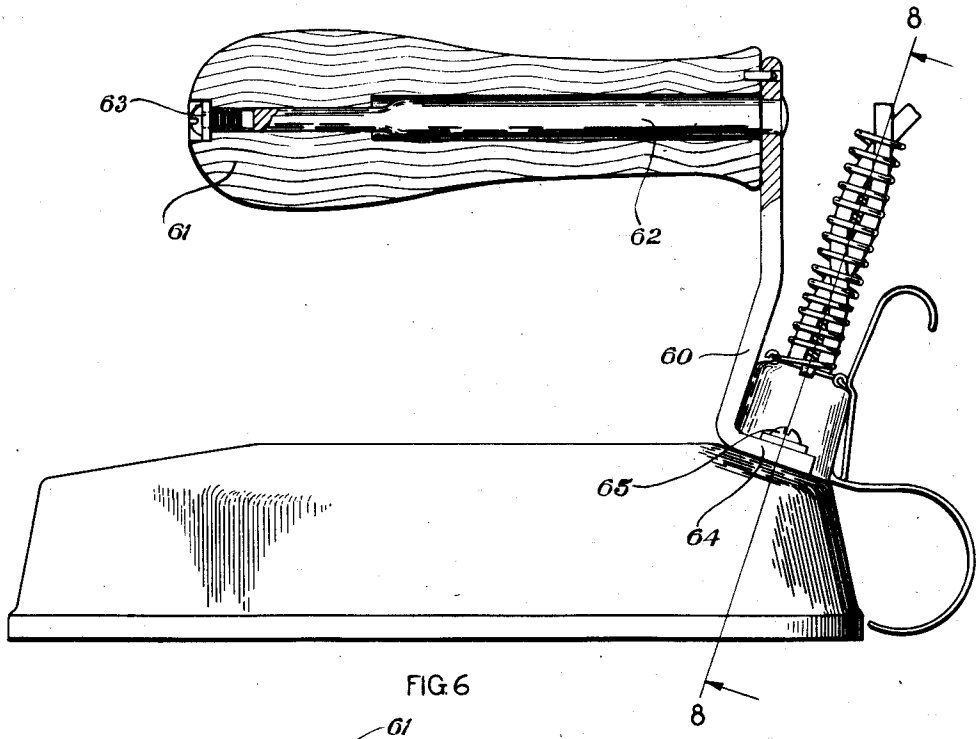


FIG. 6

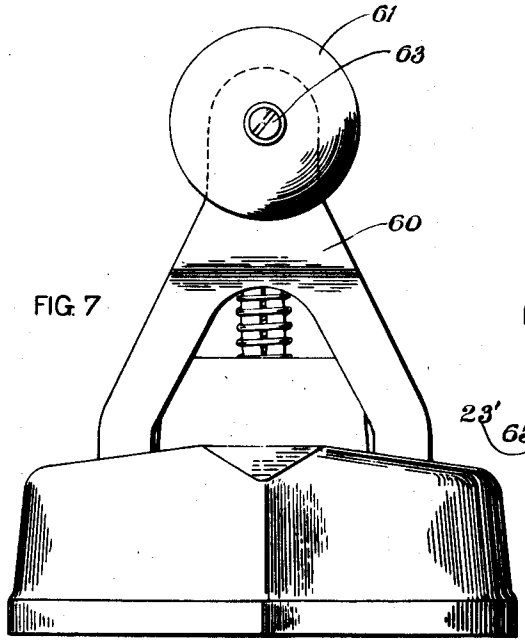


FIG. 7

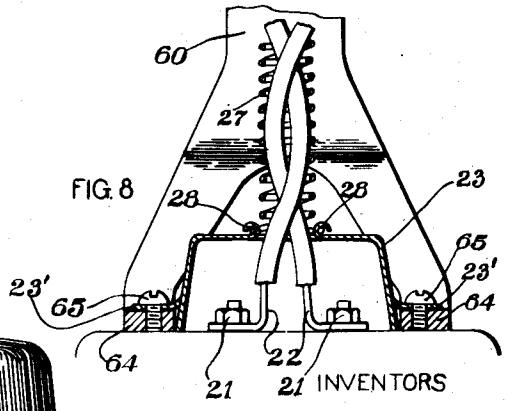


FIG. 8

INVENTORS
Herbert V. Leckie
AND
Watson H. Woodford

BY A. A. Hicke
ATTORNEY

WITNESS
Vera E. Ramsey

Patented June 24, 1930 1,767,249

UNITED STATES PATENT OFFICE

HERBERT V. LECKIE, OF STRATFORD, AND WATSON H. WOODFORD, OF BRIDGEPORT, CONNECTICUT, ASSIGNORS TO REMINGTON ARMS COMPANY, INC., A CORPORATION OF DELAWARE

ELECTRIC HEATER

Application filed August 9, 1920, Serial No. 402,276. Renewed December 18, 1928.

The present invention relates to electric heaters such as electric irons, soldering irons, water and room heaters, utensils, etc., the general objects being to improve the thermal conductivity between the heat generating conductor and heat consuming surfaces of the heater, to increase the reliability, durability and efficiency of such heater and to greatly reduce the cost of manufacture.

Another object is to construct such heaters so that the heat developed decreases with increase in temperature, whereby the temperature of the heater is automatically held approximately constant.

Another object is to accomplish this result by the use of a conductor having a high positive temperature coefficient in series with a conductor having a very low temperature coefficient, positive or negative.

A further object is to provide an electric heater device having a relatively low thermal drop between the heat generating conductor and the heat consuming surfaces whereby the working temperature of the conductor is greatly reduced, making it possible to utilize the cheaper kinds of resistance wire. On this account it will not be necessary to use such expensive conductors as those made of the well-known nickel-chromium alloys which have been specially developed to resist very high temperatures.

A further object is to prevent the heat loss as much as possible by providing those surfaces of such heaters which are not used for consuming heat with a coating which will reduce radiation of heat therefrom.

These several objects are attained by the construction shown in the attached drawings, wherein the invention is shown embodied in an electric iron. It is to be noted, however, that the invention may find expression in mechanical form in other electric heater devices, as for example, soldering irons, water and room heaters, utensils, etc.

In said drawings,

Fig. 1 is a central vertical sectional view of an electric iron illustrating the present invention, the handle supports and cord supporting spring being shown in elevation.

Fig. 2 is a sectional view on line 2—2 of Fig. 1.

Fig. 3 is a top plan view of the insulating core, the conductor being shown in place.

Fig. 4 is a bottom view of the core, the conductor being shown in place.

Fig. 5 shows graphs of resistance and current at different temperatures as shown by experiment.

Fig. 6 is a side elevation of an electric iron provided with a modified form of handle.

Fig. 7 is a front view of the iron of Fig. 6.

Fig. 8 is a sectional view on the line 8—8 of Fig. 6.

In said drawings the numeral 9 designates a flat core of insulating material formed with grooves 10 on its top face for housing a portion of the heat generating conductor C and having a spiral groove 11 on its bottom face for housing the remaining portion of the conductor. The contour of this core generally corresponds to the contour of the particular heater in which it is to be used. For an electric iron it will have substantially the contour shown in Figs. 3 and 4. This core is preferably formed with a lower flange 12 and an upper flange 13, extending around its outer rim for a purpose to be described later. This core also preferably is formed with a central aperture 14 of any convenient size and shape, also preferably surrounded by an upper flange 15 and a lower flange 16. In order to retain the conductor in the grooves 10 and 11 and to keep them electrically insulated and to exclude air therefrom and thereby prevent oxidation, the spaces between the flanges 13 and 15 and 12 and 16 respectively, are filled in with a plastic composition 17 which is a relatively good conductor of heat. This composition will be described later. The core and the plastic material 17 with the conductor C imbedded therein forms the heating unit of the iron or other heater. This unit is surrounded by the metallic body 18 of the iron, preferably of cast iron, brass, copper or aluminum, the heating unit being preferably incased in the body 18 by having the body cast around it. The iron body serves as a heat storing device

and its bottom face or sole 18′ serves as a heat applying or distributing surface.

The numeral 20 designates a block of insulating material carrying terminals 21 to which the covered wires 22 and the heat generating conductors are connected, Figs. 1 and 8. Any suitable means may be employed for covering the connections but it is preferred to utilize the combined connection box and iron stand shown in the drawings. This preferably comprises the box 23 fastened to the top of the iron body by suitable means, the downwardly and rearwardly extending support 24 and the upwardly and rearwardly extending support 25. The top of the box is perforated as at 26 for the electric cord which may, as is usual, be supported by a coil spring 27 attached to the box 23 possibly by integral ears 28. The shape of the supports 24 and 25 is such that the support 25 may be formed from material cut from the central portion of the support 24. The supports 24 and 25 form an iron supporting stand on which the iron may be supported when not in use.

The numeral 30 represents the handle, attached to the iron body in any suitable way as by the handle strap 31 secured to the iron body by screws 32. The part 33 of the handle, about two thirds its length from the front end, is of relatively small diameter from which point the handle increases in diameter forwardly to a maximum at 34, near the forward end of the handle. This general shape has been found by experiment to be a great improvement over handles heretofore used. Most of the work of ironing is done by sliding the iron forwardly across the work under considerable pressure. In order that this may be done without undue tiring of the arm and finger muscles, the stronger fingers, first, second and third, should grip the handle at a point where it increases in diameter forwardly. The handle disclosed herein fulfills this requirement and has been found a great improvement. Rearwardly from the point 33 the handle increases in diameter to the point 35. This enables the fourth finger to grip the handle for drawing the iron rearwardly and also prevents the hand sliding against the rear handle strap.

It is desirable to reduce heat losses from electric irons and other heaters as much as possible both for the comfort of the operator and to reduce the cost of operation. To this end and to improve the appearance it has been found desirable to cover those surfaces of the iron or other heater which are not used for applying or distributing heat with a substance 40 which is a poor conductor of heat and has a smooth preferably white heat reflective surface, which will reduce heat radiation to a minimum. It has been found that ordinary vitrified enamel forms an excellent coating for this purpose. The finished heater body is coated with the siliceous or other material generally used for this purpose and it is then baked in an oven at a high temperature. The resulting covering is of a good appearance, can be easily kept clean, and, unlike nickel plating, will not be discolored by heat.

Any suitable plastic composition may be used for the core 9, such as Portland cement, asbestos, soapstone, talc or quartz, etc., with the possible addition of sodium silicate. The selected ingredients are moistened to a proper consistency and pressed into a properly shaped mold and allowed to set.

The imbedding composition 17 must (1) be easily molded and then set; (2) it must be heat conductive; (3) it need not be electrically conductive but slight conductivity is not harmful; (4) it must not give off gases at the casting in temperature, (about 2400 degrees Fahr.); (5) it must not crumble or crack at this high temperature; (6) its coefficient of expansion should not be excessive so as to enable it to resist sudden changes of temperature.

After extensive research it was found that the following composition met all these difficult requirements:—

	Part by volume
Ground slate	1
Baked ground slate	1
"Crystolon" (silicon carbide fused at a high temperature, made and sold under this name by the Norton Co.)	1

After mixing these ingredients the mixture is moistened by a solution of sodium silicate and, if desired, a small quantity of soapstone is added. The resulting mortar is plastered over the core, in the grooves of which the conductor C has been placed. Enough of the mortar is used to fill the space surrounded by the flanges 12 and 13. These flanges conveniently serve to hold the mortar in position and also to measure the quantity applied thereby assuring units of equal thickness. The resulting units are allowed to dry for a few days and are then baked at a temperature of about 1600 degrees Fahr., the mortar forming a hard, brittle refractory cover for the conductors.

After application of the imbedding compound the heating unit is complete and ready to be cast in. The insulating block 20 is placed in position and the ends C^a and C^b of the conductor are connected with the terminals 21. These parts are then placed into a mold having the shape of the finished iron and molten metal is poured into the mold and completely surrounds the heating unit. The contraction of the metal in cooling places the incased heating unit under enormous pressure with the result that intimate mechanical and thermal relation is brought about

and the possibility of breakage or disarrangement of the parts is entirely obviated. When the casting is removed from the mold the heating element is enclosed therein. After machining the sole and tapping holes for the screws 32 the iron is ready for its enamel coating and for assembling.

As far as certain of the features of the present invention are concerned, any suitable conductor C may be employed. It is preferred, however, to make use of an improved heat generating conductor the resistance of which will increase with temperature, i. e., have a positive resistance temperature coefficient. It has been proposed heretofore to secure this result by employing a heating conductor of iron which has a very high positive co-efficient. These attempts were apparently unsuccessful for the reason that not enough space is available in such electrically heated devices to permit of the use of a sufficient length of the proper sized wire; this for the reason that the resistance of iron is quite low and its permissible working temperature is likewise low. Such high resistance alloys as nickel-steel, nickel-chromium, etc., have a negligible temperature coefficient and therefore can not be utilized for regulation. After considerable experiment we have discovered that when iron is used in series with a high resistance conductor the resulting combined conductor will have sufficient regulating effect while also giving sufficient resistance to enable it to be placed in the small space available.

In the drawings that part of the conductor C which lies above the core 9 and designated C_1 is preferably composed of a substance having a high positive resistance temperature coefficient, as iron, and the part C_2 below the core is preferably of high resistance material having a low temperature coefficient, positive or negative, as for example, nickel-steel, nickel-chromium, or other suitable alloy.

Very good regulating effects have been obtained with the two conductors so proportioned that the iron furnishes 10% of the total resistance (at low temperature) and the high resistance alloy 90 per cent. The iron wire therefore furnishes only a small part of the heat generated. At low temperatures, this may be only 10 per cent of the total but at high temperatures the total resistance is increased and the regulating wire may furnish as much as 18 per cent of the total resistance. These figures are merely illustrative.

Fig. 5 shows graphically the regulating effect of iron-wire in series with high resistance alloy wire. By reference to curve A it will be seen that from 75 degrees Fahr. to 500 degrees the resistance was increased about 41 per cent. Curve B shows a corresponding decrease in energy input.

In the construction illustrated the conductors C_1 and C_2 are in intimate thermal relation with the body of the iron and the temperature of the conductors will vary closely with the temperature of the iron body. Therefore, when the iron or other heater is cold, the resistance is low and a heavy current is drawn so that the heater will be quickly brought up to working temperature. As the temperature rises, resistance increases and if the heater remains idle a point will soon be reached where the heat input just equals heat lost by convection, conduction and radiation. As no heat is available for further raising the temperature of the iron the highest temperature has been reached and this temperature will be sustained indefinitely. If, however, heat consumption is increased, as by use of the device, the temperature will be reduced. This lowers the temperature of the iron conductor C, reducing its resistance. More heat is developed and the temperature is raised, with the general result that the temperature is held fairly constant in spite of variations in heat energy consumed.

It has been proposed heretofore to use in series two conductors having respectively, positive and negative resistance temperature coefficients with the object of overcoming the effect of the negative coefficient or for securing a combination conductor having a zero coefficient so that the resistance will not be affected by temperature changes. But a conductor having a high positive temperature coefficient has not to our knowledge been heretofore used in series with a high resistance conductor having a negligible coefficient for the purpose of obtaining a high resistance combination conductor having a high positive resistance temperature coefficient for purposes of regulation.

In order to improve the responsiveness of the regulating conductor C, it has been found very beneficial to form this conductor of two strands twisted together as shown in Fig. 3. In this way the surface of the conductor is greatly increased without increasing the total cross-sectional area. This decreases the thermal drop between the conductor and the iron body and therefore increases the responsiveness of the regulating conductor.

As stated above the core 9 is preferably formed with a substantially central aperture 14. This improves the circulation of the molten metal in the mold and therefore aids greatly in avoiding blow holes, etc. In the finished iron this provides a tie bar 50 between the top plate 51 and the bottom 52 of the iron which strengthens the iron and increases the heat conduction.

In Figs. 6, 7 and 8 is illustrated a modified form of electric iron. In this form the front handle support is omitted and the handle supported only from a rear handle strap 60 in cantilever fashion. The handle 61 is

supported on a tie rod 62 attached to the strap 60 preferably by riveting. The handle is slid over the rod and fastened in place in any suitable way as by a holding screw 63. The shape of the handle is preferably substantially the same as the handle shown in Fig. 1. This construction has been found a great improvement as it permits of entering almost the entire iron into sleeves and other openings of the clothing being ironed. In the case of the forms heretofore used this was prevented by the front handle strap. Another advantage is that the danger of burns due to the fingers coming into contact with the front handle strap is entirely absent. A further advantage is that such a handle may be grasped so that its forward end lies against the palm with the fingers extending rearwardly. This position is of advantage in certain operations and greatly reduces fatigue due to the choice of different positions of the hands and fingers.

The strap 60 is widened out at its lower part and preferably bifurcated as shown in Figs. 7 and 8. The bottom ends are bent laterally to provide feet 64 bearing on the iron body and attached thereto by screws 65. These screws may also be utilized to secure the connection box 23 in place by having ears 23′ formed thereon and overlying the feet 64 and formed with holes to receive the screws 65.

The construction shown in the drawings and described herein illustrate the application of the present invention to electric irons. It is to be understood, however, that many of the features thereof are applicable to electric heaters in general and that others can now by applying current knowledge adapt this invention to other physical applications thereof without omitting certain features that, in view of the present condition of the art, fairly constitute essential characteristics of the generic or specific aspects of this invention, and therefore such adaptations should and are intended to be comprehended within the meaning and range of equivalency of the following claims:

1. An electrically heated device comprising in combination a heat storing and applying body and a resistance for heating said body, comprising a high resistance conductor having a very low positive resistance temperature coefficient and a regulating conductor in series therewith having a high positive resistance temperature coefficient.

2. An electrically heated device comprising in combination a heat storing and applying body and a resistance for heating said body, a high resistance conductor having a very low resistance temperature coefficient and a regulating conductor in series therewith having a high positive resistance temperature coefficient, both conductors being adjacent to said heat storing and applying body, and connected therewith by short heat conducting paths of relatively great cross sectional area.

3. An electrically heated device comprising in combination a heat storing and applying body and a resistance for heating said body, comprising a high resistance metallic conductor having a negligible resistance temperature coefficient and a regulating conductor in series therewith having a high positive resistance temperature coefficient.

4. A resistance conductor comprising in combination a conductor of nickel-steel and a regulating conductor of iron in series therewith.

5. An electrically heated device comprising in combination a heat storing and applying body and a resistance for heating said body, comprising a nickel-steel conductor and a regulating conductor of iron in series therewith.

6. An electrically heated device comprising in combination a heat storing and applying body and a resistance for heating said body, comprising a high resistance metallic conductor having a very low resistance temperature coefficient and a regulating conductor in series therewith having a high positive resistance temperature coefficient, said regulating conductor comprising a plurality of strands in parallel.

7. In an electrically heated device, a relatively flat insulating core having a contour corresponding to the contour of the device, an aperture in said core, a series of grooves in each face of said core surrounding said aperture, a heating conductor in one of said series of grooves, and a regulating conductor in the second series of grooves.

8. In an electrically heated device, an insulating core having a contour corresponding to the contour of the device, an aperture in said core, a groove in the upper side of said core surrounding said aperture, a continuous heating conductor in said groove, a spiral groove in the lower face of said core, a continuous conductor in said spiral groove, said conductor being connected in series with the continuous conductor in the first groove.

9. An insulating core for heating units of an electrically heated device, comprising a relatively flat body of insulating material having a contour corresponding to the contour of such device, a series of grooves in the upper surface of said insulating core, upwardly extending ribs separating said grooves, a second series of grooves in the lower surface of said insulating core, downwardly extending ribs separating the grooves of said second series and upwardly and downwardly extending flanges surrounding said core integral therewith and extending beyond said ribs.

10. In an electrically heated device, an insulating core comprising a central aperture,

a series of grooves formed in the upper surface of said core upwardly extending ribs separating the grooves of said series, a second series of grooves formed in the lower surface of said core, downwardly extending ribs separating the grooves of said second series, upwardly and downwardly extending flanges projecting beyond said ribs, and a heat storing and applying body surrounding said core and filling the aperture therein.

11. In an electric heater, an insulating core comprising a relatively flat body of insulating material having a contour corresponding to the contour of the heater, a central aperture in said core, upwardly and downwardly extending flanges surrounding said core and said aperture and a heat storing and applying body surrounding said core and filling said aperture.

12. A heating unit for electric heaters comprising in combination an insulating core having a contour corresponding to the contour of the heater, grooves formed in said core, outwardly projecting ribs separating said grooves, a flange surrounding said core integral therewith and projecting outwardly beyond said ribs, a heat generating conductor in said grooves and a plastic heat conducting composition covering said conductor and said grooves and filling the space within said flange.

13. A heating unit for electric heaters comprising in combination an insulating core having a contour corresponding to the contour of the heater, grooves formed in the top and bottom faces of said core, ribs separating said grooves, a heat generating conductor in said grooves, upwardly and downwardly extending flanges surrounding said core and extending beyond said ribs and a heat conducting composition covering said conductor and said ribs and filling the space bounded by said flanges.

14. A heating unit for electric heaters comprising in combination an insulating core having a contour corresponding to the contour of the heater, a central aperture in said core, a groove formed in said core extending around said aperture, a heat generating conductor in said groove, a flange extending around said core, a flange surrounding said aperture, said flanges forming a recess above said groove and a heat conducting composition covering the conductor in said groove and filling the recess bounded by said flanges.

15. A heating unit for electric heaters comprising in combination an insulating core having a contour corresponding to the contour of the heater, a central aperture in said core, grooves formed in the top and bottom faces of said core around said aperture, a heat generating conductor in said grooves, upwardly and downwardly extending flanges surrounding said core and aperture, said flanges forming recesses over said grooves, and a heat conducting composition covering the conductor in said grooves and filling the recesses bounded by said flanges.

16. In an electric heater, a heating unit comprising in combination an insulating core having a contour corresponding to the contour of the heater, grooves formed in said core, ribs separating said grooves, a heat generating conductor in said grooves, a flange surrounding said core and extending outwardly beyond said ribs, a heat conducting composition covering said conductor and said ribs and filling the space bounded by said flange, and a heater body surrounding said unit, and in close contact therewith.

17. In an electric heater, a heating unit comprising in combination an insulating core having a contour corresponding to the contour of the heater, grooves formed in the top and bottom faces of said core, ribs separating said grooves, a heat generating conductor in said grooves, upwardly and downwardly extending flanges surrounding said core and extending beyond said ribs, a heat conducting composition covering said conductor and said ribs and filling the space bounded by said flanges, and a heater body surrounding said unit and in close contact therewith.

18. In an electric heater, a heating unit comprising an insulating core having a contour corresponding to the contour of the heater, a central aperture in said core, a groove formed in said core extending around said aperture, a heat generating conductor in said groove, a flange extending around said core and a flange surrounding said aperture, said flanges forming a recess above said groove, a heat conducting composition covering said conductor filling the recess bounded by said flanges and a heater body filling said aperture and surrounding said unit in close contact therewith.

19. In an electric heater, in combination, a heating unit comprising an insulating core having a contour corresponding to the contour of the heater, a central aperture in said core, spiral grooves formed in the top and bottom faces of said core around said aperture, a heat generating conductor in said grooves, upwardly and downwardly extending flanges surrounding said core and aperture respectively and forming recesses over said grooves, a heat conducting composition covering said conductor and filling the recess bounded by said flanges, and a heater body filling said aperture and surrounding said unit in close contact therewith.

20. An electric heater comprising a heat storing and applying body having cast therein a heating element comprising a core of insulating material having a contour corresponding to the contour of the heater, a central aperture in said core and upwardly and downwardly extending flanges surrounding said

core and said aperture and forming conductor containing grooves.

21. An electric heater comprising a heat storing and applying body having cast therein a heating unit comprising an insulating core having a contour corresponding to the contour of the heater, grooves formed in said core, ribs separating said grooves, a heat generating conductor in said grooves, a flange surrounding said core and extending outward beyond said ribs, and a heat conducting composition covering said conductor and said ribs and filling the spaces bounded by said flange.

22. An electric heater comprising a heat storing and applying body having cast therein a heating unit comprising an insulating core having a contour corresponding to the contour of the heater, a central aperture in said core, grooves formed in the upper and lower faces of said core around said aperture, ribs separating said grooves, a heat generating conductor in said grooves, upwardly and downwardly extending flanges surrounding said core and aperture and extending outwardly beyond said ribs to form recesses over said grooves, and a heat conducting composition covering the conductor in said grooves and filling the recesses bounded by said flanges.

HERBERT V. LECKIE.
WATSON H. WOODFORD.