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2,367,985

CONTROL DEVICE

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Fig. 1.

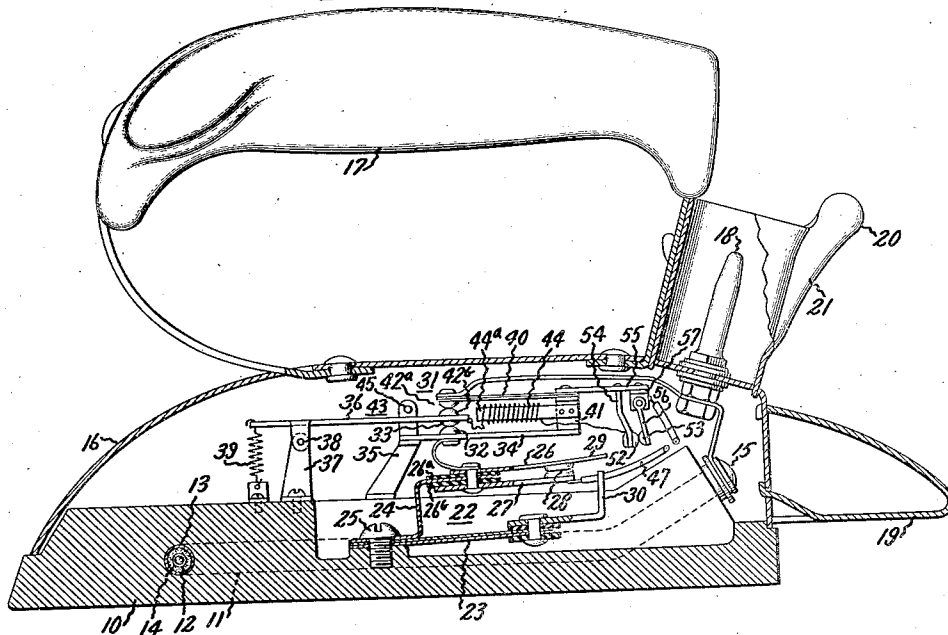
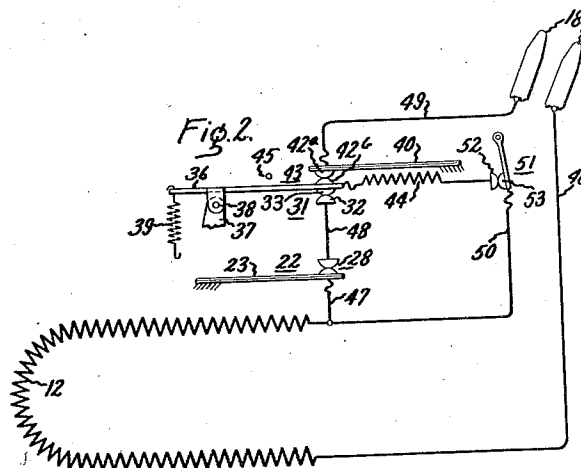


Fig. 2.



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UNITED STATES PATENT OFFICE

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CONTROL DEVICE

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11 Claims. (Cl. 219—25)

My invention relates to electrically heated flatirons and more particularly to improved means for deenergizing the iron in case it is inadvertently left connected to the power supply in a position where damage from burning or scorching would be likely to occur.

Electric flatirons are commonly provided with heelstands for supporting the iron in a substantially vertical position in which the heated soleplate is out of contact with the supporting surface, thereby preventing burning or scorching during the times when the iron is energized. Occasionally, however, the operator forgets to place the iron on the heelstand and leaves it energized in a horizontal ironing position and in contact with a combustible surface such as an ironing board. In such a case damage from fire or scorching is very likely to occur.

It is an object of my invention to provide an improved means for automatically deenergizing an electric flatiron in case it is left connected to the power supply in the horizontal ironing position.

It is a further object of my invention to provide an automatically deenergizing means of the above type that does not require the actuation of any control means by the operator to render it operative.

A still further object of my invention is to provide an improved automatic deenergizing means of the above type which is disabled when the iron is placed in a vertical position on its heelstand thereby permitting normal heating of the iron when it is left unattended in this position.

In order to provide means for automatically deenergizing or disconnecting the iron when it is left idle, which means does not require actuation of any control means by the operator, such as, for example, a handle operated switch, I make use of the fact that the rate of dissipation of heat from the soleplate is much lower when the iron is idle than when it is moved about over relatively cool surfaces being ironed. Hence, according to my invention I provide means responsive to the rate at which heat is dissipated from the soleplate for actuating a disconnecting means when the rate of heat dissipation falls below the value encountered when the iron is moved about in normal use. In the illustrated embodiment of my invention the disconnecting means is a thermally actuated control switch and the means for actuating the auxiliary switch is an auxiliary heating element energized in accordance with the percentage of time the contacts

of the main thermostatic switch remain in the "off" position, which, in turn, varies in accordance with the rate of heat dissipation from the iron. Also, a novel control system is provided whereby the auxiliary control switch is maintained in the open circuit or disconnecting position once it has been actuated until the iron is either disconnected from the power supply or placed in an upstanding position on its heelstand.

My invention will be better understood by reference to the following description taken in connection with the accompanying drawing in which Fig. 1 is an elevation view, in section, of an electric flatiron embodying an improved automatic disconnecting means constructed in accordance with my invention; and Fig. 2 is a diagrammatic showing of the circuit connections of the flatiron.

For the purpose of illustrating the preferred form of my invention I have shown in the drawing an electrically heated flatiron having a soleplate 10 that is formed of any suitable material, such as cast iron or aluminum. Cast within the soleplate 10 is a sheathed heating element 11 preferably of the type described in the United States patent to C. C. Abbott 1,367,341, dated February 1, 1921. As shown, this heating element comprises a helical resistance heating element 12 mounted in a tubular metallic sheath 13 and supported in spaced relation with reference to the sheath by a compacted layer of insulating material 14 which is preferably powdered magnesium oxide. Heating elements of this type can be easily bent to the desired shape and the heating element is usually formed roughly in the shape of a horseshoe having its terminals 15 at the heel of the iron and its apex at the toe of the iron.

The iron is provided with a cover member 16 on which is mounted a suitable handle 17, the cover being mounted to the soleplate by fastening means not shown. Power is supplied to the heating element of the iron through terminal prongs 18 which are mounted upon the cover and are adapted to receive an attachment plug in the usual manner. Extending rearwardly from the iron is a heelrest 19 which, together with a projection 20 on a plug guard member 21, provides means for supporting the iron in an upstanding non-ironing position.

In order to maintain the temperature of the iron within predetermined limits I provide a main thermal switch or thermostat 22 having contacts connected in series circuit relation with the heating element 12 and movable between open and closed positions in accordance with

the temperature of the iron in the well-known manner. While any type of suitable main thermal switch may be used, I have illustrated one of the type disclosed in United States Patent 2,158,850, granted May 16, 1939, on the application of J. R. Campbell and assigned to the assignee of the present invention. Briefly, the thermostatic switch 22 described in the above-mentioned Campbell patent comprises a bimetallic element 23 and a Z-shaped supporting member 24, the ends of which are secured together and fastened in good thermal relation to the soleplate 10 by means of a fastening screw 25. Extending outwardly from the upper end of the supporting member 24 are a pair of current conducting switch arms 26 and 27 carrying cooperating contacts 28, the switch arms being electrically insulated from each other and the support 24 by means of suitable insulating washers 26a and 26b. The upper switch arm 26 is resilient in construction and arranged to bias the contact 28 to the closed circuit position. The switching member 28 also has a portion 29 extending beyond the contact 28 which is adapted to be engaged by one end of an L-shaped member 30 extending outwardly and upwardly from the free end of the bimetallic member 23. The portion of the bimetallic member 23 having the higher coefficient of expansion is on the lower side so that when the bimetallic member becomes heated to a predetermined temperature by the soleplate its free end moves upwardly whereby the end of the L-shaped member 30 engages the outer end 29 of the spring switch arm 26 and opens the contacts 28 to open the series circuit at the thermal switch 22, this switch then being in an "off" position. When the temperature of the soleplate falls below the predetermined value, due to the dissipation of the heat therefrom, the free end of the bimetallic element 23 moves downwardly permitting the contacts 28 to reclose whereby heating current is again conducted to the heating element 12, the thermostat then being in the "on" position. The operation of the main thermal switch 22 in intermittently moving between the "on" and "off" positions, in order to maintain the temperature of the soleplate at some selected predetermined value, is entirely conventional and well understood by those skilled in the art.

In accordance with my invention I provide means responsive to the rate at which heat is dissipated from the soleplate 10 and the heating element 12 for substantially deenergizing the heating element 12 when the heat dissipation rate falls below the value encountered during normal use of the iron. In order to accomplish this I provide a thermally actuated auxiliary switch 31 which is connected in a manner, to be described more completely below, so that it controls the energization of the main heating element 12.

As shown, the auxiliary switch 31 comprises a fixed contact 32 and a relatively movable contact 33. The fixed contact 32 is mounted on a rigid supporting and insulating arm 34 which is in turn mounted in spaced relation with the top of the soleplate by means of a bracket 35. The movable contact 33 is carried on one end of a lever 36 an intermediate portion of which is pivotally mounted by means of a pivotal connection 38 on a stationary bracket 37 which in turn is mounted on the soleplate 10. The lever 36 is biased for counterclockwise rotation about the pivot 38 by means of a tension spring 39 so that the auxiliary switch 31 is biased to the open

position. The auxiliary control switch 31 is normally held in a closed position against the bias of the spring 39 by means of a temperature responsive element which has been illustrated in the form of a bimetallic element 40. One end of the bimetallic element 40 is rigidly secured to an upstanding projection 41 extending upwardly from the supporting arm 34.

The bimetallic element 40 carries on the lower side of its free end a contact 42a which is adapted to engage a cooperating contact 42b mounted on the free end of the pivotally mounted lever 36, the contact 42b being placed in back-to-back relation and in electrical contact with the contact 33 of the auxiliary switch 31. The contacts 42a and 42b constitute a heater switch 43, the purpose of which will be described below. The bimetallic element 40 is mounted so that it normally exerts a downward force on the pivoted lever 36 through the contacts 42a and 42b and thereby maintains the auxiliary switch 31 in a closed circuit position.

In order to actuate the auxiliary switch 31 to the open circuit position, and thereby practically cut off the heat by substantially deenergizing the heating element 12, I provide an auxiliary heater coil 44 which is placed in heat exchange relation with the bimetallic element 40. As shown, the heater coil 44 may be wound on an insulating core 44a which is mounted on the projection 41 so that the coil lies adjacent the bimetallic element 40. The bimetallic element 40 is arranged with the portion having the higher coefficient of expansion on the lower side so that when the bimetallic element is heated by the heater coil 44 the free end thereof deflects upwardly thereby permitting the arm 36 to pivot in a counterclockwise direction and open the contacts of the auxiliary control switch 31. After the contacts of the auxiliary switch have opened upon the heating of the bimetallic element by the coil 44 the counterclockwise movement of the lever 36 is interrupted by a stop pin 45 which is mounted on an extension of the bracket 35 and extends into the path of movement of the lever. Continued upward movement of the free end of the bimetallic element 40 then causes an opening of the contacts 42a and 42b of the heater switch 43.

The manner in which the main heating element 12, the main thermal switch 22, the auxiliary switch 31 and the heater switch 43 are connected may be best observed by reference to the circuit diagram shown in Fig. 2 of the drawing. The energizing circuit for the main heating element 12 may be traced as follows:

One of the terminal prongs 18, the conductor 46, the heating element 12, the conductor 47, the contacts of the main thermal switch 22, the conductor 48, the contacts of the auxiliary thermal switch 31, the contacts of the heater switch 43, the conductor 49, back to the other terminal prong 18.

It is evident, therefore, that the main thermal switch 22 and the auxiliary thermal switch 31 are connected in series relation in the energizing circuit and that the opening of either one of these switches will act to cut down the heat.

In normal operation the bimetallic element 40 keeps the heater switch 43 and the auxiliary switch 31 in a closed circuit position and the main thermal switch 22 intermittently opens and closes to control the flow of heating current to the heating element 12 and thereby maintains its temperature substantially constant.

The heater coil 44 is connected in parallel with the main thermal switch 22 and the auxiliary switch 31 by means of a shunt circuit 50. The shunt circuit 50 including the heater coil 44 has a relatively high impedance so that when the switches 22 and 31 are in the closed circuit position very little current flows through the heater coil 44. However, when the contacts of the thermal switch 22 move to the open circuit or "off" position, the flow of current through the heating element 12 is transferred to the shunt circuit 50 and the heater coil 44 so that the heater coil 44 is heated.

Connected in series with the high impedance shunt circuit 50 is a gravity operated switch 51 comprising a fixed contact 52 and a relatively movable contact 53. The fixed contact 52 is carried on the lower end of a fixed depending switch arm 54 which is mounted on a bracket 55 extending horizontally from the projection 41. The movable contact 53 is carried on the lower end of the depending switch arm 56, the opposite end of which is pivotally connected to a lug 57 depending from the supporting bracket 55. The lug 57 is located so that the weight of the pivotally mounted switch arm 56 tends to bias the movable contact 53 into engagement with the fixed contact 52 when the iron is in the horizontal or ironing position. However, when the iron is placed in a vertical upstanding position on the heelrest 19 the switch arm 56 rotates in a counterclockwise direction and opens the switch 51.

In operation let it be assumed that the iron is cold and that the terminal prongs 18 are connected to a suitable source of power supply. Since the bimetallic elements 23 and 40 are cold the switches 22, 31 and 43 will be closed to complete the energizing circuit for the main heating element 12. Due to the fact that the impedance of the shunt circuit 50 is high very little current will flow through the heater coil 44 and there will be substantially no heating action therein. When the soleplate reaches a temperature for which the main thermal switch 22 is set, the bimetallic element 23 moves upwardly opening the contacts of the main thermal switch 22. It will be assumed that the iron is now used in a normal ironing operation and is therefore in a horizontal position so that the gravity switch 51 is closed. The opening of the switch 22 therefore causes current to be diverted through the shunt circuit 50 including the heater coil 44 and the temperature of the coil 44 begins to rise. Since the rate of heat dissipation from the soleplate of the iron is relatively high when the iron is in use due to the fact that the iron is moved about over the relatively cool surfaces being ironed, the contacts of the main thermal switch 22 quickly reclose and the heater coil 44 is again shunted or short circuited. It will be understood that the amount of heat generated in the heater coil 44 depends upon the percentage of time that the contacts of the main thermostat 22 remain in the open circuit position and that the bimetallic element 40 is adjusted so that the heat generated by the coil 44 is not sufficient to move the free end of the bimetallic element 40 upward when this percentage is low as at times when the iron is in use.

If the operator now leaves the iron unattended in the horizontal ironing position the rate of heat dissipation from the soleplate 10 will greatly decrease due to the fact that the material below the soleplate becomes heated thereby de-

creasing the heat flow from the soleplate. The contacts of the main control switch 22 therefore remain in the "off" position for a much greater percentage of the time since less average current is required to maintain the temperature of the soleplate. Since, as pointed out above, the heating effect in the coil 44 is proportional to the percentage of "off" time of the main thermal switch 22, the temperature of the coil 44 begins to rise whereby the bimetallic element 40 is heated. The free end of the bimetallic element 40 then moves upwardly permitting the contacts of the auxiliary switch 31 to move to the open circuit position. The opening of the switch 31 substantially deenergizes the main heating element 12 and also makes it impossible for the subsequent closing of the contacts of the main thermal switch 22 to short circuit the auxiliary heater coil 44. Therefore, the heater coil 44 remains energized continuously irrespective of the action of the thermal switch 22 so that the auxiliary switch 31 cannot reclose. The amount of current flowing through the heating element 12 via the high impedance shunt circuit 50 is very small so that it produces substantially no heating effect therein whereby the main heating element 12 cools down to substantially room temperature.

The heater switch 43 operates to prevent overheating of the auxiliary heater coil 44. As pointed out before, after the auxiliary switch 31 opens the auxiliary heater coil 44 remains energized continuously so that its temperature continues to increase thereby causing the free end of the bimetallic element 40 to continue its upward movement. When the rotatable lever 36 engages the stop pin 45 its rotating movement ceases and the continued upward movement of the free end of the bimetallic element 40 causes the separation of the contacts of the heater switch 43. This interrupts the flow of current through the heater coil 44 so that it begins to cool down. The cooling of the coil 44 continues until the free end of the bimetallic element moves downwardly a sufficient distance to reclose the contacts of the heater switch 43 at which time the coil 44 is reenergized. The switch 43 is again reopened by the reheating of the bimetallic element 40 and this cyclic action continues and prevents overheating of the heater coil 44. During this cyclic heating and cooling of the heater coil 44, however, the temperature of the bimetallic element does not fall sufficiently far to cause a reclosing of the auxiliary switch 31 so that the main heating element 12 remains substantially deenergized.

In order to restore the iron to a normal operating condition it is merely necessary to place the iron in a vertical upstanding position on the heelrest 19. This causes an opening of the gravity operated switch 51 whereby the shunt circuit 50 is opened and the heating in the auxiliary heater coil 44 terminated. This causes the bimetallic element 40 to cool down so that the free end thereof moves downwardly and rotates the pivotally mounted lever 36 in a clockwise direction against the bias of spring 39 closing the contacts of the auxiliary switch 31. The main thermal switch 22 is then again placed in control of the flow of heating current to the main heating element 12 so that the temperature thereof is returned to the predetermined value for which the main thermostat 22 is set.

The normal operating condition of the iron may also be restored simply by disconnecting the iron from the power supply since this also will cause a

cooling down of the bimetallic element 40 and a reclosing of the switch 31.

If the iron is again left idle in a horizontal ironing position so that the percentage of time that the contacts of the thermal switch 22 remain in the "off" position increases beyond the value for which the thermal switch 31 is set, the switch 31 will again open to deenergize the heating element 12 in the manner described above, the cycle of operation being repeated.

It will be apparent from the foregoing that I have provided a simple and dependable means for automatically disconnecting an electric flatiron from the power supply in case it is left unattended in a horizontal ironing position. It will be observed that the protective arrangement is entirely automatic in operation and does not require the operation of an auxiliary control means by the user. Furthermore, the arrangement is inexpensive to manufacture and may be readily applied to electric flatirons of standard design.

While I have shown and described particular embodiments of my invention, it will occur to those skilled in the art that various changes and modifications may be made without departing from my invention, and I therefore aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In an electric flatiron, a heating element for heating said iron, a thermal switch responsive to the temperature of said iron operating between heat "on" and "off" positions as the iron heats and cools controlling the energization of said heating element to hold a substantially constant temperature in said iron, and auxiliary safety means for effecting a substantial deenergization of said heating element including an auxiliary switch which when operated to a predetermined position effects a substantial deenergization of said heating element, power means for operating said auxiliary switch to said predetermined position and for holding the same in said position, and means for controlling the operation of said power means responsively to the operation of said thermostatic switch between said "on" and "off" positions to cause said means to operate said auxiliary switch to said predetermined position when said thermal switch is in said "off" position in excess of a predetermined percentage of time.

2. In combination, flatiron having a soleplate and heating element for said soleplate, and an energizing circuit for said heating element, a thermostatic switch responsive to the temperature of said soleplate for controlling the flow of current from said circuit to said heating element, said thermostatic switch moving to an "on" position when the soleplate temperature falls below a predetermined value and moving to an "off" position when said soleplate temperature exceeds said predetermined value, means controlled by said thermostat for substantially deenergizing said heating element when the percentage of time said thermostat remains in the "off" position exceeds a predetermined value, and means for disabling said last-mentioned means when said soleplate is placed in a vertical non-ironing position.

3. In combination, an electric flatiron having a main heating element, a thermal switch responsive to the temperature of said main heating element for controlling the temperature thereof, an auxiliary heating element, a normally closed aux-

iliary thermal switch responsive to the temperature of said auxiliary heating element, an energizing circuit for said flatiron including said main heating element, said main thermal switch and said auxiliary thermal switch connected in series circuit relation, and means for connecting said auxiliary heating element in shunt with said main thermal switch and said auxiliary thermal switch whereby said auxiliary heating element is normally energized during the time when said main thermal switch is in the open circuit position, said auxiliary thermal switch being set to open so as to cause a continuous energization of said auxiliary heater when the percentage of time said main thermal switch remains in said open circuit position exceeds a predetermined value.

4. In combination, a flatiron having a soleplate, a heating element for said soleplate, an energizing circuit for said heating element, a main thermal switch responsive to the temperature of said soleplate for controlling the temperature thereof, said main thermal switch being connected in series with said circuit, a normally closed auxiliary thermal switch connected in series with said main thermal switch and said circuit, an auxiliary heating element for causing actuation of said auxiliary thermal switch, and a relatively high impedance circuit including said auxiliary heating element connected in shunt with said main thermal switch and said auxiliary thermal switch so that current flowing in said energizing circuit is diverted through said high impedance circuit and said auxiliary heating element when said main thermal switch is in the open circuit position, said auxiliary thermal switch being actuated to the open position when the percentage of time said main thermal switch remains in the open circuit position and consequently the temperature of said auxiliary heating element exceeds a predetermined value whereby the current then continuously flows through said auxiliary heating element maintaining said auxiliary thermal switch open irrespective of the position of said main thermal switch, the current flow being limited to a value insufficient to cause any substantial heating in said main heating element.

5. In an electric flatiron, a sole plate having a main heating element therefor, an energizing circuit for said main heating element, said circuit including a main thermal switch responsive to the temperature of said heating element and functioning normally to control the temperature thereof, and auxiliary means for controlling said heating element to substantially deenergize it including a normally closed auxiliary thermal switch which when operated to its open position effects a substantial deenergization of said heating element, an auxiliary heater for causing actuation of said auxiliary thermal switch to operate to its open position, and a shunt circuit for energizing said auxiliary heater connected in parallel with said switches, said auxiliary thermal switch being operated to open by said auxiliary heater when the percentage of time that said auxiliary heater is shunted by said thermostatic switch falls below a predetermined value, said auxiliary heater then being continuously energized whereby said auxiliary switch remains open irrespective of a subsequent reclosing of said main thermal switch upon a cooling of said main heating element.

6. An electric flatiron comprising a main heating element, an energizing circuit for said main heating element, a thermostatic switch connected in series with said energizing circuit, said ther-

mostatic switch being responsive to the temperature of said heating element and functioning normally to control the temperature thereof, and auxiliary means for controlling said heating element to substantially deenergize it including a normally closed auxiliary control switch which when opened effects the substantial deenergization of said heating element, a temperature responsive element for opening said auxiliary control switch, a heater for heating said temperature responsive element, a shunt circuit for energizing said heater connected in parallel with said switches, said temperature responsive element actuating said auxiliary switch to open when the percentage of time said thermostatic switch remains in the open circuit, non-shunting position exceeds a predetermined value, said heater being then continuously energized whereby said auxiliary control switch remains open, and means operable upon a continued movement of said temperature responsive element for interrupting the flow of current through said auxiliary heater.

7. In an electric flatiron, a sole plate having a heating element therefor, an energizing circuit for said heating element, said circuit including a main thermal switch, said main thermal switch being responsive to the temperature of said heating element and functioning normally to control the temperature thereof, and auxiliary means for controlling said heating element to substantially deenergize it including a normally closed auxiliary thermal switch connected in series with said main thermal switch and which when opened effects the substantial deenergization of said heating element, an auxiliary heater for causing actuation of said auxiliary thermal switch to open by heating it to a predetermined degree, a shunt circuit for energizing said auxiliary heater connected in parallel with said switches so that when said main thermal switch is opened and said auxiliary thermal switch is closed said auxiliary heater is energized and when both of said switches are closed it is deenergized, a normally closed control switch connected in said shunt circuit, and means for opening said switch when said sole plate is tilted to an inclined non-ironing position for preventing energization of said auxiliary heater and actuation of said auxiliary thermal switch.

8. In an electric flatiron, a main heating element having an energizing circuit therefor, a main thermal switch responsive to the temperature of said main heating element for controlling said circuit, an auxiliary control switch comprising a fixed contact and a relatively movable contact, said movable contact being carried on a movable switch arm, means for biasing said switch arm for movement in a direction to open said auxiliary switch, stop means for limiting the opening movement of said movable switch arm after said auxiliary switch opens, a temperature responsive element mounted in operative relation with said switch arm so as to keep normally said auxiliary switch closed, an auxiliary heater adjacent said temperature responsive element, a normally closed heater switch for controlling said auxiliary heater, said heater switch comprising a contact carried on said movable switch arm and a cooperating contact carried by said temperature responsive element, said heater switch being arranged to open upon a continued

movement of said temperature responsive element beyond a point where said movable switch arm engages said stop means, means for connecting said main thermal switch, said auxiliary switch and said heater switch in series relation in said circuit and an energizing circuit for said auxiliary heater connected in parallel with said main thermal switch and said auxiliary control switch.

9. In a flatiron having a heating element, means for controlling said heating element comprising a thermostat responsive to the temperature of said iron controlling said heating element to increase and decrease the heat applied by cycling between heat "on" and heat "off" positions, means controlling said heating element controlled responsive to the operation of said thermostat so that when the percentage of time said thermostat remains in said "off" position exceeds a predetermined value said heating means is controlled to decrease the heat to said iron irrespective of the subsequent operation of said thermostat, and position operating means for disabling said last-named control means and restoring the control of said heating element to said thermostat when said iron is tilted from its ironing position to an inclined non-ironing position.

10. In an electric flatiron, a heating element for heating said iron, a main thermal switch responsive to the temperature of said iron operating between heat "on" and "off" positions as the iron heats and cools controlling the energization of said heating element to hold a substantially constant temperature in said iron, and auxiliary safety means for effecting a substantial deenergization of said heating element including an auxiliary thermal switch which when operated to a predetermined position effects a substantial deenergization of said heating element, said auxiliary thermal switch having heat generating means, and means for controlling the operation of said heat generating means responsively to the operation of said main thermostatic switch between said "on" and "off" positions to cause said auxiliary thermal switch to operate to said predetermined position when said main thermal switch is in said "off" position a predetermined percentage of time.

11. In an electric flatiron, a heating element for heating said iron, a main thermal switch responsive to the temperature of said iron operating between heat "on" and "off" positions as the iron cools and heats controlling the energization of said heating element to hold a substantially constant temperature in said iron, means including an auxiliary thermal switch for effecting substantial deenergization of said heating element when said auxiliary thermal switch is heated to a predetermined degree, and means for locally heating said auxiliary thermal switch controlled responsively to the operation of said main thermostatic element between said "on" and "off" positions so that said auxiliary thermal switch is heated proportionately to the percentage of time said main thermostatic switch is in said "off" position, whereby when said percentage of time exceeds a predetermined high value said auxiliary switch is heated to said predetermined

degree.

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