June 30, 1942. W. DUBILIER 2,288,517

THERMOSTATIC SWITCH

Filed Feb. 3, 1939 2 Sheets-Sheet 1

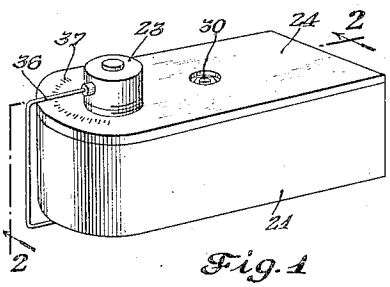


Fig. 1

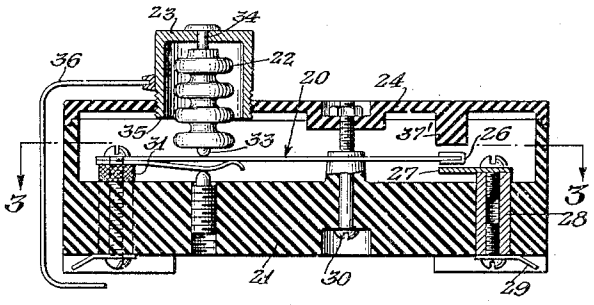


Fig. 2

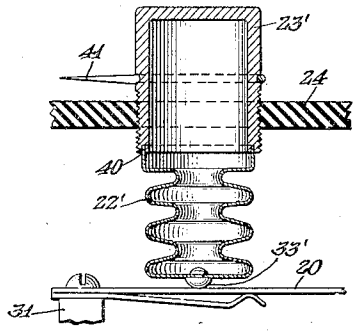


Fig. 4

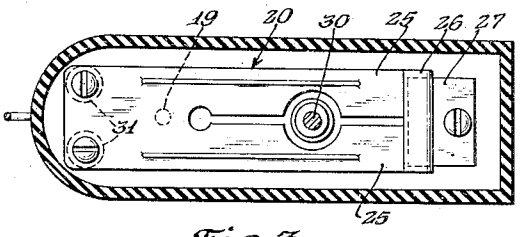


Fig. 3

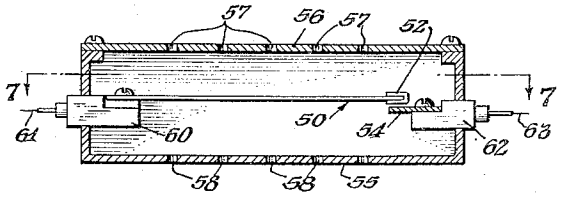


Fig. 6

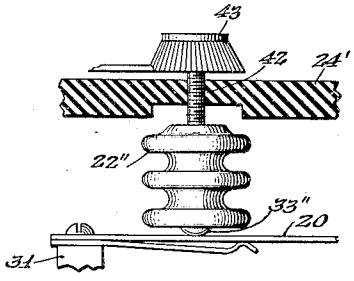


Fig. 5

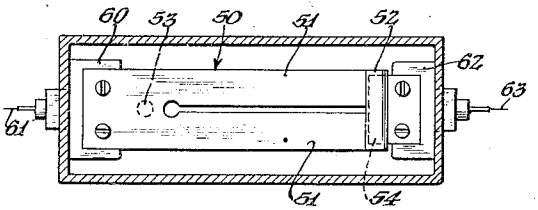


Fig. 7

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June 30, 1942. W. DUBILIER 2,288,517

THERMOSTATIC SWITCH

Filed Feb. 3, 1939 2 Sheets-Sheet 2

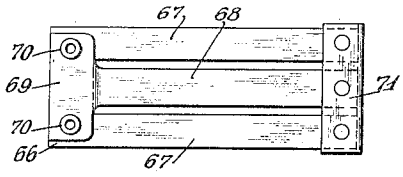


Fig. 8

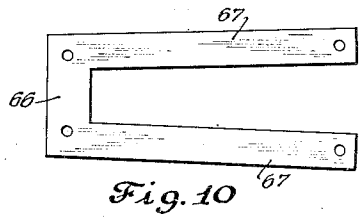


Fig. 10



Fig. 9

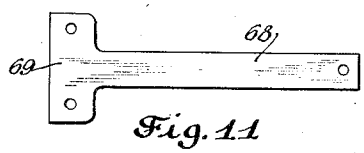


Fig. 11

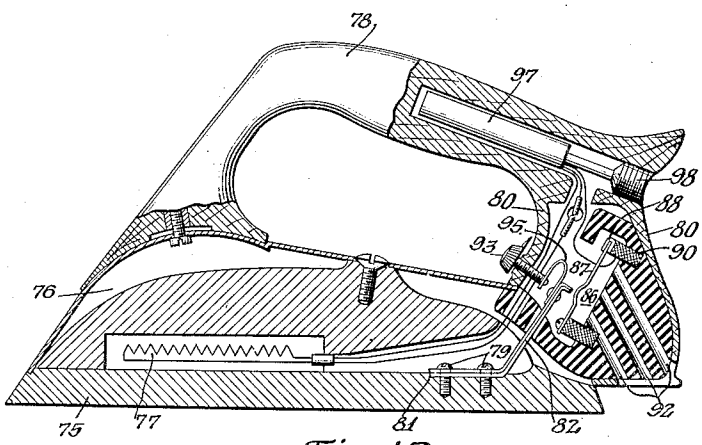


Fig. 12

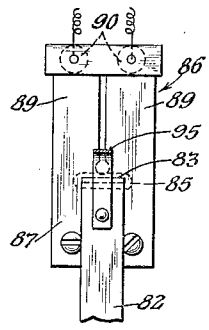


Fig. 14

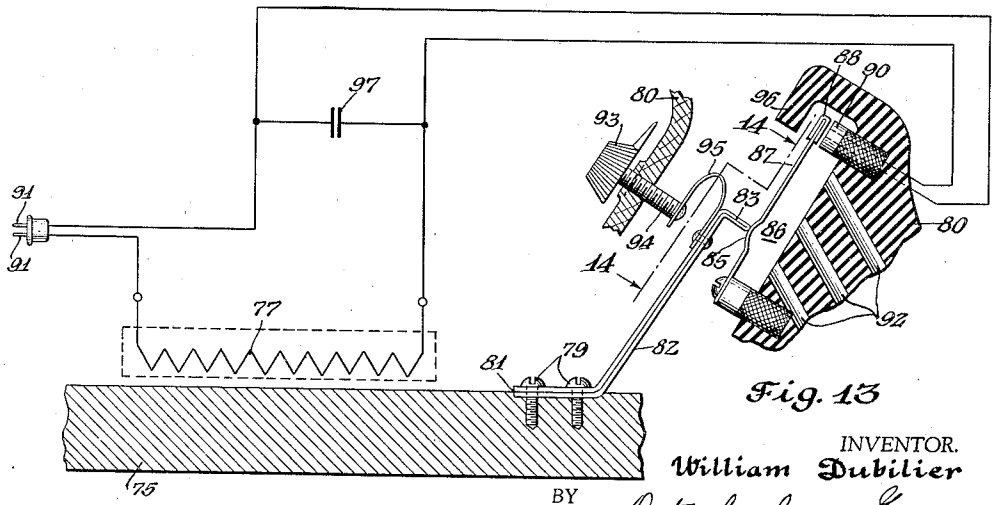


Fig. 13

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2,288,517

THERMOSTATIC SWITCH

William Dubilier, New York, N. Y.

Application February 3, 1939, Serial No. 254,337

5 Claims. (Cl. 219—25)

This invention relates to novel thermostatic electrical switches and more particularly relates to novel arrangements for switching relatively large currents in response to relatively small temperature variations.

The general type of switch to which the improvements of the present invention relate is disclosed for instance in Patent No. 1,780,758. These switches can interrupt substantially large currents upon relatively small physical application of force or pressures and displacement on the multiple switch element. The switch actuating element of the type disclosed in the patent consists essentially of a flat spring which is tensioned or biased in a manner to give a material displacement of one section thereof upon a relatively small movement of a different section thereof.

According to my present invention I contemplate novel arrangements and improvements in such switching devices for facilitating their application for temperature control systems. In one form of the invention I incorporate a compact thermostatic expansible unit such as a bellows adjacent the sensitive area on the switch element to actuate the switch upon a predetermined difference in temperature on the element. Novel means are also incorporated for adjusting the temperature range of actuation by the element and switch. Such unit can be formed to be responsive solely to gaseous pressure.

In another form of the invention, I incorporate a spring of thermostatic material directly in the switch displacing member to directly control the movement of the spring. The temperature influence is communicated directly to the spring member of the unit which is substantially unaffected by external pressures or displacement actions but rather solely upon temperature conditions.

In a further form of the invention, I incorporate the novel small-pressure switch in an electrical flat iron, or the like, with novel arrangements for controlling the temperature action of the iron as will be described in more detail hereinafter.

It is accordingly among the objects of the present invention to provide novel thermostatic electrical switching arrangements for interrupting relatively large currents upon relatively small temperature variations; a novel barometric pressure relay switch; novel adjustments for controlling the temperature action of thermostatic elements on the switch; a novel spring switch displacing member incorporating springy thermostatic metal; and to provide novel thermostatic switching arrangements for electric heating structures.

These and further objects of the present invention will become apparent in the following description taken in connection with the drawings, in which:

Figure 1 is a perspective view of one form of switch of the invention.

Figure 2 is a cross-sectional view through the switch of Figure 1 taken along the line 2—2 thereof.

Figure 3 is a horizontal sectional view of the switch taken along the line 3—3 of Figure 2.

Figures 4 and 5 are enlarged cross sectional detailed views of a modified form for the sensitive expansible element of the switch of the invention.

Figure 6 is a thermostatic switch directly incorporating a thermostatic actuating member.

Figure 7 is a horizontal sectional view taken along the line 7—7 of the thermostatic switch of Figure 6.

Figure 8 is a plan view of a thermostatic switch actuating element constituting another form of the invention.

Figure 9 is a side view of the element of Figure 8.

Figures 10 and 11 are plan views of component parts of the thermostatic switch element of Figures 8 and 9.

Figure 12 is a cross-sectional view through an electric flat iron incorporating a novel thermostatic switching control.

Figure 13 is an enlarged detailed view of a portion of the iron of Figure 12 together with a schematic electrical diagram of components associated therewith.

Figure 14 is a plan view of the electrical switching control part of the iron as viewed along 14—14 in Figure 13.

Referring now to Figures 1 to 3, where I illustrate one form of the invention which consists of a mechanically actuated electrical switch element 20 contained within the casing 21 in combination with a small and compact expansible unit 22 supported by a metallic cup 23 upon cover 24 of the switch. The type of switch element 20 here illustrated is similar to that described in the patent above referred to, as well as shown and illustrated in my copending application S. N. 251,746, entitled "Electric switches" filed Jan. 19, 1939.

Switch element 20 is characterized by an essentially flat spring member slit to form two leg portions 25—25 which are drawn together at the free ends by a metallic switch contact 26 to form a sensitive biased or buckled region in the vicinity of 19 shown dotted at the unslitted end of member 20. A contact element 27 is arranged opposite switch contact 26 for electrical switch coaction therebetween. Contact 27 is supported on a metallic post insert 28, and electrical connection is made therewith by lug 29. Cover 24 is secured to housing 21 by bolt 30. The electrical circuit through switch part 26, 27 is completed

through the secured end of member 20 through supporting posts 31 and lug 32.

A distinguishing factor of switch element 20 is the relatively large displacement by its free contact end 26 upon a relatively small pressure or displacement upon its sensitive region 19, as explained in the patent and the copending application. Expansible bellows 22 has a projecting button 33 arranged opposite sensitive region 19 of member 20. Bellows 22 consists of a hollow fluted expansible metallic shell which expands or contracts longitudinally in accordance with its temperature condition. One end of bellows 22 is fixedly supported in cup 23 by a pin 34. The open end of cup 23 is threaded at 35 and coacts with a corresponding threaded opening in switch cover 24.

The distance between button 33 and member 20 is accordingly adjustable through the thread arrangement as will now be evident. Lever 35 is attached to cup 23 for manually adjusting the setting. A calibrated scale 37 is marked on the cover 34. The end of the casing 21 is rounded as shown to permit rotation of lever 36 through a wide angle. By properly adjusting lever 36, the position of button 33 with respect to member 20 is controlled to require a predetermined temperature differential on member 22 for its expansion to reach and press button 33 against sensitive area 27 of switch member 20 for operating switch 26, 27.

A stop 37' is located above contact 36 to limit its upward excursion when button 33 presses against member 20 in opening the circuit from contact 27. This electrical contact may be substituted for stop 37' as explained in the copending application for greater circuit possibilities. The switch as shown in Figure 2 is normally "make." However, it may be readily modified to a normally break or to a make-and-break circuit, as will be understood by those skilled in the art.

In utilizing the switch of Figures 1, 2 and 3, metal cup or cap 23 is placed in the region of temperature to control the operation of the switch. Cap 23 is metallic to readily conduct the temperature condition to bellows 22. Figure 4 shows a modified view of the bellows wherein cap 23' integrally supports the bellows 22' through the joint connection 40. Button 33' depends from the free end of bellows 22' and cooperates with the sensitive region of switch element 20. An indicator 41 is secured to cap 23'. Temperature adjustment of bellows 22' is made by manual rotation of cap 23', as will now be evident.

Figure 5 shows a further modification of the bellows arrangement. Bellows 22'' is supported from cover 24' through a threaded rod 42. An adjusting knob 43 is secured to the top of rod 42 outside of casing 24'. Button 33'' of bellows 22'' coacts with the switch member 20. Casing 24' is preferably metallic for facilitating transmissions of temperature variations from the exterior to the contained bellows 22''.

The bellows described above need not be air sealed to effect expansion and contraction with temperature change. The convolutions thereof cause a sensitive expansion characteristic with temperature, imparting relatively small additional bulk to the switch. It is to be understood however that the described bellows arrangement may be sealed from the atmosphere and contain a suitable gas for increasing the expansion and contraction sensitivity of the bellows under temperature variations. Since the movement and pressure required for actuating spring switch member 20 is small, a high temperature sensitivity may be incorporated in the disclosed switch of relative high current interruption characteristic and small bulk.

The essential structure described above in connection with Figures 1 to 5 may be readily modified to form a pressure switch responsive to predetermined changes in atmospheric or other gaseous pressure conditions. By evacuating or substantially reducing the gaseous pressure in the bellows arrangements (22, 22', 22'') and sealing the same, a resultant bellows structure is produced which is expandable and contractible in accordance with the exterior gas pressure conditions. In this case, it is preferable to employ a metallic shell for the bellows, which shell does not expand or contract much with temperature variations, in order to minimize the effect of temperature on the pressure switch. An integral barometric or gas pressure responsive electrical switch of relatively small and compact form, capable of interrupting relatively large currents, is had which constitutes an important commercial advantage derived from the disclosed combination. The response of the switch to pressure and/or temperature variations is readily predetermined in the design and construction thereof as will now be evident to those skilled in the art.

Figures 6 and 7 illustrate an important form of the invention which does not require external mechanical pressure for thermo-switch actuation. In this construction I employ a spring switch element 50 which is constructed of thermostatic material. The switching element 50 is mechanically constructed in a manner similar to element 20 and the corresponding mechanically actuated elements described in the patent and the copending application referred to.

Switch element 50 however of this modification is displaceable solely by temperature change rather than by pressure application. Spring 50 is preferably constructed of springy bimetallic sheet metal. The thermostatic metal used may be a standard conventional bimetallic combination, such as copper, brass or the like. The metal is properly temperated to insure sufficient springiness for member 50. In the illustrated form of spring 50, it is longitudinally slit to form leg portions 51—51, the free ends of which are bolted together by an armature 52 to produce a tensioned or biased sensitive region schematically indicated in dotted at 53 in Figure 7. The normal, or low temperature condition of the illustrated switch element 50 is downwards, when contact 52 coacts with contact 54 in a normally closed circuit condition. It is to be understood that by placing switch arm 50 upside down from that shown, a normally "break" switch operation can instead be effected. However, only one form is believed sufficient for the disclosure.

Upon a predetermined temperature rise, the thermostatic metal of switch 50 causes a distortion and internal pressure in the body thereof to flip the switch to its opposite or "heated" position. In the illustrated condition, Figure 6, the upward position of the switch indicates the later condition, when the circuit is opened. Thermostatic metal switch arm 50 may be designed to abruptly open the circuit by flipping away from contact 54 under the action of a relatively small temperature difference, for example, 2° F. An even more sensitive temperature response may be incorporated by proper mechan-

ical design and construction of the switch arm 50. In a like manner, the temperature response may be made less sensitive by increasing either the spring tension in the switch or changing its dimensions, as will now be evident to those skilled in the act.

The thermostatic switch of Figures 6 and 7 is preferably encased in a metallic structure 55 capped by a metallic plate 56 to allow good communication of temperature variations from the exterior to thermostatic switch arm 50. To increase the temperature communications from the exterior, cover plate 56 may be removed or vents 57 and 58 may be made in the cover and case as shown. The switch construction of Figures 6 and 7 is characterized by a simplicity of assembly and manufacture.

Switch arm 50 is supported at its right end by a post 60 insulatingly fixed in the right side of housing 55. A terminal connection 61 communicates electrically with spring 50 or may extend directly to the contact 52 should a reduction in the switch circuit resistance be essential. Opposite contact 54 is supported beneath (or above) armature 52 through a post 62 insulatingly supported in the left side of case 55. A terminal 63 establishes external electrical connection with contact post 54. Additional contacts may be arranged to coact with contact 52 if desired. The essential feature of the switch of Figures 6 and 7 is its physical construction of expansible thermostatic material such as bi-metallic metal, to effect the switch operation under temperature change.

A modified form for the thermostatic switch arm is illustrated in Figures 8 and 9. Spring switch member 65 is incorporated in the unit of Figures 6 and 7 by replacing it for switch member 50. Spring switch 65 is constructed of two portions, namely a U-shaped spring metal portion 66 containing two legs 67, 67 as shown in Figure 10, and intermediate thermostatic metal arm 68 shown in Figure 11. Thermostatic arm 68 has a tongue 69 for being secured to U-member 66. It may be formed of bi-metallic metal or other suitable thermostatic material which has a high coefficient of expansion with temperature rise. As shown in Figures 8 and 9, central thermostatic arm 68 is riveted to U-shaped spring member 66 by rivets 70.

U-shaped member 66—67 may be of stiff copper, beryllium copper, phosphor bronze or the like. Contact 71 secures the free ends of legs 67 and 68, constricting or bowing them together to form a buckled or biased element in a manner similar to the construction of switch members 20 and 50 hereinabove described. The free end of arm 68 is also secured to contact 78 as shown. The tensioned or buckled region is formed in the region of the junction of thermostatic arm 68 with the member.

Under the action of a temperature change, thermostatic arm 68 expands or contracts to exert a corresponding pressure upon the tensioned buckled region at the base of the U-member 66, to cause a flip of the spring member 65 from its normal temperature position. It is to be understood that switch arm 50 may be designed to flip either upwards or downwards with temperature increase or decrease as desired, and may be arranged with switch contacts cooperating with contact 71 to form a normally "open" or normally "closed" switch construction.

A further form of the invention is illustrated in Figures 12, 13 and 14 where a small pressure, large current capacity mechanical switch 86 corresponding to the switch unit of Figures 1 to 3, and of the patent and copending application referred to, is used for controlling the temperature condition in an electrical heating appliance, specifically an electric flat iron. The iron illustrated has a conventional flat base 75 underlying it and contains schematically illustrated heating element 77. A handle 78 is attached to shell 76, and at the right end 80 thereof contains the thermo-electrical circuit control and adjustment means illustrated in enlarged detail in Figure 13.

One end 81 of a bimetallic thermostatic element or bar 82 is secured by screws 79, rivets, or by welding to the surface of iron base 75. Free end 83 of thermostatic bar 82 is arranged to coact with the sensitive region 85 of the mechanical switch 86. Switch 86 is supported on iron frame 80, and essentially comprises a spring switch arm 87 having an armature 88 at the free end thereof.

Figure 14 shows a plan view of the preferred switch 86. Switch 86 is similar to switch element 20 of the above modifications and also the corresponding spring switch elements described in the patent and copending application referred to. It comprises a slit section forming two arms 89—89 bowed together by contact 38 at the free ends to form the sensitive buckled region 85 which coacts with the free end 83 of the thermostatic bar 82. Armature 88 coacts with series-circuit contacts 90 supported on iron frame 80. Switch 86 is characterized by a large interrupting current capacity controlled under the action of a relatively small pressure exerted by tip 83 of thermostatic bar 82.

Switch contacts 90 are in series circuit with the heating element 77 of the iron and terminal plugs 91—91 of the iron are coactable with an external plug for conventional connection to a power supply (not shown). An important feature of the thermostatic switch for the flat iron shown is that the current switching arrangements are performed in a region outside the heating shell 76 and base 75 of the iron unit. The electrical switch is incorporated in the frame or casing portion 80 at the rear end of the iron and is substantially removed from the high temperature conditions within the heating region. I prefer to employ vents 92 in the frame work 80 communicating to the switch member 86 to maintain it at a reasonably constant and substantially reduced temperature condition. The novel feature of the iron construction also entails the extension of thermostatic bar 82 from the high-heat region at its secured end 81 to the control region at switch 86 at free bar end 83. Thus the circuit switching is effected outside the heating region and is directly responsive to the temperature condition in the heating region.

The iron may be adjusted for different temperature settings by means of control knob 93 extending from the inside of frame 80 as shown in the figures. Control knob 90 communicates to a U-spring 95 through a screw 94. The opposite end of U-spring 95 is riveted near the free end of thermostatic bar 82. Thus the control tip 83 of bar 82 may be brought closer to or further away from sensitive region 85 of switch 86. A given temperature condition at the heating region of the iron will extend and force tip 83 of bar 82 towards switch 86. By biasing the free bar end 83 away from switch 86 through spring 95, a correspondingly greater iron temperature

will be required to cause bar tip 83 to press against the switch to open the circuit.

Contact 88 of switch 86 normally presses against its contacts 90 to maintain the electrical circuit through heating element 77 closed. Ventilation through frame 80 by ducts 92 maintains switch 86 at a comfortable operable ambient temperature. When base 75 and the heating region of the iron are sufficiently hot to cause thermostatic bar 82 to warp and press bar tip 83 against sensitive region 85 of switch 86, spring switch member 87 snaps upwards to open the circuit across posts 90. Contact 88 moves against stop 96 to prevent undue distention and keep it in condition to spring back when thermostatic bar tip 83 is withdrawn.

Thus, when the iron starts to cool down from the predetermined temperature it is set to operate, switch 86 is permitted to snap to its normal circuit closer position connecting heating element 77 to supply additional heat to the iron. Upon further overheating the above cycle of operation is repeated to keep the iron temperature substantially constant at the predetermined value set by the adjustment of the knob 93, as will now be understood. An electrical condenser 97 is connected across switch contacts 90 as shown, to minimize and absorb sparking at the switch during use. Condenser 97 is encased in handle 78 as shown, and is introduced therein thru plug 98.

Although I have illustrated several embodiments of preferred forms of the present invention it is to be understood that the modified arrangement and constructions are feasible falling within the broader spirit and scope of the invention. Accordingly I do not intend to be limited except by the following claims.

I claim:

1. The combination with an electric flat iron having a metal base, a heating element therefor and a handle attached to said base, of a displaceable switch element in circuit with said heating element and mounted within said handle at a point remote from said base, a thermostatic unit having one end engaging said base and another end projecting into said handle, and an electrical contact cooperating with the displaceable part of said switch element for opening the electric circuit for said heating element when said switch element is displaced, the projecting end of said thermostatic unit being arranged to coact with said switch element to cause a displacement thereof when a predetermined temperature condition occurs in said metal base to open the electrical circuit of said heating element.

2. The combination with an electric flat iron having a metal base, a heating element therefor and a handle attached to said base, of a snap switch element in circuit with said heating element and mounted within said handle at a point remote from said base, said switch element comprising a leaf spring biased so as to be capable of moving a displaceable part thereof with a snap action when the spring is pressed on the biased region, a thermostatic unit having one end engaging said base and another end projecting into said handle, and an electrical contact cooperating with the displaceable part of said switch element for opening the electric circuit for said heating element when said switch element is displaced, the projecting end of said thermostatic unit being arranged to engage the biased region of said spring to cause a displacement thereof when a predetermined temperature condition occurs in said base to open the electrical circuit of said heating element.

3. The combination with an electric flat iron having a metal base, a heating element therefor and a handle attached to said base, of a snap switch element in circuit with said heating element and mounted within said handle at a point remote from said base, said switch element comprising a leaf spring having two leg portions bowed together to form a biased condition in the spring capable of moving a displaceable part thereof with a snap action when the spring is pressed on the biased region, a thermostatic bar having one end attached to said base and another end projecting into said handle, and an electrical contact cooperating with the displaceable part of said switch element for opening the electric circuit for said heating element when said switch element is displaced, the projecting end of said bar being arranged to engage the biased region of said spring to cause a displacement thereof when a predetermined temperature condition occurs n said metal base to open the electrical circuit of said heating element.

4. The combination with an electric flat iron having a metal base, a heating element therefor and a handle attached to said base, of a snap switch element in circuit with said heating element and mounted within said handle at a point remote from said base, said switch element comprising a leaf spring biased so as to be capable of moving a displaceable part thereof with a snap action when the spring is pressed on the biased region, a thermostatic unit having one end engaging said base and another end projecting into said handle, and an electrical contact cooperating with the displaceable part of said switch element for opening the electric circuit for said heating element when said spring is displaced, the projecting end of said thermostatic unit being arranged to engage the biased region of said spring to cause a displacement thereof when a predetermined temperature condition occurs in said base to open the electrical circuit of said heating element, and means for controlling the action of said thermostatic unit on said switch element in dependence upon different thermal operating conditions of said metal base, said means being attached to said unit to adjustably bias said projecting part thereof with respect to the biased region of said leaf spring.

5. The combination with an electric flat iron having a metal base, a heating element therefor and a handle attached to said base, of a displaceable switch element in circuit with said heating element and mounted within said handle at a point remote from said base, a thermostatic unit having one end engaging said base and another end projecting into said handle, and an electrical contact cooperating with the displaceable part of said switch element for opening the electric circuit for said heating element when said switch element is displaced, the projecting end of said thermostatic unit being arranged to coact with said switch element to cause a displacement thereof when a predetermined temperature condition occurs in said metal base to open the electrical circuit of said heating element, said handle being provided with ventilating ducts connecting said switch element with the outside atmosphere.

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