April 3, 1956 F. BIELING ET AL 2,740,879

TEMPERATURE-REGULATED ELECTRIC HOTPLATES

Filed Aug. 4, 1953 2 Sheets-Sheet 1

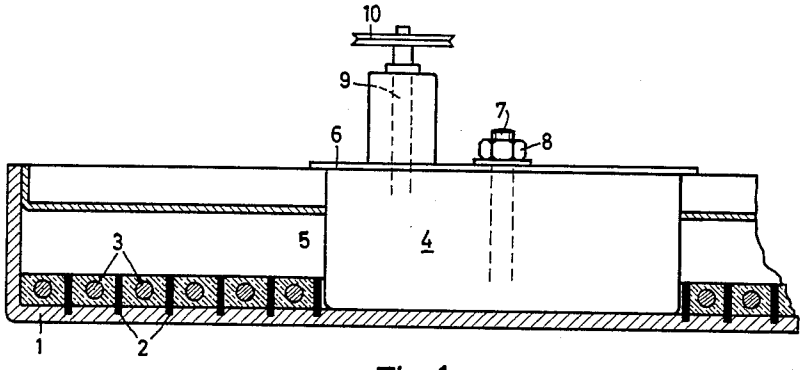


Fig.1

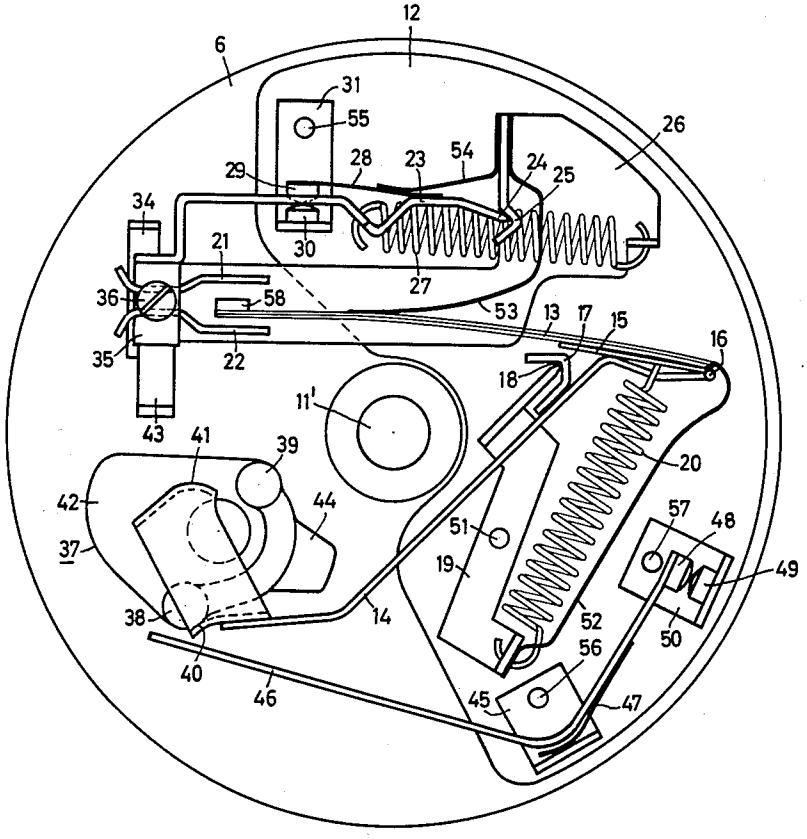


Fig.2

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TEMPERATURE-REGULATED ELECTRIC HOTPLATES

Filed Aug. 4, 1953 2 Sheets-Sheet 2

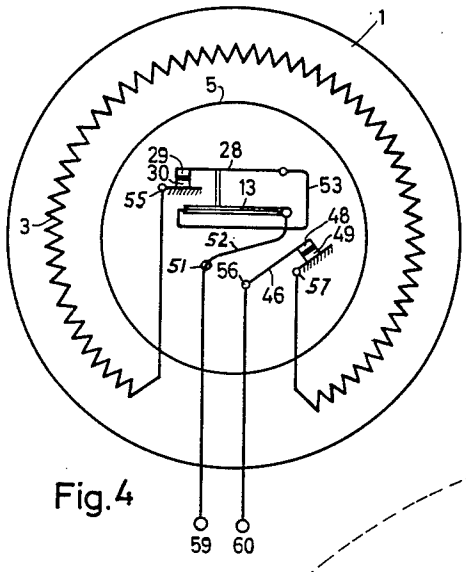


Fig.4

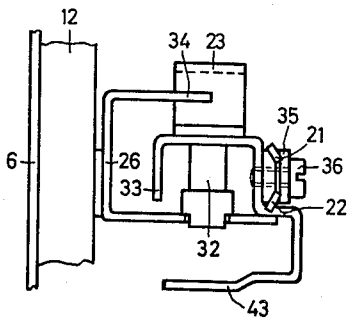


Fig.3

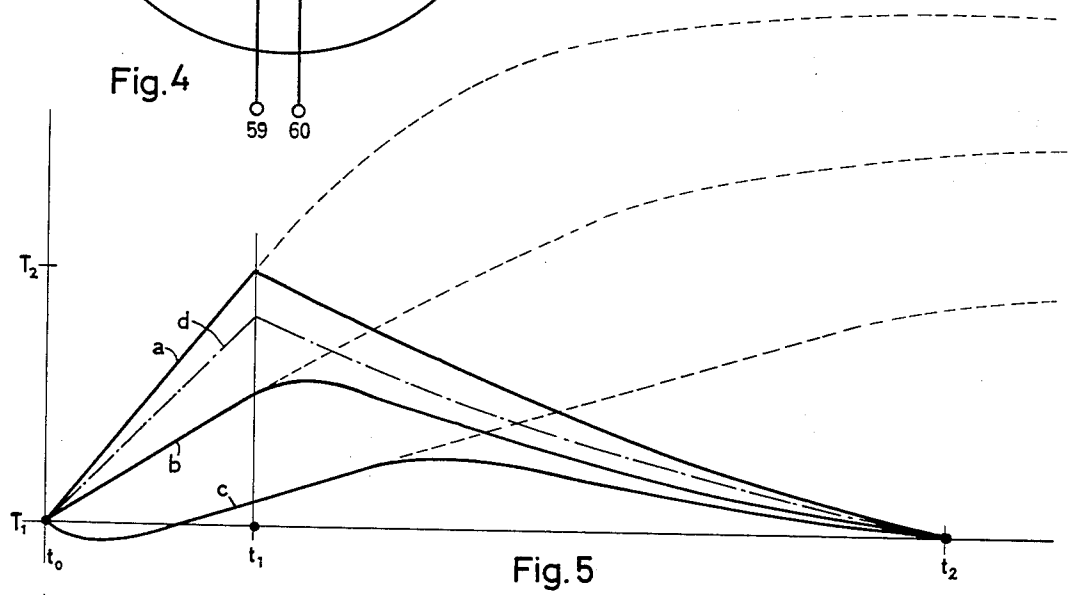


Fig.5

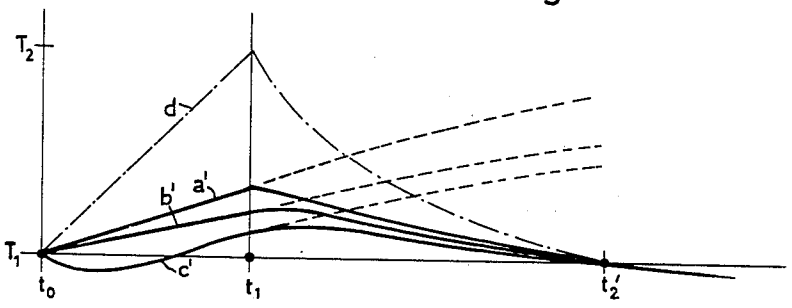


Fig.6

United States Patent Office

2,740,879

Patented Apr. 3, 1956

2,740,879

TEMPERATURE-REGULATED ELECTRIC HOTPLATES

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Application August 4, 1953, Serial No. 372,238

4 Claims. (Cl. 219—37)

Our invention relates to temperature-regulated electric hotplates suitable as individual cooking apparatus or as surface heaters for electric stoves and the like appliances. In such hotplates, the heat-sensitive bimetal strip of the temperature regulator is exposed to the heat generated by the hotplate and serves to periodically make and break the electric heating circuit of the hotplate.

The temperature regulators in the known hotplates of this type have the shortcoming of operating with very small contact pressures at the electric contacts that control the heating circuit, this being especially noticeable with regulators of small size. These devices have the further disadvantage that, during the break operation of the contacts, the contact pressure decreases gradually from its original value to zero so that the separating movement of the contacts is more or less creeping. Such temperature regulators are not suitable for high current capacities since their contacts tend to become fused.

It is an object of our invention to provide electric hotplates with a temperature regulator that combines small overall dimensions with a high interrupting capacity and shows no appreciable wear at the contacts even after prolonged and continuous periods of operation.

To this end, and in accordance with one of the features of our invention, we provide the bimetal strip of the hotplate regulator with a snap-action switch mechanism that is equipped with a tiltable and inherently rigid toggle member carrying a resiliently dragging contact to cooperate with a stationary contact in the heating circuit. The dead-center toggle member is biased by a toggle spring and is also under the effect of a permanent magnet which tends to magnetically hold the toggle member in the make position. During the make movement initiated by the heat-expansive deflection of the bimetal member, the toggle member must be torn away from the magnet and is thus caused to perform an abrupt snap-action movement accompanied by a likewise abrupt and virtually instantaneous reduction in contact pressure. During the cooling period the bimetal member causes the toggle member to return toward the make position, until the toggle member reaches a point where the attractive force of the magnet comes into effect with such a steep rise as to secure an instantaneous contact engagement under abrupt tensioning of the contact spring that joins the dragging contact with the toggle member.

The provision of a magnet, acting upon the toggle member aside from the toggle spring, permits a free choice of the contact-pressure conditions within much wider limits than heretofore available so that it is possible to give the contact pressure at the regulator contacts a very large magnitude. The magnetic action also provides the regulator mechanism with a resting or threshold condition which must be overcome by force previously stored in the regulator or its bimetal member. At the moment when the threshold condition is overpowered, the stored force is released for accelerating the switching movement of the toggle member so that an instantaneous action takes place. Due to the resilient dragging contact of the toggle member, the contact pressure drops virtually instantaneously to zero at the break moment so that the contacts separate from each other at high velocity. This prevents fusion of the contacts. The magnet is also effective during the make operation in accelerating the make movement of the contact-carrying toggle member by magnetic attraction. The high contact pressure, the abrupt diminution in contact pressure during break performance, and the snap-action movement of the toggle member all contribute to making a temperature regulator according to the invention safe for a high current-carrying duty and for long periods of continuous operation. By virtue of the fact that the magnet is of the permanent type and can be given a small size without necessity for additional electric terminals or circuit connections, the magnet can be readily accommodated within the temperature regulator virtually without increase in the otherwise necessary dimensions.

According to another feature of our invention, we provide the temperature regulator in an electric hotplate with a snap-action switch mechanism and with a bimetal strip which controls the mechanism to supply the heating current when an adjustable temperature value (datum value) is reached and which is additionally heated by the heating current of the hotplate during the make period of the regulator. By virtue of this additional heating, the interruption of the heating current caused by the bimetal strip is independent of the temperature distribution of an essential portion of the hotplate. The switching-on period of the regulator is chosen so large that at the reclosing moment, the essential portion of the hotplate has assumed a substantially uniform temperature due to heat equalization. Such a regulator has a large temperature differential between make moment and break moment and, as a result, is capable of furnishing a relatively large amount of energy for the actuation of the switch mechanism. This large energy, drawn from the power supply line by the heating of the bimetal strip due to the heating current, permits providing the switch mechanism with an especially effective snap action as desired for considerably increasing the current capacity. Consequently, correspondingly large heating currents can be reliably controlled during prolonged periods of hotplate operation. As a result, the power capacity of the hotplate can be greatly increased, thus affording the possibility of obtaining a much shorter heating-up period of the hotplate than heretofore practicable.

The foregoing and other features and advantages of the invention will be apparent from the embodiment of a hotplate according to the invention exemplified by the drawing.

Fig. 1 shows a cross section of the hotplate.

Fig. 2 is a view of the temperature regulator of the hotplate.

Fig. 3 shows a side elevation of part of the same temperature regulator.

Fig. 4 is a schematic circuit diagram of the hotplate; and

Figs. 5 and 6 are coordinate diagrams explanatory of the operation of the temperature regulator.

According to Fig. 1, the housing 1 of the hotplate consists of a pan-shaped shell of sheet metal. The bottom surface of the shell, illustrated in inverted position, forms the cooking surface when the plate is properly installed. The sheet metal is preferably of a thin wall thickness to minimize the mass to be heated. The plate structure has heat conductive annular fins 2 between which a heating resistor 3 is mounted. The resistor occupies an annular space in the interior of the structure and leaves the central part of the structure free. Disposed in the central space is a heat regulator 4 for automatically regulating

the temperature of the hotplate. For easy exchangeability of the regulator, it is placed within a cup-shaped casing 5, for instance of brass, which is covered by a circular plate 6. Casing 5 is sunk into the interior of the plate structure and is in a good heat conducting face-to-face contact with housing 1. Plate 6 and casing 5 are both firmly pressed against the housing 1 by a central bolt 7 and a nut 8. For adjusting the response temperature of the regulator, plate 6 carries on its exterior side a rotatable adjusting member 9 whose upper end is equipped with an actuating element, for instance, a rope sheave 10. The rope sheave and the member 9 transmit the rotary adjusting movement from the outside to the interior of the regulator casing 5. The individual parts of the temperature regulator proper are mounted on the inner side of the circular cover plate 6. According to Figs. 2 and 3 some of these individual parts are secured to an insulating base plate 12 attached to plate 6. All regulator parts are preferably arranged about a central hole 11' of plate 6 (Fig. 2). This hole serves for mounting the temperature regulator as a unit in the center of the hotplate upon the fastening bolt 7.

The temperature-sensitive element of the regulator consists of a bimetal strip 13 that does not carry any electric switch contacts. One end of the bimetal strip is joined with an adjusting lever 14 preferably by an articulate connection. In the illustrated embodiment, the bimetal strip 13 is mounted on an intermediate plate 15 which, in turn, is joined with the adjusting lever 14 by a hinge-type joint 16. The adjusting lever 14 has an angular projection 17 seated upon the pivot edge 18 of a stationary bearing bracket 19 that is firmly secured to the insulating base plate 12. A return spring 20 has one end attached to the bearing bracket 19, while the other end is connected with the intermediate plate 15 thus pressing the bimetal strip 13 resiliently against the adjusting lever 14.

The free end of bimetal strip 13 is straddled by two stops 21, 22 that form part of a snap-action mechanism. The mechanism has a dead-center toggle member 23. Member 23 consists of a rigid part and has a bearing edge 24 in engagement with a bearing seat 25 of a fixed bearing bracket 26. A toggle spring 27 engages the toggle member 23 and is secured to a lug of bearing bracket 26. Attached to the toggle member 23 is a dragging spring 28 with a contact part 29. Part 29 is engageable with a stationary contact part 30 mounted on a terminal bracket 31. The toggle member 23 is capable of pendulous movements about its dead-center position. In one of its two end positions the two contact parts 29 and 30 engage each other to close an electric circuit between the brackets 26 and 31. In the other end position of toggle member 23, the contact parts 29 and 30 are separated from each other to interrupt the circuit. The toggle spring 27 has such an action upon the toggle member 23 that the counter force to be overcome by the driving force is decreasing when the toggle member is moving (upwardly in Fig. 2) from the make position toward the break position of the contact parts.

The free end of toggle member 23 is subject to the effect of a magnetic holding device which is active in the illustrated closing position of contact parts 29, 30. That is, the bearing bracket 26, extending to beneath the free end of the toggle member 23, carries a permanent magnet 32 (Fig. 3) coacting with a U-shaped armature 33 on toggle member 23. In the illustrated make position of the toggle member 23, the middle portion of armature 33 is held fast by the permanent magnet 32 and rests against this magnet. The limbs of the armature then form a magnetic flux path for the magnet. In the break position of toggle member 23, this member rests against a laterally bent lug 34 of bearing bracket 26.

The stops 21 and 22 on toggle member 23 are preferably formed of bent pieces of wire, so that the active position of each stop can be varied by turning the wire piece about its fastening place. The ends of the wire pieces 21, 22 remote from the bimetal strip 13 are bent laterally to facilitate turning the wire pieces. A clamp 35 and a centrally located fastening screw 36 serve to firmly secure the wire pieces in proper position. For varying the effective position of the stops, it is only necessary to somewhat loosen the clamp 35, thus permitting the wire pieces to be turned in their seats. The bimetal strip 13 carries a flat abutment part 58 between the two stops 21 and 22.

The adjusting lever 14 for the bimetal strip 13 is controllable from the outside by means of a revolvable cam structure 37. The cam structure has dog pins 38, 39 radially spaced from the axis of cam rotation. Dog pin 38 coacts with a cam face 40, and dog pin 39 coacts with a different cam face 41 of the adjusting lever 14. When turning cam 37, the dog pin 38 thus acts upon one portion of the adjusting travel, and the other pin 39 upon another portion of the travel so that, when passing from one to the other dog pin, the point of action of the cam relative to adjusting lever 14 is shifted in a direction tangential to the axis of rotation of lever 14. The provision of two dog pins and of respective two cam faces on lever 14 has the advantage that the change in adjustment of lever 14 can be effected at points relatively far removed from its pivot axis while requiring dog pins of small diameter so that the entire cam structure 37 can conveniently be mounted on plate 6 virtually without enlarging the plate beyond the size anyhow required by the other parts of the regulator mechanism.

The cam 37 has preferably an additional cam projection 42 which may cooperate with a lateral lug 43 (Figs. 2, 3) of the toggle member 23 when member 23 is in the break position. When cam 37 is turned until it abuts against lug 43 of toggle 23, the toggle is directly moved by cam 37 from the make position to the break position. Cam 37 has still another cam projection 44 engageable with a lever 46 pivotally mounted on a bearing bracket 45. Lever 46 is attached to bracket 45 by means of a leaf spring 47 and carries a switch contact 48 cooperating with a stationary contact 49 on a terminal bracket 50.

The circuit connection of the temperature regulator within the hotplate will now be described with reference to Figs. 2 and 4.

One line terminal 59 of the circuit to be regulated is connected to point 51 of the bearing bracket 19. Bracket 19 is connected by a flexible conductor strip 52 with the bimetal strip 13. The latter is connected through another flexible conductor strip 53 with the bearing bracket 26. A flexible conductor strip 54 connects bracket 26 with the movable contact part 29 through leaf spring 28. When contacts 29, 30 are closed, the circuit extends from contact 30 and terminal bracket 31 to the bracket point 55, with which one end of the heating winding 33 of the hotplate is connected.

The other line terminal 60 is connected to point 56 of the bearing bracket 45. Thence, the circuit extends through the leaf spring 47, lever 46 and contacts 48, 49 to the terminal bracket 50 with whose point 57 the other end of the heating winding 3 is connected. Consequently, the contact parts 29 and 30 actuated by the dead-center toggle 23 lie in one pole and the switch contacts 48, 49 in the other pole of the circuit to be regulated. The bimetal strip 13, therefore, is heated by the heating current of the hotplate. While in the illustrated embodiment, the bimetal strip is heated directly by the passage of current therethrough, the additional heating may also be effected by a separate heating winding mounted on or near the bimetal strip and traversed by the heating current of the hotplate.

The operation of the temperature regulator is as follows:

Fig. 2 shows the temperature regulator in the make condition. The pairs of contacts 29, 30 and 48, 49 are both closed. The dragging spring 28 is forced into a slightly bent shape and hence is tensioned. The dog pin

38 of cam 37 abuts against the starting end of the cam face 40 of adjusting lever 14. The bimetal strip 13 is approximately in the center between the two stop wires 21 and 22 of toggle 23. The toggle spring 27 and the permanent magnet 32 coact in securing the toggle 23 in the make position. The holding force of the magnet considerably increases the contact pressure partly produced by the force of toggle spring 27. Consequently, the provision of the permanent magnet permits a considerable increase in contact pressure.

When the bimetal strip 13 is heated by the heat of its environment and also by the current flowing through the strip, the strip starts bending toward the stop 21. When the bimetal strip reaches the stop 21, the toggle 23 does not at first move from its make position since it is still firmly held by the joint action of toggle spring 27 and magnet 32. During further heating, however, the bimetal strip presses more and more strongly against stop 21 while becoming additionally deformed. When the resilient bending of the bimetal strip reaches a given threshold magnitude, the force imposed upon stop 21 suddenly tears the toggle 23 away from its make position in opposition to the holding forces of magnet 32 and toggle spring 27. The toggle then flings beyond the dead-center position into its make position. Consequently, immediately after being torn away from the magnet, the toggle reaches a high velocity. As a result, the dragging spring 28 carrying the contact part 29 rapidly loses its previously deflected shape and is suddenly torn away from the stationary contact part 30 also at high velocity. In consequence, the contact pressure decreases abruptly and drops virtually instantaneously to the zero value, so that the separation of the contacts occurs at extremely high speed thus preventing the occurrence of fusing.

When the bimetal strip 13 cools down, it moves back and abuts against the stop 22. During the return movement, the toggle 23 is displaced through its dead center into the other end position, while the contact parts 29 and 30 are closed and the dragging spring 28 is tensioned. The closing of the contact parts is likewise abrupt due to the fact that when the dead center is traversed, the toggle spring 27 acts to accelerate the toggle toward the end position. Shortly before reaching the end position, the attractive force of the permanent magnet 32 becomes also effective and causes an additional acceleration of the toggle movement. Since the temperature regulator is heated by the heat transfer from the hot plate as well as by the current that traverses the heating resistors as well as the regulator, the circuit is periodically made and broken in the above-described manner so that a definite average temperature is adjusted. Due to the fact that the opening and closing of the regulator contact is by snap action, the temperature regulator has a large current-carrying capacity.

For changing the temperature to be regulated, the cam structure 37 is turned from the outside about its axis. When turning the cam structure counterclockwise (Fig. 2), the dog pin 38, moving along cam face 40 of adjusting lever 14, turns the lever downwardly and tilts the bimetal strip about its pivot joint 16 in the downward direction. This displacement of the bimetal strip changes the spacing of the entraining part 58 from the stops 21 and 22 of toggle 23, so that part 51 lies closer to abutment 22. Consequently, the end of bimetal strip 13 must now pass through a larger distance until it touches the stop 21. This increases the switching-on travel of the regulator. With a still larger amount of cam rotation in the counterclockwise direction, the bimetal end part 58 reaches the stop 22, thus still further increasing the distance to be traversed by part 58 until it reaches the stop 21. If the cam structure 37 is turned still further in the same direction, the dog pin 39 reaches the cam face 41 of adjusting lever 14, thus moving this lever a further amount downwardly. Then, however, the bimetal strip 13, resting against stop 22, lifts itself as well as the intermediate plate 15 away from the abutment lever 14, this being possible because the plate 15 and the strip 13 are linked with lever 14 only at the hinge-type joint 16. This prevents excessive mechanical deformation of the bimetal strip due to the revolving movement of the cam structure 37. In the last-mentioned position of adjusting lever 14, the heating of bimetal strip 13 must be so large that when the strip becomes thermally deformed, it must first move itself and the intermediate plate 15 into contact with the lever 14 before part 58 can start moving away from stop 22 toward stop 21. This has the consequence that with the last-mentioned adjustment, the temperature regulator has a prolonged switching-on period so that the temperature value regulated by the device is correspondingly high.

If, starting from the position shown in Fig. 2, the cam structure 37 is turned clockwise, its dog pin 38 leaves the cam face 40 of adjusting lever 14, and lever 14 turns clockwise under the force of spring 20. This causes part 58 of bimetal strip 13 to abut against stop 21. Under certain conditions, the bimetal strip 13 may then be capable of pressing against stop 21 with a force sufficient to move the toggle 23 from its end position to the other end position against the holding forces of magnet 32 and toggle spring 27. However, if this does not occur, then the cam projection 42 of cam structure 37 abuts during the further cam movement against the lateral lug 43 of toggle 23 so that the toggle is moved into the break position directly by the cam. This causes a single-pole interruption of the circuit to be regulated. During the further movement of cam structure 37, cam projection 44 abuts against lever 46. Lever 46 turns counterclockwise and opens contacts 48, 49, thus disconnecting the second pole of the circuit being regulated. In this manner, the cam structure 37 permits effecting a positive double-pole disconnection of the circuit.

When the cam structure 37 is turned back in the counterclockwise direction, the cam projection 44 runs off the lever 46, thus closing the contacts 48, 49. Thereafter, the dog pin 38 reaches cam face 40 and turns the adjusting lever 14 with the result that bimetal strip 13 places its part 58 against the abutment 22 and passes the toggle 23 from the break position back to the illustrated make position. The two poles of the circuit being regulated are then closed again.

The operation of the regulated hotplate according to the invention will be further understood from the following references to the diagrams of Figs. 5 and 6. The diagram shown in Fig. 5 represents a period of a regulating operation subsequent to the heating-up of the hotplate without withdrawal of heat by a cooking load. Fig. 6 is a corresponding diagram of a regulating operation occurring when a quantity of cooking material is placed on the hotplate and consumes part of the heat. In each diagram, the abscissa denotes time and the ordinate represents temperature. T_1 is the temperature at which the bimetal strip recloses the heating circuit (datum temperature). T_2 is the temperature at which the bimetal strip interrupts the heating current. The heating of the hotplate is switched on at the make moment t_0 of the regulating period. The interruption of the heating current takes place at the break moment t_1. The moments t_2 and $t_{2'}$ represent the timepoints of the next following make operation.

In the diagram of Fig. 5, the curve *a* represents the temperature of the hot plate at its hottest spot, that is directly at the heating winding. Curve *b* represents the temperature at the rim of the hotplate. Curve *c* indicates the temperature at the regulator casing. These curves differ from one another since the corresponding spots of the hotplate are differently heated. The acending portions of the curves are shown continued by broken lines beyond the break moment t_1. The dotted line extensions indicate which temperature the particular spot of the hotplate would have if the interruption of the cur-

rent would not be effected by the regulator. Curve *d* represents the temperature at the bimetal strip itself. In the interval between t_0 and t_1, curve *d* has a very steep rise and is virtually linear. This step increase is caused by the heating of the bimetal strip due to the same heating current that also flows through the heating resistor of the hotplate. The temperature interval T_1 and T_2 (about 30° C.) is chosen as large as possible in order to give the bimetal strip a large power capacity desirable for a secure switching operation. In this manner, the current-carrying capacity of the switch mechanism for the heating current is increased considerably. Such an increase in capacity is possible only because of the additional heating of the bimetal strip by the heating current of the hotplate. The additional heating of the bimetal strip is preferably so chosen that the temperature increase in the bimetal strip is virtually equal to the temperature increase of the hotplate at its hottest spot. In this case, the heating of the bimetal strip within the interval t_0 to t_1 is essentially a thermal image of the heating at the hottest spot. This has the advantage of securing an accurate and reliable temperature regulation also during idle operation of the hotplate, a result difficult to obtain with hotplates of small mass because of the facility with which undesired temperature increases may occur.

When at the moment t_1 the heating current is interrupted, the hottest spot of the hotplate immediately starts cooling. Hence, curve *a* commences to slope down at this moment. Curve *b*, indicating the temperature of the hotplate at its rim, continues to increase somewhat even after the cut-off moment of the heating current. This is due to the fact that the rim of the hotplate still receives some heat from hotter places. Consequently, the cooling of the rim occurs with some delay. Curve *c*, indicating the temperature at the regulator casing, continues to rise for a somewhat longer interval of time since the regulator casing is still being heated from the hotter parts of the plate. Thereafter, however, the temperature of the regulator casing also decays. The temperature at the heat-responsive element drops immediately after the interruption of the heating current as is apparent from curve *d*. As time progresses, the curves *a* to *d* converge toward one another since, due to heat exchange, the various parts of the hotplate assembly gradually assume the same temperature. The cooling curve of the bimetal strip can never be lower than the other cooling curves of the respective other points of the hotplate structure. As explained, the reclosing of the contacts and hence the start of the next supply of heating current occurs at a moment when a uniform temperature due to heat exchange is virtually established over an essential or predominant portion of the hotplate. This moment is denoted by t_2. Since after each interruption of the heating current the temperature curves merge with each other during the cooling interval, the selection of time point t_2 provides a suitable means for securing a definite and reliable control of the hotplate temperature.

In the diagram of Fig. 6, representing a period of the regulating performance when heat is withdrawn from the hotplate by a cooking operation, the curves *a'* and *b'* indicate the temperature of the hotplate at the hottest spot and at the rim respectively. Curve *c'* indicates the temperature at the regulator casing. In the interval between make moment t_0 and break moment t_1, the curves *a'* and *b'* are lower than the corresponding curves *a* and *b* in the diagram of Fig. 5 due to the fact that heat is withdrawn by the material to be cooked. Curve *d* again denotes the temperature at the bimetal strip. This curve has substantially the same increase as curve *d* in the diagram of Fig. 5 because the same heating current flows through the heat resistor during the current-flow period, regardless of whether or not a cooking vessel is placed upon the hotplate. The interruption of the heating current occurs when the bimetal strip has reached the temperature T_2. This occurs at the same moment t_1 as in the diagram of Fig. 5. When the flow of heating current ceases, the temperature at the hottest spot declines immediately as is apparent from curve *a'*. Near the rim of the hotplate, as apparent from curve *b'*, a slight heating continues until the rim also begins to cool. At the regulator casing, a continued heating is observed for a somewhat longer interval of time due to the fact that the adjacent parts of the hotplate are considerably warmer than the regulator casing. After elapse of the additional heating period, the temperature at the regulator casing declines according to curve *c'*. As more time elapses, the curves *a'*, *b'* and *d* approach and eventually merge with each other. At the moment when, due to heat exchange, a considerable portion of the hotplate structure has virtually assumed a uniform temperature, the heating current is again switched on. This occurs at the moment $t_{2'}$. In the diagram of Fig. 6, the time point $t_{2'}$ occurs earlier than the time point t_2 in the diagram of Fig. 5. This has the result that, when heat is withdrawn from the hotplate by cooking material, the regulating period is shorter than when the hotplate runs idle. That is, the frequency of the regulating operation when the hotplate is being used is larger than the regulating frequency of an idle hotplate. This is in accordance with the fact that the hotplate requires a larger energy supply when heat is withdrawn therefrom.

With a temperature regulator according to the invention, the flow period of the heating current during each regulating cycle after the heating-up of the hotplate is virtually uniform irrespective of whether or not heat is withdrawn from the hotplate by cooking material. This flow period is determined by the additional heating of the bimetal strip due to the heating current, and this additional heating is always substantially the same and is determined only by the chosen temperature interval T_1 to T_2. The flow period is made so long that at the make moment of the regulator, during steady-state operation of the hotplate, an essential portion of the hotplate has assumed a uniform temperature due to heat exchange. During the closed interval of the heating circuit, the bimetal strip operates only as a timing device. When the heating current is interrupted, the bimetal strip, having been heated up during the preceding current-flow period, cools down at a larger or smaller rate of temperature change, depending upon the heating of the hotplate, and then effects the make operation of the switch mechanism at the moment in which the heat exchange has resulted in temperature equalization. During the interrupted interval of the heating circuit, the bimetal strip, in contrast to the current-flow interval, operates as a control thermostat.

While the temperature T_1 of the hotplate can be varied at will by moving the adjusting member, the current-flow interval of the heating current is fixed and determined by the construction of the temperature regulator. Hence, when designing the temperature regulator, it should be kept in mind that small current-flow intervals result in large frequencies of regulating operation, and conversely long current-flow intervals correspond to small frequencies of regulating operation. Larger frequencies have the advantage of a higher accuracy in regulated temperature, lower frequencies have the advantage of lesser wear at the contacts.

Since the interruption of the heating current does not require a heat transfer from the hotplate structure to the bimetal strip, the performance of the temperature regulator according to the invention is not affected by the detrimental reaction period observable with the known temperature regulators that interrupt the heating circuit in dependence upon the heating of the appliance. The temperature regulator in a hotplate according to the invention, therefore, operates fully free of inertia regardless of whether or not the hotplate is active in supplying heat to cooking material; and by virtue of the relatively high

frequency of regulating operation, it controls the desired temperature with a higher degree of accuracy than heretofore obtainable in such devices.

It will be understood by those skilled in the art, upon a study of this disclosure, that apparatus according to our invention may be modified in various respects, especially as regards the design and shape of individual components, without departing from the essential features of our invention and within the scope of the claims annexed hereto.

We claim:

1. An electric hotplate, comprising a heater circuit, a temperature regulator for periodically making and breaking said heater circuit, said regulator having a thermally deflective bimetal strip responsive to the hotplate temperature and a snap-action switch mechanism actuated by said bimetal strip, said mechanism having a rigid dead-center toggle member pivotally movable between make and break positions, a movable contact, a contact spring yieldingly mounting said movable contact on said toggle member, a stationary contact engaged by said movable contact in said make position of said toggle member, said two contacts being connected in said circuit, a toggle spring connected with said toggle member and operative to bias said toggle member toward each of said positions selectively, and a permanent magnet magnetically coupled with said toggle member in said make position for holding said member in said make position conjointly with said toggle spring, said bimetal strip being engageable with said toggle member and having relative thereto a direction of deflection toward said break position, said toggle spring, when effective to bias said toggle member toward said make position being of decreasing biasing force as said toggle member is moved in the direction to said break position, whereby said toggle member when torn away from said magnet by the deflective action of said strip when heated, performs an abrupt break movement accompanied by an abrupt reduction in contact pressure and, during cooling of said strip, returns abruptly to the make position and tensions said contact spring due to the steep increase in the force of said magnet occurring as said toggle member approaches said make position.

2. With an electric hotplate comprising a plate structure, heating means joined with said plate structure, and an electric power circuit including said heating means, the combination of a temperature regulator means operative to maintain said plate structure at a substantially constant temperature independently of the amount of heat being withdrawn from said hotplate, said means comprising a snap-action mechanism having a pair of contacts connected in said power circuit for periodically making and breaking said circuit, a thermally deflective bimetal strip responsive to the temperature of said plate structure and engageable with said mechanism for controlling the latter to make said circuit at a certain temperature and manually operable means for adjusting the magnitude of said certain temperature at which said circuit is made, said bimetal strip having a strip heating circuit connected in series with said power circuit and said contacts to provide said strip with additional heat during the make period of said mechanism for breaking said power circuit substantially independently of the temperature distribution in said hotplate, said regulator having between each break moment and the subsequent make moment a timing period of sufficient length for temperature equalization to occur at said hotplate.

3. An electric hotplate comprising a shell-shaped plate structure having a cooling surface, heating means disposed in said structure over said surface, an electric power circuit including said heating means, a temperature regulator mounted within said structure for periodically making and breaking said heater circuit, said regulator having a thermally deflective bimetal element responsive to the hotplate temperature and a snap-action switch mechanism controlled by said bimetal element, said mechanism having a rigid dead-center toggle member pivotally movable between make and break positions, a movable contact, a contact spring yieldingly mounting said movable contact on said toggle member, a stationary contact engaged by said movable contact in said make position of said toggle member, said two contacts being connected in said circuit, a toggle spring connected with said toggle member and operative to bias said toggle member toward each of said positions selectively, and a permanent magnet magnetically coupled with said toggle member in said make position for holding said member in said make position conjointly with said toggle spring, said bimetal strip being engageable with said toggle member and having relative thereto a direction of deflection toward said break position, said toggle spring, when effective to bias said toggle member toward said make position being of decreasing biasing force as said toggle member is moved in the direction of said break position.

4. An electric hotplate comprising a shell-shaped plate structure having a cooling surface, heating means disposed in said structure over said surface, an electric power circuit including said heating means, a temperature regulator mounted within said structure operative to maintain said heating means at a substantially constant temperature independently of the amount of heat being withdrawn from said hotplate, said temperature regulator comprising a snap-action mechanism having a pair of contacts connected in said power circuit for periodically making and breaking said circuit, and a thermally deflective bimetal strip responsive to the temperature of said plate structure and engageable with said mechanism for controlling the latter to make said circuit at a certain temperature, and manually operable means for adjusting the magnitude of said certain temperature at which said circuit is made, said bimetal strip having a strip heating circuit connected in series with said power circuit to provide said strip with additional heat during the make period of said mechanism for breaking said power circuit independently of the temperature distribution in the hot plate, said bimetal strip having a cooling period and a corresponding idle travel distance from each break moment of said contacts until the moment when said strip engages said mechanism for making operation, and said distance having a length corresponding to a period of time sufficient for temperature equalization to occur over a predominant portion of said cooling surface.

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