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INFINITELY VARIABLE CONTROL SWITCH

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This invention relates to electric switches, and more particularly to switches of the type adapted to control the power supplied to an electric heating element or the like.

While not limited thereto, my improved control switch is particularly adapted to regulate the power supplied to an electric surface heating unit so that the heat output of the unit may be varied in small increments from zero to a predetermined maximum.

Infinitely variable heat control switches wherein the amount of current supplied to the heating unit is regulated by intermittently interrupting the circuit and varying the duration or frequency of the interruptions are of course well known in the art. An important advantage of such switches over heat control switches of the type having a limited number of separate and distinct positions is the flexibility of control afforded by the former. Thus the heat output of a heating element controlled by a so-called "infinite heat" switch may be varied in small increments and thereby may be regulated more nearly in accordance with the heat requirements of various cooking vessels and various cooking operations. However, infinite heat switches of the type arranged to operate on a single voltage sufficiently high to provide suitable maximum heat output (230 volts, for example) sometimes do not afford sufficiently precise heat control in the low heat range or sufficiently low minimum wattage for certain warming operations. In other words, the adjustment of such switches in the range from "off" to "low" heat position (corresponding to approximately 15% rated wattage) is difficult to achieve with accuracy, and the minimum heat provided is too high for the warming of light cooking loads.

Accordingly, a principal object of this invention is to provide an infinitely variable control switch which provides precise control throughout the entire range of the device.

Another object of this invention is to provide an improved infinitely variable control switch arranged to supply relatively high voltage power throughout one portion of its range of adjustment and relatively low voltage power throughout another portion of this range adjustment.

Further objects and advantages of the invention will become apparent as the following description proceeds, and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Briefly stated, in accordance with one embodiment of my invention I provide a periodically actuated switching mechanism including a pair of spaced contacts adapted to be connected to a relatively high voltage power source and a relatively low voltage power source respectively, an intermediate contact arranged for movement therebetween, a reciprocating actuator for the intermediate contact, and manually operable means for adjusting the path of movement of the actuator between a first path in which the intermediate contact remains continuously

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in engagement with the high voltage contact and another path in which it engages that contact during 20% of each switching cycle and engages the low voltage contact during the remaining 80% of the cycle. Thus if only the low voltage contact is energized a heating element connected to the intermediate contact may be energized at low voltage through a range from zero watts to one fourth of the rated wattage of the unit, and if only the high voltage contact is energized a wattage range from one quarter rated wattage to full wattage is obtained. It will be noted that the highest wattage rating on low voltage corresponds to the lowest wattage rating on high voltage, and hence a substantially circular cam surface may be utilized to adjust the path of the intermediate contact.

For a better understanding of my invention reference may be made to the following description and the accompanying drawing in which the single figure illustrates in diagrammatic form a control device embodying the invention.

Referring to the drawing, the numeral 1 designates an electric heating element adapted to be supplied with electrical power from a three wire electric power system including supply lines L1 and L2, and a neutral line N. It will of course be understood that the voltage between lines L1 and L2 is twice that of the voltage between either of these lines and the neutral line N, a common voltage rating being 230 volts and 115 volts respectively. In accordance with the present invention, the current is supplied to heating element 1 through a control device including a constant speed motor 2 and preferably a line switch 3 including cooperating contacts 4 and 5 placed in the circuit between heating element 1 and line L2. The electrical heating circuit provided by my control device may be completed either through voltage selector switch 6 which includes contacts 7 and 8, contact 7 being directly connected to supply line L1, or through voltage selector switch 9 which includes contacts 10 and 11, contact 10 being directly connected to neutral line N.

Contact 8 of voltage selector switch 6 is directly connected by means of conductor 12 to one of a pair of spaced switch contacts 13, while contact 11 of voltage selector switch 9 is connected by means of conductor 14 to spaced switch contact 15. Contacts 13 and 15 cooperate with an intermediate double faced contact 16 mounted for reciprocating movement therebetween and electrically connected by means of conductor 17 to heating element 1. Preferably, contact 16 is arranged for snap acting movement between contacts 13 and 15, and accordingly may be mounted on a spring arm 18 arranged to cooperate with a U-spring 19 arranged in compressed engagement with a frame member 20. It will of course be understood that the elements identified by the numerals 13-20 constitute the basic components of a double throw snap action switch, and that such switches are well known in the art. One commercially available switch which may be used in practicing my invention is manufactured by Microswitch Division of Minneapolis-Honeywell Regulator Company, and identified by catalog listing B2-2R.

In accordance with the present invention I provide means for periodically applying an actuating force to switch arm 18 in such a manner that contact 16 may be reciprocated so as to engage periodically contacts 13 and 15 for manually variable time intervals. Thus, by closing voltage selector switch 6 and opening switch 9, or vice versa, power at two different voltage levels may be periodically supplied to heating unit 1.

As shown in the drawing, switch arm 18 is actuated by a cam follower, generally designated by the numeral 21, including a cam finger portion 22, an end portion 23 in engagement with a constant speed rotary cam 24, and an

other end portion 25 in engagement with a manually adjustable cam 26. Cam 21 is resiliently held in engagement with cams 24 and 26 by a spring arm 26a bearing on the central portion thereof. Cam 24 is rotated at relatively slow constant speed (2 R. P. M., for example) by motor 2 so as to impart a vertical reciprocating motion to cam finger 22. The upper and lower limits of the path of movement of cam finger 22 are determined by the position or setting of cam 26, which is provided with a manually operable control knob 27 arranged to rotate the cam through 360° of movement. It will be noted that counterclockwise rotation of knob 27 from the off position shown in the drawing produces a downward movement of end portion 25 of cam follower 21 during the first 180° of rotation, and that continued rotation of knob 27 to the highest heat setting raises portion 25 to its original position as rotation continues through the remaining 180° of movement.

In the low heat range of control knob 27 (indicated by indicia numbered 1-7) relatively low voltage power is supplied to heating unit 1, and accordingly, voltage selector switch 9 is closed while switch 6 is open when knob 27 is positioned in this range. Also, of course, line switch 3 is closed when knob 27 is in either the low heat range or the high heat range. Therefore, voltage selector switches 6 and 9 are preferably actuated by a rotary cam 28 and line switch 3 is preferably actuated by a cam 29, both of these cams being arranged to be positioned by movement of control knob 27. As schematically illustrated in the drawing, cams 26, 28 and 29 may be conveniently mounted on a common shaft with control knob 27. It will be evident that line switch 3 is closed whenever knob 27 is in any position other than the two "off" positions spaced 180° apart, and that voltage selector switch 6 is open and voltage selector switch 9 is closed when knob 27 is in any position in the low heat range. In the high heat range (corresponding to settings on knob 27 indicated by the indicia numbered 7-12), voltage selector switch 6 is closed and switch 9 is open, so that in the low heat range power is supplied to heating unit 1 from lines L2 and the neutral line N while in the high heat range power is supplied from lines L1 and L2.

Cams 24 and 26 are arranged with respect to shape and relative size so that in the position shown in the drawing contacts 13 and 16 remain continuously in engagement upon rotation of cam 24. Upon counterclockwise rotation of knob 27 to positions in the low heat range, contact 16 engages contact 15 for progressively longer time intervals, ranging from zero percent in the "off" position illustrated to 80 percent of the total contact engagement time in heat position "7." Upon movement of knob 27 from low heat position "7" to heat position "7" in the high heat range, voltage selector switch 6 closes and switch 9 opens so that heating unit 1 then receives current through contact 13 rather than contact 15. In this control knob position contact 16 continues to engage contact 13 during 20% of each switching cycle and to engage contact 15 during the remaining 80% of the cycle, the result being that the total power supplied to heating unit 1 is the same as the total power supplied when knob 27 is positioned at numeral "7" in the low heat range. This is true, of course, because the wattage output produced by current at a specified relatively low voltage during 80% of a particular time interval equals the wattage output produced by current at double the specified voltage supplied during 20% of an equal time interval. Thus it will be seen that my invention provides a smooth transition from a low voltage heating range to a high voltage heating range, and permits use of an adjusting cam having a continuous cam surface uninterrupted by a sharp rise or drastic change in the cam surface configuration.

From the foregoing description of presently preferred embodiment of my invention, it will be evident that

movable contact 16 is periodically reciprocated upon rotation of cam 24 by motor 22 and that the path of movement of cam finger 22 may be adjusted by the manual positioning of knob 27. As knob 27 is turned in a counterclockwise direction progressively higher heat outputs are obtained, it being understood that current is supplied at relatively low voltage in the low heat range when only contact 15 is connected to the power source, and at relatively high voltage in the high heat range when only contact 13 is connected to the power source. In the low heat range, the percentage "on" time may be varied from zero percent to 80%, and in the high heat range the percentage "on" time may be varied from 20% (producing a wattage output equal to the wattage produced at the 80% setting on low voltage) to 100%, which of course provides the full rated wattage of the heating unit.

While I have shown and described a specific embodiment of my invention, I do not desire my invention to be limited to the particular construction disclosed, and I intend by the appended claims to cover all modifications within the true spirit and scope of my invention.

What I claim is:

1. A control device for supplying electric current to a heating element or the like for selectively variable intervals of time comprising first and second spaced switch contacts adapted to be connected to a relatively high voltage power source and a relatively low voltage power source respectively, a third switch contact positioned between said first and second contacts and arranged for reciprocating movement therebetween, said third contact being adapted to be connected in circuit with a heating element so as to provide a first circuit for supplying current thereto when said first and third contacts are in engagement and a second circuit for supplying current thereto when said second and third contacts are in engagement, actuating means for periodically actuating said third contact, manually operable means for adjusting the path of movement of said actuating means within a first range of path positions extending from a first path position in which said first and third contacts are continuously in engagement to a second path position in which said first and third contacts are in engagement during 20% of each switching cycle and said second and third contacts are in engagement during the remaining 80% of said cycle, said manually operable means having a first range of settings providing a first series of path positions progressing from said first path position to said second path position and a second range of settings providing a second series of path positions progressing from said second path position to said first path position, and switch means adapted to connect only said second contact to its power source when said manually operable means is within said first range of settings and to connect only said first contact to its power source when said manually operable means is within said second range of settings.

2. A control device as defined in claim 1 in which said actuating means includes a cam follower arranged to reciprocate said third contact, a rotary cam in operative engagement with said cam follower, and a constant speed motor arranged to rotate said cam.

3. A device as defined in claim 2 in which said normally operable means includes a movable cam surface, and said cam follower includes a first portion connected to said third contact so as to impart motion thereto, a second portion supported on said rotary cam, and a third portion supported on said cam surface, whereby said first portion of said cam follower is reciprocated through a predetermined path of movement by said rotary cam and the limits of said path are determined by the position of said cam surface.

4. A device as defined in claim 1 in which said third contact is mounted on a spring arm associated with an over-center spring providing snap acting movement of

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said third contact between the limits of its path of movement.

5. A control device for supplying electric current to a heating element or the like for selectively variable intervals of time comprising first and second spaced switch contacts adapted to be connected to a relatively high voltage power source and a relatively low voltage power source respectively, a third switch contact positioned between said first and second contacts and arranged for reciprocating movement therebetween, said third contact being mounted on a spring arm associated with an overcenter spring providing snap acting movement, said third contact being adapted to be connected in circuit within a heating element so as to provide a first circuit for supplying current thereto when said first and third contacts are in engagement and a second circuit for supplying current thereto when said second and third contacts are in engagement, a cam follower arranged to actuate said third contact, a first rotary cam in operative engagement with said cam follower, a constant speed motor arranged to rotate said first cam, manually operable means for adjusting the path of movement of said cam follower within a first range of path positions extending from a first path position in which said first and third contacts are continuously in engagement to a second path position in which said first and third contacts are in engagement during 20% of each switching cycle and said second and third contacts

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are in engagement during the remaining 80% of said cycle, said manually operable means including a second rotary cam having a first range of settings providing a first series of said path positions progressing from said first path position to said second path position and a second range of settings providing a second series of path positions progressing from said second path position to said first path position, said cam follower having a first portion connected to said spring arm so as to impart motion thereto, a second portion supported on said first rotary cam, and a third portion supported on said second rotary cam, whereby said first portion of said cam follower is reciprocated through a predetermined path of movement by said first rotary cam and the limits of said path are determined by the position of said second rotary cam, and switch means adapted to connect only said second contact to its power source when said manually operable means is within said first range of settings and to connect only said first contact to its power source when said manually operable means is within said second range of settings.

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