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ELECTRIC CONTROL SWITCH

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This invention relates to electric switches, and, more particularly, to adjustable control switches adapted to automatically operate to supply electric current a selected percentage of "on" and "off" time to any device or apparatus desired.

Heretofore, various efforts have been made to provide control switches for electric heating pads, advertising signs, electric stoves and other electric heating or electric apparatus, but such known control switches have generally taken the form of rheostats or the form of switches for changing the circuit characteristics or resistance. Rheostats are expensive and impractical in many relations whereas electric switches for changing circuit characteristics and resistance are open to the objection that a wide and fully variable control is not possible. Moreover, variations in circuit and resistance bring in undesirable complications, for example, localized heating.

Still again, some efforts have been made to employ thermostat control switches, but these are usually pre-set, are difficult of variable adjustment, are not adapted to use over a wide and fully variable range of electric loads and currents, and tend to be expensive to construct and maintain in operation.

It is the general object of my invention to avoid and overcome the foregoing and other objections to and difficulties of prior art practices by the provision of an electric control switch characterized by smallness of size, lightness of weight, simplicity and inexpensiveness of construction, wide variety of control under substantially any conditions of electric load and resistance, and having long and substantially maintenance free life.

Another object of my invention is the provision of a control switch of the character indicated, and particularly adapted for use in conjunction with electric heating means, such as electric heating pad for invalid or bed use, the switch being characterized by light weight, compactness of size, ease of operation, and being adapted to use with an electric heating pad having a single circuit which can be supplied electric current by the control switch over the broad range of from about 5% to about 95% of the time the pad is being used, and with a complete "on" and a complete "off" position.

Another object of my invention is to provide a control switch for electric appliances and apparatus, the switch operating through an "on" and "off" cycle of controllable and variable duration.

The foregoing objects of my invention, and

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other objects which will become apparent as the description proceeds, are achieved by the provision in a control switch of a contact and an insulated stop, an element mounting said contact and stop, a contact member movable between the contact and stop, mechanism for moving the contact member between the contact and stop in a continuously repeated cycle, and means for changing the relation of the element and mechanism to vary the time the contact member is in engagement with the contact. Conveniently, but not necessarily, the mechanism for moving the contact member between the contact and stop is thermostatic in character and is operated by electric heating means.

For a better understanding of my invention reference should be had to the accompanying drawings wherein:

Fig. 1 is a vertical longitudinal cross-sectional view, on an enlarged scale, through one embodiment of a control switch incorporating the principles of my invention; and

Fig. 2 is a schematic wiring diagram illustrating the switch of Fig. 1 connected to an electric appliance or apparatus.

It will be understood that the control switch of my invention can be built in a wide variety of sizes and styles adapted to control electric current of various voltages and amperages for use with electric apparatus and appliances of many different types. However, a typical use of my improved switch is in conjunction with an electric heating pad for bed or invalid use, and this embodiment of my invention has been illustrated in the drawings and will be described.

In Fig. 1 of the drawings the numeral 10 indicates generally a switch made of plastic or other suitable material, and including a bottom portion 12 and a top 14 removably secured thereto by means (not shown) of any desired character. Received within the case 10 is a member 16 which is adapted to be moved cyclically in a continuously repeated path. The member 16 can be reciprocated with a straight line movement, or it can be oscillated through an arc, or it may take other forms of movement, for example, circular, which will suggest themselves to the skilled designer. Suffice it to say that the member 16 must move to continuously repeat a series of motion steps in a given time interval. Any suitable means may be utilized to move the member 16, for example, an electric motor, fluid motor, or other known mechanisms.

In the embodiment of my invention illustrated the member 16 conveniently takes the form of an

arm mounted for oscillating movement through an arc about an insulated post 18 secured to the bottom 12 of the case. In order to effect movement of the member 16 in the form of the invention shown, the member is formed as a bi-metal strip or arm adapted when cold to be positioned in the manner shown in the drawing, and when heated to move downwardly through an arc. The member 16 can be heated in any of a plurality of ways, but one convenient way to achieve the heating of the member 16 is to associate an electric resistance heating coil 20 with the member, for example, by fastening the coil to or around at least a portion of the member.

As diagrammatically shown in Fig. 2, but as also illustrated in Fig. 1, the heating coil 20 is connected by a lead 22 to an electric conductor 24 running back to an electric power source, and the other side of the coil 20 connects through a switch mechanism to a second electric conductor 26 running back to the electric power source. The switch mechanism just referred to includes a spring arm 28 pivotally mounted in insulated relation and in cantilever fashion on the block 18, the spring arm being electrically connected to the conductor or wire 26 by a jumper 60. The spring arm 28 carries at its unsupported end a contact 30 which is adapted to removably engage with a contact screw 32 adjustably carried by a metal plate 34 mounted in the base of the case 10, the plate being electrically connected by flexible wire 36 to the other end of the heating coil 20.

With the contacts 30 and 32 closed, it will be recognized that electric current will flow from the conductors 24 and 26 to the heating coil 20 to heat the bi-metal forming the member 16 so that the bi-metal moves in a downward arc. In order to get the cycling effect previously described, the member 16 is formed with a downwardly extending bracket portion 40 pivotally secured, as at 41, to one end of an over-center member which may obviously take a variety of forms but which is for purposes of example shown as a U-shaped ribbon compression spring 42, whose other end is pivotally secured at 43 to the spring arm 28. The spring arm 28 may be centrally slotted or apertured to allow the movement of the narrower bracket 40 and ribbon spring 42 down into and through the plane of the spring arm.

It will be recognized that as the member 16 continues to move downwardly under the influence of the heat generated by the electric coil 20 that the pivot point 41 between the bracket 40 and the spring 42 will pass below the line joining the pivot point 43 and the pivot point of the spring arm 28 on the post 18. For convenience and shortness of nomenclature, I will refer hereafter in the specification and claims to the line just described as the effective plane of the spring arm or merely as the plane of the spring arm. In any event, as the pivot point 41 moves down through the plane of the spring arm 28 the spring arm is thrown in an upward direction under the force of the over-center spring 42 to move the contact 30 away from the contact 32 with a snap action to thereby break the flow of electric current to the heating coil 20. The upward movement of the spring arm 28 and the contact 30 is limited by the provision of a shoulder 44 formed on an insulating block 46 secured to the base 12 of the case. It might be noted that the fast snap action of the over-center spring 42 reduces arcing to a minimum even under heavy electric load. This also reduces radio interference.

Breaking the flow of electric current to the coil

20 causes the bi-metal strip of the member 16 to cool to move the member 16 in an upward direction until such time as the pivot point 41 between the bracket 40 and the spring 42 passes vertically above the effective plane of the spring arm 28 at which time the spring arm 28 is snapped downwardly under the action of the over-center spring 42 to again bring the contacts 30 and 32 quickly together, so that electric current will again be supplied to the heating coil 20.

This cycle of operations will be continuously repeated, namely, the arm 16 is continuously moved down and up with an oscillating or arcuate movement a given number of times in a selected time interval. By appropriately designing the parts, for example, the size of the coil 20, the clearance of the shoulder 44, the position of the contact screw 32, or the like, the total time of one complete cycle can be established as desired or required for a given use, for example, but not by way of limitation, between ten seconds and five minutes. In the heating pad control switch illustrated the total time of one cycle of movement of the member 16 may be designed to be in the neighborhood of thirty seconds.

As already noted above, other means than those particularly illustrated and described could be employed to effect a controlled cyclic movement of the member 16, but the means shown and described are particularly practical and convenient in the form of the switch shown, being characterized by compactness, simplicity and long life. The purpose of the cycle circuit just described is to establish periodicity of the cycle entirely independent of the wattage or other electrical characteristics of the controlled apparatus which may vary in construction or use.

The continuous cyclic movement of the member 16 is utilized to control the flow of electric current to a heating pad 50 or other appliance or apparatus controlled by the switch. This is achieved by opening and closing contacts 52 and 54 in the electric circuit to the pad or appliance 50 in response to the cyclic movement of the member 16. Preferably the movement of the contact 52 away from the contact 54 is limited by an insulated stop 56. The contact 52 is carried by a contact or spring arm 58 pivotally supported in cantilever fashion by the insulated post 18, with the contact arm 58 being electrically connected by the jumper 60 with the electric conductor 26. The end of the member 16 is pivotally connected, as at 62, to one end of an over-center member 64, such as the member 42 above described, for example a U-shaped ribbon spring, with the contact arm 58. The contact arm 58 is centrally slotted to allow movement of the narrow bracket 40 and spring 64 there-through.

Thus, in the continuous cyclic movement of the member 16 in an up and down direction the contact 52 and contact arm 58 are held down against the insulated stop 56 until such time as the pivot point 62 moves through the line joining the pivot 66 and the point of pivotal support of the contact arm 58 on the post 18. For simplicity this line will hereinafter be referred to as the effective plane or the plane of the contact arm 58. Upon movement of the pivot point 62 through the plane of the contact arm the over-center spring 64 will throw the arm and contact point 52 with a snap action up into engagement with the contact 54. The contacts 52 and 54 will stay together until the pivot point 62 on the member moves back through the plane of the contact arm 58 at which time the spring 64 will snap the contact arm 58 and con-

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tact 52 back into engagement with the insulated stop 56.

Both the insulated stop 56 and the contact 54 are secured, in the manner illustrated, in opposed, spaced relation on a U-shaped end 70 of a metal arm 72 supported as a cantilever on the insulated post 18. The metal arm 72 is connected by an electric conductor 74 to the heating pad or appliance 50.

From the foregoing description, it will be evident that with the member 16 moving or cycling through a fixed up and down arc that the contact 52 will be in engagement with the insulated stop 56 for a part of the cycle of movement of the member 16, and will be in engagement with the contact 54 for the remainder of the cycle of movement. Now if the position or relation of the insulated stop 56 and contact 54 is made adjustable with respect to the extent of movement of the member 16, and particularly the pivot point 62, it is possible to vary within wide limits the percentage of the cycle time that the contact 52 is in engagement with the contact 54 or is in engagement with the insulated stop 56.

More specifically, with the arm 72 near its most downward position, it takes a relatively long time for the pivot point 62 on the member 16 to move through the plane of the contact arm 58, and when the pivot point 62 moves through the plane of the contact arm 58 the pivot point 62 is very near the end of the downward movement of the member 16. Thus, the contact 52 is held against the insulated stop 56 for the very large percentage of the cyclic movement of the member 16, for example, up to as much as approximately 95% of the total time of cyclic movement of the member 16.

Of course, when the pivot point 62 does move through the plane of the contact arm 58 the contact 52 is thrown up into engagement with the contact 54 to complete the flow of electric current to the heating pad or appliance 50. However, the time of contact between the contacts 52 and 54 is relatively short inasmuch as the member 16 reaches the end of its downward travel and begins its return movement almost simultaneously with the movement of the contacts 52 and 54 together. Just as soon as the return upward movement of the member 16 moves the pivot point 62 through the plane of the contact arm 58 in the other direction the contact arm 58 is thrown downwardly under the action of the over-center spring 54 to move the contact 52 and contact arm 58 down against the insulated stop 56. The amount of electric current passed to the heating pad or appliance 50 is thus relatively small because the current is supplied for a time as little as approximately 5% of the total time of cyclic movement of the member 16.

On the other hand, if the arm 72 is raised so that the pivot point 62 lies just above the plane of the contact arm 58 at the beginning of the downward cyclic movement of the member 16, then the first part of the downward movement of the member 16 will move the pivot point 62 through the plane of the contact arm 58, and the spring 64 will throw the contact arm upwardly to move the contact 52 into engagement with the contact 54. The downward movement of the member 16 will continue through the full extent of its normal movement until the pivot point 62 is finally returned during the last part of the upward movement of the member 16, and is passed through the plane of the contact arm 58 in the opposite direction at which time the

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spring 64 throws the contact arm 58 and the contact 52 back into engagement with the insulated stop 56.

With the arm 72 positioned in the last described relation the contacts 52 and 54 are together and electric current is flowing to the pad or appliance during the very large percentage of the movement of the member 16, for example, up to approximately 95% of the cyclic time of movement of the member 16.

It is to be noted that during the operation of the switch as just described to supply current up to as much as 95% of the time that the pivot point 62 has passed well below the plane of the arm 58. This is important for the reason that with the pivot point 62 well below the plane of the arm 58 the spring 64 acts at an angle to provide the greatest pressure between the contacts 52 and 54 to reduce heating thereof. Thus, my improved switch has the inherent advantage that with greater current flow in point of time there is provided greater contact pressure to reduce contact heating and erosion.

By appropriately positioning the arm 72, and thus the contact 54 and insulated stop 56 with respect to the cyclic movement of the member 16, the control switch will perform to establish and maintain any desired relation of current "on" with current "off" between the limits "on" approximately 95% of the time and current "off" approximately 95% of the time.

Of course, full "on" and full "off" of the flow of current to the pad or appliance can be obtained by positioning the arm 72 in a completely up or a completely down position so that the pivot point 62 will not pass through the plane of the contact arm 58 during the cyclic movement of member 16.

From Fig. 1 it will be noted that the contact 54 is shown in the form of a screw which is adjustably carried in the arm 72. This permits the clearance between the contact 54 and insulated stop 56 to be adjusted. The farther apart the stop 56 and contact 54 are the quicker and more positive is the make between the contact 54 and the contact 52. On heavy current loading this may be advantageous. The closer together the stop 56 and contact 54 are the greater is the range of control, due, of course, to reducing the lost motion pick-up of contact arm 58. In other words, if the contact 54 is adjusted away from the stop 56 the limits of the switch control may be dropped from between about 95% on and about 95% off to a percent somewhat less than those stated. The clearance between the contact 54 and the stop 56 may be adjusted to obtain the best operating characteristic for any given switch use. Of course, the best clearance when once determined for a given switch use can be built into all switches to be put into such use and the contact 54 can be fixed to the arm 72.

Any suitable means may be provided for controlling the position of the arm 72, for example, slides, knobs, and the like. In the embodiment of the invention illustrated, and by way of example only, such adjusting means for the arm 72 comprise a threaded stud 80 adapted to engage with an upwardly off-set portion 82 on the arm 72. The stud 80 extends slidably through the top 14 of the case 10, and is held against relative rotary movement with respect to the case by a key 84 whose ends are received in key ways or slots 86 of a collar formed with or secured to the top 14. The upper end of the stud pin 80 is threaded and receives a nut 88 which

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is molded in a knob or dial 90, the dial 90 being held on the top 14 of the case 10 for rotary movement with respect thereto, but non-axial movement. A spring detent 92 may be incorporated with the dial 90 to releasably hold the dial in a full "on" or a full "off" position, or at any series of selected angular positions there between. It will be understood that the relation between the dial 90 and the threaded stud 80 is such that when the dial is rotated the stud 80 will move up or down to position the arm 72 in any desired relation to the pivot point 62 of the cyclic member 16.

Fig. 2 illustrates in schematic wiring diagram form the connections for the control switch illustrated in Fig. 1. A signal light 94 can be incorporated with the switch, as can be a separate "on" and "off" switch 96.

From the foregoing it will be appreciated that the objects of my invention have been achieved by the provision of an improved, relatively inexpensive, light-weight, electric control switch for supplying electric current to an appliance or apparatus over a very wide range of "on" and "off" limits. The switch is compact, easily operated, and is capable of operation for long periods without maintenance or repair. For example, in the form of switch shown and described, it can be easily incorporated with the electric wires running to the heating pad or other appliance, and can be conveniently held in the hand being not more than about three inches long and weighing less than three ounces. The character of the control switch is such that it can be calibrated for many uses with a high degree of accuracy in terms of time or heat.

While in accordance with the patent statutes I have specifically illustrated and described one embodiment of my invention, it is to be particularly understood that I am not to be limited to the forms of my invention shown and described, but that the scope of my invention is defined in the appended claims.

I claim:

1. A control switch including a movable member, motor means associated with the member to effect reciprocal movement of the member in a predetermined fixed time and distance cycle, a contact arm, an over-center spring connecting the contact arm and the member, a movable element, a pair of spaced stops carried by the element, at least one of the stops being an electrical contact, the contact arm being biased into contact with one stop or the other as the spring is actuated over center by the reciprocal movement of said member, and adjusting means for varying the position of the element to control the fraction of one cycle of the motor means during which the contact arm is biased into contact with either of the stops.

2. An electric control switch including frame means, a contact arm, a member, said contact arm and member being supported adjacent each other at one end to said frame means, the contact arm being longer than the member and slotted to permit movement of the member to either side of the contact arm, an expansion spring between the free end of the member and the contact arm, a cantilever arm having a U-shaped end extending around the free end of the contact

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arm for limiting the movement of the contact arm, motor means associated with the frame and adapted to actuate the member in a reciprocating movement at a predetermined rate, and adjustable means for positioning said U-shaped end of the cantilever arm to control the fraction of one cycle of the motor means during which the contact arm is against one portion of the U-shaped end by shifting the point in the cycle of the member at which the spring snaps over center.

3. An electrical control switch comprising frame means, a first contact arm, a bi-metal strip, said first contact arm and bi-metal strip being secured at one end to the frame means adjacent each other, said first contact arm being longer than the strip and slotted to permit relative movement of the strip and contact arm past each other, an expansion over-center spring between the free end of the bi-metal strip and said first contact arm, a cantilever arm supported at one end by the frame, the free end of the arm being substantially U-shaped and extending around the free end of said first contact arm, said U-shaped end providing a pair of spaced stops for limiting the movement of said first contact arm, electric heating means associated with the bi-metal strip, a second contact arm secured at one end to the frame means in substantially parallel relation to said first contact arm, a bracket secured to the free end of the bi-metal strip bridging the space between the two contact arms, said second contact arm being slotted to permit relative movement of the bracket and second contact arm, an expansible over-center spring between the end of the bracket and the second contact arm, an electrical contact supported by the frame means adjacent the free end of the second contact arm, the heater means being electrically actuated by closing of the second contact arm and contact whereby cyclic movement of a predetermined rate is imparted to the bi-metal strip, through alternate heating and cooling of the heater means, a dial rotatably carried by the frame, and a stud actuated by rotation of the dial and engaging the cantilever arm for adjusting the position of the U-shaped end of the arm to control the point in the cycle of the bi-metal strip at which the associated spring snaps over center.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,578,360	Phelps -----	Mar. 30, 1926
1,620,806	Denison -----	Mar. 15, 1927
1,933,083	Ackerman -----	Oct. 31, 1933
2,068,374	Carlson -----	Jan. 19, 1937
2,237,705	Kohl -----	Apr. 8, 1941
2,275,917	Newell -----	Mar. 10, 1942
2,288,640	Paulus -----	July 7, 1942
2,299,215	Elkin -----	Oct. 20, 1942
2,409,420	Clark -----	Oct. 15, 1946
2,414,778	Tratsch -----	Jan. 21, 1947
2,425,030	Clark -----	Aug. 5, 1947