Nov. 12, 1963 H. F. HILD ET AL 3,110,789

THERMALLY ACTUATED CYCLING SWITCH

Filed Nov. 19, 1959 2 Sheets-Sheet 1

Fig. 1.

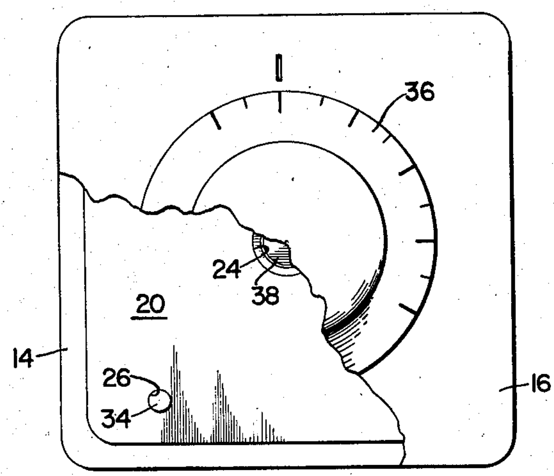


Fig. 2.

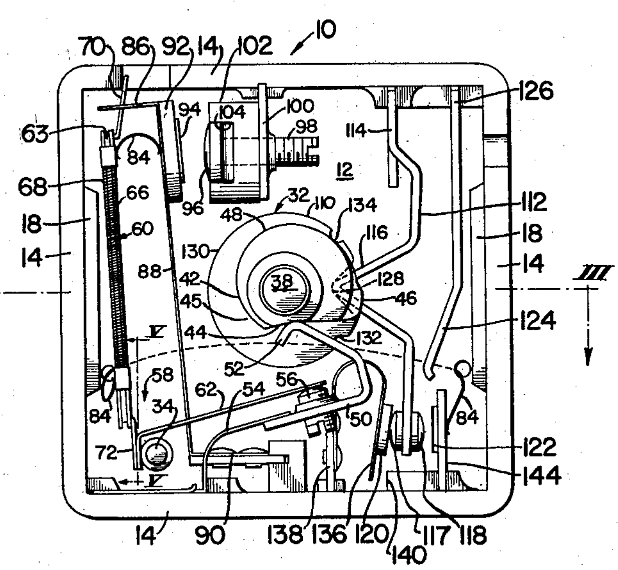
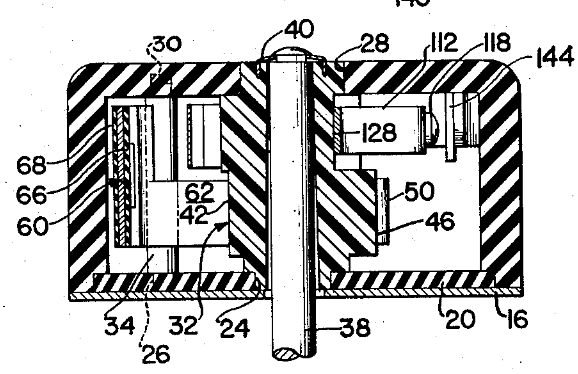


Fig. 3.



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Filed Nov. 19, 1959 2 Sheets-Sheet 2

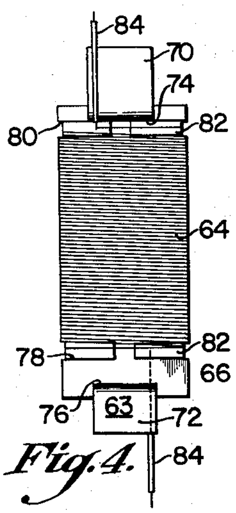

Fig. 4.

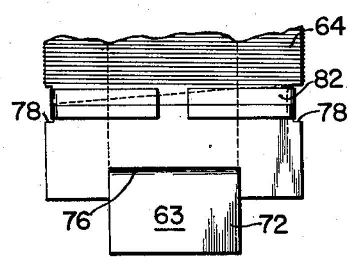

Fig. 5.

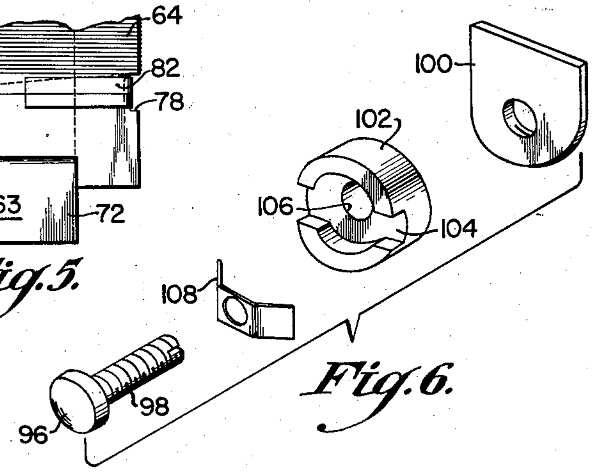

Fig. 6.

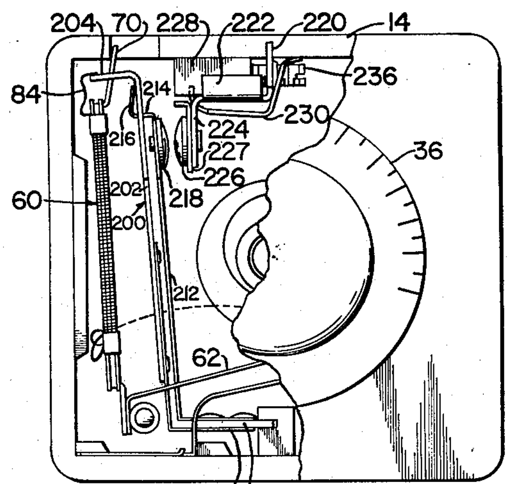

Fig. 7.

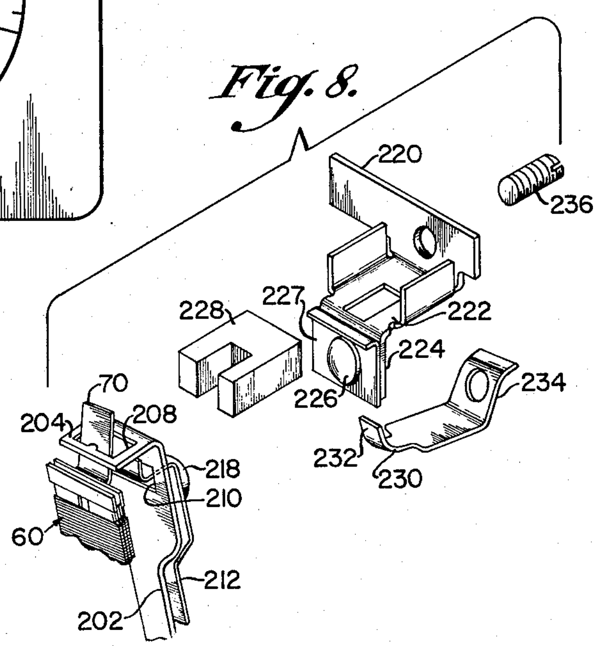

Fig. 8.

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3,110,789

THERMALLY ACTUATED CYCLING SWITCH

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10 Claims. (Cl. 200—122)

This invention relates generally to electric energy regulators and more particularly to a thermally actuated cycling switch for controlling the rate of energization of a surface heating unit for an electric range or the like.

Thermal devices are known to control the wattage input to a heating load by the cyclic making and breaking of a circuit from a supply line to the heating load at adjustable predetermined average rates. These available devices are, however, generally unsatisfactory for providing effective control throughout an entire range of 0–100% wattage input. More particularly, the operation of these devices is generally most unsatisfactory in both the high and low range of wattage inputs due to the detrimental arcing which occurs at the switching contacts. This detrimental arcing usually results from the combined effect of the low magnitude of the contact pressures available at the contacts and the slowness of the action of the thermal means which is usually utilized to actuate these contacts between positions.

Some devices of this character have utilized a snap action type switch means actuated by the thermal means in an attempt to improve the operation. However, although the operation may be somewhat improved by this expedient, it is still generally unsatisfactory in the lower range of wattage inputs because the relatively weak forces generated by the thermal means are usually of an insufficient magnitude to actuate these snap action switches between controlling positions.

The present invention embodies a thermal cycling switch arrangement which achieves a greater range of average wattage inputs than has been heretofore available with prior art devices. These results are achieved largely through the use of a switching arrangement which is capable of developing high contact pressures and which is also capable of being actuated between positions by the relatively weak operating forces that are developed by the usual thermal cycling means. Accordingly, an object of this invention is to obtain a high contact force between a pair of contacts operated between controlling positions by a low force thermal cycling means.

Another object of this invention is to magnetically influence movement of a thermomotive element which actuates a pair of contacts between positions.

Still another object of this invention is to prevent arcing at the contacts of a thermally actuated cycling switch.

A further object of this invention is a switch of simple, compact construction which lends itself to mass production techniques and which is extremely reliable and consistent in operation.

In carrying out this invention, a thermomotive member is pivoted at one end and includes a heating element for controlling movement thereof about its pivoted end; a switch is connected in circuit with the heating element and is actuated between controlling positions in response to movement of the thermomotive member. Means are provided to engage the thermomotive member and to adjust its initial position about its pivoted end to predetermine the average wattage to be delivered by the switch. Additionally, a magnetic member is provided to cooperate with the switch and to influence the operation thereof between controlling positions.

These and other features and advantages will become apparent from the following description of the preferred

embodiment of this invention taken in connection with the accompanying drawings wherein:

FIG. 1 is a front elevation of the switch of this invention shown partially in section;

FIG. 2 is a view similar to FIG. 1 with the front cover and retaining member removed;

FIG. 3 is a section taken on line III—III of FIG. 2, with the front cover and retaining member in place;

FIG. 4 is a front elevation view of the thermomotive actuating member of the present invention;

FIG. 5 is an enlarged view taken on line V—V of FIG. 2;

FIG. 6 is an exploded perspective of a stationary contact assembly shown in FIG. 2;

FIG. 7 is a front elevation of a modification with a part broken away; and

FIG. 8 is an exploded perspective of a detail in FIG. 7.

The thermally actuated switch of the present invention includes a substantially rectangular switch casing, indicated generally at 10. Casing 10 is preferably made of an insulating material and includes a base portion 12 and four upstanding sidewall portions 14. Sidewall portions 14 have disposed thereon a centrally apertured cover member 16 which is held in fixed relation by suitable fastening means (not shown). A pair of opposed sidewall portions 14 are provided with protrusions 18 which terminate beneath the top edges of these sidewalls and which extend inwardly of the casing 10. A substantially flat retaining member 20 is disposed immediately beneath cover member 16 and is preferably made of a suitable insulating material.

Retaining member 20 is of substantially rectangular form and is dimensioned to have its edge portions abut the inner surfaces of sidewall portions 14. The undersurface of retaining member 20 abuts the upper edges of protrusions 18 so as to be positively positioned and aligned with respect to the switch parts to be hereinafter described with the cover member 16 is in place.

Retaining member 20 is suitably apertured at 24, coaxially of the aperture in cover member 16, and is also apertured at 26, adjacent to a junction of a pair of the sidewall portions 14. Base portion 12 is similarly apertured at 28, coaxially of the aperture 24, and is also apertured at 30, coaxially of the aperture 26. A control cam 32 is journalled in apertures 24 and 28, while a pivot pin 34 is similarly journalled in apertures 26 and 30, for purposes to be hereinafter made apparent.

A manually operable control knob 36, having suitable indicia, is used for adjusting the control cam 32 to obtain a plurality of rates of energization for a heating element (not shown) to be controlled by the switch of this invention. Control knob 36 is carried on one end of a control shaft 38 which extends coaxially through a suitable bore provided in control cam 32. The ends of control cam 32 and shaft 38, opposite the control knob 36, are suitably joined by a retaining member 40. The interior bore in control cam 32 may be provided with a slight taper to permit a slight amount of pivotal movement of shaft 38 about retaining member 40 without affecting the position of control cam 32. With this arrangement of shaft 38 and control cam 32, it is possible to completely assemble and calibrate the switch of the present invention without the shaft and the control knob and thereafter provide a shaft and control knob of any suitable design, as may be required.

Control cam 32 is provided with a cam surface 42 generated by a line generally parallel to the axis of rotation thereof and movable thereabout to form an off portion 44 and a plurality of active portions, such as, a low portion 45, a high or full heat portion 46 and an infinite number of intermediate positions 48. Control cam 32 is rotatable in either direction and operates in each of its adjusted positions to exert a force on an adjusting member 50.

Adjusting member 50 is pivoted at one end on a sidewall portion 14, adjacent pivot pin 34, and has a bent over lip portion 52 at its opposite end. The pivoted end of adjusting member 50 is formed of a resilient material 54 which continuously biases the lip portion 52 into continuous engagement with cam surface 42. A threaded adjustable member 56 is provided on adjusting member 50 opposite the bent over lip portion 52 for transmitting movement of adjusting member 50 to a bifurcated assembly, indicated generally at 58.

Bifurcated assembly 58 includes a heat motor or thermal actuator, indicated generally at 60, and an ambient compensating bimetal 62. Heat motor 60 and compensating bimetal 62 are secured together at adjacent ends and to the pivot pin 34, as by welding, for pivotal movement thereabout. The free end of compensating bimetal 62 is disposed to continuously engage the adjusting member 56 while the heat motor 60 is disposed in substantially parallel spaced relationship to one of the side wall portions 14.

Referring now to FIGS. 2, 4, and 5, heat motor 60 is shown comprising a main actuating bimetal 63, a heating coil 64 disposed about the bimetal 63, and insulating members 66, 68 disposed on either side of bimetal 63 between the heating coil and the bimetal. Bimetal 63 is of a generally elongated form and is provided with offset portions 70, 72 adjacent its opposite ends.

Insulating members 66, 68 are generally rectangular strips of suitable electrical insulating material, such as mica, each provided with a pair of oppositely disposed notches 78, 80 adjacent to their opposite ends. Although each of the insulating members 66, 68 may be of similar form, only one of the members 66 is shown as provided with notches 74, 76 in its opposite ends.

Notches 74, 76 in insulating member 66 cooperate with offset portions 70, 72 in bimetal 63 to determine the vertical position of member 66 relative to bimetal 63. A pair of staples 82, 82 are adapted to be disposed in notches 78, 80 to maintain the insulating members 66, 68 in mechanical relation on the bimetal 63. In actual practice, staples 82, 82 are formed of a substantially flat electrical conducting material which is bent about the assembly comprising insulating members 66, 68 and bimetal 63 within the notches 78, 80 provided in the insulating members 66, 68.

Heating coil 64 is formed by a continuous resistance winding wrapped around the assembly comprising the bimetal 63 and insulating members 66, 68 intermediate staples 82, 82. As best illustrated in FIG. 5, the ends of heating coil 64 are electrically connected to the respective staples 82 by a suitable electrically conductive paint, such as silver. Electrical connections are made to the opposite ends of heating coil 64 by securing a suitable lead wire 84 to each of the staples 82 as by welding.

Offset portion 70, corresponding to the free end of bimetal 63, is disposed in a suitable elongated aperture 86 provided in a moving contact assembly 88. The ambient compensating bimetal 62 and the main actuating bimetal 63 are arranged with their high expansion sides disposed toward the right, as viewed in FIG. 2, so as to flex generally toward the left on being heated. The base portion 12 and the sidewall portions 14 may be suitably apertured and/or cut away (not shown) in the vicinity of the heat motor 60 to permit the circulation of air through the switch casing 10.

The moving contact assembly 88 is generally in the form of a resilient switch arm which is suitably pivoted at one end on an electrical terminal 90. The opposite or free end of moving contact assembly 88 is provided with a bent over portion having therein the elongated aperture 86 which is adapted to receive the free end 70 of bimetal 63. An armature 92 is suitably secured to moving contact assembly 88, as by welding, adjacent to the bent over portion. An electrical contact button 94 is suitably secured to one surface of armature 92 in electrical conducting relation to moving contact assembly 88, as by welding, and is disposed to cooperate with a stationary contact button 96.

As best illustrated in FIG. 6, contact button 96 is formed at one end of an electrical conducting element, in the form of a threaded stud 98, which is adapted to make threaded engagement with a contact support member 100. A generally cylindrical permanent magnet 102 is disposed coaxially of the magnetic keeper 92 and is provided with an elongated slot 104 in one face thereof and an axial bore 106 therethrough, which is adapted to receive stud 98. A generally U-shaped resilient member 108 is disposed in the slot 104 to engage the undersurface of stationary contact button 96. Resilient member 108 biases magnet 102 into engagement with contact support member 100 and prevents relative movement of stud 98 and contact support member 100, once their initial position has been adjusted.

The magnetic influence of magnet 102 upon armature 92 and the normal resiliency of moving contact assembly 88 are such that contact button 94 is continuously urged toward engagement with contact button 96. However, as viewed in FIG. 2, movement of moving contact assembly 88 in a clockwise direction causes the left hand wall of slot 86 to engage offset portion 70 of bimetal 63, thereby causing clockwise movement of bifurcated assembly 58 and continuous engagement of ambient compensating bimetal 62 with adjustable member 56. Thus, when bent over portion 52 engages off portion 44 of cam 32, the bifurcated assembly 58 opposes the normal bias of moving contact assembly 88 and the magnetic influence between magnet 102 and armature 92 to maintain a separation between contact buttons 94, 96.

Control cam 32 has a second cam surface 110, generally parallel to the cam axis and positioned to the rear of the cam surface 42, for actuation of a resilient switch arm 112. Switch arm 112 is pivoted at one end on an electrical terminal 114 and is formed with a V-shaped section forming a cam surface 116 intermediate its ends. Cam surface 116 is biased into continuous engagement with cam surface 110 by the normal resiliency of switch arm 112. The free end of switch arm 112 is provided with a pair of opposed electrical contact buttons 117, 118 which are adapted to make engagement with stationary contact buttons 120, 122, respectively. A pilot light switch 124 is disposed in generally parallel spaced relation to switch arm 112 and is pivoted at one end on an electrical terminal 126 carried on a sidewall portion 14. Pilot light switch 124 is self-biased toward switch arm 112 and is adapted to have its free end engage the switch arm 112 adjacent to the cam surface 116 to establish a circuit for a pilot light (not shown).

Control cam 32 is adapted to move switch arm 112 in a manner to alternately engage the contact buttons 117, 118 with the contact buttons 120, 122, respectively. To effect movement of switch arm 112, surface 110 is provided with a low portion 128, which corresponds to the off position of the switch, and a raised portion 130, which corresponds to each of the active positions of the switch. Raised portion 130 is provided with a pair of detents 132, 134, respectively corresponding to the low and high positions of the switch, disposed on either side of the low portion 128.

It should be noted that stationary contact button 120 is mounted adjacent one end of a generally U-shaped resilient element 136. One end of resilient element 136 is operatively connected to an electrical terminal 138 while the other end thereof extends beyond the stationary contact button 120. This other end of resilient element 136 is adapted to engage an abutment 140 provided within the switch casing structure on one of the sidewall portions 14. Contact button 122 is shown as being fixedly mounted on an electrical terminal 144 carried on a sidewall portion 14.

All of the above-mentioned terminals and the contact support member 100 are provided with portions extending beyond the outer surface of base portion 12 for making external electrical connections thereto. The described switch is so arranged that the contact buttons 94, 96 will be connected in series circuit with one conductor of a power source supplying energy to the controlled heating element (not shown). The contact button 122 and the switch arm 112 are connected in series circuit with another conductor of the power source for the controlled heating element.

The lead wires 84 are suitably connected, as by welding, to the moving contact assembly 88 and to the contact button 122, respectively, whereby the heating coil 64 is connected across the controlled heating element to effect operation of this switch. With heating coil 64 connected across the controlled heating element, the switch, it should be apparent, will be voltage compensated. Thus, if the potential applied to heating coil 64 and to the controlled heating element should rise or fall, the heat motor 60 will provide a larger or smaller percentage of "on" time, as the case may be.

In FIG. 2, the control cam 32 is shown in the off position with cam surface 116 of switch arm 112 resting upon low portion 128 of cam surface 110. The free end of resilient element 136 is caused to disengage abutment 140 when contact button 117 engages contact button 120, permitting cam surface 116 to rest upon the low portion 128. At the same time, portion 52 of adjusting member 50 is engaged by off portion 44 on cam surface 42 to separate the contact buttons 94, 96.

When control cam 32 is adjusted to any one of its active positions, by manipulation of control knob 36, switch arm 112 is actuated to the right, as viewed in FIG. 2, to be engaged by the free end portion of pilot light switch 124. At the same time, contact button 117 is separated from contact button 120, upon engagement of the free end of resilient element 136 with abutment 140. Thereafter, contact button 118 is moved into engagement with contact button 122 upon active cam surface 130 being moved into engagement with cam surface 116.

Simultaneously with the movement of switch arm 112, bifurcated assembly 58 is allowed to pivot in a clockwise direction about pivot pin 34; moving contact assembly 88 continuously biasing bimetal 62 into continuous engagement with adjusting member 56. When bent over portion 52 engages one of the active cam surfaces of cam surface 42, contact button 94, under the influence of moving contact assembly 88 and magnet 102, closes upon contact button 96.

Depending upon the active position to which control cam 32 is positioned, heat motor 60 will be set to energize the controlled heating element at some predetermined rate. Heating coil 64 is connected across the controlled heating element to rapidly heat main actuating bimetal 63 and, as is apparent from FIG. 2, main actuating bimetal 63 moves its free end 70 to the left. At this time, armature 92 is being permeated by the flux from magnet 102 to maintain contact buttons 94, 96 in a closed position. The movement of bimetal 63, under the influence of heating coil 64, will oppose the magnetic attractive force between the armature 92 and the magnet 102 as well as oppose the biasing force of moving contact assembly 88. Bimetal 63 will thus be stressed, and when the force developed by the thermal energy stored therein exceeds the magnetic attractive force between the armature 92 and the magnet 102 and the force due to the resiliency of moving contact assembly 88, armature 92 will be caused to snap away from the influence of the magnet 102 to open contact buttons 94, 96 with a snap action.

When contact buttons 94, 96 are open, the controlled heating element and the heating coil 64 are deenergized.

The heating effect is thus removed from main actuating bimetal 63 and it cools rapidly and moves its free end 70 to the right, as viewed in FIG. 2. Continued cooling of bimetal 63 allows gradual movement of moving contact assembly 88 to the right. When the forces produced by the bias of moving contact assembly 88 and the magnetic attraction between magnet 102 and armature 92 exceed the force due to thermal stresses exerted by the main actuating bitmetal 63, contact buttons 94, 96 will close with a snap action. Heating coil 64 and the controlled heating element will be reenergized to repeat the operation heretofore described and the cycling action of heat motor 60 will continue so long as the control cam 32 remains in any one of its active positions.

It should be apparent that a high contact force is obtained between the contact buttons 94, 96 with the arrangement disclosed herein. Moreover, this high contact force is obtained between the contacts even though the thermal actuator is capable of generating only relatively small operating forces. The switch of this invention is thus actuated by a relatively weak main bimetal which may be of reduced dimensions to respond rapidly to the heating effects of the heating coil 64. By heating and cooling rapidly, the bimetal actuates the contacts between positions with a minimum of thermal lag. Thus, improved operation is achieved over a wide range of rates of energization of the controlled heating element with a minimum of thermal lag.

Moreover, the arrangement of magnet 102 relative to cycling contact buttons 94, 96 allows the use of relatively high current carrying components because of the relatively large contact pressures which are obtained. Magnetic snap action of the contact buttons between controlling positions minimizes contact bounce and also prevents undesirable arcing thereat to extend the useful life of this switch.

The percentage of closed contact or "on" time with respect to total cycling time may be varied by adjustment of cam surface 42. As cam surface 42 biases the adjusting member 50 further in a direction away from the axis of cam 32, the bifurcated assembly 58 is pivoted further in the clockwise direction about pivot pin 34. The free end 70 of bimetal 63 and the cycling contact button 94 are thus moved nearer to the stationary contact button 96. The percentage of "on" time relative to the total cycling time is thus increased, since it now takes longer for the main actuating bimetal 63 to be heated and develop a sufficient amount of thermal stress to overcome the force produced by the resiliency of the moving contact assembly 88 and the magnetic attraction between armature 92 and magnet 102.

Conversely, as cam surface 42 biases the adjusting member 50 further in the direction toward the axis of cam 32, the percentage of "on" time relative to the total cycling time will be decreased for it will now take less time to heat main actuating bimetal 63 to develop sufficient force, due to the thermal stresses, to overcome the force produced by the resiliency of moving contact assembly 88 and the magnetic attraction between armature 92 and magnet 102.

When the ambient temperature within the casing 10 rises, the main actuating bimetal 63 will respond to this temperature rise, and the free end 70 thereof will deflect further toward the left as viewed in FIG. 2, thereby tending to decrease the total time that the contact buttons 94, 96 are engaged. To compensate for the additional deflection in main actuating bimetal 63, ambient compensating bimetal 62 deflects in a similar manner and moves the bifurcated assembly 58 in the clockwise direction about pivot pin 34. The position of the free end 70 of main actuating bimetal 63 relative to moving contact assembly 88 is thus unchanged and the percentage of "on" time relative to the total cycling time remains substantially independent of changes in ambient temperature within the casing 10.

When control cam 32 is adjusted to the maximum or full heat position in which the high position 46 of cam surface 42 engages the portion 52 of adjusting member 50, the bifurcated assembly 58 is adjusted in the clockwise direction about pivot pin 34 to such an extent that main actuating bimetal 63 cannot develop sufficient force, when continuously heated by heating coil 64, to overcome the force developed by the resiliency of moving contact assembly 88 and the magnetic attraction between the magnet 102 and armature 92. Contact buttons 94, 96 are thus continuously engaged to continuously energize the controlled heating element.

The adjusting members 56 and 98 are accessible through suitable openings in the casing 10 and are provided to enable calibration of the switch. Adjustment of the member 56 causes movement of the bifurcated assembly 58 about pin 34 and by this means the "zero" position of the switch may be adjusted.

Movement of member 98 varies the proximity of contact button 96 relative to contact button 94. This adjustment is only made during initial calibration to compensate for variations in the magnetic strength of the individual magnets which may be utilized. The magnetic attractive force between armature 92 and magnet 102 is thus adjusted by member 98 to provide a constant value of magnetic force between the contacts, from switch to switch, so that calibration techniques can be standardized.

With regard to the modification illustrated in FIGS. 7 and 8, the following description is directed only to the structure and operation which are different from the structure and operation disclosed in the above described switch of FIGS. 1 through 6.

In this modification the moving contact assembly is indicated generally at 200 and includes a substantially rigid armature arm 202, the upper end of which is perpendicularly bent to form a connecting tab 204 and the lower end of which is securely fastened to an L-shaped flexible strip 206. The tab 204 is provided with a generally rectangular opening 208 which receives the bimetal offset 70 and the arm 202 is provided with a similar opening 210 in its upper portion adjacent the bent tab 204. A flexible current carrying strip 212 is disposed in juxtaposed relationship with the arm 202 and has a lower end perpendicularly bent in the same direction as the mounting strip 206. The arm 202 and the strip 212 are pivotally mounted by means of their flexible L-shaped mountings which are secured to one end of the electrical terminal 90. The upper or free end of the strip 212 has a first perpendicularly bent portion 214 which extends through the aperture 210 in the arm 202 and a second perpendicularly bent tab 216 engageable with the rear face of the arm 202. An electrical contact button 218 is secured to the strip 212 just below the offset portion 214.

A contact and magnet assembly is fixedly mounted to the casing wall 14 by means of an electrical terminal support member 220. A generally U-shaped magnet holder 222 integrally extends from one end of the lower edge of the support member 220 and has a depending flange 224 extending from the free end thereof. A fixed electrical contact button 226 is secured to the flange 224 with a shield 227 therebetween so as to be oppositely disposed to the contact button 218 for cooperation therewith. A horseshoe permanent magnet 228 fits within the U-shaped member 222 and is held therein by means of a retainer 230. The retainer 230 is disposed beneath the U-shaped member 222 and one end has an upwardly extending finger 232 which projects through the slotted base of U-shaped member 222 and engages the horseshoe magnet 228. The opposite end of the retainer 230 has another upwardly extending finger 234 which projects upwardly behind the support member 220. An adjusting screw 236 extends through aligned apertures in the retainer finger 234 and the support member 220 and engages the rear face of the permanent magnet 228 for adjustably positioning the same.

The switch is shown in FIG. 7 in the off position in which the bimetal exerts a force on the armature arm 202 which in turn exerts a force on the tab 216 of the contact carrying strip 212, retaining the contacts 218 and 226 in an open position. Rotation of the control knob 36 to a desired setting causes pivotal movement of the bimetal assembly 60, relaxing the bimetal force so that the permanent magnet 228 attracts the armature arm 202. At this point the armature arm 202 would no longer be touching the tab 216 but would be pushing against the rear head of contact 218, leaving a gap of approximately .015 inch between the armature arm 202 and the tab 216.

Since the contacts are closed, the energized heater causes warping of the bimetal until the bimetal force is sufficient to overcome the magnetic force, which causes the armature arm 202 to move out of the field of the magnet 228 with a snap action. After the armature arm has moved approximately .015 inch, it will engage the tab 216 to move the contact carrying strip 212 to an open position. The inertia of the armature arm 202 in completing its movement and striking the tab 216 is sufficient to break any weld which may have occurred between the contact 218 and 226.

The shield 227 acts to prevent the magnetic lines of flux from influencing the electric arc. If this shield were not used, the magnet 228 would draw the arc up into its magnetic field causing a cracking noise and demagnetization of the magnet.

Inasmuch as this invention is subject to many variations and modifications and reversals of parts, it is intended that all matter contained in the above description and the drawing shall be interpreted as illustrative and not in a limiting sense.

We claim:

1. In a cycling switch operable over a range of wattage inputs, the combination comprising an adjustable cam for selecting a wattage input within the range, an ambient compensating bimetal and an operating bimetal secured together at one of their respective ends and to common pivotal means on which said one ends are mounted, a resilient member adjustable by said cam and engaging another end of said ambient compensating bimetal for moving said ambient compensating bimetal and said operating bimetal about said common pivotal means to provide a predetermined wattage input, the resiliency of said resilient member normally urging said ambient compensating and said operating bimetals about the common pivotal means in one direction, a fixed contact means, a movable contact means including a moving end and a pivoted end, said moving end being operatively engaged by another end of said operating bimetal and causing movement of said movable contact means into and out of engagement with said fixed contact means, the resiliency of said movable contact means normally tending to urge said movable contact means toward said fixed contact means to move said ambient compensating and said operating bimetals about said common pivotal means in a direction opposite to said resilient member, the resiliency of said resilient member being stronger than the resiliency of said movable contact means, a heating element for said operating bimetal connected in circuit with said fixed and movable contact means, an armature mounted on said movable contact means and movable therewith, and a magnet mounted on said fixed contact means in opposed relation to said armature and operable therewith for urging movement of said movable contact means toward said fixed contact means.

2. In a cycling switch operable over a range of wattage inputs, the combination comprising an adjustable cam for selecting a wattage input within the range, an ambient compensating bimetal and an operating bimetal secured together at one of their respective ends and to common pivotal means on which said one ends are mounted,

a resilient member adjustable by said cam and engaging another end of said ambient compensating bimetal for moving said ambient compensating bimetal and said operating bimetal about the common pivotal means to provide a predetermined wattage input, the resiliency of said resilient member normally urging said compensating and said operating bimetals about the common pivotal means in one direction, a fixed contact means, a movable contact means including a moving end and a pivoted end, said moving end being operatively engaged by another end of said operating bimetal and causing movement of said movable contact means into and out of engagement with said fixed contact means, the resiliency of said movable contact means normally tending to urge said movable contact means toward said fixed contact means to move said ambient compensating and said operating bimetals about said common pivotal means in a direction opposite to said resilient member, the resiliency of said resilient member being stronger than the resiliency of said movable contact means, a pair of electrical insulating strips disposed on either side of said operating bimetal in juxtaposed relationship thereto, means holding said operating bimetal and said pair of electrical insulating strips in predetermined mechanical relation, a heating element operatively associated with said pair of electrical insulating strips and connected in circuit with said fixed and movable contact means, an armature mounted on said movable contact means for movement therewith, and a magnet mounted on said fixed contact means in opposed relation to said armature and cooperable therewith for urging movement of said movable contact means toward said fixed contact means.

3. In a cycling switch operable over a range of wattage inputs, the combination comprising an adjustable cam for selecting a wattage input within the range, an ambient compensating bimetal and an operating bimetal secured together at one of their respective ends and to common pivotal means on which said one ends are mounted, a resilient member adjustable by said cam and engaging another end of said ambient compensating bimetal for moving said ambient compensating and said operating bimetals about the common pivotal means to provide a predetermined wattage input, the resiliency of said resilient member normally urging said ambient compensating and said operating bimetals about the common pivotal means in one direction, a contact support member, a fixed contact means adjustably mounted on said contact support member, a movable contact means including a moving end and a pivoted end, said moving end being operatively engaged by another end of said operating bimetal for moving said movable contact means into and out of engagement with said fixed contact means, the resiliency of said movable contact means normally tending to urge said movable contact means toward said fixed contact means to move said ambient compensating and said operating bimetals about said common pivotal means in a direction opposite to said resilient member, the resiliency of said resilient member being stronger than the resiliency of said movable contact means, a heating element for said operating bimetal connected in circuit with said fixed and movable contact means, an armature mounted on said movable contact means and movable therewith, a cylindrical magnet disposed coaxially of said fixed contact means in a position to attract said armature, and resilient means operatively engaging said fixed contact means and said magnet for positively positioning said magnet with relation to said armature and said fixed contact means with relation to said movable contact means.

4. In a cycling switch operable over a range of wattage inputs, the combination comprising an adjustable cam for selecting a wattage input within the range, an ambient compensating bimetal and an operating bimetal secured together at one of their respective ends and to a common pivotal means on which said one ends are mounted, a pivoted member adjustable by said cam and

engaging another end of said ambient compensating bimetal for moving said ambient compensating bimetal and said operating bimetal about the common pivotal means to provide a predetermined wattage input, a contact support member, a fixed contact adjustably mounted on said contact support member, a movable contact means pivoted at one end and having the movable end thereof engageable by another end of said operating bimetal for movement thereby into and out of engagement with said fixed contact means, an armature mounted on said movable contact means and movable therewith, a pair of electrical insulating strips disposed on either side of said operating bimetal in juxtaposed relationship thereto, means holding said operating bimetal and said pair of electrical insulating strips in predetermined mechanical relation, a heating element operatively associated with said pair of electrical insulating strips and connected in circuit with said fixed and movable contact means, a magnet disposed coaxially of said fixed contact means in a position to attract said armature for urging movement of said movable contact means toward said fixed contact means, and resilient means operatively engaging said fixed contact means and said magnet for positively positioning said magnet with relation to said armature and said second contact with relation to said movable contact means.

5. A heat motor, the combination comprising a bimetal element, a first electrical insulating strip disposed on one side of said bimetal element in juxtaposed relationship thereto and cooperable therewith to maintain a predetermined mechanical relation therewith, a second electrical insulating strip disposed on another side of said bimetal element in juxtaposed relationship thereto, each of said insulating strips being provided with a pair of oppositely disposed notches adjacent their opposite ends, clamping means disposed in said notches for holding said first and second insulating strips and said bimetal element in a predetermined mechanical relation, and heating means wound around said pair of electrical insulating strips and electrically connected with electrically conductive paint to said clamping means.

6. In a switch, the combination comprising a switch arm pivoted at one end, an armature mounted on the movable end of said switch arm, a first contact carried by said armature, a contact support member, a second contact adjustably mounted on said contact support member, a magnet disposed adjacent said second contact in a position to attract said armature, said magnet being held to said contact support member by said second contact, means engaging said switch arm and adapted for moving said first contact into and out of engagement with said second contact, and resilient means operatively engaging said second contact and said magnet for positively positioning said magnet with relation to said armature and biasingly mounting said magnet on said contact support member.

7. In a switch, the combination comprising a switch arm pivoted at one end, an armature mounted on the movable end of said switch arm, a first contact carried by said armature, a contact support member, a cylindrical magnet disposed in a position to attract said armature and having an axial bore therein, a slot in one face of said magnet having an axis disposed transversely of the axis of the bore therethrough, a second contact, a stud having one end secured to one face of said second contact and adapted to be received in the bore of said magnet, another end of said stud being adapted to make threaded engagement with said contact support member, means engaging said switch arm and adapted for moving said first contact into and out of engagement with said second contact, and U-shaped resilient means disposed in the slot in said magnet and engaging the one face of said second contact for positively positioning said magnet with relation to said armature and biasing said magnet for yielding movement relative to said first contact.

8. In a switch, the combination comprising a switch housing having a fixed contact therein, a switch arm having a contact thereon and being movable toward and away from said fixed contact, an armature movably mounted in said housing, a magnet disposed adjacent said fixed contact in a position to attract said armature, a loose fitting connection between said armature and said switch arm whereby said armature and said switch arm are separated by a gap when said movable contact is in engagement with said fixed contact, and a shield disposed adjacent said magnet and isolating the magnetic circuit from the electric circuit.

9. In a switch, the combination comprising a switch housing having a fixed contact therein, a switch arm having a contact thereon and being movable toward and away from said fixed contact, an armature movably mounted in said housing, a magnet disposed adjacent said fixed contact in a position to attract said armature, a lost motion connection between said armature and said switch arm whereby said armature and said switch arm are separated by a gap when said movable contact is in engagement with said fixed contact, heat motor means positioned in said housing and operable when said movable contact is in engagement with said fixed contact, and a second lost motion connection between said heat motor means and said armature and causing movement of said armature away from said magnet to separate said movable and fixed contacts with a snap action.

10. In a switch, the combination comprising a switch housing having a fixed contact therein, a movable switch arm having a contact thereon for cooperation with said fixed contact, an armature movably mounted in said housing and causing movement of said switch arm, a magnet disposed adjacent said fixed contact in a position to attract said armature causing movement of said switch arm to a closed position, heat motor means positioned in said housing and operable when said movable contact is in engagement with said fixed contact, a lost motion connection between said heat motor means and said armature and causing movement of said armature away from said magnet to move said switch arm to an open position in response to energization of said heat motor means, and a loose fitting connection between said armature and said switch arm permitting movement of said armature relative to said switch arm through a predetermined gap.

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