April 20, 1948. E. K. CLARK 2,439,842

CONTROL MECHANISM

Filed Nov. 6, 1944 2 Sheets-Sheet 1

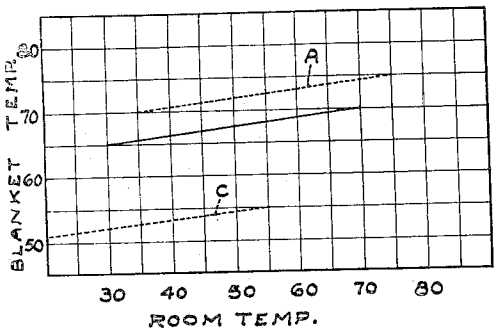


FIG. 6.

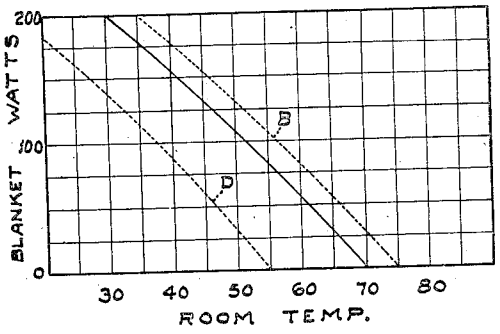


FIG. 7.

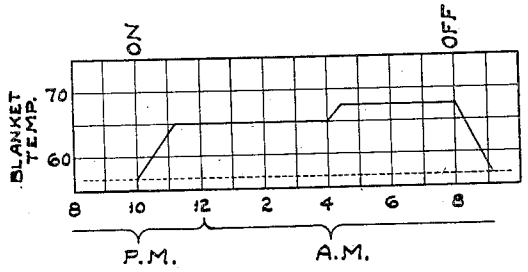


FIG. 8.

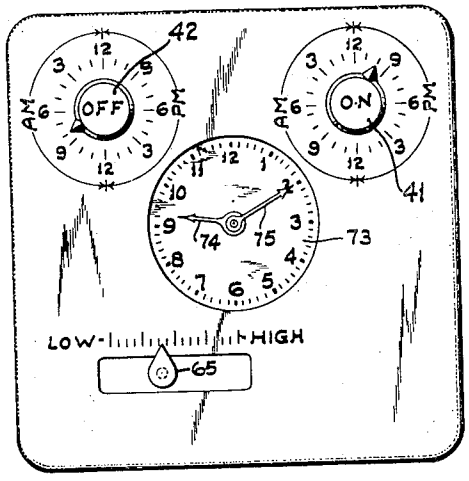


FIG. 1.

WITNESSES:

R. J. Ringer

E. H. Lutz.

INVENTOR

EARL K. CLARK.

BY Roy A. Emrich

ATTORNEY

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CONTROL MECHANISM

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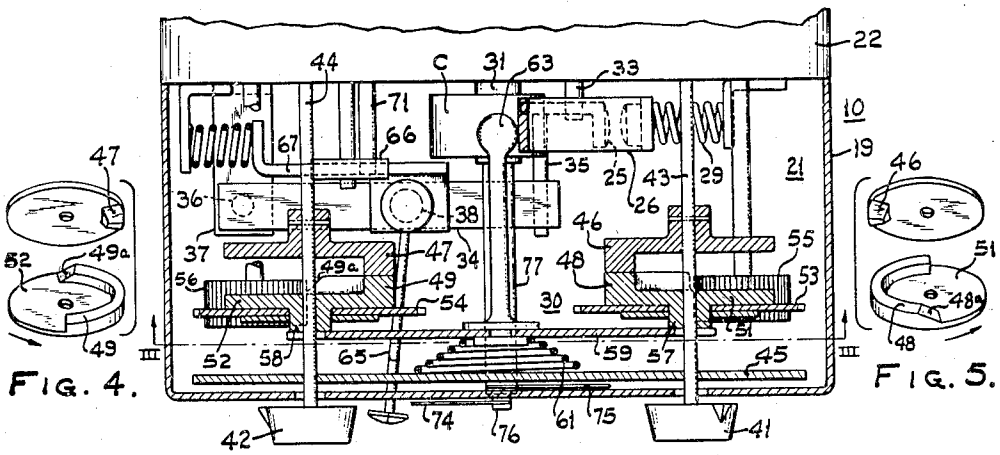


FIG. 4.

FIG. 5.

FIG. 2.

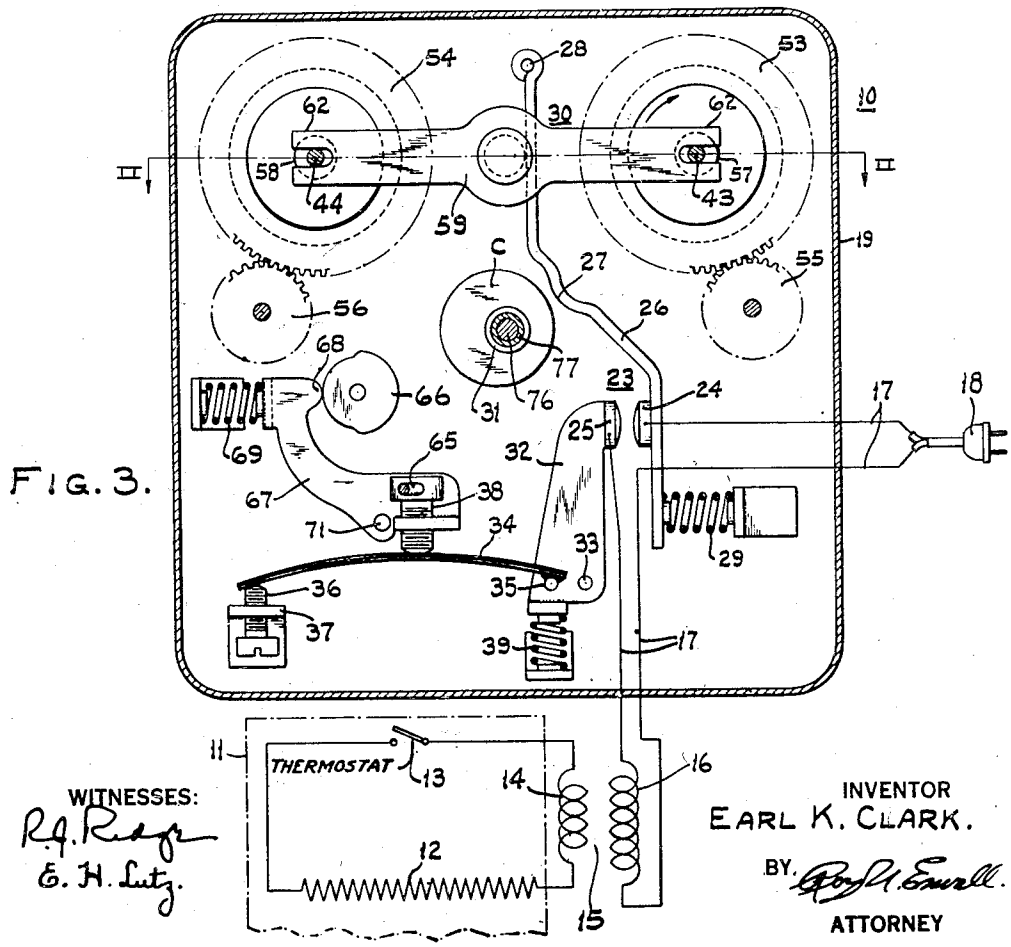


FIG. 3.

WITNESSES:
R. A. Rieger
E. H. Lutz.

INVENTOR
EARL K. CLARK.
BY. Ross A. Ewell.
ATTORNEY

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CONTROL MECHANISM

Earl K. Clark, Mansfield, Ohio, assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

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5 Claims. (Cl. 200—139)

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My invention relates to a mechanism for controlling energization of an electric blanket or the like in response to variations in the temperature of the air in the room in which the blanket is used, and it has for an object to provide an improved mechanism of this kind.

A further object of the invention is to provide an improved time and temperature controlled mechanism for an electric blanket which will automatically initiate and terminate operation of the blanket at preselected hours of the day, and which will vary the rate of energization of the blanket and, therefore, the blanket temperature, inversely with changes in the temperature of the air in the room wherein the blanket is used.

These and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a front view of a blanket control mechanism constructed and arranged in accordance with the invention;

Fig. 2 is a plan view of the mechanism shown in Fig. 1, with a portion thereof shown in section taken along the line II—II of Fig. 3;

Fig. 3 is a sectional view taken along the line III—III of Fig. 2;

Figs. 4 and 5 are exploded views of cam details shown in Figs. 2 and 3;

Fig. 6 is a curve showing blanket and corresponding room air temperatures;

Fig. 7 is a curve showing power consumption or effective wattage for corresponding room air temperatures; and

Fig. 8 is a temperature-time curve illustrating a feature carried out by the control mechanism shown in Figs. 1 to 5, inclusive.

Referring now to the drawings, I have shown my improved control mechanism, generally indicated at 10, controlling an electric blanket, diagrammatically shown at 11 and including a heating element 12 and the usual over-temperature protective thermostats, one of which is diagrammatically shown at 13. The heating element 12 is energized by the secondary 14 of a step-down transformer 15, the primary of which is shown at 16. The latter is energized, usually at 115 volts A. C., by means of a circuit 17 which extends to the control mechanism 10 and thence to an attachment plug 18 which is adapted to be connected to a receptacle (not shown) connected in a conventional 115-volt lighting circuit.

The control mechanism 10 includes a casing

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19 enclosing a compartment 21, the latter housing the various instrumentalities of my control mechanism. The casing 19 is carried by a housing 22 of a timing mechanism (not shown) which may either be of the spring wound or electric motor driven type. It will be apparent from Fig. 3 that the control mechanism 10 is disposed remote from the blanket 11 in the room wherein the blanket is used and, as described hereinafter, controls energization of the blanket element 12 in accordance with the temperature of the air in the room.

As clearly shown in Fig. 3, the energization of the primary winding 16 of the transformer 15 is under control of a switch generally indicated at 23 and including relatively movable, first and second contacts 24 and 25 which are connected in series in the circuit 17. During active periods of the control mechanism, the contact 24 is reciprocated through a range of movement by a rotatable cam C and a pivoted support 26 having a follower 27 engageable with the cam. The support 26 is carried by a pivot 28 which may be supported in any well-understood manner by the timing mechanism 22. The pivoted support 26 is biased toward the cam C at all times by a compression spring 29. The cam C is rotated at a speed of approximately one revolution per minute by a shaft 31 driven by the timing mechanism 22. As shown in the drawings, the control mechanism is in an inactive or "off" position wherein the switch 23 is maintained open. A time-controlled "on" and "off" mechanism 30, to be described hereinafter, engages the contact support 26 at this time and prevents engagement of the contacts 24 and 25.

The second contact 25 is movable relative the contact 24 in accordance with changes in temperature of the air in the room in which the blanket is operated. The contact 25 is supported by a movable arm 32 carried by a fixed pivot 33 which may be supported by the timing mechanism 22. A heat-responsive element, preferably of bimetal and shown at 34, is fixed at one of its ends to a pin 35 which is pivotally supported within the arm 32. The opposite end of the bimetal 34 rests upon an adjustable abutment such as a screw 36, the latter being threaded in a support 37 carried by the timing mechanism 22. The bimetal element 34 is arched, as shown, with the high expansive side thereof uppermost, as viewed in Fig. 3. The central portion of the bimetal element 34 engages an adjusting screw 38 to be referred to more in detail hereinafter. The contact 25 is biased at all times toward the contact

24 by means of a compression spring 39 engaging the supporting arm 32 and biasing it clockwise about its pivot 33.

From the foregoing description, it will be apparent that, when the mechanism is rendered active by the "on and off" mechanism 30, the blanket element 12 is energized during cycles of one minute's duration for variable periods of time as the switch 23 is opened and closed by the rotation of the cam C. The ratio between the period of time that the contacts 24 and 25 are closed and the period of time that they are open or disengaged varies, inversely, with changes in temperature of the air in the room in which the control 10 and the blanket 11 are operated. Since the high expansive side of the bimetal 34 is uppermost, any increase in temperature in the room will tend to increase the arching of the element 34 and, therefore, swing the arm 32 counterclockwise about its pivot 33. Accordingly, the contact 25 is moved away from the contact 24 and, therefore, the period of time that the switch 23 is closed relative the period of time that it is open during a revolution of the cam C is reduced. A depression of the temperature of the air in the room effects the reverse result, in that the bimetal 34 becomes more nearly straight and effects a clockwise movement of the arm 32 about its pivot 33. Accordingly, the contact 25 is moved toward the contact 24 so that the period of time that the switch 23 is closed during a cycle of operation of the cam C relative the period of time that it is open is increased.

The heating element 12 of the blanket is always energized at a fixed wattage, for example, 200 watts, at any and all times that the switch 23 is closed. The rate of energization of the blanket element 12 or the period of time that it is energized during a cycle of operation of the switch 23, depends upon the position of the contact 25 relative the contact 24. With a very cold room, the contact 25 may be positioned to the right, as viewed in Fig. 3, sufficiently to prevent the cam C from actuating the contact 24 out of engagement with the contact 25. Accordingly, the heating element 12 will be continuously energized so that the effective wattage at this time is 200 watts in the example given. With a higher room air temperature, the contacts 24 and 25 are engaged only part of the time in a cycle of operation of the switch 23, for example, one-half of the time, and, therefore, the element 12 is effective only half of the time for the heating of the blanket. Accordingly, its effective wattage at this time is equivalent to a 100-watt element energized continuously. This explanation is given to clarify my meaning of the term "effective wattage" which is employed throughout this specification. In other words, the effective wattage of the element 12 at any given time is equivalent to its rated wattage multiplied by the percentage of the total time period of a cycle of operation of the switch 23 that its contacts 24 and 25 are closed.

The "on and off" mechanism 30, referred to heretofore, is provided to initiate energization of the blanket element 12 at a preselected hour of the day and to terminate energization thereof at a second preselected hour of the day. This operation is carried out by the mechanism 30 day after day without requiring any further attention on the part of the operator. In this connection, it will be understood that the attachment plug 18 is permanently connected to the energizing electric circuit. The mechanism 30 includes a pair of "on and off" adjusting knobs 41

and 42, respectively, having pointers which cooperate with suitable indicia on the front of the control mechanism 10, as clearly shown in Fig. 1. It will be apparent from this figure that energization of the blanket element 12 is initiated at ten p. m. and is terminated at eight a. m.

The knobs 41 and 42 are fixed to respective shafts 43 and 44 which are rotatably mounted in the timer housing 22 at their rear ends and in a suitable fixed plate 45 adjacent the front ends thereof. A pair of dogs 46 and 47 are fixed to the shafts 43 and 44, respectively, and are rotatable to selected positions by the knobs 41 and 42. A pair of cams 48 and 49 (see Figs. 4 and 5) are engageable with the dogs 46 and 47 and are carried by respective cam plates 51 and 52 (Fig. 2). It will be noted from Figs. 4 and 5 that these cams 48 and 49 are arcuate in configuration and extend approximately 180 degrees on the face of their respective cam plates 51 and 52. The cam plates 51 and 52 are fixed to gears 53 and 54 and are journalled on the shafts 43 and 44. The gears 53 and 54 are rotated at a speed of one revolution in twenty-four hours by pinions 55 and 56 which are driven by the timing mechanism 22.

The cam plates 51 and 52 are provided with hub portions 57 and 58 which are engaged by plate 59, the latter being biased into engagement with the hubs 57 and 58 by means of a compression spring 61 interposed between an intermediate portion of the plate 59 and the fixed plate 45. The ends of the plate 59 are forked, as shown at 62 in Fig. 3, to receive the shafts 43 and 44. The plate 59 is provided with an arm 63 extending at right angles thereto and the end of which is engageable with the pivoted contact support 26. In the position of the apparatus shown in Fig. 2, the arm 63 is in engagement with the support 26 so that the contact 24 is maintained out of engagement with the contact 25. Accordingly, spring 29 is ineffective to close the switch 23, irrespective of the position of the cam C.

It will be understood that the gears 53 and 54 and their respective cam plates 51 and 52 rotate in the direction shown by the arrows in Figs. 3 to 5, inclusive. With the setting of the knobs 41 and 42 as shown in Fig. 1, the cam 48 will be moved out of alignment with the dog 46 at ten o'clock at night, so that the cam plate 51 will be moved axially of the shaft 43 by the plate 59 under the influence of the spring 61. Accordingly, the arm 63 will be moved to the left, as shown in Fig. 2, about the hub 58 as a pivot. This movement of the arm 63 releases the contact support 26 so that the spring 29 actuates the follower 27 towards the cam C and renders the switch 23 effective to energize the blanket element 12. At this time, of course, the switch 23 is opened and closed by the rotating cam C to energize the blanket element 12, the rate of energization, of course, being dependent upon the temperature of the bimetal 34.

At a later period of the day, eight a. m. in the example cited, the cam 49 is rotated out of alignment with the dog 47 so that the cam plate 52 and its gear 54 are moved axially of the shaft 44 by the plate 59 under the influence of the spring 61. This operation again returns the arm 63 to the position shown in the drawing, wherein it engages the pivot contact support 26 and arrests any further movement thereof. Accordingly, the switch 23 is rendered inactive and energization of the blanket terminal 12 is terminated. It will be understood at this time that the relative positions of the cam plates 51 and 52 are as shown

in Fig. 2, except that they have been moved axially of the shafts 43 and 44 a distance corresponding to the height of the cams 48 and 49. Continued rotation of the cam plate 51 throughout the day causes the dog 46 to ride up on the cam 48, the leading edge of the cam 48 being inclined, as shown at 48a, to facilitate this operation. This operation is effected at approximately ten o'clock in the morning, since it is understood that the angular extent of the cam 48 is approximately 180 degrees. It will be noted at this time that there is a clockwise swinging of the arm 63 about the hub 58 as a pivot, but this is of no moment as it merely biases the contact supporting arm 26 further to the right, as viewed in Fig. 3, or in its switch-opening direction.

At a later period in the day, eight o'clock in the evening in the example cited, the sloping leading edge 49a of the cam 49 forces the cam plate 52 and its gear 54 to the position shown in the drawing, Fig. 2. This operation effects a counterclockwise movement of the arm 63 about the hub 57 as a pivot to the position shown in the drawing. While this latter motion is in a switch-closing direction, it does not render the switch 23 active, as the arm 26 is still arrested by the arm 63 and is retained in the position shown in Fig. 2.

It will be apparent from the foregoing description that the switch 23 is active only during periods when the dog 46 is out of engagement with its cam 48 and when the dog 47 is engaged with the cam 49. At any and all other times, the switch 23 is rendered inactive.

The solid line curve shown in Fig. 6 shows temperatures beneath the blanket for different temperatures of the ambient atmosphere. It will be understood that the blanket temperatures indicated by this curve are those prevailing without an occupant beneath the blanket. The effective wattages of the blanket which provide the blanket temperatures shown by the solid curve in Fig. 6 are indicated by the solid curve of Fig. 7. It will be noted that for ambient room air temperatures above 70 degrees F., the blanket element is deenergized and that the effective wattage of the element increases inversely as the room air temperature decreases. With a 30 degree F. room, the effective wattage of the blanket is maximum or 200 watts in the example cited.

In Fig. 6 it will be noted that the blanket temperature progressively decreases as the room air temperature decreases from 70 degrees F. The decrease in blanket temperature is relatively small, however, the minimum temperature being 65 degrees F. with a 30 degree F. room air temperature. It will be understood, of course, that the relationship between the blanket temperature and the room air temperature may be changed from that shown in Fig. 6 by modifying the shape of the cam C. A modification of the cam shape would change the effective wattage of the blanket element for the different room air temperatures. For example, the blanket could be maintained at a constant temperature of 70 degrees F. as the room air temperature decreases from 70 degrees F., if desired by a cam shaped for this operation.

I have found that a blanket operating as indicated in Figs. 6 and 7 provides comfortable conditions for the average person. I find, however, that it is desirable to provide an adjustment whereby these blanket temperatures may be increased or decreased. Elderly or sickly persons may require a higher blanket temperature than

that shown in Fig. 6, while other persons would be more comfortable with a lower temperature. Means is provided for varying the temperatures maintained beneath the blanket and includes the adjusting screw 38 which may be threaded upwardly or downwardly to change the relative positions of the bimetal 34 and the contact 25.

If a higher blanket temperature is desired, the screw 38 is adjusted to permit the bimetal 34 to rise slightly under the influence of the spring 39. This operation moves the contact 25 clockwise toward the contact 24, so that the ratio between the period of time that the contacts are closed and the period of time that they are open for a given room temperature is increased. With such an adjustment, blanket temperatures, such as indicated by the broken line A, and effective wattages, such as indicated by the broken line B in Figs. 6 and 7, respectively, are effected. It will be noted from the curve B that energization now starts with a room temperature of 75 degrees F. and maximum effective wattage obtains with a room temperature of 35 degrees F. Under these circumstances, the blanket temperature is maintained between 75 degrees F. and 70 degrees F. with room temperatures of 75 degrees F. and 35 degrees F., respectively.

An adjustment of the screw 38 in the opposite direction lowers the bimetal 34 and separates the contacts 24 and 25, whereby the ratio between the period of time that the contacts 24 and 25 are closed and the period of time that they are open is reduced for a given room temperature. The conditions are indicated by the curves C in Fig. 6 and D in Fig. 7. An inspection of these curves will show that energization of the blanket does not start until the room temperature has dropped to 55 degrees F., and maximum effective wattage is obtained with a room temperature of approximately 15 degrees F. It will be noted from Fig. 6 that the blanket temperature decreases from 55 degrees F. at a similar room temperature to a temperature of approximately 50 degrees F. with a 15 degree F. room air temperature.

A handle 65, readily accessible to the operator, is fixed to the screw 38 and extends exteriorly of the casing 19. This handle may be provided with a pointer, as shown in Fig. 1, which cooperates with indicia provided on the front of the casing 19, as clearly shown in Fig. 1. Movement of the handle 65 to the right, as viewed in Fig. 1, increases the temperature of the blanket as described and, conversely, movement of the handle to the left reduces the temperature of the blanket.

It has been found that sleep is promoted if, during the early hours of the morning, the temperature of the blanket is increased slightly. Many persons become chilled and restless about this time, probably because of the slower heart action after an early period of rest. Means is provided for increasing the temperature of the blanket at or about four o'clock in the morning, as indicated by the curve in Fig. 8. Referring to this curve, it will be apparent that, when a blanket temperature of 65 degrees F. is maintained, the temperature is increased to approximately 68 degrees F. at four o'clock in the morning. This operation is obtained by a cam 66 which is rotated by the timing mechanism at a speed of one revolution in twenty-four hours. An arm 67 having a cam follower portion 68 in engagement with the cam is biased clockwise about a fixed pivot 71, as viewed in Fig. 3, by means of a spring 69. The screw 38 is threaded in a por-

tion of the arm 67 and is moved upwardly to increase the blanket temperature when the raised portion of the cam 66 engages the follower 68 at 4 o'clock in the morning, as described. It will be apparent that the raising of the adjusting screw 38 produces the same effect as threading the adjusting screw upwardly, as described heretofore.

A clock face 73 may be provided at the front of the casing 19. The hands 74 and 75 of the clock may be driven by respective shafts 76 and 77 concentrically arranged with respect to the shaft 31 and actuated by the timing mechanism in a well understood manner.

From the foregoing description, it will be apparent that I have provided an improved control mechanism for energizing and deenergizing an electric blanket at preselected hours of the day without any attention required of the operator subsequent to the initial adjustment of the mechanism. The control mechanisms may be continuously connected to the circuit used for energizing the blanket, during the season in which the blanket is used. Since the temperature of the blanket is varied, inversely, with changes in ambient air temperatures, comfortable conditions are maintained regardless of changes in ambient air temperatures.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that is is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof.

What I claim is:

1. In control apparatus, the combination of a switch having relatively movable contacts, timing means for periodically actuating one of said contacts through a range of movement toward and away from the other contact, means responsive to the temperature of the ambient air for adjusting the other of said contacts relative said one contact into and out of said range of movement so that the ratio of the period of time the switch is closed to the period of time that it is open is varied, inversely, with changes in the temperature of said air, means operated by said timing means for shifting said one contact relative said other contact from its active positions within said range of movement to an inactive position out of said range of movement, said contact shifting means being effective to return said one contact from its inactive position to said active positions, and manually operable means associated with the contact shifting means for adjusting the times of the day that said contact is moved to its active and inactive positions.

2. In control apparatus, the combination of a switch having relatively movable first and second contacts, timing means for oscillating said first contact through a range of movement, an element responsive to the temperature of the ambient air for moving said second contact into and out of said range of movement whereby the ratio between the period of time that the contacts are closed and the period of time that the contacts are open is varied, inversely, with changes in temperature of the ambient air, means actuated by the timing means and effective at a predetermined hour of the day for adjusting one of said contacts relative the other contact whereby the relation between said ratio and the temperature of the air is varied, means responsive to operation of the timing means for rendering the switch active and inactive at different times of the day and manually-operated means for adjusting said

different times of the day that the switch is rendered active and inactive.

3. In a control, the combination of a switch including first and second relatively movable contacts, a timing mechanism including a rotatable cam for oscillating said first contact through a range of movement toward and away from the second contact, a thermostatic member for actuating said second contact relative said first contact to various positions within said range of movement in response to variations in the temperature of the ambient air, the construction and arrangement being such that the ratio of the period of time that the contacts are engaged to the period of time that they are disengaged varies, inversely, with said ambient air temperature, means driven by said timing mechanism for shifting said first contact relative the second contact to an inactive position out of engagement with the second contact and wherein its actuation by the cam is terminated, said shifting means being effective to return the first contact to its active position for oscillation by the cam, and manually operable means for adjusting the shifting means and thereby varying the hours of the day at which the shifting means actuates the first contact to its active and inactive positions.

4. In a control mechanism, the combination of a switch including first and second relatively movable contacts, a timing mechanism including a rotatable cam for oscillating said first contact through a range of movement toward and away from the second contact, a thermostatic member for actuating said second contact relative the first contact to various positions within said range of movement in response to variations in the temperature of the ambient air, the construction and arrangement being such that the ratio of the period of time that the contacts are engaged to the period of time that they are disengaged varies, inversely, with said air temperature, means effective during a predetermined period of the day for increasing said ratio relative to the temperature of said air, said last-named means including a second cam driven by the timing mechanism, a cam follower, and an adjustable member interposed between the cam follower and the thermostatic member, manually-operated means for varying the relation between said ratio and the temperature of said air including an adjusting handle connected to said adjustable member, means driven by said timing mechanism for shifting said first contact to an inactive position out of engagement with the second contact and wherein its actuation by the cam is terminated, said shifting means being effective to return the first contact to its active position for oscillation by the cam, and manually operable means for adjusting the shifting means and thereby varying the hours of the day at which the shifting means actuates the first contact to its active and inactive positions.

5. In control apparatus, the combination of a switch having relatively movable contacts, timing means for periodically actuating one of said contacts through a range of movement toward and away from the other contact, means responsive to the temperature of the ambient air for adjusting the other of said contacts into and out of said range of movement so that the ratio of the period of time the switch is closed to the period of time that it is open is varied, inversely, with changes in the temperature of said air, means operated by said timing means for shift-

ing one of said contacts from its active positions within said range of movement to an inactive position out of said range of movement, said contact shifting means being effective to return said one contact from it inactive position to said active positions, manually operable means associated with the contact shifting means for adjusting the times of the day that said contact is moved to its active and inactive positions and second manually operable means for adjusting one of the contacts relative the other contact so that the relation between said ratio and the temperature of the air is varied.

EARL K. CLARK.

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