

June 5, 1934.

J. W. PAULING

1,961,778

THERMOSTATIC SWITCH

Filed April 8, 1932

2 Sheets-Sheet 1

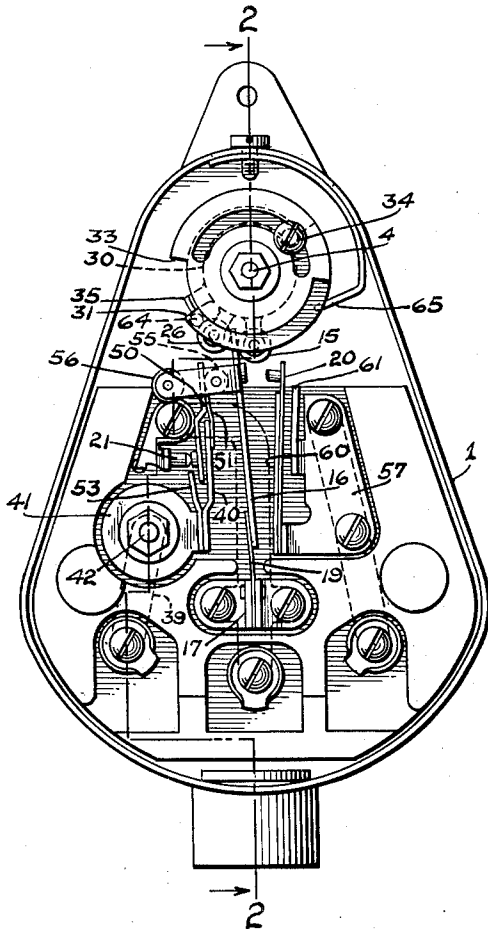


Fig. 1

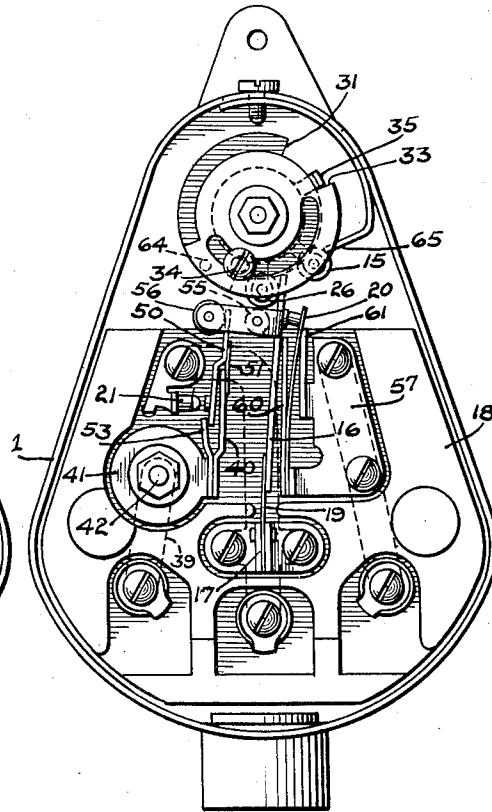


Fig. 3

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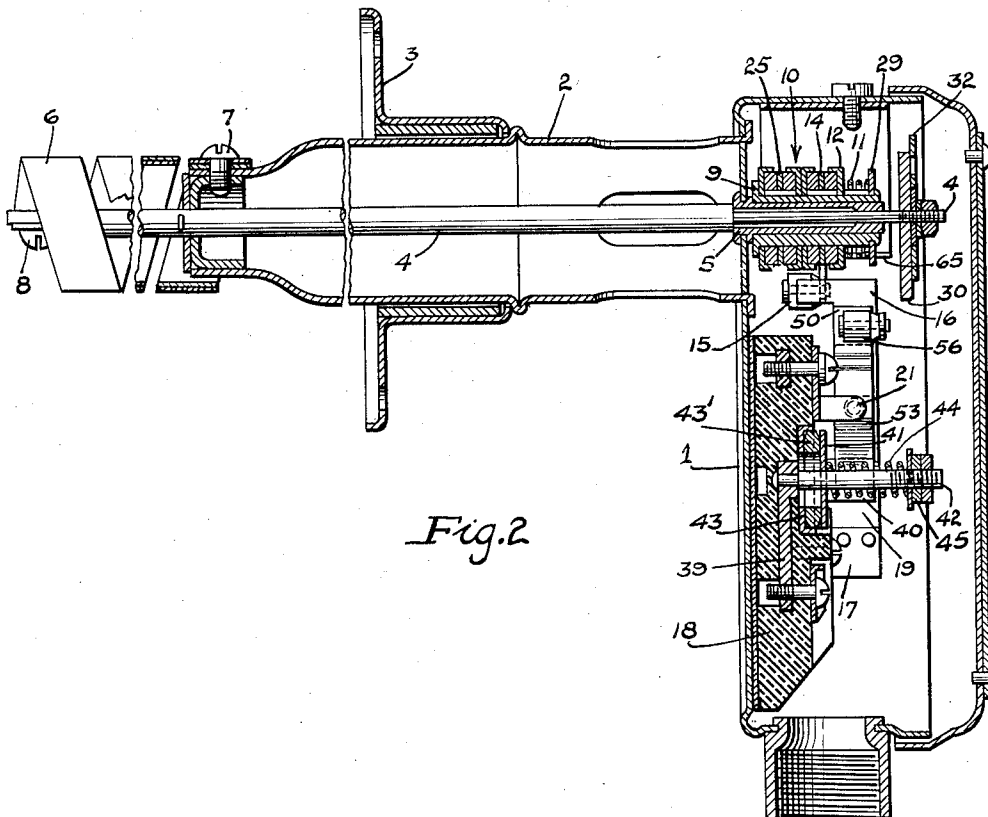


Fig. 2

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UNITED STATES PATENT OFFICE

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THERMOSTATIC SWITCH

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19 Claims. (Cl. 200—138)

This invention relates generally to improvements in switching mechanism, and contemplates a mechanism which can be used for various purposes with or without thermostatic control. Specific embodiments of the invention are also claimed both in combination and sub-combination, and one of these embodiments relates to the overlapping control of contacts or switches during temperature rise and a non-overlapping control during temperature fall. A claimed combination includes as an element, a thermostatically controlled means, exemplified in the application of Daniel G. Taylor for Thermostatic switch, Serial Number 539,224, filed May 22, 1931.

The present invention also provides means by which a hold-over contact pressure is maintained during opening of a contact or switch, so that the contact will not be prematurely opened.

Features include the details of construction along with the broader ideas of means inherent in the disclosure.

Objects, features and advantages of the invention will be set forth in the description of the drawings forming a part of this application and in said drawings

Figure 1 is a face view of one embodiment of the invention with the mechanism at one control position, as when the thermostat is at "cold" position;

Figure 2 is a vertical longitudinal section through a stack thermostat or combustion responsive device, taken on line 2—2 of Figure 1; and

Figure 3 is a view similar to Figure 1 showing the mechanism at the opposite control position, or as during heating of the thermostat.

Referring first to Figure 2 of the drawings: Numeral 1 indicates a suitable casing for housing the switch and the principal parts of the control mechanism. Numeral 2 indicates a tubular element suitably attached at the back of the casing. This element is adapted to pass through the wall of the stack, and is suitably secured to the stack by a bracket 3. Passing through the tubular member is a shaft 4 suitably journaled in the outer end of the tube and also journaled at its opposite end in a bearing 5 arranged within the casing 1. A spiral ribbon or thermostatic bimetallic element 6, secured at opposite ends as at 7—8, respectively to the tube 2 and the shaft 4, constitutes the usual thermostatic means for rotating the shaft conformably to changes in temperature. Splined

to a sleeve 9, rotatable upon the tubular bearing 5 is a slip friction assembly generally indicated at 10 and a suitable spring 11 applies pressure to the end disk 12 of the friction device. Between two of the friction disks and rotatable on the sleeve 9 is a bead-supporting disk 14 having a bead 15 of insulating material. This bead is adapted to engage one side of and move a resilient switch arm 16 suitably secured to the bracket 17 mounted on insulating block 18. The arm is connected to the bracket by resilient blade 19. This arm 16 is biased to move to a mid-position with reference to two contacts, one of which is carried by resilient arm 20, and the other of which is carried by stationary extension 21. The arm and extension will be referred to respectively as contacts 20—21. When the shaft 4 is rotated in clockwise direction, in this instance on temperature fall, the arm 16 is moved by bead 15 to the left or, in this instance, in direction of the "cold" contact 21.

Mounted also between the friction disks is a bead-supporting disk 25 having a bead 26 of insulating material adapted to engage the opposite side of the control arm 16 when the shaft 4 is rotated in counter-clockwise direction due, in this instance to rise in temperature. When moved sufficiently by the bead 26, the control element 16 engages the resilient arm 20.

Sufficient frictional resistance is provided for the bead mounts to obtain forced motions of the control element 16 to either control position, without slippage. After the proper amount of movement, the frictional force is overcome and the rotation of the sleeve 9 may continue independently of the mounts 14 and 25. In order to obtain rotation of the sleeve 9 as the result of rotation of the shaft 4, disk 30 is secured to the shaft 4 to move therewith. The disk is peripherally formed to provide a shoulder 31, see Figures 1 and 3. Rotatable also on shaft 4 is a slotted plate 33 having a radial shoulder 33. A set screw 34 passing through the slot and threaded into the disk 30 provides means for securing the plate (after rotative adjustment) for rotation with the disk. The disk 29, fixed to sleeve 9, is provided with an extension 35 which lies in the path of the shoulders 31, 33, and it will be seen that by properly adjusting the slotted plate 32, either a lost motion, or a non-lost motion, connection can be obtained. When rod 4 rotates, the sleeve and beads 15 and 26 are correspondingly moved. The above described mechanism is only

claimed herein broadly as means by which the element 16 can be thermostatically controlled, and/or as means adapted to control the element 16 in certain predetermined and adjustable relations to the switch mechanism now to be described.

The mechanism of this invention may be used independently of the thermostat, but the control of the contacts overlappingly during temperature rise and nonoverlappingly during temperature fall is a valuable feature of the invention.

Associated with and controlled by the element 16 is a relatively stiff arm 40 spaced from the arm 16 and secured as by riveting to the extension of a plate 41. This plate is rotatable about a post 42 suitably immovably connected to conducting element 39 embedded in the insulating block 18. The post traverses a cup 43 embedded in the insulating block 18. Held in this cup, is a friction washer 43' against which the plate 41 engages. Means is provided to press the plate 41 against the friction-washer. This means comprises a spring 44 surrounding the post, and a nut 45 threaded on the post for varying the compression of the spring, to adjust the degree of friction. Thus this plate is positively held in any position to which it is moved by the arm 40, but can be forcibly moved from that position. The arm 40 has a contact-engaging element 50 resiliently fulcrumed thereto by means of a short resilient element or blade 51, so as to be rockable against the action of this resilient means after the element engages its contact and on its continued motion toward the contact. The arm 40 has stop means 53 engageable by the lower or contact-making arm of the rocking element for limiting rocking motion, when moving away from the contact. The lower arm swings between stop 53 and arm 40. The resilient connection 51 is attached at that side of the contactor 50 and arm 40 which faces away from the contact 21.

The lower arm of the rocking element 50 has the usual button which engages the contact 21, and the upper arm of this element lies between spaced abutments of a lost motion connecting means which is carried by the arm 16, and by means of which this first arm controls the second. In the present instance, this means comprises two beads of insulating material 55-56 spaced apart and adapted to alternately engage the upper arm of the rockable contact-making element 50. The resilient rocking arrangement provides means by which sufficient contact pressure can be maintained during motion in contact-opening direction, to prevent premature opening after bead 55 moves away from or releases the rockable element 40 and before engagement of bead 56 with element 50, that is during the lost motion period.

It is conceivable that in some instances, the second arm can be directly operated by the beads of the lost motion connection, and not through the rockable contact-making element. However, to obtain sufficient contact pressure during temperature rise, or during opening of the contact, this resiliently controlled rockable device is valuable.

The bracket 57 is provided with stops lying at opposite sides of the resilient blade or contact 20 to limit its movement in both directions. The stop for limiting its movement toward the control arm 16 consists of a relatively stiff arm 60 secured by the same fastening device which secures the blade 20 to the bracket. The other

stop is a bent-out portion 61 of the bracket 57. The blade 20 is biased to move against the arm 60.

A feature of this invention relates to the arrangement of the arms, contacts, and lost motion means whereby on temperature rise, contact 21 will not be opened until contact 20 is closed, and so that on temperature fall, contact 21 will not be closed until contact 20 is opened. In other words, so that on temperature rise, the contacts are overlappingly controlled, and on temperature fall, non-overlappingly controlled.

Operation

Let it be assumed that the parts are positioned as shown in Figure 1, corresponding to "cold" position of the thermostat. In this position, bead 26 is against calibration stop 64, arm 16 is against bead 26, bead 15 is engaging the opposite side of the arm 16, and contact 21 is closed, and the resilient means 51 of the rocking element 50 is under tension. On rise in temperature, the beads both move together in anti-clockwise direction, releasing control arm 16 which travels with the beads to its mid-position, under its own bias. At the beginning of this movement, bead 55 of the lost motion connection moves away from contactor 50, but contact 21 remains closed, by action of its friction means and resilient blade 51. As the motion continues, the opposite bead 56 moves toward the element 50 from the opposite side. As shown, the parts are so related that contact 20 is closed before the abutment bead 56 acts to open contact 21. After contact 20 is closed, it continues to move toward the position shown in Figure 3, during which movement 56 engages and moves 50 to open contact 21. During the motion in the direction shown and after the switches have assumed the position shown in Figure 3, the beads 15, 26 will have assumed the position shown, and the bead 15 will have engaged the stop 65.

On fall in temperature, the first action is by bead 26 to allow control element 16 to move to open the contact 20. During this movement, bead 56 of the lost motion connection moves away from contactor 50, but contact 21 remains open until 50 is finally engaged and moved by bead 55 toward, and finally against, contact 21.

After 50 engages the contact 21, bead 55 still acting on 50 continues to move it in the same direction against the action of the spring blade 51 and the contactor is thus conditioned to exert the proper pressure to maintain a closed contact, when the contactor 50 is released, due to movement of the arm 16 toward the right.

I claim as my invention:

1. A first arm, a contact controlled thereby, thermostatically operable means for controlling the arm, including a lost motion connection, a second arm and a contact controlled thereby, and means by which the first arm controls the second to overlappingly control the contacts on temperature rise, and non-overlappingly control them on temperature fall.

2. A first arm, a contact controlled thereby, thermostatically operable means for controlling the arm, including an adjustable lost motion connection, a second arm and a contact controlled thereby, and means by which the first arm controls the second to overlappingly control the contacts on temperature rise and non-overlappingly control them on temperature fall, said

means including a lost motion connection between the arms.

3. A device of the class described comprising a first arm and contact controlled thereby, a second arm and contact controlled thereby, a lost motion connection by means of which the first arm controls the second, thermostatic means for operating the first arm, including a lost motion connection, said means and the arms, contacts, and arm-operating means being so related that on temperature rise one contact is closed before the other is opened, and on temperature fall that contact first to close is opened before the other is closed.

4. A first resilient arm biased to assume a mid-position with relation to two contacts and adapted to directly control one contact, a second arm controlling the other contact, and means by which the first arm controls the second, including a lost motion connection which acts alternately in both directions.

5. A first arm, a contact controlled by said arm during motion in one direction, a second arm and contact controlled thereby, means by which the first arm controls the second including abutments so spaced that the second arm is caused to open its contact only after the first arm has caused closure of its contact, and so that on reverse movement of the first arm, the second arm acts to close its contact only after the first has opened its contact.

6. A first arm, a contact controlled by said arm during motion in one direction, a second arm and contact controlled thereby to be closed when said first arm moves in an opposite direction, means by which the second arm is yieldably but positively held in any position to which it is moved, means by which the first arm controls the second during motion in either direction including spaced abutments, said second arm having a contact-engaging element engageable by the abutments, means by which the contact-engaging element is resiliently fulcrumed to the arm to be rockable against the action of the resilient means after the element engages the contact and on continued motion of the arm in contact-making direction.

7. A first arm biased to assume a mid-position, a contact controlled by said arm during motion in one direction from its mid-position, a second arm and contact controlled thereby, means by which the second arm is yieldably but positively held in any position to which it is moved, means by which the first arm controls the second during motion in either direction, including stops so spaced that the second arm is caused to open its contact only after the first arm has caused closure of its contact, and so that on reverse movement of the first arm, the second arm acts to close its contact only after the first has opened its contact, said second arm having a contact-engaging element and means by which it is resiliently fulcrumed to the arm to be rockable against the action of the resilient means after the element engages the contact and on continued motion of the arm in contact-making direction, and thermostatically controlled means adapted to control the first arm in certain predetermined and adjustable relations to temperature change.

8. A contact control element, a thermostatically controlled support, a pair of abutments on the support independently movable, each adapted to move the control element in a different direction, means frictionally resisting inde-

pendent motion of the abutments, a stop for each abutment adapted to limit motion of one while the other is controlling the contact control element, a contact controlled by the control element, an arm and contact controlled thereby, means by which the control element controls the arm including a lost motion connection, frictional means by which the arm is yieldably but positively held in any position to which it is moved, and means for adjusting the degree of friction.

9. A switching structure including a control arm, and contact controlled thereby, said arm having a contact-engaging element and means by which this element is resiliently fulcrumed to the arm to be rockable against the action of the resilient means after engaging its contact and on continued motion of the arm in contact-making direction.

10. A switching structure including a control arm, and contact controlled thereby, said arm having a contact-engaging element and means by which this element is resiliently fulcrumed to the arm to be rockable against the action of the resilient means after engaging its contact and on continued motion of the arm in contact-making direction, and operating means engageable with the contact-engaging element.

11. A switching structure, including a control arm, and contact controlled thereby, said arm having a contact-engaging element and means by which this element is resiliently fulcrumed to the arm, said element being rockable against the action of the resilient means after engaging its contact and on continued motion of the arm in contact-making direction, means for limiting the rocking motion of the contact-engaging element when moving away from the contact, and operating means engageable with the contact-engaging element.

12. A switching structure including a control arm, and contact controlled thereby, said arm having a contact-engaging element and means by which this element is resiliently fulcrumed to the arm, said element being rockable against the action of the resilient means after engaging its contact and on continued motion of the arm in contact-making direction, operating means engageable with the contact-engaging element, and means carried by the arm for limiting rocking motion of the contact-engaging element when moving away from the contact, said element and arm being so related that the arm forms a stop for limiting movement of the element after engaging its contact.

13. A switching mechanism comprising, an actuator movable through a relatively large range, a pair of abutments, continuously acting slip friction means connecting the actuator and abutments, a control element alternately engageable by said abutments upon reverse movements of said actuator circuit controlling mechanism controlling first and second circuits, and means by which said control element operates said mechanism for closing the first circuit and thereafter opening the second upon movement of the control element in one direction, and opening the first circuit prior to closing of the second circuit on movement of the control element in the opposite direction.

14. A switching mechanism comprising, an actuator movable through a relatively large range, a pair of abutments, continuously acting slip friction means connecting the actuator and abutments, a control element alternatively en-

gageable by said abutments upon reverse movements of said actuator, circuit controlling mechanism controlling first and second circuits, and means by which said control element operates
 5 said mechanism for closing the first circuit and thereafter opening the second upon movement of the control element in one direction, and opening the first circuit prior to closing of the
 10 second circuit on movement of the control element in the opposite direction, and means for limiting the movement of the abutments beyond the control element on continued movement of the actuator.

15 15. A switching mechanism comprising, an actuator movable through a relatively large range, a pair of abutments, continuously acting slip friction means connecting the actuator and abutments, a control element alternately engageable by said abutments upon reverse
 20 movements of said actuator, circuit controlling mechanism controlling first and second circuits, and means by which said control element operates said mechanism for closing the first circuit and thereafter opening the second upon movement
 25 of the control element in one direction, and opening the first circuit prior to closing of the second circuit on movement of the control element in the opposite direction, and means for adjustably limiting the movement of at least
 30 one of the abutments after the same leaves the control element on continued movement of the actuator whereby the amount of reverse movement of the actuator necessary to cause engagement of said abutment with the control element
 35 may be varied.

16. A device of the class described comprising, in combination, a first arm movable through a limited range of movement, a switch directly controlled thereby and normally in open circuit
 40 position, a second arm, a second switch directly controlled thereby and normally in closed circuit position, a lost motion connection between the arms whereby movement of the first arm in one direction moves its switch to circuit closed
 45 position and thereafter moves the second arm through the lost motion connection to move its switch to open circuit position, and reverse movement of the first arm moves its switch to open circuit position and thereafter moves the
 50 second arm through the lost motion connection to close its switch, an actuator adapted to move in reverse directions, and slip friction connecting means between the actuator and first arm whereby the actuator may continue moving unrestrictedly after it has moved said first arm to either end of its limited range of movement.

17. A device of the class described comprising, in combination, a first arm movable through a limited range of movement, a switch directly controlled thereby and normally in open circuit
 55 position, a second arm, a second switch directly controlled thereby and normally in closed circuit position, a lost motion connection between the arms whereby movement of the first arm in one direction moves its switch to circuit closed position and thereafter moves the second arm, through the lost motion connection, to move its switch to open circuit position, and reverse

movement of the first arm moves its switch to open circuit position, and thereafter moves the second arm through the lost motion connection to close its switch, an actuator movable in reverse directions, a first abutment, slip friction
 80 connecting means connecting said first abutment and actuator, said abutment being adapted to engage said first arm and move the same to one end of its limited range of movement upon movement of the actuator in one direction and
 85 thereafter allow continued unrestricted movement of the actuator in the same direction, a second abutment, slip friction connecting means between the second abutment and the actuator, said second abutment, upon movement of the actuator in the reverse direction, engaging the first arm to move the same to the other end of its limited range of movement and thereafter permit continued unrestricted movement of the actuator in the same direction and means for
 90 limiting the movement of said abutments when moved away from said first arm by said actuator.

18. A switching mechanism comprising, an actuator movable through a relatively large range of movement, a pair of abutments, continuously acting slip friction means connecting the actuator and the abutments, a control element movable through a limited range of movement and alternatively engaged by said abutments upon reverse movements of said actuator, a pair of switches normally resting in opposite circuit controlling positions, and means associated with the control element and switches for moving one of said switches to a new circuit controlling position prior to moving the other of
 100 said switches to a new circuit controlling position upon movement of said control element in either direction, said slip friction connecting means permitting continued unrestricted movement of said actuator after said abutments have moved the control element to either end of its limited range of movement.

19. A switching mechanism comprising, an actuator movable through a relatively large range of movement, a pair of abutments, continuously acting slip friction means connecting the actuator and the abutments, a control element movable through a limited range of movement and alternatively engaged by said abutments upon reverse movements of said actuator, a first switch normally in open circuit position, a second switch normally in circuit closed position, means associated with the control element and switches for moving said first switch to circuit closed position and thereafter moving said
 120 second switch to circuit open position upon movement of said control element in one direction and for moving the first switch back to open circuit position prior to moving the second switch back to circuit closed position upon movement of the control element in the other direction, and means for limiting the travel of each of said abutments in a direction away from said control element, said slip friction connecting means permitting continued unrestricted
 125 movement of the actuator when further movement of said abutments is prevented.

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