June 22, 1937. P. W. CUMMINGS 2,084,574

SENSITIVE CONTROL INSTRUMENT

Original Filed Dec. 15, 1930

Fig. 1.

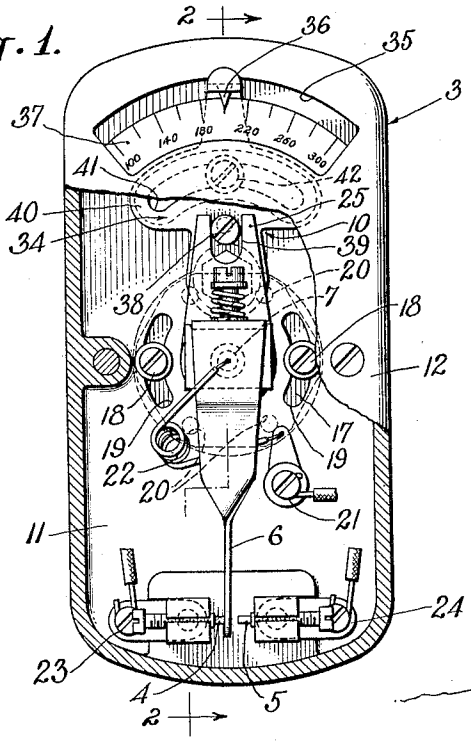
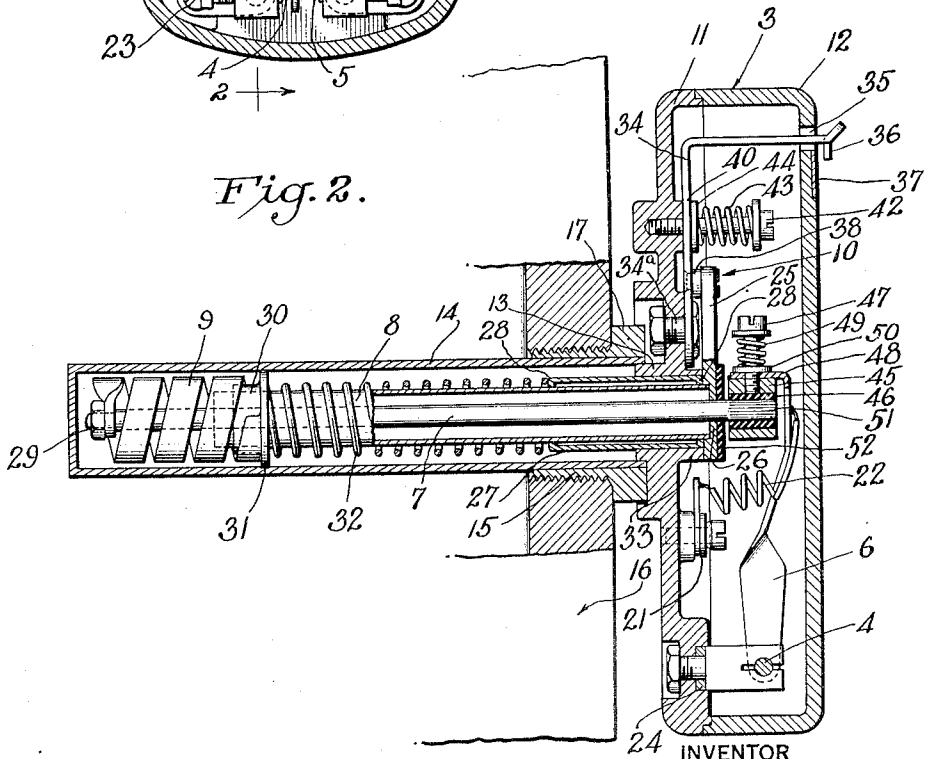


Fig. 2.



INVENTOR

Preston W. Cummings

BY

Schmidt, Parker & Carlson

ATTORNEYS

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SENSITIVE CONTROL INSTRUMENT

Preston W. Cummings, Rockford, Ill., assignor to Howard D. Colman, Rockford, Ill.

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The invention relates to sensitive control instruments such as thermostats and hygrostats, and has particular reference to thermostats of the type known in the art as insertion thermostats and commonly employed in the control of a primary heat source to avoid overheating.

One of the objects of the invention is to provide in a thermostat of the character indicated, a combined supporting and adjusting means for the sensitive actuating element which means is of an advantageous character, both from the manufacturing and operating standpoint.

Controlling instruments of the general character first above referred to commonly include a control device having a movable switch member in the form of a tongue mounted for swinging movement relative to one or more stationary switch contacts, and actuated by a sensitive element responsive to varying temperature or humidity conditions of the surrounding medium. An important object of my invention is to provide an improved motion-transmitting connection between the movable member and the sensitive actuating element, which is adapted to prevent injury to the parts in the event that the actuating element, responding to widely varying conditions in the surrounding medium, attempts to impart to the movable member a greater range of movement than is permitted by the arrangement of the stationary member or members.

A further object is to provide an improved mounting for the movable member or tongue so as to enable an easy and convenient cleaning of opposed stationary switch contacts.

The objects of the invention thus generally stated, together with other and ancillary advantages, are attained by the construction and arrangement shown in the accompanying drawing wherein my invention is illustrated in connection with an electric thermostat. In the drawing:

Figure 1 is a front elevational view of the improved thermostat with a substantial portion of the front cover broken away to illustrate the construction and arrangement employed.

Fig. 2 is a fragmentary sectional view taken approximately in the plane of line 2—2 of Fig. 1 and showing the thermostat applied to a boiler.

In the selected embodiment of the invention as illustrated, the control instrument comprises, in general, a somewhat elongated substantially rectangular casing 3 in the lower portion of which is mounted a control device of the electrical type. The latter device comprises a pair of stationary switch contacts 4 and 5 spaced apart in cooperative relation with an intermediate tongue 6 constituting a movable contact member common to both of the stationary contacts 4 and 5. The tongue 6 is mounted approximately centrally of the casing on a shaft 7 which extends rearwardly from the casing through a tube 8 of substantial length journaled in the casing. A sensitive actuating element 9 in the form of a helically coiled bimetallic strip has its opposite ends secured respectively to the shaft 7 and the tube 8, and operatively associated with the tube and disposed within the casing largely within the upper portion thereof is a manually operable setting means generally designated by the numeral 10.

The casing 3 may be made of any suitable material, metallic or non-metallic. It comprises a rear section or base 11 and a front or cover section 12, the latter being removable to permit of convenient access to the interior of the casing when desired. The base is provided with a central aperture defined at its rear edge by an annular flange 13. This flange is mounted to turn relative to the forward end of a tubular housing 14 enclosing the shaft 7, tube 8 and thermostatic element 9. The tubular housing 14 in turn is pressed into a threaded bushing 15 adapted to be secured into a suitable aperture of one wall of a boiler or the like as indicated at 16. The bushing 15 has at its outer or forward end a head 17 to which the base section 11 of the casing is secured by means of screws 18 entered through slots 19 in the base section. The head 17 may be provided with a plurality of tapped holes 20 (Fig. 1) which, together with the slots 19, permit the casing to be secured in upright position irrespective of the extent to which the bushing may be threaded into the boiler 16.

The stationary switch contacts 4 and 5 may be of any suitable or preferred character. Herein they are shown mounted upon the base 11 in suitably spaced relation for coaction with the tongue 6 which constitutes the movable contact member common to both of the stationary contacts 4 and 5. 21 designates a binding post which is connected to the tongue by means of a conductor 22, and the contacts 4 and 5 are connected to binding posts 23 and 24 respectively.

The shaft 7, in accordance with the present construction, has a supporting bearing only at its forward end. This bearing is provided in the present construction by the lower end of an arm 25 which is fast to the forward end of the tube 8 as by being pressed thereon, the journal bearing for the shaft being formed by an aperture 26 in the arm. The tube 8 in turn is mounted for rotative adjustment in a bearing sleeve 27 which is pressed into the central aperture in the base 11 and extends rearwardly a short distance into the tubular housing 14. The sleeve 27 is preferably in the form of a tube of a diameter somewhat larger than that of the tube 8 but having its opposite ends turn inwardly as at 28 to form spaced bearings for the tube 8.

The connection between one end of the thermostatic element 9 and the shaft 7 is effected by means of a nut 29 screw threaded on the rear end of the shaft which extends through the coiled element. The opposite end of the element is secured to the tube 8 through the medium of a collar 30 fixed on the tube and having a flange 31 fitting loosely within the tubular housing 14.

A coiled expansion spring 32 encircling the tube 8, bears between the rear end of the bearing sleeve 27 and the collar 30 so as to hold the arm 25 at the forward end of the tube flat against the forward end of the bearing sleeve 27, and against an annular forwardly projecting flange 33 on the base section 11, which flange terminates flush with the forward end of the bearing sleeve. The spring thus serves to hold the tube 8 in position within the tubular housing 14, while the flange 31 on the collar 30 positively prevents any contact between the thermostatic element 9 and the housing. Thus it will be observed that the tube 8 is supported at the opposite ends of the sleeve 27, whereas the shaft 7 has a bearing only in the arm 25. Because the diameter of the shaft is small, very little frictional resistance is offered by the bearing to the rotation of the shaft by the thermostatic element 9; and since the bearing is short, accurate alinement of the shaft relative thereto is rendered unnecessary.

The arm 25 constitutes a part of the adjusting means, and has for this purpose its upper end operatively connected to a hand-operated setting lever 34. This lever is pivoted at 34a to the base section 11, at a point below the upper end of the arm 25, and the upper end of the setting lever 34 is bent so as to extend forwardly through a slot 35 in the cover section 12. The forward end of the arm 34 may be provided with a pointer 36 to cooperate with a scale 37 to enable the thermostat to be adjusted for any desired temperature.

The connection between the upper end of the arm 25 and the setting lever 34 may be of the pin-and-slot type, including an eccentrically mounted adjustable stud 38 on the lever bearing in a slot 39 formed in the upper end of the arm. The stud 38 is capable of individual adjustment for the purpose of adjusting the relation between the tongue 6 and the setting lever 34. For the purpose of retaining the setting lever in its adjusted position, the latter is provided with a laterally enlarged portion 40 having an arcuate slot 41 therein (Fig. 1) through which a screw 42 is entered, which screw is anchored in the base section 11 and carries a coiled spring 43 interposed between the head of the screw and a washer 44 bearing against the front side of the setting lever 34.

The motion-transmitting connection between the tongue 6 and the shaft 7 is of a yieldable character to avoid injury to the parts in the event of an excessive movement imparted to the tongue by the thermostatic element over and above that permitted by the spacing of the stationary contacts 4 and 5. This connection comprises in the present instance a block 45 anchored to the forward end of the shaft 7 through the medium of an insulating bushing 46 and a screw 47. The screw is made of substantial length so as to project radially from the block 45 and is entered through an aperture in a rearwardly bent portion 48 of the tongue 6. Such apertured portion of the tongue rests upon the upper side of the block 45, and a spring 49 bearing between the head of the screw and a washer 50 tends to hold the anchoring portion of the tongue against rotation relative to the shaft. Thus the parts 45 and 48 provide coacting positioning surfaces normally held in engagement by the spring 49 to define a normal predetermined relation between said parts, the construction being such that the spring yieldably holds the parts against relative movement in either direction out of such normal relation. It will be apparent however that the spring 49 is capable of yielding to permit relative movement between the shaft and the tongue in the event that the shaft is turned beyond its normal range of operation in either direction with the tongue limited in its movement by either of the contacts 4 and 5. To assist in fastening the block 45 on the shaft, the latter may be knurled as indicated at 51 to receive the insulating bushing 46 in tightly fitting or interengaging relation.

To prevent contact between the block 45 and the arm 25, in the event of rearward axial movement of the shaft, an insulating washer 52 is inserted between the block and arm.

It will be apparent that when it is desired to change the setting of the thermostat, this may be accomplished readily through the manipulation of the setting lever 34 which operates through its connection with the arm 25 to rotate the adjusting tube 8 connected with one end of the thermostatic element 9. The other end of the element being connected to the tongue 6 effects the desired adjustment.

It will also be observed that the thermostat as constructed is adapted to correspond reliably to changes in the heating medium to which it is subjected, the only frictional resistance to rotation of the shaft and hence movement of the tongue by the thermostatic element being supplied by the relatively short bearing 26. If the movements imparted to the tongue by the thermostat are excessive, injury to the parts is avoided by the yielding of the spring 49.

The assembly comprising the thermostatic element, the supporting tube 8, operating shaft 7 and adjusting arm 25, is effectually held in operative position by the spring 32 coacting with the bearing sleeve 27. The construction furthermore provides for the convenient cleaning of the switch contacts by the removal of the cover section 12 of the casing. To do this, it is only necessary to grasp the block 45 carrying the tongue 6, and draw the shaft 7 and tube 8 forwardly against the action of the spring 32, the tube in this operation sliding forwardly in the bearing sleeve 27 and the arm 25 moving forwardly correspondingly out of engagement with the eccentric stud 38. By such an operation, the tongue 6 may be moved out of position with the contacts 4 and 5 thus rendering it possible readily to clean these contacts.

In general, the construction provided is of a practical character, capable because of its simplicity, of being manufactured at a low cost. Also, the device is capable of convenient adjustment, its switch contacts may be easily cleaned or repaired, and certainty and accuracy of operation is insured.

I claim as my invention:

1. A thermostat comprising a helically coiled thermostatic element, a support for one end of said element, a shaft to which the other end of said element is secured, a movable switch contact mounted on the shaft, a stationary switch contact, and means for supporting said shaft adapted to permit axial movement, and spring means nor-

mally holding the shaft in position to maintain said contacts in operative relation.

2. A thermostat comprising, in combination, a tubular member, a support for one end of said member adapted to permit of the rotative adjustment of the latter, a shaft extending through said tubular member with its opposite ends projecting therefrom, a helically coiled bimetallic element having its opposite ends fixed respectively to said shaft and said tubular member, means including a spring acting upon said tubular member to hold it in position in the support, and a switch member mounted on said shaft adjacent the support.

3. A thermostat of the character set forth comprising a shaft, a helically coiled thermostatic element fixed to one end of said shaft, an adjustable support for the opposite end of said thermostatic element, a bearing in which the opposite end of the shaft is slidably supported, a switch member mounted on said shaft and movable by said thermostatic element, a pair of stationary contacts on opposite sides of said switch member, and spring means normally acting to hold said shaft in position with said switch member disposed between said contacts, said spring means permitting an axial movement of the shaft to remove the movable switch member from position between said contacts.

4. A thermostat comprising a base, a shaft having one end rotatably and slidably mounted in said base, a temperature-responsive element for rotating said shaft, a support for said element mounted for movement with the shaft when the latter is slid endwise relative to the base, means for adjusting said support including an arm fixed thereto and a lever pivoted to the base and having a pivotal connection with said arm, a pair of stationary switch contacts, and a movable switch contact mounted on the shaft and normally disposed between the stationary contacts, said shaft being manually slidable endwise in said base to permit the movement of the movable switch contact out of operative relation to the stationary contacts, and said pivotal connection being adapted to permit disengagement of said arm from the lever in the movement of the support with the shaft.

5. A thermostat having, in combination, a base, an elongated tube, a bearing sleeve mounted in said base and having said tube rotatively adjustable therein, a member fixed to said tube adjacent said sleeve, a shaft having one end mounted in said member and its other end projecting from the opposite end of the tube, a helically coiled thermostatic element having its ends fixed respectively to said shaft and to said tube, and a spring acting between said tube and said bearing sleeve to hold the tube in position in said base.

6. A thermostat having, in combination, a support, an elongated tube having one end rotatively mounted in said support, a shaft extending through said tube, a helically coiled bimetallic element connected at one end to said shaft and at its other end to said tube, a member fixed to the tube and having bearing engagement with said support, said member providing a bearing for the adjacent end of the shaft, a spring acting between the support and the tube to hold said member in bearing engagement with the support, and a movable switch member mounted on the shaft adjacent said bearing.

7. A thermostat comprising, in combination, a support, an elongated tube rotatively mounted in said support and projecting a substantial distance to one side thereof, an arm rigid with one end of said tube adjacent the opposite side of the support, a shaft journaled at one end in said arm and extending through said tube, a thermostatic element in the form of a helically coiled bimetallic strip having one end secured to said tube and the other end secured to said shaft, spring means acting upon said tube to hold the latter in position in the support, a manually operable adjusting lever connected with said arm to move it, and a control switch having a movable contact member mounted on said shaft.

8. A control instrument of the character set forth comprising a shaft, means including a sensitive actuating element for imparting rotative movement to the shaft in response to temperature changes, a pair of stationary switch contacts spaced apart, a movable switch member having a portion interposed between said contacts, and means normally carrying said switch member in a predetermined relation to said shaft including a block fixed to said shaft, and a spring clamp adapted to yield in either direction from said normal relation to permit rotation of the shaft in either direction independently of the switch member and operable to move the switch member only when it occupies a definite angular relation to said shaft.

9. An insertion thermostat comprising a casing to be supported in a normal upright position, temperature responsive switch actuating means projecting rearwardly of the casing, and means for supporting the casing in said upright position with the temperature responsive means inserted through the wall of a furnace or other structure, said supporting means comprising a threaded bushing adapted to be screwed into said structure with the temperature responsive means passing through the bushing, and a threaded fastening member entered through said casing and anchored in said bushing, said casing having an arcuate slot through which said member extends, and said bushing having a plurality of holes for receiving said fastening member selectively depending upon the position of the bushing when secured in said structure.

10. In an insertion thermostat, a base, a member rotatably mounted on said base, an arm rigid with said member, an adjusting lever pivoted on said base and having an engagement with said arm whereby to rotate said member, said lever having an enlarged portion formed with an arcuate slot, and means including a bolt projecting through said slot urging said lever against said base to retain the lever in adjusted position.

11. A sensitive control instrument comprising, in combination, a control device having two stationary switch contacts and a movable contact interposed between the stationary contacts, means for actuating said control device including a sensitive actuating element, and a motion-transmitting connection between the movable contact and said actuating element including two members, one connected with the actuating element and the other connected to said movable contact, and spring means constantly acting to maintain said two members in a predetermined angular relation for motion transmitting purposes but adapted to yield to permit relative movement between them in either direction, said spring means being operative to transmit movement to said movable contact only when said two members have been restored to said predetermined angular relation.

12. A control instrument having, in combination, a sensitive actuating element having a nor-

mal range of operation, a pair of opposed closely spaced contacts, a movable contact disposed between said stationary contacts and having a limited normal range of movement determined by the spacing of said stationary contacts in the normal range of operation of said actuating element, and a motion-transmitting device operative to cause said movable contact to move with said actuating element in opposite directions; said device comprising relatively movable parts interposed between the actuating element and said movable contact and operative to permit movements of said actuating element beyond its normal range in either direction, and spring means acting to hold said parts against relative movement in either direction from a predetermined normal relation and coacting therewith to cause said movable contact to move with said actuating element only when said parts occupy said predetermined normal relation.

13. A control instrument having, in combination, a sensitive actuating element having a normal range of operation, a pair of opposed closely spaced contacts, a movable contact disposed between said stationary contacts and having a limited normal range of movement determined by the spacing of said stationary contacts in the normal range of operation of said actuating element, and a motion-transmitting device operative to cause said movable contact to move with said actuating element only in the normal range of operation of said actuating element, said device comprising relatively movable parts respectively connected with the actuating element and the movable contact and having coacting positioning surfaces to establish a normal predetermined relation between the parts, and spring means cooperating with said surfaces to hold said parts yieldably against relative movement in either direction from said normal relation, said spring means being operative as an incident to the movement of said actuating element beyond its normal range of operation in either direction to permit relative movement between said parts in either direction and to re-establish said normal relation between the parts as an incident to the reverse movement of the actuating element into its said normal range of operation.

14. A control instrument comprising, in combination, a shaft, a thermostatic element arranged to turn the shaft in opposite directions in response to temperature changes, a movable contact arm supported from said shaft, a pair of opposed normally stationary contacts between which said arm is movable and defining a limited range of movement of said arm, and means cooperating with said shaft and arm and coupling the arm to move with the shaft through certain phases only of the movement of the shaft corresponding to said limited range of movement of the arm, said means including a member rigid with the shaft, a second member movable with said arm, said members having cooperating surfaces normally engageable with each other to determine a definite angular relation between said arm and said shaft during the movement of said arm between said contacts, but adapted for relative movement in opposite directions as an incident to continued rotational movement of the shaft in opposite directions after engagement of said arm with the respective contacts, and a spring normally acting on one of the members to maintain said predetermined angular relation and yieldable upon engagement of said arm with either of said contacts to permit relative movement between said members to be continued irrespective of the direction of movement of the shaft by said thermostatic element.

15. A control instrument having in combination a pair of fixed contacts spaced a short distance apart, a movable contact having a limited range of movement between said fixed contacts, a rotatable member, a sensitive actuating element for imparting rotational movement to said member having a normal range of operation proportional to the limited range of movement of the movable contact, and a yieldable motion transmitting connection between said member and the movable contact operative to impart movement to the movable contact only during said normal range of operation of the actuating element, said connection comprising two parts fixed to the rotatable member and the movable contact respectively, and spring means acting to hold said parts together with a yielding pressure, said spring means acting on said parts to transmit movement to the movable contact only during said normal range of operation of the actuating element and yieldable to permit relative movement between the parts upon movement of the actuating element beyond its normal range of operation in either direction.

16. A control instrument having, in combination, a pair of fixed contacts spaced a short distance apart, a movable contact element having a limited range of movement between said fixed contacts, sensitive actuating means for imparting movement to said movable contact element including an actuating member having a normal range of operation proportional to the limited range of movement of the movable contact, and a yieldable motion transmitting connection between said member and the movable contact element, said connection comprising spring means acting to transmit movement from said member to the movable contact only during said normal operation of the actuating member, and said connection being yieldable upon the engagement of the movable contact with either of said stationary contacts to permit movement of the actuating member beyond its normal range of operation in either direction.

17. A control instrument having, in combination, a movable switch arm having a limited normal range of movement, a thermal actuating element having a normal range of operation proportional to the limited range of movement of said arm and an abnormal range of movement in response to extreme temperature changes substantially greater than said limited movement of the switch arm, and a motion transmitting connection between said arm and said thermal element including a spring acting upon said arm to effect the transmission of movement from the thermal element to the arm only during said normal range of operation of the element, said connection being yieldable upon the interruption of the movement of the switch arm in either direction to permit abnormal movement of the actuating element beyond said normal range of operation thereof.

PRESTON W. CUMMINGS.