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PROBE TYPE THERMOSTATIC CONTROL EMPLOYING A BIMETAL LEAF AND FORCE-TRANSMITTING LEVER

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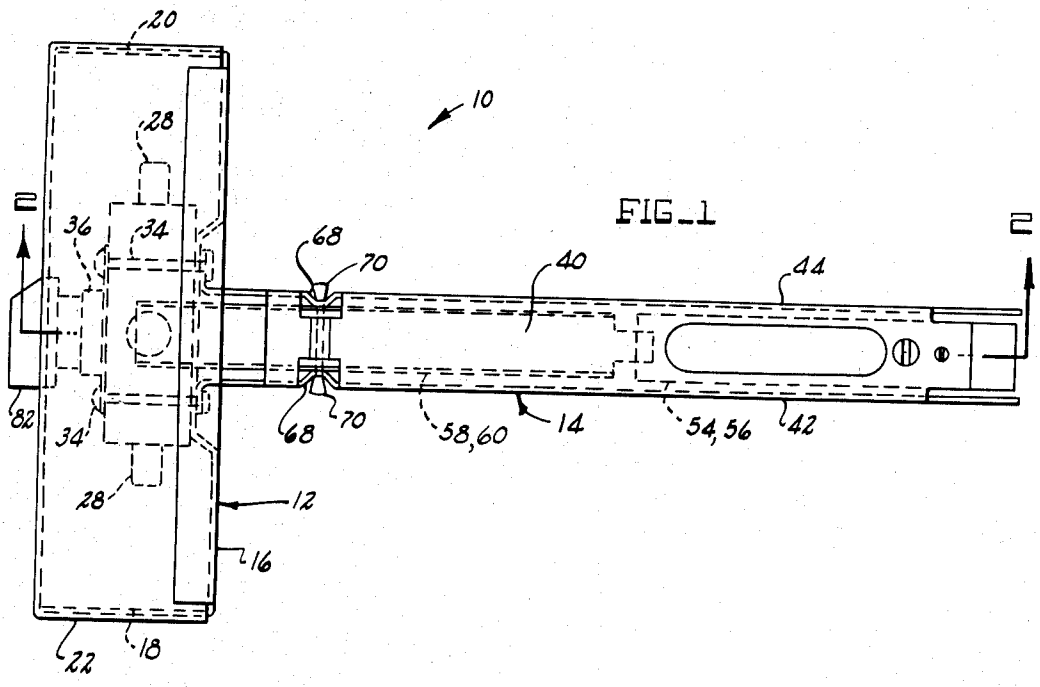


FIG_1

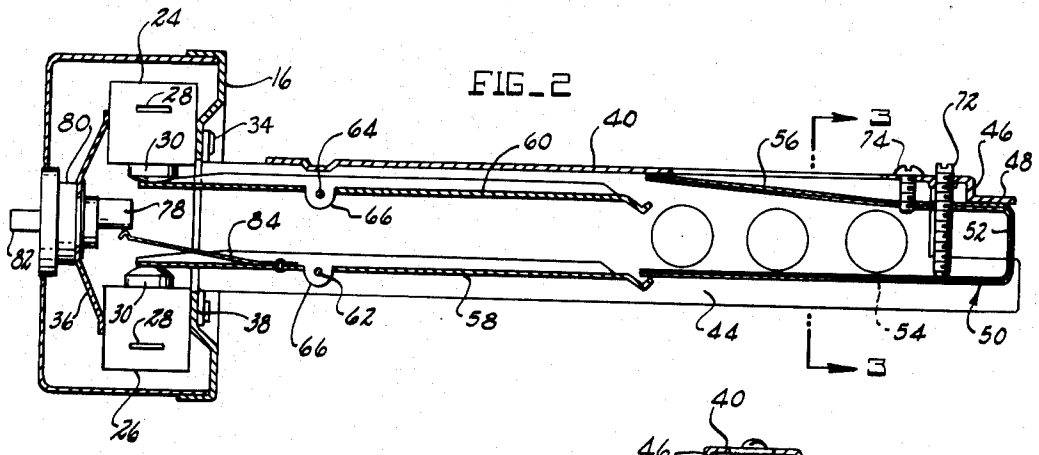


FIG_2

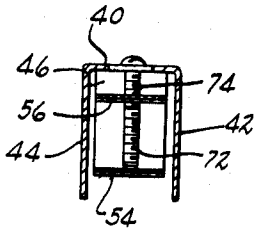


FIG_3

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PROBE TYPE THERMOSTATIC CONTROL EMPLOYING A BIMETAL LEAF AND FORCE-TRANSMITTING LEVER

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This invention relates to probe-type thermostatic controls for operating one or more electric switches. One application of the control is in domestic heating systems where it is desired to control the upper temperature limit attained by the heat producer and the cut-in temperature of the heating medium circulator. In the case of air heating systems this type control is commonly referred to as a fan-limit control.

These fan-limit controls usually embody a box-like housing containing a pair of switches, and an elongated probe-forming frame extending from the housing so that when the housing is positioned on the wall of a hot air furnace the probe-forming frame can extend into the hot air stream to be exposed to the temperature conditions prevailing therein. The probe frame carries a bimetal which warps in response to temperature change to thus operate the two switches located in the aforementioned housing. One of the switches controls the air fan in a low temperature range, as for example from forty degrees F. to one hundred twenty degrees F., and the other switch controls the heat producer to de-energize same if the air temperature reaches an abnormally high limiting value such as two hundred degrees F.

In copending application Serial No. 132,058, now Patent No. 3,151,229, filed August 17, 1961 there is shown a fan-limit control wherein the actuating bimetal is constructed as a U-shaped member having leg portions which extend into a switch housing so as to directly actuate the switches therein. Such an arrangement is quite suitable when the furnace is constructed to permit a fairly short probe length, as for example three or four inches. However in certain types of furnace constructions the bimetal must be located a considerable distance inwardly from the furnace wall in order to sense temperatures which are representative of the outlet air temperatures which it is desired to control. In such furnace constructions the use of a very long probe frame and correspondingly long bimetal is not economically practical because of the relatively high cost of the bimetal.

With the above in mind, the present invention has for its primary object the provision of a probe-type control which can have a relatively long probe frame and which at the same time can utilize a relatively short length of bimetal.

A further object of the invention is to provide a probe-type control having a relatively long probe and being constructed at substantially the same cost as controls having shorter length probes.

A particular object of the invention is to provide a probe-type control having a simplified force-transmitting lever arrangement between the bimetal actuator and the electric switch which it operates.

Other objects of this invention will appear from the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

FIGURE 1 is an elevational view of one embodiment of the invention;

FIG. 2 is a sectional view taken on line 2—2 in FIG. 1;

FIG. 3 is a sectional view taken on line 3—3 in FIG. 2.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

In the drawings there is shown a probe-type control 10 comprising a base structure on casing 12 and an elongated probe-forming frame 14. Structure 12 in the illustrated embodiment takes the form of a generally flat plate 16 having right angularly projecting end walls 18 and 20 which interfit with the walls of a removable cover 22. Disposed within base structure 12 are two trigger-equipped snap switches 24 and 26, each having a pair of terminals 28 and a plunger-type actuator or trigger 30. A shield or barrier wall 36 is fixedly disposed against the switch casings so as to contain the atmosphere adjacent the switch triggers. Securement of the switches, barrier wall 36, base wall 12, and frame 14 into a unitary rigid assembly is effected by four rivets 34, all as better shown in copending application Serial No. 132,058.

Frame 14 is preferably constructed as a channel member having a web wall 40 and two side walls 42 and 44. As best shown in FIG. 2, the free end of web wall 40 is directed downwardly at 46 and then horizontally at 48 to provide a securement surface for the U-shaped bimetal 50. As seen in FIG. 2, the bimetal is provided with a relatively short web 52 and two relatively long legs 54 and 56. The bimetal in its fabrication is formed with the high expansion surfaces on the outside so that temperature increase is effective to warp the bimetal legs 54 and 56 toward one another.

The free ends of the bimetal legs operatively engage the end portions of levers 58 and 60 which are fulcrumed on small diameter shafts or pins 62 and 64. Each lever is of channel cross section and is formed with a pair of ears 66 for its pivotal mounting on the respective pin 62 or 64. Preferably as shown in FIG. 1 the frame walls 42 and 44 are embossed inwardly at 68 to provide bearing surfaces for the ears 66 to thus provide for free swinging movement of the levers on the pivot pins without interference from the frame wall surfaces. The ends of the pivot pins are suitably crimped as at 70 to retain the pins in place. It will be noted that the left ends of levers 58 and 60 extend into the base structure 12 so as to engage the facing triggers of switches 24 and 26. By this arrangement the warping movements of bimetal legs 54 and 56 are transmitted to the switch triggers.

The illustrated control is designed as a fan-limit control for use in a hot air heating system. In such an application the control is installed with base structure 12 adjacent an external surface of the furnace and with frame 14 extending into the hot air stream so that bimetal 50 senses a representative temperature therein. Bimetal leg 54 is intended to cut-in the fan at a selected temperature within a low temperature range, as for example from about forty degrees F. through one hundred twenty degrees F., and bimetal 56 is intended to de-energize the heat producer when the temperature in the hot air stream reaches an abnormally high value, as for example two hundred twenty degrees F.

In order that the two bimetal legs may operate in the desired temperature ranges it is necessary to factory calibrate the initial positions of these legs, as for example by the two calibrating screws on elements 72 and 74. Screw 72 is threaded into threads formed in frame wall 40 and extends freely through an opening in bimetal leg 56 so

that its lower end abuts against the bimetal leg 54. By factory adjustment of screw 72 it is possible to set the initial position of leg 54 and thus control the temperature range in which it will undergo a prescribed warping movement.

Screw 74 extends freely through an opening in wall 40 and has its threads meshed with threads formed in an opening in bimetal leg 56. By factory adjustment of screw 74 it is possible to adjust the initial position of bimetal leg 56 such that it will warp to a prescribed position at a relatively high set temperature such as two hundred twenty degrees F. This calibration is made so that when the two hundred twenty degree F. mark is reached the leg 56 will have warped downwardly sufficiently to have pivoted the lever 60 a sufficient clockwise distance about its pivot shaft 64 to operate the trigger of the normally closed switch 24 to thus de-energize the heat producer.

As before noted, warping movement of bimetal leg 54 is intended to control the operation of the fan in the heating system. The adjustment at 72 sets the range of movement of bimetal leg 54. In order to vary the switch-actuating temperature within the set range there is provided a mechanism which includes a manually rotatable cam 78 located eccentrically on a rotary barrel element 80 which is suitably journaled for rotary movement in fixed wall 36. A combination pointer and operating knob 82 is provided on the barrel to rotate it to different positions of adjustment. As best shown in FIG. 2, cam 78 engages a leaf spring 84 which is suitably secured at its right end to lever 58 so as to apply a preload force onto the lever. The value of this preload force is adjusted and varied by the rotated position of cam 78 in the same manner as in the aforementioned copending application Serial No. 132,058. In general, when cam 78 is rotated to increase the preload force the lever 58 applies an increasing force on bimetal leg 54 which helps the bimetal to warp inwardly; this then results in lowering the switch-actuation temperature. Rotating cam 78 to decrease the preload force of spring 84 raises the switch-actuating temperature.

Assuming the control is installed on a furnace, during the attainment of normal air stream temperatures within the forty degree to one hundred twenty degree range the bimetal leg 54 will on temperature increase warp upwardly to allow spring 84 to move lever 58 for actuating trigger 30 to cut in the fan. During temperature decrease in the air stream bimetal leg 54 warps downwardly to pivot lever 58 clockwise and allow the internal spring within switch 26 to move its trigger 30 outwardly for cutting out the fan. During normal operation bimetal leg 56 warps back and forth but not in an arc sufficient to operate lever 60. On the attainment of an abnormally high air stream temperature bimetal leg 56 will warp sufficiently to pivot lever 60 clockwise for thereby operating the trigger 30 of switch 24 to thus de-energize the heat producer.

A primary feature of the illustrated control resides in the fact that bimetal 50 has legs 54 and 56 which are relatively short as compared with the length of probe frame 14. Thus the frame can be constructed as a relatively long length device, as for example seven or eight inches, and the bimetal can be constructed as a relatively short member, as for example three inches. By this arrangement it is possible to utilize a relatively light gage bimetal material and to economize on the mass of bimetal employed in the control. The levers 58 and 60 add to the cost of the control but they do not add as much into the cost as would be involved in utilizing a bimetal which extended into direct engagement with the switch triggers 30. Thus the use of levers as shown provides for cost reduction in a long length probe-type control, which as before mentioned is the primary object of this invention.

It is contemplated that some minor variation in construction and arrangement can be resorted to without departing from the spirit of the invention. For example, the invention within its broader aspects can be incorporated in a control for operating only one switch rather than two switches as shown. Also, it is possible within the broader aspects of the invention to construct a control which utilizes two separate bimetal legs, in which case each leg would be secured to a part of the probe frame. Other variations can be resorted to while still practicing the invention as set forth in the accompanying claims.

I claim:

1. In a probe-type control: a base structure; an elongated probe frame extending from said base structure; a U-shaped bimetal mounted in the end of the frame remote from the base structure with the legs thereof extending toward said base structure but terminating substantial distances therefrom; a pair of actuator-equipped switches arranged on the base structure with the actuators thereof facing one another; and a pair of force-transmitting levers individually pivotally mounted in the frame with their opposite ends operatively engaging the bimetal legs and switch actuators.

2. The combination of claim 1 wherein the levers are elongated members of greater length than the bimetal legs.

3. In a probe-type control: a base structure; an elongated probe frame extending from said base structure; a pair of flat bimetals mounted in the end of the frame remote from the base structure and arranged on temperature increase to warp toward one another; a pair of actuator-equipped switches arranged on the base structure with the actuators thereof facing one another; and a pair of force-transmitting levers individually pivotally mounted on separate fixed parallel axes in the frame with their opposite ends operatively engaging the bitmetals and switch actuators; said levers being arranged to pivot in opposite directions around their fulcrum axes during temperature change.

4. In a probe-type control: a base structure; an elongated probe frame extending from said base structure; a pair of flat bimetals mounted in the end of the frame remote from the base structure and arranged on temperature increase to warp toward one another; a pair of actuator-equipped switches arranged on the base structure with the actuators thereof facing one another; a pair of force-transmitting levers individually pivotally mounted on separate fixed parallel axes in the frame with their opposite ends operatively engaging the bimetals and switch actuators; and a spring operatively associated with one of the levers for biasing it toward its actuator and bimetal.

5. In a probe-type control: a base structure; an elongated probe frame extending from said base structure; a pair of flat bimetals mounted in the end of the frame remote from the base structure and arranged on temperature increase to warp toward one another; a pair of actuator-equipped switches arranged on the base structure with the actuators thereof facing one another; a pair of force-transmitting levers individually pivotally mounted on separate fixed parallel axes in the frame with their opposite ends operatively engaging the bimetals and switch actuators; a spring operatively associated with one of the levers for biasing it toward its actuator and bimetal; and manually operated means mounted on the base structure for applying a variable load on the spring to thus vary the temperature at which said one lever operates its switch actuator.

6. The combination of claim 5 wherein the spring comprises a leaf spring carried by said one lever, and the manually operated means comprises a rotary cam carried by said base.

7. In a probe-type control: a base structure; an elongated probe frame extending from said base structure; a flat bimetal having one of its ends mounted in the end of the frame remote from the base and having its other end terminating within the frame a substantial distance

from the base structure; an actuator-equipped switch arranged on the base; a force-transmitting lever pivotally mounted in the frame with its opposite ends operatively engaging the bimetal and switch actuator; a leaf spring carried by the lever; and a manually-operable rotary cam carried by the base structure for applying a variable load on the spring to thereby vary the switch-actuation temperature of the bimetal.

8. In a probe type control: a casing; an elongated probe frame extending from said casing; a pair of flat bimetals mounted in the end of the frame remote from the casing and arranged on temperature increase to warp toward one another; a pair of actuator-equipped switches arranged in the casing with the actuators thereof facing one another; a pair of force-transmitting levers pivotally mounted on separate fixed parallel axes in the frame with their opposite ends operatively engaging the bimetals and switch actuators; said levers being constructed as elongated substantially straight structures having their pivotal axes located approximately midway between their opposite ends; said levers being disposed generally longitudinally within the frame, and having greater lengths than the bimetals.

9. In a probe type control: a casing; an elongated probe frame extending from said casing; a pair of flat bimetals mounted in the end of the frame remote from the casing and arranged on temperature increase to warp toward one another; a pair of actuator-equipped switches arranged in the casing with the actuators thereof facing one another; a pair of force-transmitting levers pivotally mounted on separate fixed parallel axes in the frame with their opposite ends operatively engaging the bimetals and switch actuators; said levers being constructed as elongated substantially straight structures having their pivotal axes located approximately midway between their opposite ends; said levers being disposed generally longitudinally within the frame, and having greater lengths than the bimetals; and two separate adjusting elements located on the elongated probe frame in engagement with individual ones of the flat bimetals adjacent their mounted portions to adjust the positions of the bimetals relative to the levers.

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ROBERT K. SCHAEFER, *Examiner.*