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F. D. JOESTING

2,564,222

TEMPERATURE RESPONSIVE CONTROL APPARATUS

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Fig. 1.

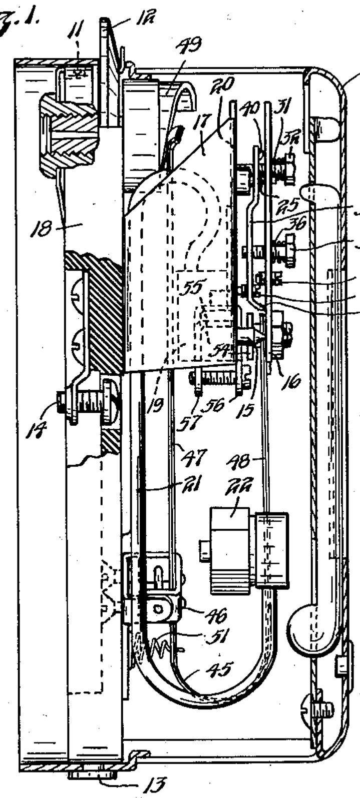


Fig. 2.

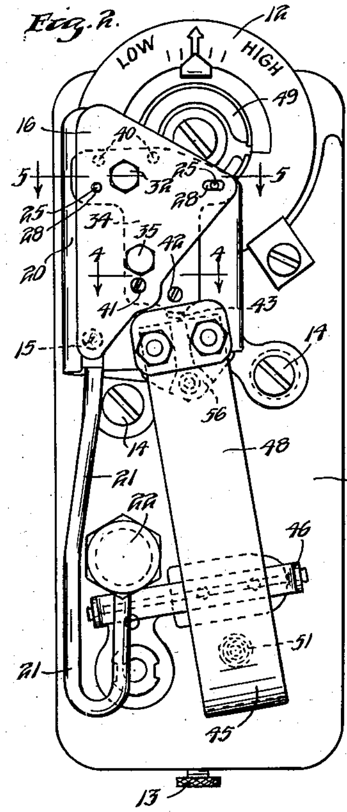


Fig. 3.

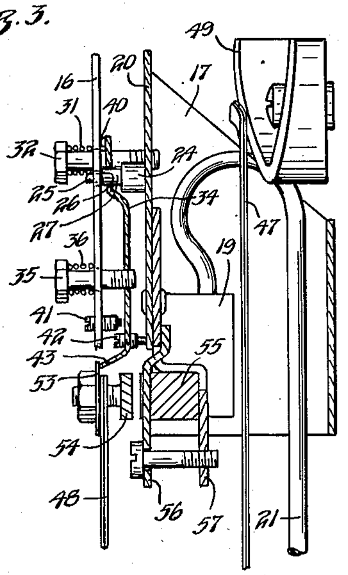


Fig. 4.

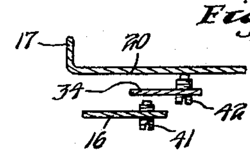
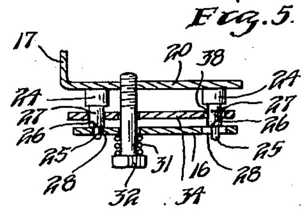


Fig. 5.



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TEMPERATURE RESPONSIVE CONTROL APPARATUS

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3 Claims. (Cl. 236—48)

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The present invention relates to a bleed type pneumatic snap acting thermostat using a permanent magnet for the snap action.

Snap action pneumatic thermostats are especially desirable for control applications such as one pipe steam heating systems. In these systems, the steam valve must be either fully open or completely closed to exercise proper control and to minimize heating system noises, this requiring, in a bleed type pneumatic control system, snap acting control devices. Various types of mechanical snap acting mechanisms have been used in pneumatic thermostats but they have resulted in expensive and bulky constructions. Permanent magnets have long been used for snap action in electric thermostats but, due to the peculiar requirements of pneumatic control devices, they have not, prior to the present device, been successfully used in a pneumatic thermostat. It is thus a principal object of this invention to provide an improved snap acting pneumatic control device.

It is a more specific object to provide a simple and compact pneumatic thermostat using a permanent magnet for snap action.

It is also an object to provide a snap acting control device having relatively movable control members wherein one of the members is actuated through a strain release mechanism by an auxiliary lever operated by a condition responsive means.

It is an additional object to provide a snap acting pneumatic control device especially adapted for controlling one pipe steam heating systems.

These and other objects will become apparent upon the study of the following specification and drawings wherein:

Figure 1 is a left elevation view of the present thermostat with parts broken away and other parts in section.

Figure 2 is a front elevation of the device with the cover removed.

Figure 3 is an enlarged right elevation of an upper portion of the present device.

Figure 4 is a section view of certain operative parts taken on the line 4—4 of Figure 2.

Figure 5 is a similar section view taken on the line 5—5 of Figure 2.

Referring to Figure 1, the present thermostat is shown complete with its cover 10 but without the sub-base or mounting plate by which it is attached to a wall or the like. Cover 10 is held in place by down-turned tongues 11 coperating with suitable notches at the top of base 18 and by a

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suitable clamp screw 13 at the bottom of the instrument. This cover and its attachment, as shown in Figure 1 and as above described, is conventional and forms no part of the present invention. Screws 14, accessible from the front of base 18, are used to attach the base to the mounting plate or sub-base, not shown.

The control members or elements of the present device comprise a nozzle 15 and a movable valve plate 16, these members being carried by a bracket member 17 attached to base 18. Nozzle 15 extends outwardly at right angles to base 18 and is mounted in a connector block 19 secured to the back side of the outer portion or platform 20 of bracket 17. A tube 21 connects connector block 19 to a suitable fitting 22 which is used to connect the thermostat to the branch line of a pneumatic control system, not shown. When valve plate 16 is in engagement with nozzle 15, no air can escape hence pressure may build up to a maximum in the branch line of the control system, whereas, when plate 16 is sufficiently removed from nozzle 15, air in the branch line may bleed out through the nozzle 15 and thus reduce the branch line pressure in a manner common to bleed-type controllers.

Valve plate 16 is essentially triangular in shape and is pivotally mounted near its base on a pair of pedestal members 24 attached to the outer surface of platform 20, each of the members 24 having an outer pivot pin portion 25 with an inner shoulder 26 formed by an adjacent guide pin portion 27 of a diameter greater than 25. Holes 28 in plate 16 are of sufficient diameter to fit loosely over pin portions 25 but too small to slip over shoulders 26, one of the holes being elongated along the line defined by the holes to minimize assembly difficulties.

A compression spring 31 is adjustably held against plate 16 by a bolt 32 located on the base side of the pivot axis and opposite from the nozzle engaging portion of the plate, hence this spring biases plate 16 about pins 25 and shoulders 26 in a manner to disengage said plate from nozzle 15 and also holds the plate 16 in place on said pin portions and against said shoulders.

To provide a mechanism for actuating plate 16 against the bias of spring 31, and the force due to air blowing through nozzle 15 against said plate, a substantially T-shaped auxiliary lever 34 is secured in spaced relation to the inner side of plate 16 by a bolt 35 and a compression spring 36, bolt 35 being screwed into lever 34 but engaging plate 16 only through spring 36 in a manner to urge lever 34 and plate 16 together. Lever 34 is guided by holes 38 fitting over guide portions 27 of pedestal members 24 and includes projections 40 formed in the upper portion of the lever 34 for engaging the base portion of member 16 to space the upper portion of the lever from the base portion of plate 16 and to act as pivot points. An adjustable stop screw 41 carried by plate 16 and engageable by lever 34 limits the proximity of the lower end of the lever to member 16. The lever 34 also carries an adjustable stop screw 42 that coacts with the outer surface of platform 20 to limit the movement of lever 34 toward that surface. An outwardly directed tip portion 43 formed at the lower most part of lever 34 is adapted to be engaged by a suitable condition responsive means, as will be seen.

The temperature sensitive element or condition responsive means, of the present thermostat comprises a generally U-shaped bimetal element 45 attached to base 18 by a hinge 46, the element having its most expansive metal on its outside so that it tends to contract with a rise in temperature. The inner arm 47 of the element 45 is somewhat longer than outer arm 48 and its free end bears against a cam 49 operable by the adjusting dial 12. Rotation of cam 49 by dial 12 shifts the position of the bimetal 45 and thus changes the control point of the instrument. A spring 51 is arranged between the lower end of element 45 and the base 18 to bias the element in a counterclockwise direction (Figure 1) and thus normally maintains the free end of arm 47 against cam 49. The other free end of the element 45, the upper end of arm 48, carries an abutment plate 53 for engaging the pivot portion 43 of lever 34 upon a temperature rise. A magnet armature 54 is attached to the underside of arm 48 by the same screws that hold plate 53 and cooperates with a small, notched, permanent magnet 55 held by a clamping arm 56 fitting within the notch and coacting with an angular support member 57 attached to the underside of platform member 20.

Armature 54 is so positioned relative to bimetal arm 48 and stop 42 is adjusted in such a manner that the armature 54 and magnet 55 are slightly spaced when arm 34 is urged to its innermost position by abutment member 53. At this point, the attraction of magnet 55 for armature 54 is at its maximum effectiveness, its attractive force at this point being sufficient to deflect the bimetal element 45 to some extent and to overcome springs 31 and 36 and the force on member 16 due to the air pressure in nozzle 15.

To better illustrate the relative strength of the aforementioned springs and the magnet, as well as to show the function of the apparatus, its operation is explained below.

Operation

An inspection of the drawing shows member 16 in engagement with nozzle 15, lever 34 is spaced a short distance below stop screw 41, and stop screw 42 is in engagement with platform 20, lever 34 being held in this lower most position due to a contraction of the bimetal element 45 and inward movement of arm 48 brought about by a relatively high temperature affecting said element and by the attractive force of magnet 55.

If the temperature should now decrease, arm 48 tends to move outward due to the action of the bimetal element 45 and spring 36 but it is restrained by the force of magnet 55 acting on armature 54, thus storing resilience in element 45. However, upon a continued decrease in temperature, the expansive force of the bimetal increases and becomes sufficient to move armature 54 slightly further away from its position near magnet 55, this movement permitting a like movement of lever 34 but having no effect on valve member 16 until the movement becomes sufficient for lever 34 to engage stop screw 41. Because the initial movement of arm 48 does not affect valve member 16 and as it is held in engagement with nozzle 15 by the force of spring 36, there is no leakage at the nozzle which could interfere with the proper operation of the control device.

While arm 48 moves slightly outwardly, however, the attractive force of the magnet 55 on armature 54 diminishes very rapidly. The lessened magnetic force permits the resilience stored in bimetal element 45 to further increase the outward movement of arm 48 and still further reduce the magnetic attraction, resulting in a rapid or snap movement of arm 48 by the time lever 34 engages stop pin 41. An abutment plate 53 on arm 48 tends to disengage tip 43 of lever 34, spring 31, assisted by the air pressure of nozzle 15, is effective to bias member 16 away from nozzle 15 and fully open the valve, a considerable movement being possible because of the resilience in element 45 causing additional movement outwardly of arm 48 as the restraining forces are minimized.

With the thermostat valve fully opened, as above described, an increase in temperature will cause a contraction of bimetal 45 and tend to move arm 48 inwardly but, upon plate 53 engaging tip 43 of lever 34, the resistance to further movement of plate 16 and lever 34 caused by spring 31 will cause some resilience to be stored in the bimetal element. As the temperature continues to decrease, however, the contracting force of the element 45 is sufficient to start moving lever 34 and plate 16 toward closed position, plate 16 following lever 34 because spring 36 is effectively stronger than spring 31. As this movement takes place, armature 54 is being moved toward magnet 55 and the attractive force of the magnet for the armature increases rapidly. With the contracting force of the bimetal substantially balancing the resisting force of spring 31 and the air pressure from the nozzle 15, only a slight increase in the magnetic attraction is sufficient to cause further contractive movement of the bimetal which still further increases the magnetic attraction with the result that the member 16 and lever 34 are suddenly moved to their innermost positions. On this occurring, member 16 engages and closes nozzle 15 but a further slight movement of lever 34 is permitted by strain release spring 36, this spring limiting the closing force that can be imposed on member 16 and permitting movement of lever 34 without an accompanying movement of member 16, as before described. Obviously, member 16 is held against nozzle 15 by the force of spring 36 whenever lever 34 is out of engagement with stop screw 41, thus preventing air leakage from the nozzle.

Because the above described mechanism is such that valve member 16 is either in engagement with nozzle 15 or spaced an appreciable distance therefrom, and as both the closing and opening movements of the valve member are accomplished with great rapidity, the present device is an effective two position snap acting pneumatic thermostat.

While the above description has been in terms of a thermostat, obviously any control device having a resilient actuating element may be substituted for the bimetal described. As this and other substitutions are readily apparent to those skilled in the art, the scope of the present invention is to be determined only by the appended claims.

I claim as my invention:

1. A fluid control device comprising valve members relatively movable to open or closed positions, means for definitely guiding one of said members relative to the other, a lever means for moving said one valve member in one direction, spring means for moving said one member in an opposite direction, means for resiliently attaching said lever means to said one member so that said lever means is carried by said one member, stop means coacting with said lever means for limiting the movement of said lever means in a direction to close said valve, said limiting means permitting a predetermined movement of said lever means after said valve is in a closed position resulting in a stressing of said resilient attaching means, a condition responsive means for moving said lever means and the attached valve member against said spring means, an armature attached to said condition responsive means, and a permanent magnet for attracting said armature.

2. A control device comprising a base and having relatively movable control members mounted thereon, a movable lever member, resilient means for urging one of said members and said lever means together, spring means for biasing said one member in one direction, said one direction being opposite to that of the bias of said resilient means, said spring means having less ability for controlling motion of said one member than has said resilient means, condition responsive means attached to said base and engageable with said lever means in a manner to move said one member against said biasing spring, and permanent magnet means cooperating with said resilient means and said spring means for causing said one member to assume one of two predetermined positions when said lever means is actuated by said condition responsive means.

3. A control device comprising a base and having relatively movable control members mounted thereon, a movable lever attached to one of said members in pivotal relation thereto, resilient means for urging said one member and said lever means together, spring means for biasing said one member in one direction, said one direction being opposite that of said urging means, said spring means having less ability for causing motion of said one member than has said resilient means, condition responsive means adjustably mounted on said base and engageable with said lever means in a manner to move said one member against said biasing spring, and permanent magnet means arranged to oppose said biasing means with a maximum force when said one member is in one of two positions and to oppose said biasing means with considerably reduced force when said one member is in the other of the two positions.

FREDERICK D. JOESTING.

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