June 4, 1940. J. M. LARSON 2,203,535

HUMIDITY CONTROLLER

Filed Dec. 8, 1937 2 Sheets-Sheet 1

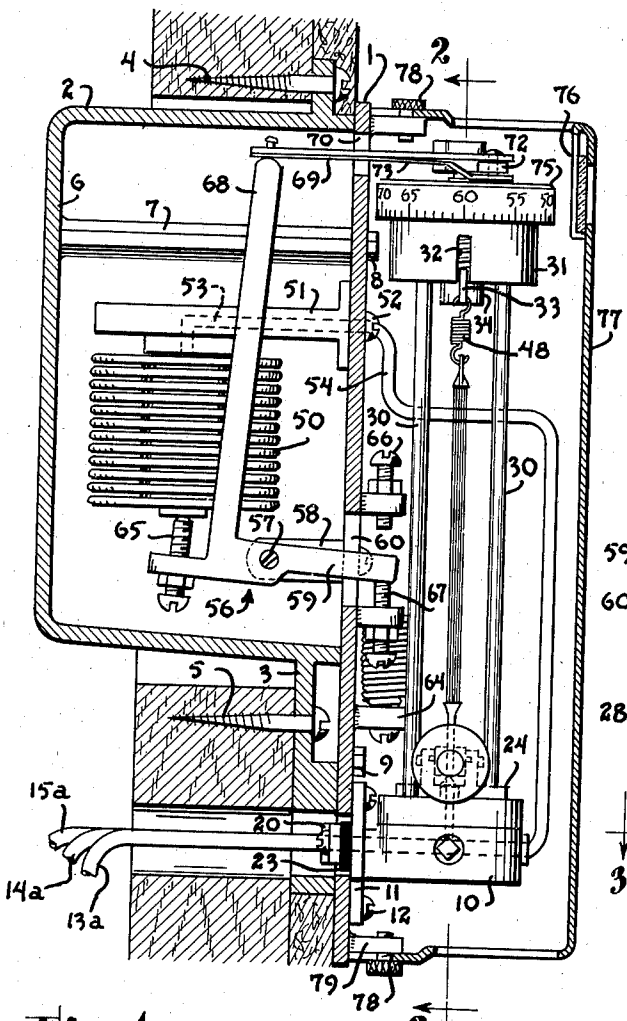


Fig. 1

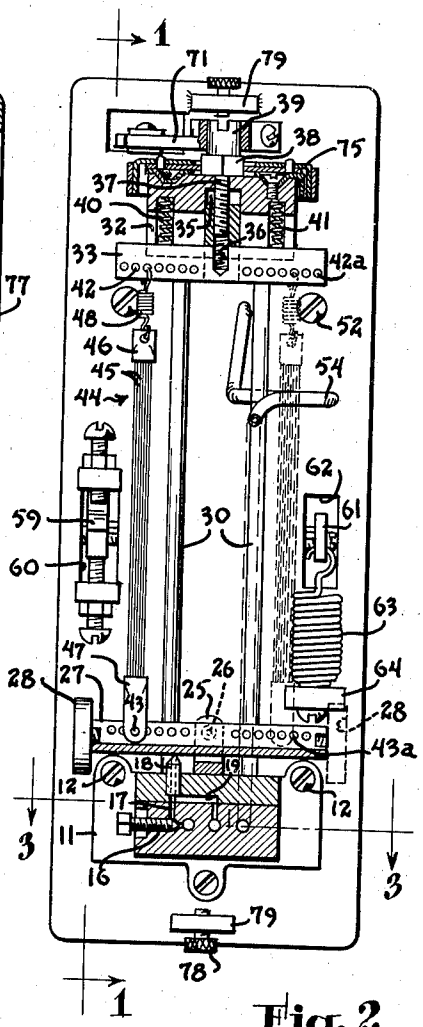


Fig. 2

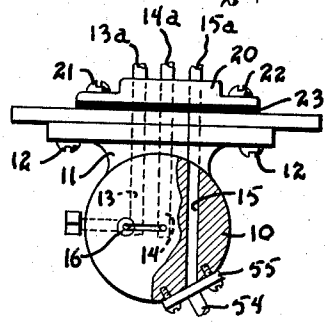


Fig. 3

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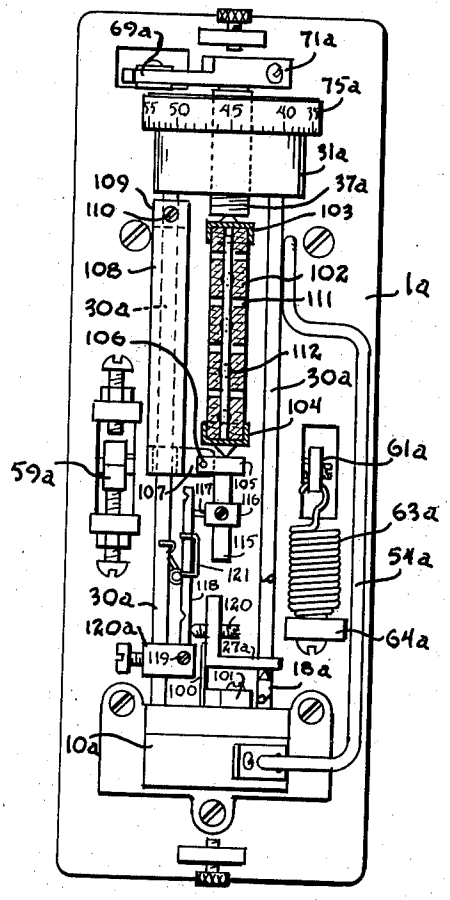


Fig. 4

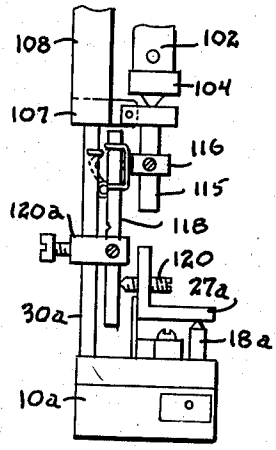


Fig. 5

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2,203,535

HUMIDITY CONTROLLER

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Application December 8, 1937, Serial No. 178,765

8 Claims. (Cl. 236—44)

This invention relates in general to automatic controllers and is more particularly concerned with controllers which are adapted to be adjusted from a remote point, and with controllers for maintaining desired humidity conditions.

It is an object of my invention to provide a simple and compact type of humidity controller which is adapted to be enclosed by a cover of attractive design, and which is accurate and dependable in operation.

It is a further object of my invention to provide a device of this character which is capable of being adjusted from a remote point, this device including an adjusting motor which is arranged in a manner not affecting the outward appearance of the instrument.

Another object of my invention is the provision of a humidity controller having relatively few operating parts in which the range or sensitivity of the instrument may be readily adjusted to best suit the particular type of installation to which the controller is applied.

A still further object of my invention is the provision of a controller of this general type in which the parts may be selectively assembled to provide either a direct acting or reversed acting instrument.

Other objects lie in the various novel details of construction and mode of operation of my improved controller and will become apparent from the following description and the appended claims.

For a full disclosure of my invention, reference is made to the following detailed description and to the accompanying drawings, in which

Figure 1 is a side elevation partly in section of one form of my improved humidity controller, this figure showing the manner of mounting the controller on a wall.

Figure 2 is a front elevation partly in section taken on line 2—2 of Figure 1.

Figure 3 is a section taken on line 3—3 of Figure 2.

Figure 4 is a view similar to Figure 2 but showing a modified form of humidity responsive element and valve actuating mechanism.

Figure 5 is a fragmentary view of a modification of Figure 4.

Referring to Figures 1, 2 and 3, reference character 1 indicates a base plate for the humidity controller, this base plate being adapted for mounting upon a wall box 2, which wall box is adapted to be inserted in an opening in the wall behind the controller. The wall box 2 is provided with a depending extension 3, and the box is secured to the wall by means of screws 4 and 5. The rear wall 6 of the wall box is provided with an outward extension 7 which leads to a point flush with the face of the box. The base plate of the controller is secured to the wall box by means of a screw 8 which is threaded into the extension 7 and by means of a screw 9 which is threaded into the extension 3.

Mounted upon the lower portion of the base plate 1 is a lower base member 10, this base member being cylindrical in shape and formed with an integral bracket 11 which is secured to the base plate by means of screws 12. This base member is drilled out to provide air passages 13, 14 and 15 (Figure 3). The air passage 13 leads horizontally through the base member to a restriction 16. The outlet side of this restriction communicates by means of a passage 17 with a bleed port member 18 which is mounted upon the upper face of the base member 10. The passage 17 is in turn connected by a cross passage 19 to the passage 14. The air passages 13, 14 and 15 are adapted for connection to pipes 13*a*, 14*a* and 15*a* respectively, these pipes being connected to a connecting member 20 which is secured to the back of the bracket 11, this connecting member having air passages therein which coincide with the air passages 13, 14 and 15 in base member 10. The connecting member 20 is attached to the bracket by means of screws 21 and 22, a gasket 23 of rubber or other suitable material being provided for making an air-tight connection.

Mounted upon the upper face of the base member 10 is a bracket or standard 24, this bracket having upward extensions 25 which are perforated in alignment to receive a pin 26 which forms a fulcrum for a lever 27. The lever 27 is arranged to cooperate with the bleed port member 18 to form a control valve. This member or valve is provided with a removable weight 28 which biases this member towards engagement with bleed port member 18.

The pipe 13*a* is an air supply pipe for the instrument and supplies air at constant pressure to the restriction 16 which meters the flow of air to the bleed port member 18. The pipe 18 leads from the instrument to a control valve such, for instance, as a water valve if the instrument is applied to a humidifying system or to a refrigerant valve or dampers if the instrument is applied to a cooling system. It will be apparent that the pressure in the pipe or branch line 14*a* will vary in accordance with the position of the valve member 27 relative to the bleed port member 18. Thus, as the member 27 approaches the

bleed port the flow through this port will be restricted thereby increasing the pressure in the branch line 14a. When the valve member 27 is moved away from the bleed port, however, the pressure within the pipe 14a will be reduced.

Mounted upon the upper surface of the base member 10 are vertical posts 30 which support an upper base member 31. The upper base member 31 may be cylindrical in shape and is provided with a transverse slot 32 into which fits a movable transverse support member 33. This transverse support member 33 is provided with an upwardly extending collar 34, this collar being received in an opening 35 in the upper base member 31. This opening 35 acts as a guide for the collar 34 in guiding vertical movements of the support member 33 in the slot 32. The collar 34 is also provided with a threaded opening 36 for receiving an adjusting screw 37, this adjusting screw extending through an opening at the upper face of the base member 31 and having a head, this head consisting of a lower rectangular portion 38 and an upper cylindrical portion 39. The transverse opening 32 in member 31 is enlarged to receive springs 40 and 41 which urge the support member downwardly to a point determined by the position of the adjusting screw 37. It will be apparent that rotation of the adjusting screw 37 will raise or lower the support member 33 and that the slot 32 and opening 35 will guide the support member for maintaining this member in a fixed plane.

The support member 33 is provided with a series of horizontally spaced holes 42 and the valve member 27 is likewise provided with a series of horizontally spaced holes 43. These holes provide for the mounting of a moisture responsive device between the support member 33 and the valve member 27. This moisture responsive device is shown at 44 and preferably is formed of a plurality of strands 45 of hair or other moisture responsive material, these strands being secured together at their upper and lower ends by means of clamping members 46 and 47. The upper clamping member 46 is attached to a strain release connection which may take the form of a spring 48 which is in turn inserted in one of the holes 42 of the support member 33. The lower clamping member 47 is arranged for attachment to the lever arm 27 and may be secured thereto by means of a pin which extends through one of the holes 43. By this arrangement, the lever arm or valve 27 will be actuated in accordance with changes in relative humidity. When the relative humidity increases, the strands 45 will increase in length, thereby permitting the weight 28 to urge the valve member 27 towards the bleed port member 18. When the relative humidity decreases, however, the strands 45 will shrink, thereby raising the left-hand end of the valve member 27 for urging this valve member away from the bleed port member 18. This arrangement will therefore act to graduatingly vary the pressure in the pipe 14a which leads from the controller to a device to be controlled, in accordance with changes in relative humidity within the space in which the humidity controller is located.

By connecting the humidity responsive element 44 to various of the holes in the valve member 27, the movement of the valve member for a given change in relative humidity may be varied. For instance, if the humidity responsive device 44 is connected to the valve member 27 at the hole 43 nearest the fulcrum 26, the angular movement of the valve member for a given change in length of the strands 45 will be greater than if the device 44 is connected to one of the holes 43 more remote from the fulcrum 26. This therefore provides for readily adjusting the sensitivity or operating range of the instrument. Due to the plurality of holes 42 in the support member 43, the device 44 may be maintained in vertical position no matter in which hole of the lever 27 the clamping member 47 is attached.

It will be noted that the right-hand ends of the lever 27 and the support member 33 are provided with a set of holes 43a and 42a respectively. This provides for assembly of the instrument to act in a reverse manner. It will be apparent that if the device 44 is relocated as shown in dotted lines, the effect on the lever 27 will be in the opposite direction to that which occurs in the arrangement shown in full lines. In other words, with the humidity responsive device 44 connected to the right-hand side of the lever arm, the lever arm 27 will be caused to approach the bleed port member 18 when the humidity decreases. With the controller arranged in this manner, an increase in relative humidity will allow the right-hand end of the lever 27 to be lowered by the action of the weight 28 which then would be attached to the right-hand end of the lever 27 as shown in dotted lines. This would cause the lever 27 to be shifted away from the bleed port member 18 upon a rise in relative humidity. The arrangement just described, it will be seen, provides for readily assembling the instrument to provide either direct or reverse action, and for readily assembling the instrument to obtain any desired range or sensitivity.

It will be apparent that rotation of the adjusting screw 37 will raise or lower the support member 33 and this will have the effect of changing the position of the lever 27 relative to the bleed port member 18. Rotation of the adjusting screw 37 therefore changes the control point of the instrument. The adjusting screw 37 may if desired be manually actuated, and in the present embodiment of the invention is arranged for actuation from a point remote to the instrument. Referring now to this adjusting arrangement, reference character 50 indicates an expansible and contractible diaphragm located within the wall box 2. This diaphragm 50 is mounted upon a bracket 51 which is secured to the rear of the base plate 1 by means of screws 52. The bracket 52 is formed to provide an air passage 53 therein, this air passage leading from the diaphragm 50 into a tube 54, this tube leading downwardly to the lower base member 10, and is secured to said base member 10 by a connecting member 55, this connecting member connecting the tube 54 into communication with the air passage 15 which in turn is connected to the pipe 15a. The pipe 15a may lead from a master controller such as a thermostat, or may lead from a control valve on a panel board. It will be apparent that by supplying varying pressures to the pipe 15a, the pressure within the bellows 50 will be varied and consequently the bellows 50 will be caused to expand or contract.

Reference character 56 indicates a bell crank lever which is pivoted at 57 to a bracket 58 mounted upon the base plate 1. The bell crank lever 56 is formed as a yoke and is provided with a lever arm 59 which extends through an opening 60 in the base plate 1 at the left-hand side of the instrument as shown in Figure 2. Also a parallel arm 61 of the lever 56 extends through an opening 62 at the right-hand side of the base

plate 1. This arm 61 is attached to a spring 63, the lower end of which is secured to a bracket 64 formed integrally with the base plate 1. This spring, it will be seen, urges the bell crank lever 56 to rotate in a clockwise direction, thereby tending to collapse the diaphragm 50, the diaphragm 50 being contacted by an adjusting screw 65 which is mounted in a portion of the lever 56. The lever arm 59 of the bell crank acts to limit the rocking movement of the bell crank under the action of the bellows 50 and the spring 53. This arm 59, it will be noted, is limited in motion by means of stop screws 66 and 67 which are mounted in lugs formed integrally with the base plate 1.

The bell crank lever 56 is provided with an upwardly extending lever arm 68, the upper end of this lever arm being attached to a link 69 which extends through an opening 70 in the base plate member 1 to a lever arm 71 which is attached to the portion 39 of the adjusting screw. The link 69 is attached to the lever arm 71 by means of a pin 72 and is held in place by means of a spring member 73. It will be apparent that expansion and contraction movements of the diaphragm 50 will cause rotation of the adjusting screw 37. Thus, when the pressure within the diaphragm 50 is increased, this diaphragm will expand, which urges the bell crank lever 56 in a counter-clockwise direction which in turn causes rotation of the lever 71 and adjusting screw towards the left as viewed in Figure 2. When the pressure within diaphragm 50 is decreased, this diaphragm will contract and will cause rotation of the adjusting screw 37 in the opposite direction. This arrangement, therefore, provides for adjusting the control point of the instrument either automatically or manually from a remote point. If desired, a drum-shaped dial 75 may be mounted upon the upper base member 31, this dial being arranged so as to be rotated with the adjusting screw 37. This dial may be graduated to indicate relative humidity, and this indication will appear through a window 76 in the instrument cover 77. By this arrangement, whenever the adjustment of the instrument is varied, the dial 75 will be rotated to indicate the new adjustment. The instrument cover 77 may be formed to surround the instrument and is secured to the base plate 1 by means of screws 78 which engage brackets 79 formed integrally with the base plate 1.

Referring to Figure 4, this figure shows a modified form of humidity responsive element and sensitivity adjusting means. In this figure, the lower base member 10*a* is mounted upon the base plate 1*a* and may be formed similarly to the lower base member 10 of Figure 1, this member having mounted thereon a bleed port member 18*a* which cooperates with a valve member 27*a* forming a part of a bell crank lever which is pivoted on a spring 100, this spring being secured to a block 101 which in turn is secured to the upper face of the base member 10*a*. Leading upwardly from the upper face of member 10*a* are supporting rods or posts 30*a* which support an upper base member 31*a*. This member may be formed of the same general configuration as the base member 31 of Figure 1 and is provided with a threaded opening which receives an adjusting screw 37*a*, this adjusting screw extending upwardly through the base member and is attached to a lever arm 71*a* which connects this adjusting screw to the pressure operated diaphragm located behind the base plate 1*a*.

The adjusting screw 37*a* is arranged to receive the upper end of a humidity responsive element generally indicated as 102. This element may be formed of a block of wood which is cut so as to allow the grain to be exposed to the surrounding air. This block is provided with an upper cap 103 which engages the adjusting screw 37*a*, and with a lower cap 104 which engages a lever arm 105, which lever arm is pivoted at 106 to a block 107 which is formed as a collar loosely surrounding the post 30*a*. This block 107 is held in vertical position by means of a pair of strips 108 which extend upwardly on each side of the post 30*a* to a collar 109 which is secured to the post 30*a* by means of a set screw 110. The block 102 if desired may be drilled out as shown at 111 to provide for access of air to the interior thereof for increasing the surface which is exposed to the surrounding air. If desired, this block may be stiffened to prevent warping by means of a metallic rod 112 which is inserted longitudinally thereinto.

It will be noted that the strips 108 are of substantially the same length as the humidity responsive element 102 and extend parallel to this element. The purpose of this arrangement is to overcome or compensate for the effect of change in temperature upon the instrument. It will be apparent that upon change in temperature the posts 30*a* will expand or contract, and this would cause movement of the lever arm 105 about its pivot even though the relative humidity had not changed. By the arrangement described, however, the block 107 floats upon the post 30*a* and hence does not shift in position relative to the adjusting screw 37 upon expansion or contraction of the posts 30*a*. The strips 108 may be formed of any desirable material having the desired thermal coefficient of expansion, thus obviating the necessity of forming the entire instrument of a material having the necessary thermal coefficient of expansion.

To the lever arm 105 is attached a depending rod 115, this rod being adapted to support a slider 116. The slider 116 in turn has a projection 117 which engages a lever arm 118. The lever arm 118 is pivoted at 119 to a block 120*a* which is mounted upon the post 30*a*. This lever arm is also provided with a spring 121 which is inserted between the post 30*a* and the lever arm for urging this lever arm into engagement with the projection 117 of the collar 116. This in turn urges the lever arm 105 upwardly and maintains the moisture responsive element 102 in position. The lever arm 118 engages an abutment screw 120 which is mounted upon the valve member 27*a*. The spring 100 which supports this valve member 27*a* is arranged to bias this valve member away from the bleed port member 18*a*, thereby tending to cause free flow of air through said bleed port member. When the relative humidity increases, the block 102 will increase in length this causing clockwise rotation of the lever arm 105, this moving the collar 116 to the left. This will shift the lever 118 in a counter-clockwise direction, thereby allowing the valve member 27*a* to be lifted off of bleed port member 18*a* by the action of spring 100. Upon a decrease in relative humidity, the block 102 will shrink, thereby permitting movement of the parts in the opposite direction under the action of the spring 121, this acting to reduce the rate of bleed through port member 18*a*. It will be noted that the lever 118 is provided with a number of notches in which the spring 121 may be mounted. This

provides for ready adjustment of the spring tension which urges the valve member 27a towards the bleed port 18a and for retaining the moisture responsive element 102 in position.

The collar 116 may be shifted along the lever or stem 115. This provides for adjustment of the sensitivity or range of the instrument. If the collar 116 is located at the uppermost point on stem 115, the angular movement of the lever 118 for a given angular movement of the lever 115 will be less than if the collar 116 were placed further down the stem 115. Thus, by moving the collar 116 upwardly, the sensitivity of the instrument may be decreased while by moving the collar 116 downwardly the sensitivity may be increased.

If it is desired to reverse the action of the controller shown in Figure 4, this may be done in the manner illustrated in Figure 5. In this figure, it will be noted, the lever arm 118 instead of being pivoted to the block 120a at its lower end, is pivoted to this block at a point between the collar 116 and the abutment screw 120 of the valve member 27a. By this arrangement, it will be noted that the valve member 27a will be moved oppositely to the manner in which it is moved in Figure 4. The instrument shown in Figures 4 and 5 may therefore be readily assembled in a manner to provide either a direct acting or reverse acting instrument.

From the foregoing it will be seen that my invention provides a humidity controlling device which is simple and compact in construction and which may be readily adjusted in sensitivity to suit the conditions to which the instrument is applied, and which may be adjusted in control point from a point remote of the instrument. Also it will be apparent that my improved forms of controllers are adapted to be selectively assembled for providing either a direct or reverse acting instrument. While I have disclosed two preferred forms of my invention, it is obvious that many modifications which are within the scope of my invention will occur to those skilled in the art. I therefore desire to be limited only by the scope of the appended claims as construed in the light of the prior art.

I claim as my invention:

1. In a humidity controller, in combination, a first base member, control valve means mounted on said first base member, a second base member, means for fixedly mounting said first base member in spaced relationship with said second base member, an adjusting screw in said second base member, means actuated by said adjusting screw for receiving a portion of a humidity responsive element, a lever arm, said lever arm controlling said control valve means, connecting means between another portion of said humidity responsive element and said lever arm for actuating said lever arm in accordance with changes in relative humidity, said connecting means including means for varying the ratio of movement and reversing the movement of said lever arm with respect to movement of said other portion of the humidity responsive element.

2. In a humidity controller, in combination, a first base member, control valve means mounted on said first base member, a second base member, means for fixedly mounting said first base member in spaced relationship with said second base member, an adjusting screw in said second base member, means actuated by said adjusting screw for receiving a portion of a humidity responsive element, a lever arm fixedly fulcrumed with respect to said first base member, said lever arm controlling said control valve means, connecting means between another portion of said humidity responsive element and said lever arm for actuating said lever arm in accordance with changes in relative humidity, said connecting means including means for reversing the direction of movement of said lever arm with respect to movement of said other portion of the humidity responsive element to permit selective assembly of the controller as a direct acting controller or a reverse acting controller with substantially the same parts.

3. In a humidity controller, in combination, a base plate adapted for mounting on a wall or other surface, a first base member mounted upon one side of said base plate, said first base member carrying a control valve means, a second base member, means for fixedly mounting said second base member in spaced relationship with said first base member, an adjusting screw in said second base member, an adjusting screw lever arm carried by said adjusting screw for rotating said adjusting screw, means actuated by said adjusting screw for receiving a portion of a humidity responsive element, a lever arm fixedly fulcrumed with respect to said first base member, said last mentioned lever arm controlling said control valve means, connecting means between another portion of said humidity responsive element and said lever arm for actuating said lever arm in accordance with changes in relative humidity, said connecting means including means for varying the ratio of movement of said lever arm with respect to movement of said other portion of the humidity responsive element, a pressure operated motor mounted upon the other side of said base plate and adapted to be received in an opening in the wall behind the base plate, and actuating means extending from said motor through said base plate to the adjusting screw lever arm for positioning said adjusting screw.

4. In a humidity controller, in combination, a first base member, control valve means mounted on said first base member, a second base member, means for fixedly mounting said first base member in spaced relationship with said second base member, an adjusting screw in said second base member, a support member actuated by said adjusting screw, a lever arm, said lever arm controlling said control valve means, said lever arm also having a portion thereof parallel to a portion of said support member, a humidity responsive element extending between the parallel portions of said support member and said lever arm for adjusting said control valve in accordance with humidity, and adjustable mounting means for said humidity responsive element on said lever arm and said support member for varying the sensitivity of the controller.

5. In a controller of the class described, in combination, a support member, a lever arm having a portion substantially parallel to a portion of said support member, said lever arm being arranged to actuate a control device, a condition responsive device extending between the parallel portions of said support member and said lever arm for actuating said lever arm in accordance with changes in value of the condition to which said condition responsive device responds, and means for shifting said condition responsive device along said support member and said lever arm for adjusting the sensitivity of the controller.

6. In a controller of the class described, in combination, a support member, a lever arm having a portion substantially parallel to a portion of said support member, said lever arm being arranged to actuate a control device, a condition responsive device extending between the parallel portions of said support member and said lever arm for actuating said lever arm in accordance with changes in value of the condition to which said condition responsive device responds, means for shifting said condition responsive device along said support member and said lever arm for adjusting the sensitivity of the controller, and means for varying the position of said support member for adjusting the control point of the controller.

7. In a humidity controller, in combination, a humidity responsive element adapted to change its dimensions upon change in humidity, means for mounting one portion of said element in a manner permitting movement of another portion of said element, a control device, connecting means between the movable portion of said element and said control device for causing actuation of said control device upon change in humidity, said connecting means including a lever having a pivot, said lever cooperating with said control device, and means for selectively actuating said lever by said humidity responsive element on either side of said pivot for thereby permitting selective assembly of the controller as a direct acting controller or as a reverse acting controller with substantially the same parts.

8. In a humidity controller, in combination, a humidity responsive element adapted to change its dimensions upon change in humidity, means for mounting one portion of said element in a manner permitting movement of another portion of said element, a control device, connecting means between the movable portion of said element and said control device, said connecting means including a first lever having a pivot and actuated by said element, a second lever having a pivot and actuating said control device, abutment means between said levers for causing movement of the first lever to be transmitted to the second lever, and means for selectively locating said abutment member on either side of the pivot of one of said levers for thereby permitting selective assembly of the controller as a direct acting controller or as a reverse acting controller with substantially the same parts.

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