May 23, 1972 R. L. MARTIN 3,664,580

CHANGEOVER APPARATUS FOR A CONDITION RESPONSIVE DEVICE

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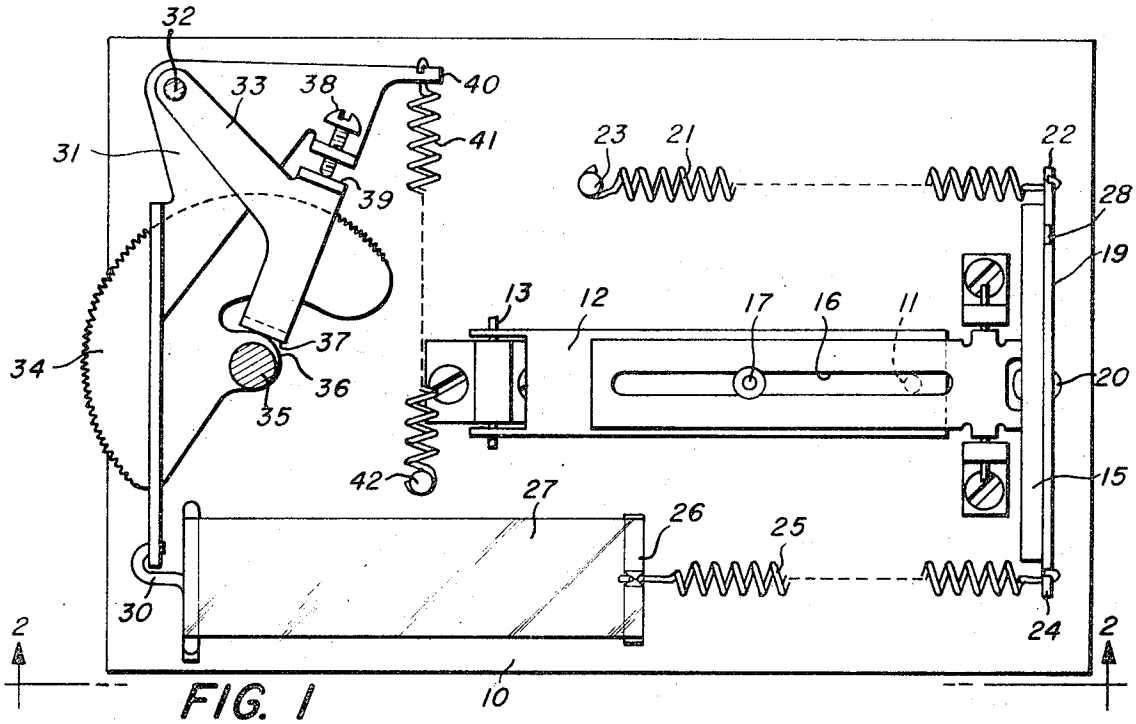


FIG. 1

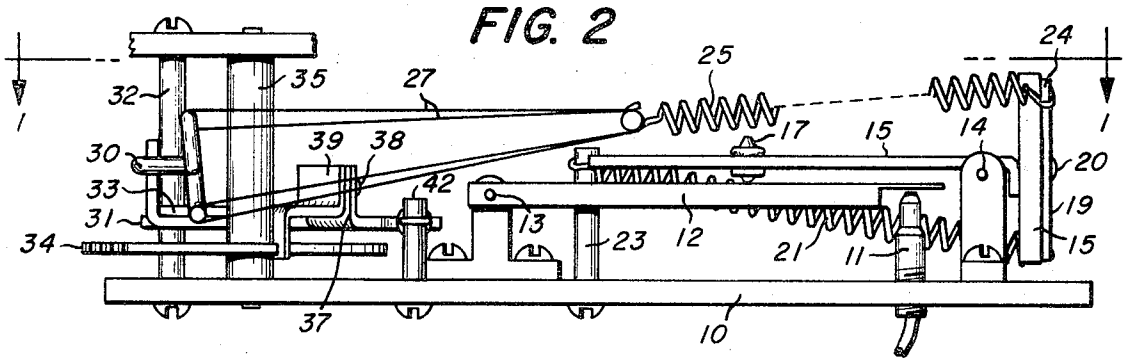
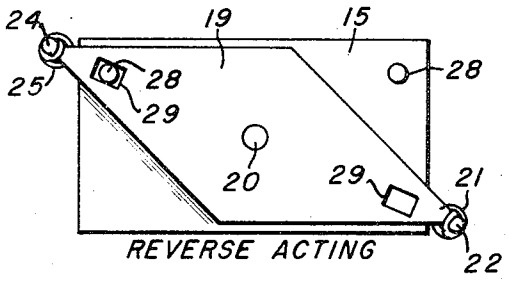
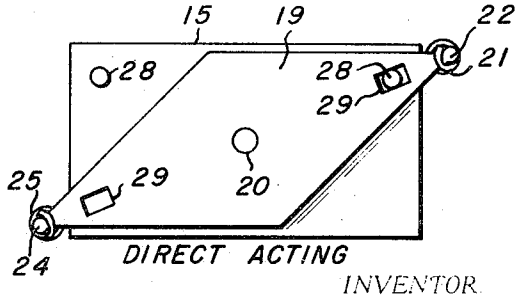


FIG. 2



REVERSE ACTING

FIG. 3



DIRECT ACTING

FIG. 4

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CHANGEOVER APPARATUS FOR A CONDITION RESPONSIVE DEVICE

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ABSTRACT OF THE DISCLOSURE

Apparatus for a pneumatic condition responsive device for facilitating the changeover from direct acting control to reverse acting control. A first biasing means including a condition responsive element and a second biasing means are connected to a rotatable member which is connected to a member pivotable about an axis to urge a flapper to variably restrict flow through a nozzle. Rotating the rotatable member from a first pre-selected position to a second pre-selected position causes a reversal of moments about the pivot means established by the first and second biasing means and thereby changes the condition responsive device from, for example, direct acting to reverse acting.

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to a condition responsive control device and more particularly to a novel mechanism for converting such a device from direct acting to reverse acting control.

In a direct acting pneumatic condition control, for instance, an increase or decrease in the condition, such as an increase or decrease in relative humidity or temperature, results in a corresponding increase or decrease in the output or branch line pressure. In a reverse acting device, an increase or decrease in the condition results in a decrease or increase in the branch line pressure. The type of control to be used, direct acting or reverse acting, depends upon the system used. It is obviously expensive to manufacture two distinct devices, one direct acting and one reverse acting. Hence it is desirable to incorporate some mechanism in the device for converting the device from direct acting to reverse acting or from reverse acting to direct acting. Prior art mechanisms have provided this changeover capability but have also required recalibration after such a changeover is made.

Accordingly, it is a principal purpose of this invention to provide a condition responsive device capable of being converted from direct acting to reverse acting or from reverse acting to direct acting by a simple adjustment without need for recalibration. The provision of such a device allows one to ascertain the user's needs at the time and place of installation so that the device may be easily converted to the proper form of control. Costly recalibration procedures are accordingly eliminated.

In the subject invention a condition responsive element, working through a first spring, and opposed by a second biasing spring are connected to a rotatable member which is connected to a member pivotable about a pivot or axis means. The points of connection between the element and the rotatable member and between the second biasing spring and the rotatable member are so located as to establish opposing moments about the pivot means. The pivotable member acting through a proportional band adjustment, in the event of a pneumatic controller, is arranged to cause a flapper

to variably restrict a nozzle. By moving the rotatable member from a first pre-selected position to a second pre-selected position, the directions of the moments about the pivot means are reversed whereby the device is changed from direct acting to reverse acting or from reverse acting to direct acting.

The novel changeover apparatus disclosed herein is, of course, equally suitable for use in other devices wherein either direct acting or reverse acting control may be required. Such devices include temperature and pressure controllers in addition to humidity controllers and remote sensors.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a humidistat incorporating the subject invention.

FIG. 2 is a view along section 2—2 of FIG. 1.

FIG. 3 is a view of the rotatable member shown in FIGS. 1 and 2 when the member is adjusted for reverse acting control.

FIG. 4 is a view of the rotatable member illustrated in FIGS. 1 and 2 when adjusted to provide direct acting control.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. 2 extending through a base **10** is a nozzle **11** adapted to be connected to a suitable pneumatic control line. A flapper member **12** is pivoted at hinge **13** and is arranged to control flow through nozzle **11**. Pivoted at a hinge **14** is a pivoted member **15** having a longitudinal groove **16** formed therein. Adjustable along groove **16** is a thrust member or pin **17** arranged to provide a proportional band or throttling range adjustment for the humidistat. As member **15** pivots about axis **14**, the pin **17** biases the flapper **12** to variably restrict flow through the nozzle **11**.

As shown in FIG. 1, a rotatable member **19** is pivotally connected to member **15** by means of a loosely fitted rivet or the like **20**. The rivet **20** also serves as a pivot means or point for the member **19**. One end of the biasing spring **21** is connected at **22** to the member **19** and is retained at the other end by a pin or shaft **23** connected to the base **10** at a height above base **10** corresponding to that of axis **14**. Connected at **24** to member **19** is spring **25** which is in turn connected at **26** to a humidity responsive element **27**. The need for the biasing spring **21** arises because the humidity responsive element **27** can exert tension forces only. The biasing spring **21** accordingly provides the force necessary to move the flapper against the tension forces of the humidity responsive element.

As can be appreciated in FIG. 2, the biasing spring **21** and the humidity responsive element **27** acting through the spring **25** establish opposing moments about the pivoted axis or hinge **14**. The spring **25** and element **27**, hereinafter referred to as the first biasing means, tend to establish a counter-clockwise moment about the axis **14**. The second biasing means **21** tends to establish a clockwise moment about the pivot means **14** when in the position illustrated in FIG. 2. The directions of these moments may be reversed by simply rotating the rotatable member or adjustment means **19** from a first pre-selected position, illustrated in FIG. 3, to a second pre-selected position illustrated in FIG. 4. When the member **19** is in the position illustrated in FIG. 4, the first biasing means establishes a clockwise moment about the pivot means **14** whereas the second biasing means **21** establishes a counter-clockwise moment about the pivot means **14**. When the rotatable member **19** is in the first pre-selected position, which corresponds to reverse acting control, a contraction of the humidity responsive element **27** results in the flapper

12 being urged towards the nozzle. When the rotatable member 19 is in the second pre-selected position, which corresponds to direct acting control, a similar contraction of the humidity responsive element 27 results in the flapper 12 being permitted to move away from the nozzle 11 due to the air pressure from the nozzle acting against the flapper. As shown in FIGS. 3 and 4, projections 28 provided on the member 15 and cooperating slots 29 in member 19 cooperate to insure definite and accurate positioning of the rotatable member when changing from reverse to direct or from direct to reverse acting control, the ends of member 19 being movably deflected to switch from one position to the other.

The humidity responsive element 27 is connected by means of a hook 30 to an element anchor lever 31 at a height above base 10 corresponding to that of axis 14. Note that while it is not essential, it is desirable that the points of connection between the second biasing means 21 and the shaft 23, and between the first biasing means, 25, 27, and 30 and the element anchor lever 31, as well as the first and second pivot means 14 and 20, all be in the same plane. This is in order that similar force relationships be obtained whether the adjustment means 19 is in the first or the second preselected position. The element anchor lever is pivotable about a shaft 32 which is secured to base 10. Also pivoted on the shaft 32 is a second lever 33 having a cam follower 37 on one end thereof. The cam follower 37 follows a cam face 36 which is formed on a knurled set point adjusting means 34 which is pivotable about shaft 35. Calibration means for the humidistat is provided by a screw 38 threaded through a flange on element anchor lever 31 and abutting a similar flange 39 on lever 33. Adjustment of the screw controls the arc between the two levers.

During reverse action a decrease in relative humidity causes the element, acting through the spring 25, the adjustment means 19, and the pivoted member 15, to urge the flapper against the nozzle. Under extreme conditions, this may result in the overstressing of the element. To avoid such overstress, a strain relief spring 41 is included in the set point and calibration mechanism. The spring 41 is fastened to a post 42 and is connected at 40 to the element anchor lever 31. This strain relief spring allows the lever 33 to follow the cam face 36 so long as the force exerted by the humidity responsive element does not exceed the stress limit of the element. An excessive force exerted by the element relieves itself by pulling the calibration screw 38 away from the face 39 by extending the strain relief spring 41. Obviously, other forms of strain release may be used such as a careful proportioning of spring 25.

The embodiments of the invention in which an exclusive property or right is claimed are defined as follows:

1. In a pneumatic condition responsive device having means responsive to a change in the condition to variably restrict a nozzle, means to selectively establish the operation of the device as either direct acting or reverse acting, comprising:

base means;

first pivot means associated with the base means;

an elongated member for causing the nozzle to be variably restricted, the elongated member being connected to and pivotable about the first pivot means;

second pivot means associated with one end of the elongated member;

a member rotatable between first and second pre-selected positions about the second pivot means in a plane substantially perpendicular to the elongated member;

first biasing means including means responsive to a change in the condition connected between connection means and the rotatable member, the first biasing means establishing a moment about the first pivot means in a first direction;

second biasing means connected between the base means and the rotatable member, the second biasing means establishing a moment about the first pivot means in a second direction;

the points of connection between the first biasing means and the rotatable member and between the second biasing means and the rotatable member arranged so that rotation of the rotatable member between its first and second pre-selected positions affects a reversal of the moments established about the first pivot means by the first and second biasing means, whereby the operation of the device is changed between direct acting and reverse acting.

2. The invention according to claim 1, wherein the first biasing means including means responsive to a change in the condition establishes a moment about the first pivot means in a first direction when the rotatable member is in the first pre-selected position, and establishes a moment about the first pivot means in a second direction when the rotatable member is in the second pre-selected position, whereby a change in the condition in a given direction results in the elongated member increasingly causing restriction of the nozzle when the rotatable member is in the first pre-selected position and a change in the condition in the same given direction results in the elongated member decreasingly causing restriction of the nozzle when the rotatable member is in the second pre-selected position.

3. The invention according to claim 2 additionally comprising adjustable set point means including connection means, the first biasing means being connected to the connection means.

4. The invention according to claim 3 wherein the adjustable set point means includes adjustable calibration means.

5. The invention according to claim 4 additionally comprising strain relief means connected to the first biasing means to preclude overstressing the condition responsive means.

6. The invention according to claim 2 additionally comprising:

third pivot means;

flapper means pivotable about the third pivot means;

the elongated member arranged in an operable relation with the flapper means to cause the flapper means to variably restrict flow through the nozzle means in response to a change in the condition to thereby control the condition.

7. The invention according to claim 6 wherein the elongated member includes means to selectively vary the proportional band of the control of the condition.

8. The invention according to claim 2 wherein the first means, the point of connection between the first biasing means and the connection means, and the point of connection between the second biasing means and the base means are all in substantially the same plane.

9. The invention according to claim 8 wherein the condition is humidity and the condition responsive means is humidity responsive, the rotatable member being rotatable from the first pre-selected position to the second pre-selected position to the second pre-selected position to change the control of the humidity from direct acting to reverse acting.

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