

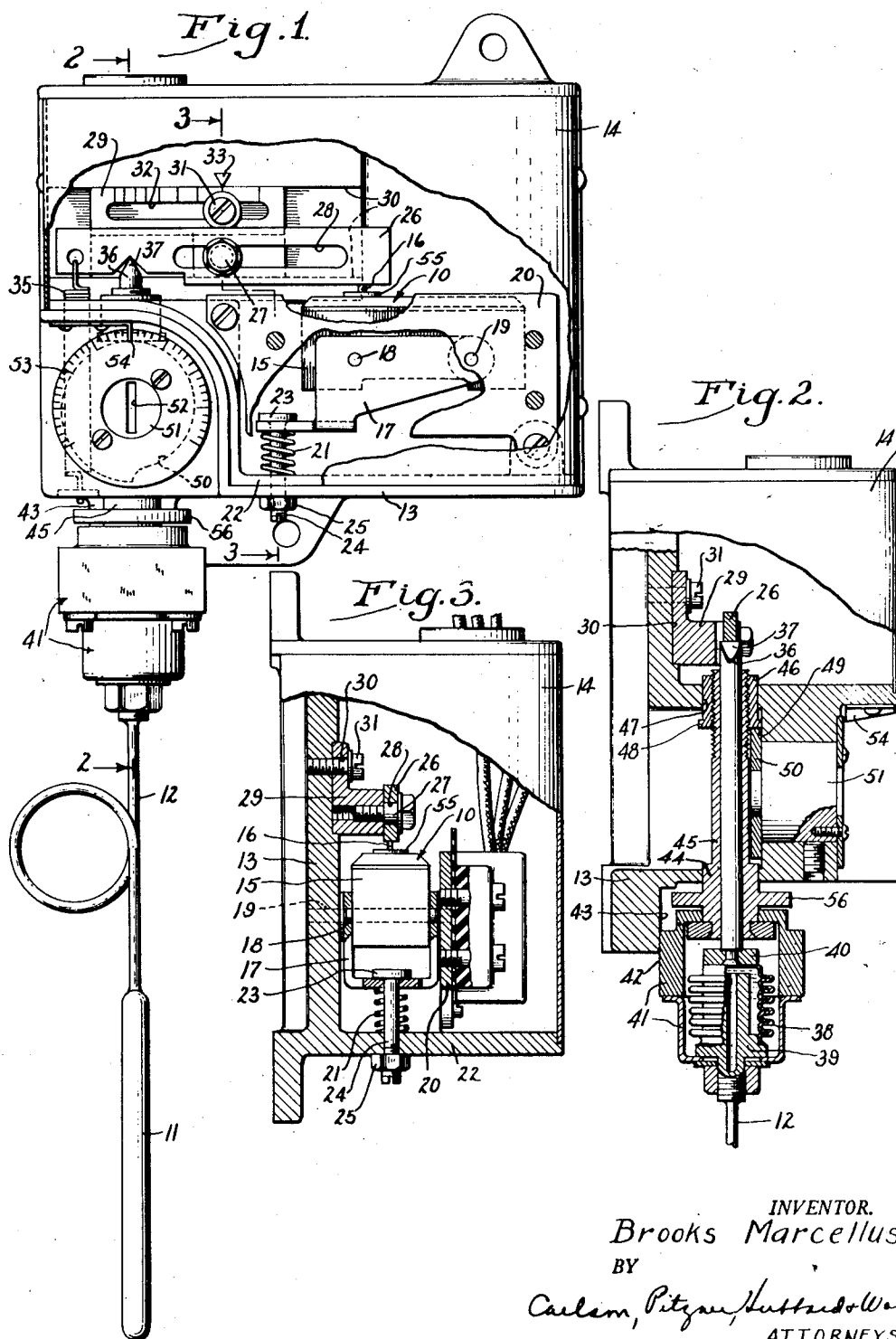
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CONDITION RESPONSIVE INSTRUMENT

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CONDITION RESPONSIVE INSTRUMENT

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This invention relates generally to condition responsive instruments such as thermostats, hydrostats, pressurestats, etc., and more particularly to those in which a snap acting control device such as a precision switch is actuated by an element such as a bellows which expands and contracts in response to opposite condition changes.

The general object is to provide a novel instrument of the above character which is simple and inexpensive in construction, which is convenient to calibrate initially and adjust in service both as to the instrument control point and the differential thereof, and which is unaffected by wide variations in ambient condition changes.

Another object is to provide for adjustment of the instrument differential in a novel manner without changing the calibration of the instrument.

A further object is to provide a mechanism of simple and compact construction for transmitting the motions resulting from condition changes to the instrument control device while providing for adjustment of the motion transmitting connection to calibrate the instrument initially and also to vary the control point thereof.

The invention also resides in the novel character of the structures employed for carrying out the foregoing objects.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a front elevational view of an instrument embodying the novel features of the present invention, the casing and certain other parts being broken away to show the operating parts.

Figs. 2 and 3 are sections taken respectively along the lines 2—2 and 3—3 of Fig. 1.

In the drawings, the invention is shown for purposes of illustration embodied in a thermostat for actuating a self-contained precision snap switch 10 in response to temperature changes of a bulb 11 containing the usual expansible fluid and connected through a capillary tube 12 to a support 13 on which the operating parts of the instrument are mounted and housed within a casing 14 thereon. Herein, the switch 10 is of a well known type as disclosed in Patent No. 1,960,020 having contacts mounted within a rigid insulated housing 15 and movable into and out of engagement with each other in response to minute endwise movements in opposite directions of a plunger 16 projecting from the top of the housing adjacent one end thereof.

Normally, the switch housing remains in a fixed

position on the support 13 but is yieldable relative thereto in response to abnormal temperature changes. To provide such a mounting, the switch housing is disposed within a yoke 17 and connected thereto by a cross pin 18 extending through the yoke arms and a hole in the base of the switch housing. A second cross pin 19 extends through the switch housing and the yoke arms with opposite ends of the pin projecting into the support 13 and a terminal plate 20 rigid therewith.

The yoke is thus pivoted on the support 13 to swing about the pin 19 and is urged upwardly relative to the support by a spring 21 acting in compression between the yoke and a flange 22 which forms the bottom of the thermostat casing and supports the terminal plate 20. Movement of the switch by the spring is limited by a stop 23 engageable with the yoke 17 and forming the head of a screw 24 projecting through the flange 22 and held by a nut 25. By adjusting the latter, it will be apparent that the normal position of the switch actuating element 16 may be adjusted vertically to any desired position.

The element or plunger 16 is actuated in the present instance by an elongated lever 26 which extends transversely of the path of movement of the plunger and bears at one end against the outer end of the plunger. The lever is mounted on the support 13 for selective adjustment of its operating ratio without changing either the position of the lever or the position of the plunger 16. For this purpose, the lever is made substantially straight and is fulcrumed intermediate its ends on a headed pin 27 which projects through and is shiftable along a longitudinal slot 28 in the lever. The pin is supported by a block 29 which fits in and is slidable along guideways 30 formed in the face of the support 13 and extending perpendicular to the normal path of actuation of the switch plunger. The block is locked in adjusted position along the guideways by a clamping screw 31 which projects through a slot 32 formed in the block and extending parallel to the guideways. Adjustment of the block may be gauged by a scale thereon coacting with a pointer 33 fixed on the support 13.

The lever 26 is urged in one direction by a spring 35 which, in this instance, is stretched between the support 13 and the end of the lever remote from the switch 10. Adjacent this end, the lever is connected to a member or rod 36 which is moved endwise back and forth in response to opposite changes in the temperature of the bulb 11. Herein, the rod is disposed perpendicular to the lever, and its pointed end 37 is

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seated in a notch in the lever so that the latter is held against endwise movement during adjustment of the fulcrum pin along the slot 28.

Temperature changes of the bulb are converted into reciprocatory motions through a bellows 38 communicating with the tube 12 through a fitting 39 which is fixed to the lower end of the bellows. The other end of the bellows is closed and secured directly to a head 40 on the lower end of the actuating rod 36.

In accordance with another aspect of the invention, the fitting 39 is mounted on the support 13 for adjustment axially of the rod 36 to effect an initial or calibrating adjustment of the instrument or to vary the control point of the instrument. To this end, the fitting is secured to a casing 41 which has a squared side 42 bearing against and slidable along a flat surface 43 of the support and suspended from a head 44 on the lower end of a sleeve 45 through which the rod 36 slides. The upper end of the sleeve is screw threaded into a nut 46 which is slidable endwise in a bore 47 in the support 13 but is held against turning by engagement of its squared head 48 with a flat surface 49. By manually turning a knob 56 on the lower end of the sleeve 45 the latter may be screwed into or out of the nut 46 to raise or lower the lower end of the bellows 38 and thus vary the position of the actuating rod 36.

Means is provided for raising and lowering the nut 46 by a separate manual adjustment to similarly vary the position of the actuating rod at a given ambient temperature and thus change the control point of the instrument. The means shown herein for this purpose comprises a rotary cam 50 fixed to the end of a shaft 51 which is journaled in the support 13 and has a slot 52 in its exposed forward end to facilitate turning of the cam by means of a suitable tool. The different control point seatings are indicated on a scale 53 which cooperates with a stationary pointer 54.

To calibrate the thermostat above described, the bulb 11 is brought to a known temperature, and the shaft 51 is turned to bring this temperature value as read on the scale 53 opposite the indicating point 54. Then, the knob 56 is turned manually to bring the lever 26 into horizontal position and parallelism with the guideways 30. Next, the nut 25 is adjusted to raise or lower the position of the switch 10 until the actuating plunger 16 just comes into contact with the lever 26. With the instrument thus adjusted, the switch 10 will be opened and closed in response to deviations in the temperature of the bulb 11 above and below a differential range determined by the angular setting of the shaft 51. This range remains of fixed length for a given setting of the fulcrum pin 27, but may be shifted up or down in service use by changing the angular position of the adjusting cam 50.

The differential of the thermostat, that is, the temperature change required in order to change the condition of the switch 10, may be varied as desired by changing the mechanical advantage of the lever 26. This is accomplished by shifting the fulcrum pin in the manner described above to the left if it is desired to decrease the temperature differential of the thermostat. If an increase in the differential is desired, or in other words, a greater movement of the actuating rod 35 in order to effect a change in the condition of the switch 10, the fulcrum pin is shifted to a corresponding position along the slot 28 and to the

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right thereby decreasing the motion transmitting ratio of the lever.

If, after calibration of the instrument in the manner described above, the temperature of the bulb 11 increases substantially from the normal operating range of the instrument, the lever 26 will eventually engage a boss 55 on the switch housing and swing the latter downwardly about the pivot 19 and against the yielding action of the spring 21. Any danger of stressing the parts unduly is thus avoided, thereby preventing damage to the instrument or any change in its calibration.

I claim as my invention:

1. A condition responsive instrument having, in combination, a support, a snap acting switch having an actuating element movable along a predetermined path relative to the switch casing to open and close the switch contacts, means mounting said casing on said support for bodily adjustment along said path, spring means urging said casing in one direction, a stop mounted on said support and selectively adjustable to vary the extent of movement of said casing by said spring, an elongated lever connected at one point to said actuating element and fulcrumed on said support to swing longitudinally of said path, a part pivotally connected to said lever at a point spaced from the lever fulcrum and mounted on said support for endwise movement back and forth in a direction transversely of the lever, means mounted on said support and selectively adjustable relative thereto to change the ratio of said lever without changing the position of said switch actuating element, a member mounted on said support for movement longitudinally of said part, a second member mounted on said first member for adjusting movement relative thereto longitudinally of said part, and a bellows expandable and contractible in response to opposite condition changes and connected at opposite ends to said second member and said part respectively.

2. A condition responsive instrument having, in combination, a support, a snap acting switch having a casing and an actuating element movable along a predetermined path relative to the switch casing to open and close the switch contacts, means mounting said casing on said support for bodily adjustment along said path, spring means urging said casing in one direction along said path, a stop mounted on said support and selectively adjustable to vary the extent of movement of said casing by said spring, an elongated lever connected at one point to said actuating element and fulcrumed on said support to swing longitudinally of said path, a part pivotally connected to said lever at a point spaced from the lever fulcrum and mounted on said support for endwise movement back and forth in a direction transversely of the lever, a member mounted on said support for movement longitudinally of said part, and a bellows expandable and contractible in response to opposite condition changes and connected at opposite ends to said member and said part respectively.

3. A condition responsive instrument having, in combination, a support, a member on said support adjustable relative thereto to positions corresponding to different control points of said instrument, said member having a thread thereon extending along the path of adjustment of said member, a sleeve having a thread mating with said first mentioned thread, a bellows adapted to expand and contract axially in response to opposite condition changes and having one end

connected to said sleeve, a rod reciprocable in said sleeve and connected to the other end of said bellows, a lever fulcrumed on said support and actuated by movement of said rod relative thereto, a switch having a casing and an actuating element movable relative thereto and connected to said lever for actuation thereby, means on said support mounting said switch casing for movement along the path of movement of said actuating element and toward and away from a predetermined position, and means yieldably urging said switch casing into said position.

4. A condition responsive instrument having, in combination, a support, an adjusting member mounted on said support and angularly adjustable to positions corresponding to different control points of said instrument, a second member slidable along said support in response to movement of said adjusting member and having an internally threaded bore, a sleeve screw threaded into said bore, a bellows adapted to expand and contract axially in response to opposite condition changes and having one end connected to said sleeve for moving the latter endwise, a rod reciprocable in said sleeve and connected to the other end of said bellows for movement therewith, a lever connected at one point to said rod, a fulcrum on said support connected to said lever at a point spaced along the lever from said first point, a control device mounted on said support and having a movable actuating element connected to said lever at a point spaced from said first and second points and movable thereby, and means on said support selectively adjustable to vary the position of one of said points relative to said lever while leaving the lever position fixed.

5. A condition responsive instrument having, in combination, a support, a rotary cam journaled on said support and angularly adjustable to positions corresponding to different control points of said instrument, a follower for said cam slidably mounted on said support and having an internally threaded bore, a sleeve threaded into said bore, a nonrotatable member slidable on said support and journaled on said sleeve, a bellows adapted to expand and contract axially in response to opposite condition changes and having one end abutting against said member, a rod reciprocable in said sleeve and connected to the other end of said bellows for movement therewith, a lever fulcrumed on said support and actuated by movement of said rod relative thereto, and a control device mounted on said support and having a movable actuating element adapted for actuation by swinging of said lever.

6. A condition responsive instrument having, in combination, a support, a member mounted on said support for adjustment relative thereto, said member having a thread thereon extending along the path of adjustment of said member, a sleeve having a thread mating with said first mentioned thread, a bellows adapted to expand and contract axially in response to opposite condition changes and having one end connected to said sleeve, a rod reciprocable in said sleeve and connected to the other end of said bellows, manually operable means for shifting said member and said rod relative to said support to different selected positions corresponding to different lengths of said bellows, means by which said sleeve may be turned relative to said member to effect a supplemental adjustment of said rod relative to the member and said support for a given length of said bellows, a lever fulcrumed on said support and actuated by movement of said rod relative thereto, and a con-

trol device mounted on said support and having a movable actuating element adapted for actuation by swinging of said lever.

7. A condition responsive instrument having, in combination, a support, a member mounted on said support for adjustment relative thereto, said member having an internally threaded bore, a sleeve threaded into said bore, a bellows adapted to expand and contract axially in response to opposite condition changes and having one end connected to said sleeve, a rod reciprocable in said sleeve and connected to the other end of said bellows for movement therewith, manually operable means for shifting said member and said rod relative to said support to different selected positions corresponding to different lengths of said bellows, means by which said sleeve may be turned relative to said member to effect a supplemental adjustment of said rod relative to the member and said support for a given length of said bellows, a lever fulcrumed on said support and actuated by movement of said rod relative thereto, and a control device mounted on said support and having a movable actuating element adapted for actuation by swinging of said lever.

8. A condition responsive instrument having, in combination, a support, a snap switch having a casing and an actuator element movable relative thereto along a predetermined path to open and close the switch contacts, an elongated lever connected at one point to said actuator and fulcrumed on said support to swing longitudinally of said path, an endwise movable rod pivotally connected to said lever at a point spaced from said fulcrum, an element axially expandable and contractible in response to opposite condition changes and connected at one end to said rod, a member mounted on said support for adjustment relative thereto axially of said rod, a second member connected to the other end of said bellows and mounted on said first member for adjustment relative thereto in a direction axially of said rod, and separate manually operable devices for adjusting said members individually.

9. A condition responsive instrument having, in combination, a support, a precision snap switch having an actuating element movable along a predetermined path to open and close the switch contacts, means mounting said switch on said support for bodily adjustment along said path, a guideway on said support extending across said path at right angles relative thereto, a member mounted in and slidably adjustable along said guideway, an elongated lever extending along said guideway and bearing at one end against said actuating element of said switch, a part pivotally connected to the other end of said lever and guided for movement back and forth in a direction paralleling said path, means for moving said part in opposite directions in response to opposite changes in a condition, said lever having an elongated straight slot therein intermediate its ends and paralleling said guideway, and a fulcrum pin on said member projecting through said slot and adjustable with said member along said guideway and said slot without changing the angular position of said lever.

10. A condition responsive instrument having, in combination, a support, a snap switch having an actuating element movable along a predetermined path to open and close the switch contacts, means mounting said switch on said support, a guideway on said support extending across said path at right angles relative thereto, a member mounted in and slidably adjustable along said

guideway, an elongated lever extending along said guideway and bearing at one end against said actuating element of said switch, a part pivotally connected to the other end of said lever and guided for movement back and forth in a direction paralleling said path, means for moving said part in opposite directions in response to opposite changes in a condition, and means providing a pin and slot connection between said lever and said member for adjustment of the member parallel to said guideway, the pin of said connection constituting the fulcrum of said lever.

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