

Feb. 5, 1952

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2,584,682

SWITCHING MECHANISM

Filed Aug. 3, 1949

2 SHEETS—SHEET 1

FIG. 1

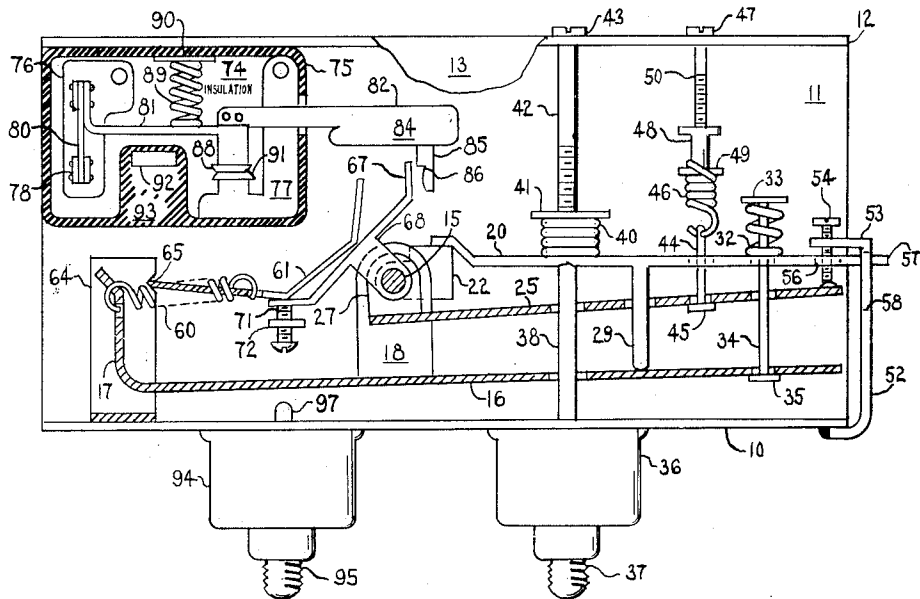
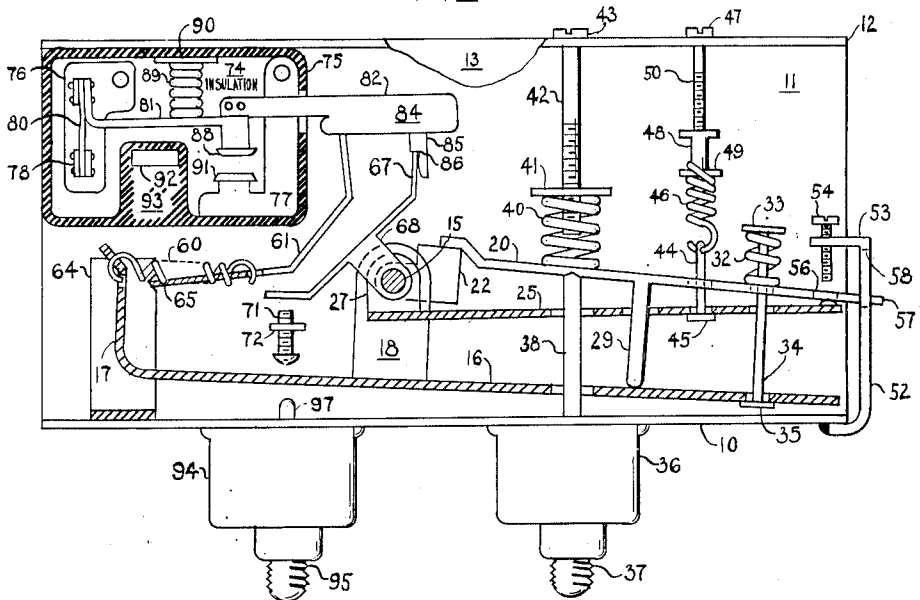


FIG. 2



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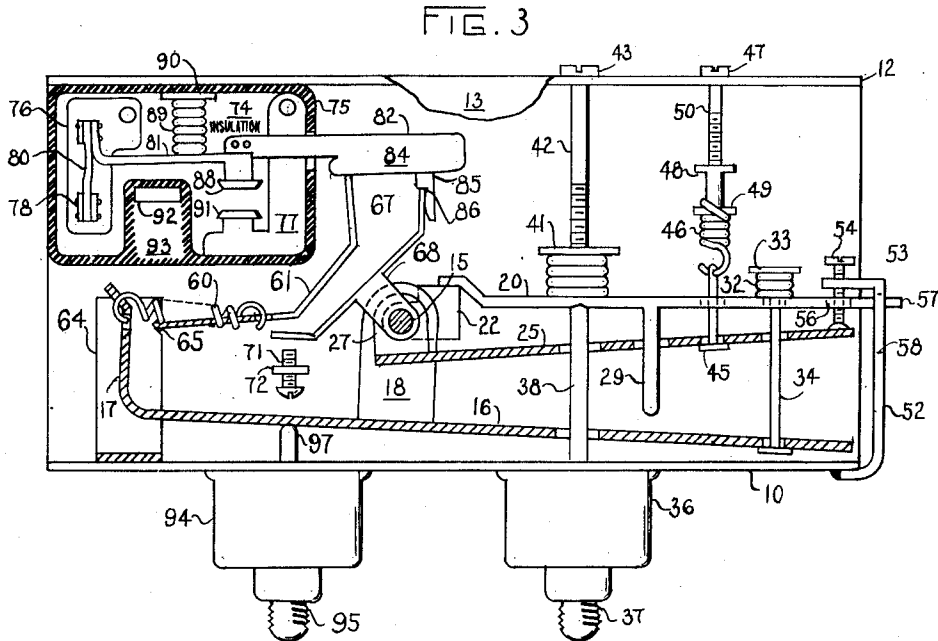
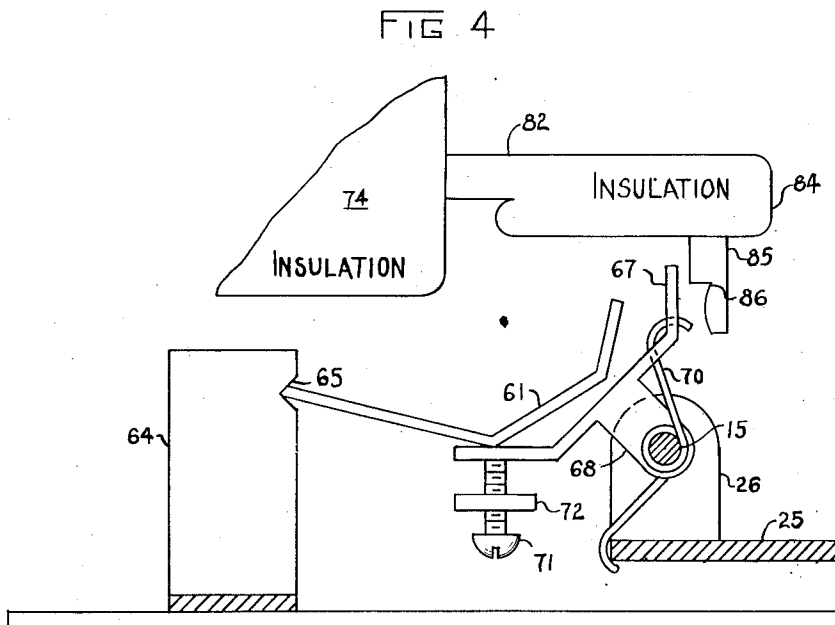
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SWITCHING MECHANISM

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This invention relates to condition responsive controllers and in particular to pressure responsive switches which operate with a snap action when the pressure to which the switch responds reaches the control value.

In condition responsive switches of the type under consideration it is customary to make provision for snap movement of the contact carrying apparatus so that, as the condition approaches the control value in small incremental changes, the contacts will remain in their original position until the control value of the condition is reached, and will then snap to their new position, thereby minimizing arcing at the switch contacts as they open and close. One method of securing such snap movement involves use of an over-center spring connection between a contact carrying beam and an actuated beam. A difficulty encountered in this construction is that as the actuated beam moves in contact-opening direction and approaches the dead-center position for the over-center spring, a zone of vanishing contact pressure is traversed within which the contact pressure is reduced and eventually reaches zero causing arcing and consequent deterioration of the contacts.

The principal object of the present invention is to provide a switch mechanism wherein the contact pressure remains constant until the contacts are separated. A further object of the present invention is to provide a switch mechanism wherein the closing of the contacts is accomplished by an uninterrupted, rapid motion of the contact carrying beam. An additional object of the present invention is to provide a condition responsive switch having safety shut-down means wherein the range setting, differential setting, and the condition value at which the safety shut-down means operates are all readily adjustable.

Other objects and advantages will become apparent upon examination of the drawings and accompanying description in which:

Fig. 1 represents a side view of the switching mechanism, in schematic form to better illustrate the relation of parts, and showing the mechanism in normal closed contact position.

Fig. 2 is a view similar to Fig. 1 but illustrating the mechanism in normal open contact position.

Fig. 3 is a view similar to Fig. 2 but illustrating the mechanism in open contact position with the parts in a different relationship than that shown in Fig. 2.

Fig. 4 is an enlarged, detail view of a portion of the mechanism.

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Referring now to Figs. 1, 2, and 3 it will be noted that the mechanism is enclosed in a rectangular box-like casing having a base plate 10, a back plate 11, a top plate 12, and a front plate 13, of which a portion only is shown. A pin 15 extends through the casing and is journaled in front plate 13 and back plate 11.

Pivotaly mounted on pin 15 by means of two upturned ears 18 (only one of which is shown) and extending lengthwise of the casing is a main operating lever or actuating beam 16. The pivotal mounting of beam 16 is at a point intermediate its ends, one end of beam 16 having an upturned portion 17 for connection with a switch operating mechanism which will presently be described in detail. Also pivotaly mounted on pin 15 is an actuated beam 20 having two downwardly extending ears 22 (only one of which is shown) through which pin 15 extends.

A differential beam 25 is also pivotaly mounted on pin 15 by means of two upwardly extending ears 27. Beam 25 is generally coextensive with beams 20 and 16. Beams 20 and 16 are held in spaced relationship by means of a spacer 29 mounted on beam 20, extending through an opening in beam 25 and engaging beam 16. Beam 16 is resiliently held in engagement with spacer 29 by means of a strain relief spring 32 which is a compression spring having one end bearing against a spring retainer 33 and its other end bearing against the upper side of beam 20. The retainer 33 is secured to a pin 34 which extends through the center of spring 32 and loosely through openings in beams 20, 25 and 16. A member 35 and pin 34 form an inverted T-shaped assembly with the member 35 bearing against the underside of beam 16. From the foregoing it will be apparent that beams 16 and 20 are normally held in a spaced relation by means of spacer 29 and spring 32, but may be moved apart, such movement resulting in further compression of spring 32.

Rigidly secured to base plate 10, by any suitable means, is a conventional pressure or other condition responsive assembly comprising a casing 36, enclosing an expansible bellows, a threaded nipple 37, the central bore of which serves as a path for the introduction of an expansible fluid into operative relation with the bellows, and a thrust pin 38 which is moved upwardly or downwardly upon movement of the bellows assembly under the influence of a condition change, as is well known in the art. It will be understood that a capillary tube and bulb filled with a temperature responsive fluid may be attached to the threaded nipple 37, or a tube

introducing the pressure into the condition responsive assembly of any hydraulic system, the pressure of which is to be controlled, might alternatively be attached to nipple 37, so that the condition responsive assembly may be made to respond either to pressure or temperature variations.

Thrust pin 38 engages the underside of beam 26 so that upward movement of pin 38 results in counterclockwise rotation of beam 20 about its pivot 15. Such movement is opposed by a range spring 40, a compression spring, which bears against the top side of beam 20 and against a spring retainer 41 which is threaded upon an adjusting screw 42. The screw 42 has its head 43 overlying the top plate 12, the shank portion of screw 42 extending loosely through an opening in plate 12. It will be apparent that adjustment of screw 42 and consequent movement of retainer 41, in a vertical plate varies the compressive stress within spring 40 and thereby the force exerted by spring 40 in opposition to upward movement of thrust pin 38.

A pin 44, having a head member 45, similar to member 35, extends loosely through openings in beams 25 and 20 and is secured to one end of a differential spring 46. The spring 46 is a tension spring and has its other end retained on a stud 48 by means of a flange 49 formed integrally with the stud 48. Stud 48 is threaded to receive a differential adjusting screw 50 which extends loosely through an opening in plate 12, its head 47 bearing against plate 12. It will be apparent from the foregoing that adjustment of screw 50 and consequent movement of stud 48 in a vertical plane varies the tension of spring 46 and thereby the force exerted by spring 46 in the direction for moving beam 25 counterclockwise about its pivot 15, as viewed in Figs. 1, 2 and 3.

A bracket 52 is secured to the base plate 10 by any suitable means and has an inwardly extending portion 53 through which is threaded a calibration screw 54. Screw 54 serves as a stop, limiting the counterclockwise rotational movement of beam 25. Beam 20 has an opening 56 therein through which screw 54 freely extends. A tongue 57, formed on the end of beam 20, extends freely through a slot 58 in the upright portion of bracket 52. The slot 58 serves to limit the rotational movement of the beam 20.

The upturned end 17 of the beam 16 has attached thereto one end of a tension spring 60. The other end of spring 60 is fastened to the central portion of an operating lever 61. Two identical members 64 (only one of which is shown in the figures) are rigidly secured to the base plate 10 and each has a notch 65 near its upper end for receiving the sharpened end of lever 61 thereby forming a pivotal, knife-edge bearing for the lever 61. It will be understood that the upturned portion 17 of the beam 16 extends between the two members 64, and that the lever 61 has a central, cut-out portion for accommodating the body of spring 60 so that the ends of spring 60 are substantially in alignment.

A latch member 67, essentially channel-shaped in cross-section, is mounted for movement about pin 15 by means of ears 68 (only one of which is shown) through which pin 15 loosely extends. As may best be seen in Fig. 4, member 67 is biased to move in a clockwise direction about pin 15 by means of a coiled spring 70. Spring 70 has one of its ends fastened to member 67 and its other end bearing against the end of beam 25. The

limit for counterclockwise movement of member 67 about pin 15 is established by calibrating screw 71 which is threaded into an opening in an extending tab 72 struck from back plate 11.

The switching mechanism 74 as shown in Figs. 1, 2 and 3 includes a switch plate 75, made of any suitable insulating material. Fastened to the plate 75 are two terminal brackets 76 and 77 formed of highly conductive metal. Bracket 76 has an ear 78 extending therefrom to which is secured, by any suitable means, one end of a resilient strip 80. The other end of strip 80 is secured by any suitable means to a switch arm or member 81. It will be understood that the resilient strip 80, which interconnects the fixed ear 78 and switch arm 81, serves as a spring hinge for the arm 81, deforming, as shown in Fig. 2, upon movement of the free end of arm 81. Attached to the free end of arm 81 by any suitable means is an extension 82, formed of insulating material. The extension 82 extends beyond the switch plate 75 and has at its outer end an ear 84 and a depending member 85, having a notched portion 86. The ear 84 is adapted to be engaged by the free end of the operating lever 61, and the notched portion 86 is adapted to receive one edge of the latch member 67, as will subsequently be pointed out in the description of operation of the mechanism. Extending from switch arm 81 is a mounting for a movable contact 88. A compression spring 89 is anchored on a tab 90 extending from the switch plate 75 and exerts a force upon switch arm 81 tending to rotate arm 81 (and consequently extension 82) clockwise on its spring hinge 80. The limit of clockwise movement of arm 81 is established by the fixed contact 91 which is mounted on an extending portion of the bracket 77. A boss 93, extending outwardly from the switch plate 75, houses a permanent magnet 92 which serves as a blow-out magnet in extinguishing the arc formed upon opening and closing of the contacts 88 and 91.

Mounted on the base plate 10 is a second condition responsive assembly comprising a casing 94, similar to casing 36, enclosing a bellows assembly and a threaded nipple 95, the central bore of which serves as a path for the introduction of a condition responsive fluid into operative relation with the bellows. A thrust pin 97 extends through an opening in the base plate 10 and is adapted to move upwardly or downwardly upon movement of the bellows assembly under the influence of a condition change. Prolonged upward movement of the pin 97 will result in its engagement with, and consequent rotation of beam 16 about its pivotal mounting 15, as shown in Fig. 3.

The mechanism described may be used to control a mechanical refrigeration system. In such an application the nipple 37 may be connected by a suitable conduit to the low pressure line of the refrigeration system, the nipple 95 may be connected to the high side of the compressor, and the contacts 88 and 91 may be connected in series with the compressor motor, such connections being well known in the art.

In operation, if the pressure in the low pressure line of the refrigeration system is above a predetermined value the pin 38 will be in the position shown in Fig. 1. In assuming this position, pin 38 will have moved beam 20, against the force of spring 40, toward its limit of counterclockwise movement. Through spring 32, pin 34, and spacer 29, actuating beam 16 will also have been moved counterclockwise an equal amount.

Spring 60 will thereby have been moved below the plane of lever 61, and, consequently, lever 61 and member 67 will have been moved to the position shown in Fig. 1. Contacts 88 and 91 will be closed because of the biasing force exerted by spring 89 on the switch arm 81. With contacts 88 and 91 closed the compressor in the refrigeration system will be operating to lower the pressure in the low pressure line of the system in a manner well known in the art.

When the pressure in the system has fallen below the predetermined amount, the pin 38 will be retracted, enabling spring 40 to move beam 20 clockwise about its pivot 15 to the position shown in Fig. 2. This movement of beam 20 will, through the spacer 29, move actuating beam 16 clockwise about its pivot 15. This movement of beam 16 will move the spring 60 above the plane of the lever 61. The upward force then exerted by spring 60 on the lever 61 will snap lever 61 from its position in Fig. 1 to its position in Fig. 2. As the lever 61 nears its limit of upward motion, its free end will engage the ear 84, and move the switch arm 81 to open the contacts 88 and 91. This movement of arm 81 takes place against the force of spring 89. As arm 81 is moved into the position shown in Fig. 2, the member 67 will be rotated clockwise about its pivot 15 by the spring 70 and into latching engagement with the notched portion 86 of the member 85. Opening of contacts 88 and 91 breaks the circuit to the compressor motor, completing the cycle of operation.

It will be noted that, as lever 61 moves from its position in Fig. 1 toward its position in Fig. 2, the contacts 88 and 91 are held closed positively by the force of spring 89 until the lever 61 strikes ear 84 to open the contacts. At this point in its movement lever 61 will be moving at an accelerated rate and will move arm 81 to open contacts 88 and 91 abruptly. The mechanism controlling the switch contacts 88 and 91 does not, therefore, pass through a zone of vanishing contact pressure, but holds the contacts 88 and 91 positively closed until they are abruptly opened by the rapid movement of lever 61. Likewise, upon actuation of the contacts to closed position, the member 67, by its latching engagement with member 85, will hold the contacts open until lever 61 strikes the lower portion of member 67 to remove it from engagement with member 85. Contacts 88 and 91 will thereupon be abruptly closed by the force of spring 89.

The cut-in point or the pressure value at which the contacts 88 and 91 will close may be adjusted by means of screw 42 to vary the force opposing motion of the pin 38. It will be noted that the adjustment of spring 46 has no effect on the cut-out point adjustment since beam 20, in moving to its position shown in Fig. 1, has left beam 25 behind and in engagement with the screw 54. The tension of spring 46, which may be adjusted by means of screw 50, does, however, determine the cut-out point or the pressure value at which the contacts 88 and 91 will open. As beam 20 moves from its position as shown in Fig. 1 to its position as shown in Fig. 2, at an intermediate point in its movement its free end engages the free end of beam 25 and moves it away from screw 54. During this latter portion of the movement of beam 20 toward its position of Fig. 2, therefore, such movement is opposed by spring 46. By appropriate adjustment of screws 42 and 50 the switching mechanism may be made to cut-in and cut-out at various, predetermined values.

In Fig. 3 is shown the positions assumed by the various parts of the mechanism when excessive pressure exists on the high side of the refrigeration system. Under these emergency conditions, contacts 88 and 91 have been opened although the pressure responsive assembly 36 and beam 20 are in their contact closing positions (Fig. 1). In response to the excessive pressure condition, pin 97 has been extended by the pressure responsive assembly 94 to move beam 16 clockwise about its pivot 15 sufficiently to actuate the switching mechanism to open-contact position. This movement of beam 16 takes place independently of the position of beam 20 and results in compression of spring 32.

It will be understood that other lever arrangements, having differing methods of adjustment, may be used to move lever 61 through its range of movement with a snap action and yet retain the features of the present invention which is to be limited only by the appended claims.

I claim:

1. In a control mechanism, a first pivotally movable lever carrying control means thereon, a movable member biased into latching engagement with said first lever by a resilient means, a second lever pivotally movable between first and second positions and engaging said first lever during movement toward said first position to permit said member to move into latching engagement with said first lever, said second lever engaging said member during movement toward said second position to overcome said resilient means and remove said member from latching engagement with said first lever.

2. In a switch mechanism, a first pivotally movable lever having an electrical contact mounted thereon, a stationary electrical contact mounted for engagement with said first mentioned contact, a movable member biased into latching engagement with said first lever by a resilient means, a second lever pivotally movable between first and second positions and engaging said first lever during movement toward said first position to permit said member to move into latching engagement with said first lever, said second lever engaging said member during movement toward said second position to overcome said resilient means and remove said member from latching engagement with said first lever.

3. A circuit controlling device comprising a switch member movable between open and closed circuit positions, biasing means for holding said switch member in closed circuit position, a latch member movable to a latching position to retain said switch member in open circuit position against the force of said biasing means once said switch member has been moved to said open circuit position, a first operating lever, a second operating lever, resilient means connecting said operating levers and movable over center by said second operating lever whereby said first operating lever is moved between two limiting positions with a snap action, said first operating lever engaging said switch member during movement toward one of said limiting positions to move said switch member to open circuit position and thereby permit said latch member to move to said latching position, said first operating lever engaging said latch member during movement toward the other of said limiting positions to move said latch member away from said latching position and thereby permit said biasing means to move said switch member to closed circuit position.

4. A circuit controlling device comprising a

switch member movable between open and closed circuit positions and carrying a notched portion adjacent one of its ends, biasing means for holding said switch member in closed circuit position, a latch member biased to move into engagement with said notched portion to retain said switch member in open circuit position against the force of said biasing means once said switch member has been moved to said open circuit position, a first operating lever, a second operating lever, resilient means connecting said operating levers and movable over center by said second operating lever whereby said first operating lever is moved between two limiting positions with a snap action, said first operating lever engaging said switch member during movement toward one of said limiting positions to move said switch member to open circuit position and thereby permit said latch member to move into engagement with said notched portion, said first operating lever engaging said latch member during movement toward the other of said limiting positions to move said latch member out of engagement with said notched portion and thereby permit said biasing means to move said switch member to closed circuit position.

5. A controlling device comprising a control member movable between first and second controlling positions, biasing means for holding said control member in its said first controlling position, a latch member movable to a latching position to retain said control member in its said second controlling position once said control member has been moved to said second controlling position, means biasing said latch member into said latching position, a first operating lever, a second operating lever, resilient means connecting said operating levers and movable over center by said second operating lever whereby said first operating lever is moved between two limiting positions with a snap action, said first operating lever engaging said control member during movement toward one of said limiting positions to move said control member to its said second controlling position and thereby permit said latch member to move to said latching position, said first operating lever engaging latch member during movement toward the other of said limiting positions to move said latch member away from latching position and thereby permit said biasing means to move said control member to its said first controlling position.

6. In a switch mechanism, a first pivotally movable lever having an electrical contact mounted thereon, a stationary electrical contact mounted for engagement with said first mentioned contact, an arc extinguishing magnet mounted adjacent said stationary contact, a movable member biased into latching engagement with said first lever, a second lever pivotally movable between first and second positions and engaging said first lever during movement toward said first position to permit said member to move into latching engagement with said first lever, said second lever engaging said member during movement toward said second position to remove said member from latching engagement with said first lever.

7. In a condition responsive controller, an actuating beam, control means actuated upon movement of said actuating beam, an actuated beam, said actuating beam being coextensive with said actuated beam and mounted for movement independent of said actuated beam, yield-

able means exerting a force for holding said actuated and actuating beams in predetermined spaced relationship whereby they are moved in unison during normal operation of said controller, condition responsive means for moving said actuated beam upon a normal change in said condition, adjustable resilient means opposing movement of said actuated beam in one direction, a differential beam coextensive with said actuated and actuating beams and mounted for movement independent of said actuated and actuating beams, adjustable resilient means biasing said differential beam in said one direction, said differential beam being engaged and moved by said actuated beam upon movement thereof by said condition responsive means, a stop member limiting movement of said differential beam in said one direction and effective to cause disengagement of said actuated beam and said differential beam during final movement of said actuated beam in said one direction and during initial movement of said actuated beam in the other direction, and emergency condition responsive means for moving said actuating beam independently of said actuated beam and against the force exerted by said yieldable means.

8. In a pressure responsive controller having emergency shut-down means, an actuating beam, control means actuated upon movement of said actuating beam, a pivotally mounted actuated beam, said actuating beam being coextensive with said actuated beam and pivotally mounted for movement independent of said actuated beam, yieldable means exerting a force for holding said actuated and actuating beams in predetermined spaced relationship whereby they are pivotally moved in unison during normal operation of said controller, pressure responsive means for moving said actuated beam upon a normal change in said pressure, adjustable range spring means opposing movement of said actuated beam in one direction, a differential beam coextensive with said actuated and actuating beams and pivotally mounted for movement independent of said actuated and actuating beams, adjustable differential spring means biasing said differential beam in said one direction, said differential beam being engaged and moved by said actuated beam upon movement thereof by said pressure responsive means, a stop member limiting movement of said differential beam in said one direction and effective to cause disengagement of said actuated beam and said differential beam during final movement of said actuated beam in said one direction and during initial movement of said actuated beam in the other direction, said emergency shut-down means comprising an emergency pressure responsive means for pivotally moving said actuating beam to actuate said control means independently of said actuated beam and against the force exerted by said yieldable means.

9. In a pressure responsive controller having emergency shut-down means, a pivotally mounted actuated beam, an actuating beam pivotally mounted intermediate its ends and having the portion on one side of said pivotal mounting coextensive with said actuated beam, switch actuating means secured to the portion of said actuating beam on the other side of said pivotal mounting, means including a strain-release spring exerting a force for holding said actuated and actuating beams in predetermined spaced

relationship whereby they are pivotally moved in unison during normal operation of said controller, pressure responsive means for moving said actuated beam and consequently said actuating beam upon a normal change in pressure, adjustable range spring means opposing movement of said actuated beam in one direction, a pivotally mounted differential beam generally coextensive with said actuated beam and engageable thereby, adjustable differential spring means biasing said differential beam for pivotal movement in said one direction, an adjustable stop engageable by said differential beam for halting movement thereof in said one direction, whereby the force exerted by said differential spring means opposes the force exerted by said range spring means until said adjustable stop is engaged by said differential beam whereupon the unopposed force of said range spring is exerted against further movement of said actuated beam in said one direction, said emergency shut-down means comprising pressure responsive means responsive to abnormal pressure values and engageable with said actuating beam upon the occurrence of such abnormal pressure values for moving said actuating beam independently of said actuated beam against the force exerted by said strain relief spring.

10. In a pressure responsive controller having emergency shut-down means, a pivotally mounted actuated beam, an actuating beam pivotally mounted intermediate its ends and having the portion on one side of said pivotal mounting coextensive with said actuated beam, switch actuating means secured to the portion of said actuating beam on the other side of said pivotal mounting, means including a strain-release spring exerting a force for holding said actuated and actuating beams in predetermined spaced relationship whereby they are pivotally moved in unison during normal operation of said controller, pressure responsive means for moving

said actuated beam and consequently said actuating beam upon a normal change in pressure, adjustable range spring means opposing movement of said actuated beam in one direction, a pivotally mounted differential beam generally coextensive with said actuated beam and engageable thereby, adjustable differential spring means biasing said differential beam for pivotal movement in said one direction, an adjustable stop engageable by said differential beam for halting movement thereof in said one direction, whereby the force exerted by said differential spring means opposes the force exerted by said range spring means until said adjustable stop is engaged by said differential beam whereupon the unopposed force of said range spring is exerted against further movement of said actuated beam in said one direction, said emergency shut-down means comprising pressure responsive means responsive to abnormal pressure values and engageable with said actuating beam at said other side of said pivotal mounting upon the occurrence of such abnormal pressure values for moving said actuating beam independently of said actuated beam against the force exerted by said strain relief spring.

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