

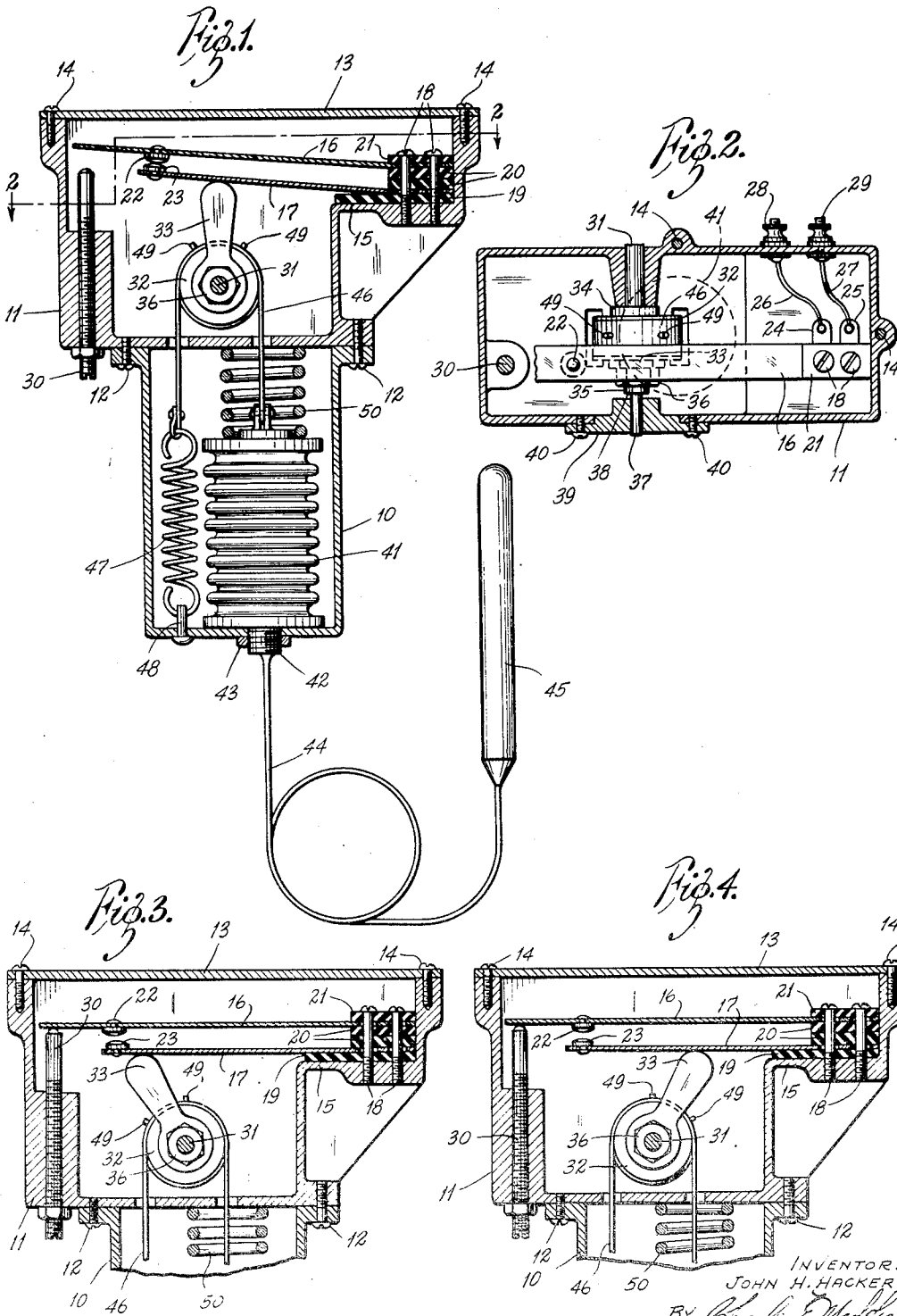
May 15, 1951

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2,552,962

THERMOSTATIC LIMIT SWITCH

Filed June 22, 1949



UNITED STATES PATENT OFFICE

2,552,962

THERMOSTATIC LIMIT SWITCH

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Application June 22, 1949, Serial No. 100,555

4 Claims. (Cl. 200-140)

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This invention relates to automatic condition change limiting switches, and more particularly to the kind employing flexible walled expansible chamber type actuators having a temperature sensitive fluid fill.

This particular type of condition responsive switch while in wide successful use and reliable in operation, does however, include the inherent possibility of rupture of its thin flexible wall. Though this possibility of rupture can be made quite remote through close quality control of the material and manufacture, a considerable hazard is nevertheless posed under conditions wherein the switch is to function as a final automatic control to prevent destructive action by excessive temperature, and it is highly desirable therefore to completely obviate any possibility of its failure.

In conventional high temperature limit switches of this type, a ruptured or leaky expansible element results in the failure of the switch to respond to a predetermined high temperature to actuate the switch to stop production of heat.

In the present invention I have provided a novel limit switch arrangement in combination with and adapted to be operated by a temperature sensitive fluid filled expansible element, arranged to break an electric control circuit in response to a predetermined high temperature when functioning normally, and arranged to effect the same change in the control circuit in event of failure of the expansible element due to rupture or leakage.

An object of the present invention is to provide a limit switch employing a temperature sensitive fluid filled expansible element type actuator, which functions to break a control circuit in response to a predetermined high temperature or upon a drop in fluid pressure in the expansible element below a predetermined point.

A further object is to provide a limit switch having first and second circuit control positions, and having means including a temperature sensitive fluid filled expansible element whereby the switch is caused to be actuated to and held in the second control position by the action of the element as it expands and contracts within an intermediate range due to temperature change and whereby the switch is caused to be moved to the first control position when the expansible element expands above the intermediate range due to the excessive temperature or contracts below the intermediate range due to leakage of the temperature sensitive fluid.

A further object is to provide a limit switch

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having means whereby it is normally returned to a first circuit controlling position, and having a temperature sensitive fluid filled expansible element actuator whereby it is caused to be actuated to and held in a second circuit controlling position by the action of the element throughout an intermediate range of its movement and whereby it is released to assume its first control position upon movement of the element above or below the intermediate range.

Further objects and advantages will become apparent upon reading the following description in connection with the accompanying drawing.

In the drawing,

Fig. 1 is a sectional view of a limit switch constructed in accordance with the principles of my invention;

Fig. 2 is a sectional view of the switch shown in Fig. 1 and is taken on line 2-2 of Fig. 1;

Figs. 3 and 4 are part sectional views similar to Fig. 1 except that the elements are shown in different operative positions.

Referring to the drawing, the switch includes a composite casing having a lower section 10 and an upper section 11, which sections are attached as by screws 12. The upper section has a cover 13 attached thereto by screws 14. The upper casing section is provided with an internal shelf 15 on which is stacked a pair of flexible switch blades 16 and 17. The blades 16 and 17 are rigidly attached at one end to the casing by screws 18, and are spaced from the casing, the screws, and each other by suitable insulators 19, 20 and 21 respectively. Carried on the blades 16 and 17 near their free ends is a pair of cooperating contact elements 22 and 23. The switch blades 16 and 17 are further provided with lateral tabs 24 and 25 near their fixed ends, see Fig. 2, to which are connected short leads 26 and 27, which extend to and are connected with a pair of terminal binding posts 28 and 29, whereby the switch may be connected in a control circuit.

The switch blades 16 and 17 in their normal free positions are substantially horizontal and parallel as indicated in Figs. 3 and 4. In this position the contacts 22 and 23 are separated. The blade 16 extends somewhat beyond the blade 17 and engages at its outer end a vertical adjustment screw 30 threadedly adjustable in the casing section 11. Centrally of and below the blades 16 and 17 there is a transverse shaft 31 journaled in the walls of the casing section 11. Mounted on the shaft 31 for rotation therewith is a drum 32, and there is a lever arm 33 mounted on the shaft 31 for rotation therewith which

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lays against one face of the drum 32. To fix the drum 32 and the lever 33 to the shaft 31, the shaft is provided with a flange 34 against which one face of the drum bears. The shaft is also provided with a threaded portion 35 and a nut 36 by means of which the arm 33 and drum 32 are tightly clamped together and against the flange 34 so that the drum, the arm and the shaft rotate together. The arm 33 contacts at its outer end with the switch blade 17. The arrangement being such that the contacts are moved to a closed position as the arm is rotated toward the blade 17 from either direction and the contacts are separated as the arm 33 is rotated away from the blade in either direction due to the stop screw 30 and the resiliency of the blade 17 as it returns to its normal position as indicated in Figs. 3 and 4.

The outer end of the shaft 31 adjacent the threaded portion 35 is reduced as at 37 to provide a shoulder 38 which limits the end play of the shaft assembly. That section of the casing wall which journals the reduced end 37 of the shaft is made removable as indicated at 39 in order to facilitate assembly and the section 39 is attached to the casing by screws 40. In the lower casing section 19 there is a vertically acting, expansible, corrugated, thin walled metal bellows 41 of a type widely known and used. The lower end of the bellows 41 is provided with a threaded hollow stud 42 which extends through a suitable perforation in the bottom of the casing section 19. The lower end of the expansible element is rigidly fastened to the bottom of the casing by a nut 43 on the stud 42. Extending into the hollow stud 42 and sealed therein against fluid pressure is one end of a capillary tube 44. The other end of the capillary tube is connected to a metal bulb 45 adapted to be placed in any heat transfer medium, the temperature of which is to be limited.

The bulb 45, the tube 44 and the expansible element 41 form a sealed system which is filled with a thermally expansible fluid. There is a thin flexible metal ribbon 46 connected at one end to the upper free end of the expansible element 41 which passes over the drum 32 and has its other end connected to one end of a tension spring 47. The spring 47 has its other end anchored at 42. The drum 32 and arm 33 are thereby rotated as the expansible element 41 expands or contracts. In order to obviate slippage of the ribbon 46 on the drum, a pair of pins 49 projecting radially from the drum surface are provided and the ribbon 46 is suitably perforated to receive these pins.

A relatively strong element return compression spring 50 is provided which bears at one end against the bottom of the upper casing section and at its other end against the upper end of the expansible element thereby to oppose its expansion.

In operation

Assume the device is to be used as a heat production limit control in a space heating system and that the bulb 45 is located so as to be sensitive to the heat output of the heat producer, as for example in the plenum of a warm air furnace. Also assume that the lowest temperature to be encountered ambient to the location of the furnace when inoperative is 40° F. and that it is desirable to stop heat production when the temperature of the heated air in the plenum reaches 275° F. To meet these conditions the calibration

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of the spring 50 and the loading pressure of the fluid fill will be such that the arm 33 will be somewhere between the positions shown in Figs. 3 and 4 through this range of temperature in order to maintain a closed circuit for operation of the furnace as required to heat the space. As the furnace operates normally under control of the usual space thermostat, the arm 33 will oscillate in response to variations in the plenum temperature but will always be in a range between the positions shown in Figs. 3 and 4 so as to maintain a closed circuit at that point will move to the position shown in Fig. 3. If for any reason the plenum temperature exceeds 275° F., the arm 33 will be rotated counterclockwise to the position shown in Fig. 3 thereby permitting the blade 17 to move away from the blade 16 which is stopped by the screw 30, thus breaking the circuit and stopping production of heat until the temperature of the medium has dropped sufficiently to cause the arm 33 to be rotated clockwise and again close the circuit.

In event the bellows 41 is ruptured or leaks for any reason the bellows will be compressed by the return spring 50 and the arm 33 will be rotated clockwise to a point as shown in Fig. 4 or beyond, thus permitting the switch blades to again separate thereby breaking the circuit. It will be understood that the system is preloaded by introduction of the thermally expansible fluid under pressure and that the expansible element is expanded some distance from its fully contracted position when in the extended position corresponding to the position of the arm 33 in Fig. 4.

The foregoing description is intended to be illustrative of the principles of the invention and not limiting, the scope of the invention being set forth in the appended claims.

I claim:

1. In a condition change limit switch, switch contact structure movable to first and second control positions, an expansible chamber responsive to variations in fluid pressure to expand and contract, spring means opposing the expansion of said chamber, said contact structure including resilient means for moving it to said first control position, and motion transmission mechanism operatively connected to said expansible chamber and including cam means for operatively engaging said contact structure and arranged to cooperate with said resilient to cause said contact structure to be moved to said second control position as the movement of said expansible chamber in expanding or contracting approaches a predetermined intermediate range of its movement, to cause said contact structure to be retained in said second control position throughout said predetermined range of movement of the expansible chamber, and to cause said contact structure to be moved to said first control position when said expansible chamber expands above or contracts below said predetermined range.

2. In a condition change limit switch, switch contact structure movable to first and second control positions, an expansible chamber responsive to variations in fluid pressure to expand and contract, spring means opposing the expansion of said chamber, said contact structure including resilient means for moving it to said first control position, and motion transmission mechanism connected to said expansible chamber including cam means for operatively engaging said contact structure and arranged to move it to

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said second control position as the expansible chamber in expanding or contracting approaches a predetermined intermediate range of its movement, to cause said contact structure to be retained in said second control position throughout said predetermined range of movement of the expansible chamber, and to permit said contact structure to return to said first position under the urging of said resilient means when said expansible chamber expands above or contracts below said predetermined range.

3. In a condition change limit switch, a pair of cooperating contact elements at least one of which is movable, a resilient switch blade for carrying said movable contact and arranged to space said contacts when in a normal free position, an expanding fluid type thermostat including an expansible element filled with a thermally expansible fluid, spring means opposing the expansion of said element, an arm pivoted adjacent said switch blade having a connection with said expansible element thereby to be oscillated as said expansible element expands and contracts, said arm being arranged to swing toward and away from said blade as it swings in one direction, and to engage it and to move it to a contact closed position as the arm swings toward it, said arm being arranged to close said contacts and to then flex said switch blade thereby to provide a predetermined dwell during which the arm may be rotated while still maintaining the contacts in a closed position.

4. In a temperature responsive limit switch, an expanding fluid type thermostat comprising an expansible element, a remote bulb and a con-

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necting capillary tube connected to form a sealed system having a thermally expansible liquid fill, spring means opposing the expansion of said expansible element, a pair of flexible switch blades fixed at one end, cooperating contacts carried at the free ends of said blades, said blades being substantially parallel in their normal free positions in which positions said contacts are separated, an arm pivoted adjacent one of said blades having a connection with said expansible element thereby to be oscillated as said element expands and contracts, said arm being arranged to swing toward and away from said blade as it swings in one direction, the length of said arm and the position of its pivot with relation to said blade being such that as it swings toward said blade it first engages it and moves it toward said other blade to close said contacts, and then flexes both blades substantially before swinging away therefrom, thereby to provide a predetermined dwell or range of expansion and contraction of said expansible element in which said contacts remain closed.

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