Nov. 12, 1940. B. E. SHAW 2,221,223

REFRIGERANT CONTROL SYSTEM

Filed Dec. 6, 1939

Fig. 1

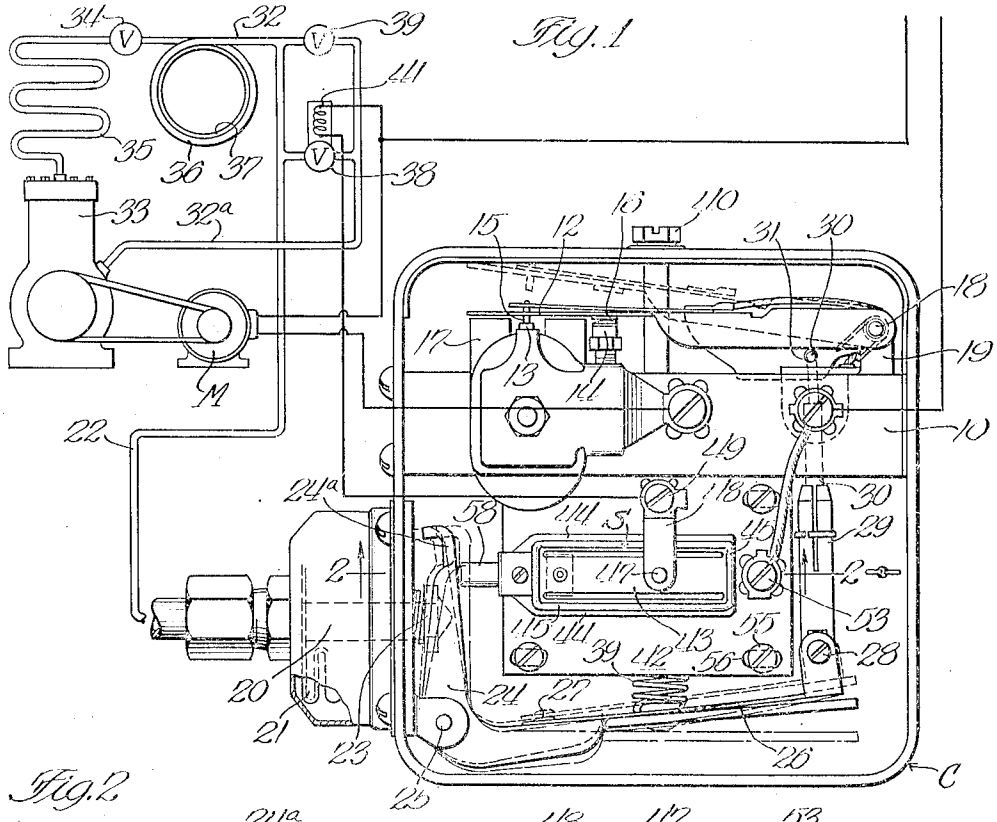


Fig. 2

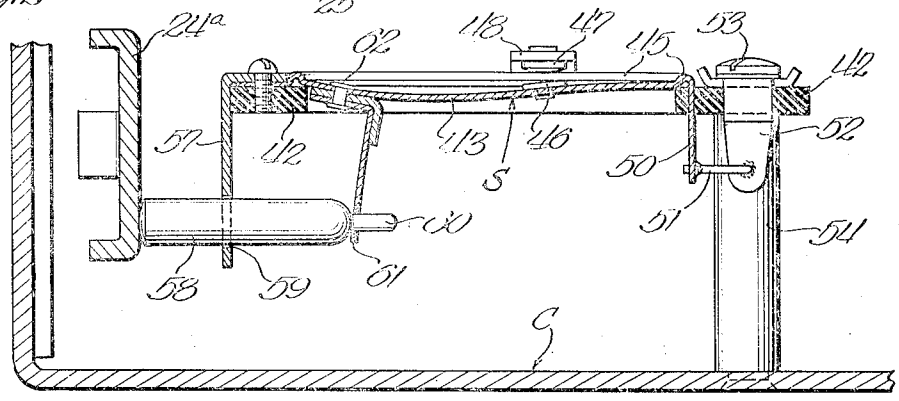
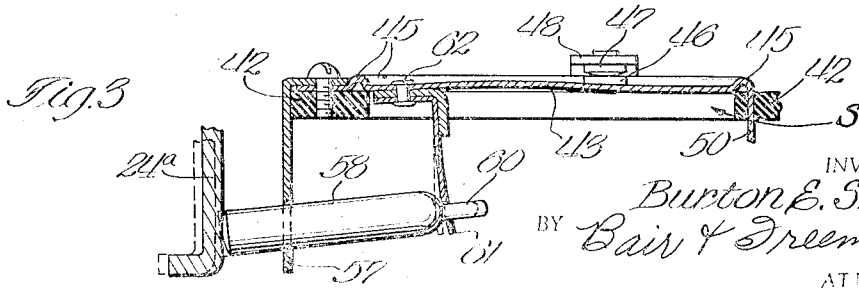


Fig. 3



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REFRIGERANT CONTROL SYSTEM

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14 Claims. (Cl. 62—4)

This invention relates to a refrigerant control system particularly designed for ice cream freezers, bottle coolers and the like wherein a freezer or bottle cooling chamber is occasionally washed out with hot water or steam.

One object of the invention is to provide a simple control system adapted to relieve excess pressure generated in one part of the refrigerant system as a result of using steam or hot water for washing out the freezer or bottle cooling chamber, my control system effecting relief of such pressure in said one part of the system by permitting it to flow into another part thereof.

Another object is to provide a control switch of the usual type having a pressure responsive main switch responding to the pressure in the low side of the refrigerant system, and a secondary switch operable when the pressure goes considerably above the normal operating range. The secondary switch is connected with a solenoid valve, the valve being normally closed and connected in the refrigerant system as from one portion thereof to another portion thereof, which portions are normally isolated from each other, thus relieving excess pressure in the one of said portions when the valve is opened by permitting it to pass to the other of said portions.

Another object is to provide the secondary switch of a type which resists movement of the pressure responsive means so as to prevent excess travel of such means, which when in the form of a bellows is susceptible to distortion and thereby subsequent alteration of the range adjustment of the switch under extreme pressure conditions.

With the foregoing and other contemplated as well as obvious objects in view, the invention comprises the combination of elements and arrangement of parts so combined as to coact and cooperate with each other in the performance of the functions and the accomplishment of the results herein contemplated, and comprises in one of its adaptations the species or preferred form illustrated in the accompanying drawing, wherein

Figure 1 is a front elevation of a switch structure used in my refrigerant control system, showing it diagrammatically hooked up with a refrigerant system and a solenoid valve;

Figure 2 is a sectional view on the line 2—2 of Figure 1 to show how the secondary switch is operated by the pressure responsive means of the main switch, the secondary switch being shown in normal or open position, and

Figure 3 is a similar view of a portion of Figure 2 showing the secondary switch in closed position.

On the accompanying drawing I have used the reference character C to indicate generally a casing. A bar 10 of insulating material is mounted in the casing C. A switch arm 12 is provided for cooperation with stationary contacts 13 and 14. The switch arm 12 carries contacts 15 and 16 for this purpose. A magnet 17 is mounted on the bar 10 for imparting snap action to the switch arm 12.

The switch arm 12 is pivoted at 18 to a bracket 19. The switch arm is operated by a bellows 21 in a bellows housing 20 through the following described mechanism: The head of the bellows 21 has a pin 23 extending therefrom. Pressure is communicated to the bellows housing 20 (for collapsing the bellows 21) through a pipe 22. The pin 23 coacts with a bell crank 24 pivoted at 25. A leaf spring 26 is riveted as at 27 to the bell crank 24.

The leaf spring 26 has a pivotal connection 28 with a link comprising portions 29 and 30. The link portion 30 coacts with an opening 31 in the switch arm 12 for swinging the switch arm as a result of longitudinal movement of the link 29—30.

For maintaining the bell crank 24 in contact with the operating pin 23, I provide a spring 39. The spring 39 is also a range adjusting spring, the tension of which is adjustable by a screw 40.

The pipe 22 is connected with the low side conduit 32 of a refrigerant compressor 33, as shown diagrammatically in Figure 1. The high side conduit is indicated at 34 and the condenser at 35. The evaporator coil 36 surrounds a chamber 37 which is adapted to contain ice cream, bottled beverages or the like. A solenoid valve 38 is connected between different portions 32 and 32a of the low side conduit so as to shunt a hand operated refrigerant valve 39 therein. The usual expansion valve of the refrigerant system is indicated at 34 and the winding of the solenoid valve is indicated at 41. For the winding 41, I provide a secondary switch, indicated generally as S, the contacts 13, 14, 15 and 16 constituting a main switch.

The main switch contacts are connected in circuit with the refrigerant compressor motor M in the usual manner. The secondary switch S is connected in circuit with the solenoid coil 41. The secondary switch includes a panel 42 on which is mounted a bowed leaf spring 43. The leaf spring 43 has frame members 44, the spring

and frame members being formed all of one piece. A reinforcing bead 45 circumscribes the frame and is depressed from the metal that forms the leaf spring and frame.

The formation of the bead causes the leaf spring 43 to assume a bowed shape and the direction of bowing obviously can be either up or down when the leaf spring is free. As shown, the bowing of the leaf spring is down, in Figure 2, so as to normally maintain a contact 46 on the leaf spring separated from a stationary contact 47. The contact 47 is mounted on a terminal bracket 48 having a terminal screw 49 for a circuit wire of the solenoid valve. The frame 44 of the leaf spring 43 has a downturned portion 50 passing through the panel 42, as shown in Figure 2, and connected by a lead 51 with a terminal bracket 52. A terminal screw 53 on the bracket 52 serves as a connection for another circuit wire, as shown in Figure 1.

The panel 42 is mounted on a plurality of posts 54 extending upwardly from the back of the casing C. Screws 55 are passed through slots 56 of the panel and screwed into the upper ends of the post 54. The slots permit adjustment for range, as will hereinafter appear.

A bracket 57 is secured to the panel 42 and a pin 58 extends slidably through an opening 59 in the bracket 57. The pin 58 has a reduced end 60 passing through a perforation in an arm 61 riveted at 62 to the leaf spring 43 and extending downwardly therefrom. The arm 61 is preferably a leaf spring. The pin 58 is in alignment with an extension 24a of the bell crank 24.

Practical operation

In the operation of the refrigerant system shown, the manual valve 39 is normally closed. When a batch of cream to be frozen is placed in the chamber 37, the valve 39 is opened so that refrigerant may flow through the evaporator 36. Thereafter the main switch 13-14-15-16 controls the refrigerant compressor motor M so as to maintain a substantially constant pressure in the low side conduit 32. The tension of the spring 39 is so set that this pressure produces the desired temperature drop in the evaporator 36. By way of example, the cut-out pressure in the housing 20 might be five pounds and the cut-in pressure twelve pounds. When the batch has been properly frozen as desired, the valve 29 is closed and the batch removed as desired.

After the chamber 37 is emptied of the batch, the chamber is washed out with steam or hot water. Many city ordinances require this operation, some specifying water heated to at least 180°. As a result of such washing, the pressure in the low side conduit 32 will rise possibly to one hundred twenty-five or one hundred fifty pounds if there is no means to release this pressure. Such high pressures are detrimental particularly to the bellows 21 and are apt to excessively distort it and change the range of operation of the switch. There is also much danger of rupturing the bellows.

Accordingly, I provide the secondary switch S set so that it will assume the closed position of Figure 3 when the pressure in the low side conduit 32 and the conduit 22 rises to about sixty pounds. This is well within the safety limit for the bellows and relieves the pressure thereon by opening the solenoid valve 38. As a result, the high pressure is relieved from the line 32 by permitting it to bypass the valve 38 and equalize with the contents of the portion 32a of the line and through the compressor (which will be operating because the main switch is closed) to the rest of the refrigerant system. Thus while the chamber 37 is being washed out, the danger of damaging the control switch is eliminated by energization of the solenoid valve 38, thus causing excess pressure developed in one part of the refrigerant system to be relieved into another part thereof.

The range of operation of the secondary switch can be changed by loosening the screws 55, shifting the panel 42 toward or away from the actuating extension 24a of the bell crank, as permitted by the slots 56, and then retightening the screws. The leaf spring 43 and the spring 61 offer a certain amount of resistance to the travel of the bellows 21, thereby shortening its travel and further minimizing the possibility of distorting the bellows. The bellows does not have to travel as far when such resistance is imposed on it as it would otherwise in order to operate the secondary switch S, and thus excessive elongation of the bellows is not necessary to operate the secondary switch even though its pressure of operation is a considerable distance above the cut-in pressure needed for operation of the main switch.

The spring 61 also makes it necessary for considerable return travel of the pin 58, as shown in Figure 3 from the full line position to the dotted line position, before the secondary switch opens again. Thus the excessively high pressure in the low side conduit 32 must be substantially reduced before the solenoid valve recloses and permits normal operation of the main switch in response to low side pressure. This insures the possibility of completing the washing out operation of the chamber 37 while the solenoid valve 38 remains open. After completion of the washing out operation, heat from the chamber 37 and evaporator 36 is dissipated to a point where the pressure in the line 32 is only slightly above the normal cut-in pressure of the main switch. Thus, a wide differential of operation of the switch S prevents the possibility of the solenoid valve 38 cutting in and out repeatedly during the washing of the chamber 37, as would be caused by a narrow differential. When the pressure in the line 32 recedes to about thirty pounds, the dotted position of Figure 3 is assumed whereupon the secondary switch opens and permits the refrigerant compressor system to operate in the normal manner in response to the main switch being thereafter operated by the bellows 21.

I have illustrated and described my improvement in an embodiment which I have found very satisfactory. I have not attempted to illustrate or describe certain adaptations or modifications which I contemplate, or the various uses and adjustments possible, as it is believed that the foregoing disclosure will enable those skilled in the art to which this invention appertains to embody or adapt my improvements as may be desired.

Having thus described my invention, I now claim and desire to secure by Letters Patent:

1. In a refrigerant control system, a main switch, pressure responsive means for automatically operating said main switch in accordance with pressure in a portion of the low side of the refrigerant system, said main switch being connected in circuit with the refrigerant compressor motor, a secondary switch operatively associated with said pressure responsive means to be closed thereby when the pressure affecting said pressure responsive means exceeds a predetermined degree above that at which it closes said main switch, said secondary switch again opening when the pressure recedes to a point between said prede-

termined degree and the degree at which said main switch opens, said point being substantially spaced from said predetermined degree, and a solenoid valve between said portion of the low side of the refrigerant compressor and another portion of the system to relieve excess pressure from the one to the other, said secondary switch being connected in circuit with said solenoid to effect opening of said valve when said secondary switch is in closed circuit position.

2. In a refrigerant control system, a main switch, refrigerant pressure responsive means for automatically operating said main switch, said main switch being connected in circuit with a refrigerant compressor motor of the refrigerant system, a secondary switch operatively associated with said pressure responsive means to be operated thereby when the pressure affecting said pressure responsive means exceeds a predetermined degree above that at which it normally operates said main switch, and a solenoid valve between two points of the refrigerant system and operable when open to relieve excess pressure from one of said points to the other, said secondary switch being connected in circuit therewith to effect opening of said valve when said secondary switch is operated.

3. In a refrigerant control system, a main switch connected in circuit with a refrigerant compressor motor for controlling it, a secondary switch responsive to pressure on the low side of an evaporator of the refrigerant system and operable upon the pressure therein exceeding a predetermined degree above normal, and a solenoid valve between said low side of the evaporator and another portion of the refrigerant system, said secondary switch being connected in circuit with said solenoid valve to effect opening thereof when said secondary switch is operated.

4. In a refrigerant control system, means for automatically controlling a refrigerant compressor motor of a refrigerant system, a secondary control responsive to pressure in a portion of said refrigerant system and acting, upon such pressure exceeding its normal operating value by a predetermined degree, to establish a circuit, and a valve between different points of the refrigerant system, said valve being electrically operated, said secondary control being effective to energize said valve when said secondary control responds to the refrigerant pressure and establishes said circuit.

5. In a refrigerant control system, main and secondary switches, means responsive to a condition of the refrigerant in the refrigerant system for normally operating said main switch for controlling the refrigerant compressor motor and for operating said secondary switch as a result of a change in the condition substantially beyond normal operating limits of the main switch, a normally closed solenoid valve connected with the low side of the refrigerant system and circuit connections with the solenoid coil thereof and with said secondary switch to effect operation of said solenoid valve when the secondary switch is operated, said secondary switch offering resistance to said condition responsive means to shorten the travel thereof.

6. A refrigerant control system comprising main and secondary switches, means responsive to a condition of the refrigerant in the refrigerant system for normally operating said main switch for controlling the refrigerant compressor motor and for operating said secondary switch as a result of a change in the condition substantially beyond normal operating limits of the main switch, a solenoid valve connected with the low side of the refrigerant system and circuit connections therewith and with said secondary switch to effect operation of said solenoid valve and thereby relief of pressure from said low side of said refrigerant system when said secondary switch is operated.

7. In a refrigerant control system, main and secondary switches, means responsive to low side pressure of the refrigerant in the refrigerant system for normally operating said main switch for controlling the refrigerant compressor motor and for operating said secondary switch as a result of an increase in the low side pressure substantially beyond normal operating limits of the main switch, a refrigerant control valve in the refrigerant circuit, a solenoid valve shunting said control valve and electric circuit connections therewith and with said secondary switch to effect opening of said solenoid valve when the secondary switch is operated.

8. In a refrigerant control system, a valve connected between different points of a refrigerant system, a control device responsive to normal pressure in a portion of the low side of the refrigerant system to automatically control the refrigerant compressor, said control device being operatively connected with said valve to open it upon movement of the control device beyond a normal operating position to a predetermined point, said control device being effective to reclose said valve at a point between said predetermined point and said normal operating position and substantially spaced from said predetermined point.

9. In a refrigerant control system, a valve connected between the low side of an evaporator circuit and another point, a control device responsive to normal pressure in the refrigerant circuit to automatically control said refrigerant compressor, said control device being also operatively connected with said valve to open it upon movement of the control device beyond a normal operating position.

10. In a refrigerant control system, a normally closed solenoid valve shunting two different points of a refrigerant circuit, a control device responsive to normal pressure in the low side of the refrigerant compressor, and a switch, said control device being operatively connected with said switch to close it upon movement of the control device beyond a normal operating position and said switch being connected in circuit with said solenoid valve.

11. In a switch structure, a main switch, an operating lever therefor, condition responsive means for normally operating said lever between predetermined operating limits and a secondary switch operated by said lever when it moves to a point beyond normal operating limits, said secondary switch comprising a supporting panel, a bowed leaf spring thereon anchored at opposite ends, a stationary contact on said panel, a contact on said leaf spring normally spaced therefrom by reason of the bowed shape of said leaf spring and an arm extending laterally from said leaf spring and operatively engaged by said leve to reverse the bow of the leaf spring and thereby engage the contact thereon with said stationary contact.

12. In a switch structure, a main switch, an operating element therefor, condition responsive means for normally operating said element between predetermined operating limits and a sec-

ondary switch operated by said element when it moves to a point beyond normal operating limits, said secondary switch comprising a support, a bowed leaf spring thereon anchored at opposite ends, a stationary contact, a contact on said leaf spring normally spaced therefrom by reason of the bowed shape of said leaf spring and an arm extending laterally from said leaf spring and operatively engaged by said element to reverse the bow of the leaf spring and thereby engage the contact thereon with said stationary contact, said leaf spring resisting movement of said element to decrease the travel thereof necessary to close said contacts.

13. In a switch structure, a main switch, an operating element therefore, condition responsive means for normally operating said element between predetermined operating limits and a secondary switch operated by said element when it moves to a point beyond normal operating limits, said secondary switch comprising a support, a bowed leaf spring thereon anchored at opposite ends, a stationary contact and a contact on said leaf spring for coaction with said stationary contact when said leaf spring is bowed in one direction, and a leaf spring arm extending laterally from said first mentioned leaf spring and operatively engaged by said element to reverse the bow of said first mentioned leaf spring.

14. In a switch structure, a main switch, an operating element therefor, condition responsive means for normally operating said element between predetermined operating limits and a secondary switch operated by said element when it moves to a point beyond normal operating limits, said secondary switch comprising a support, a bowed leaf spring thereon anchored at opposite ends, a stationary contact and a contact on said leaf spring for coaction with said stationary contact when said leaf spring is bowed in one direction and an arm extending laterally from said leaf spring and operatively engaged by said element to reverse the curvature of said leaf spring, said support being slidably mounted for movement toward or away from said element to change the operating range of said secondary switch.

BURTON E. SHAW.