Oct. 10, 1933. J. L. SHRODE 1,929,523

REFRIGERATING CONTROL MEANS

Filed April 11, 1930 2 Sheets-Sheet 1

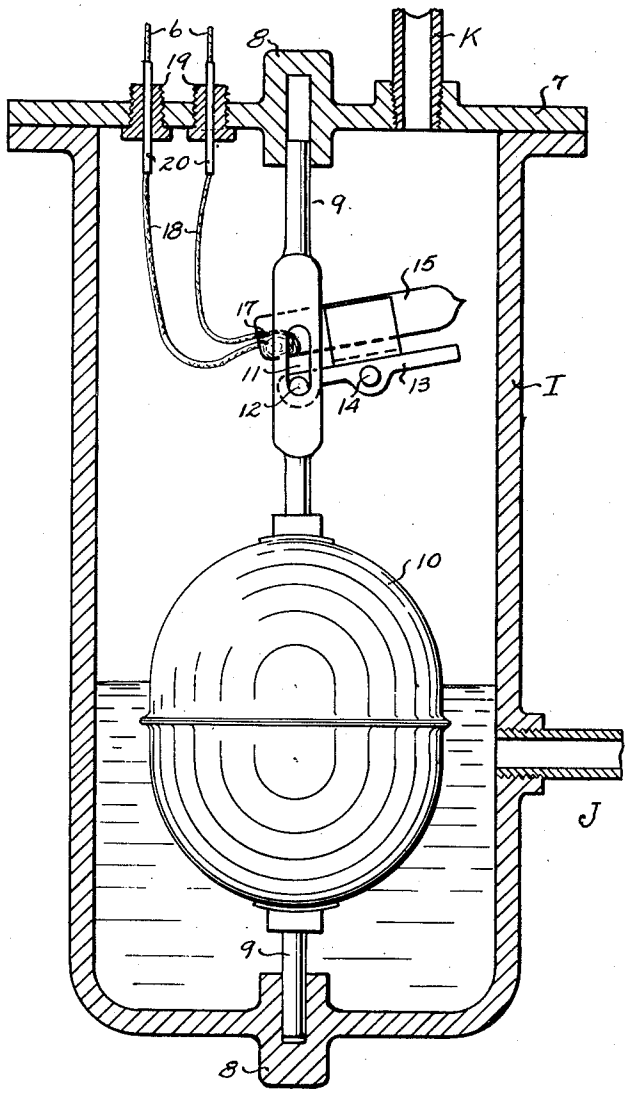


FIG. 1

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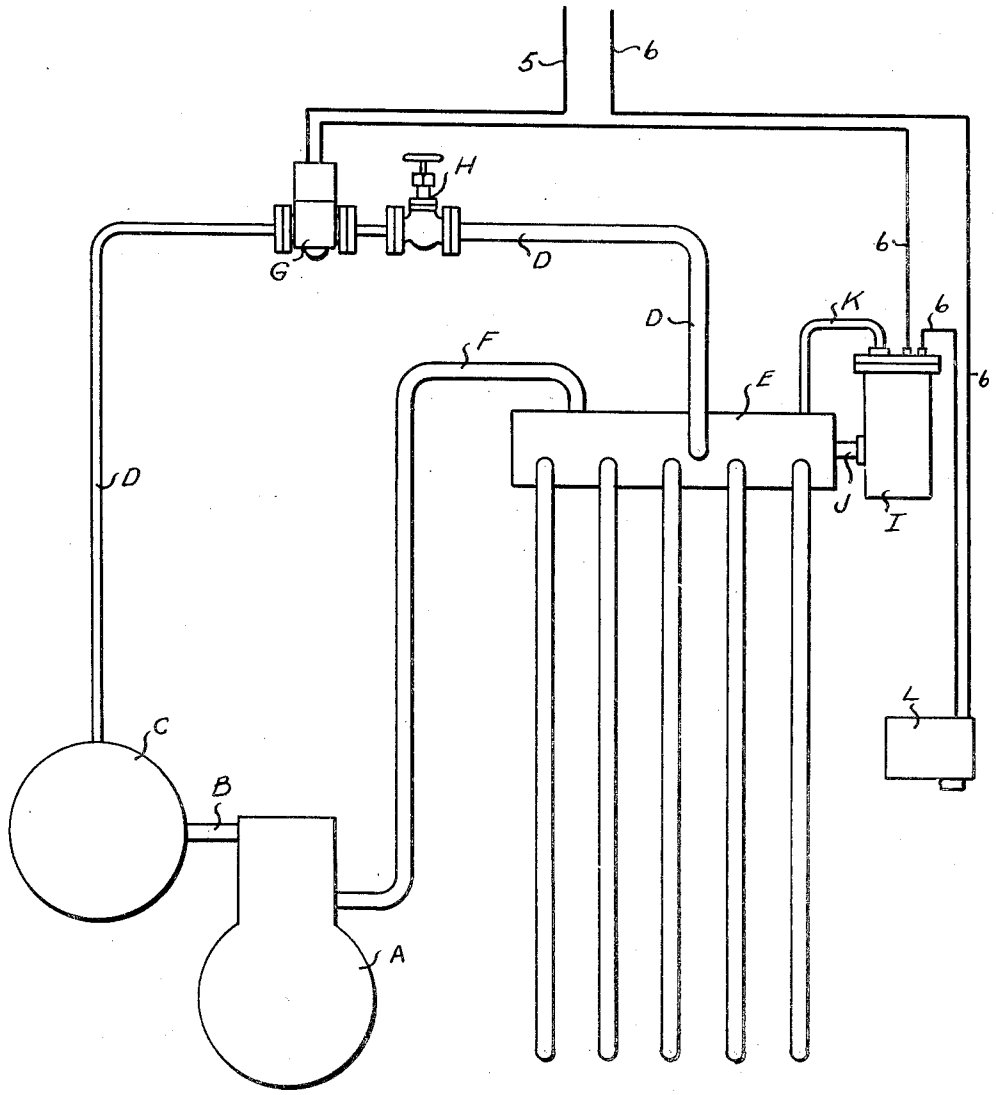


FIG. 2

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REFRIGERATING CONTROL MEANS

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9 Claims. (Cl. 62—3)

This invention relates to improvements in refrigerating control means, and particularly to an improved float-actuated switch assembly as employed for purposes of controlling a flow of liquid refrigerant.

An object of the invention may be generally stated as the attainment of an improved regulation and control of the quantity and flow of liquid refrigerant in the expansion portions of a refrigerating system.

Another object is to produce a more reliable and more readily responsive automatic control of the delivery of refrigerant to the low pressure side of a refrigerating system.

A still further object is attained in a novel combination of switching means for refrigerant flow control, disposed within the low pressure side of the system and controllable by a liquid level therein, with thermally responsive means, such as a thermostat, in the same control circuit.

A further object of the invention is found in the improved arrangement and combination of enclosed parts constituting a float actuated switch in an electric circuit including translating means for control of a valve in a liquid line of the high pressure portion of a refrigerating system.

Yet another object of the invention is attained in an improved structural arrangement of parts comprising a float-actuated switch assembly, whereby such assembly may, as a unit, be installed within, or removed from the refrigerating system for purposes of repair or replacement of parts, with a minimum, or no interruption of use of the system.

Further objects and advantages of the invention will appear from the following detailed description and drawings of a presently preferred executional embodiment of the invention. In the drawings:

Fig. 1 is a sectional elevation through a preferred form of float switch tank, and Fig. 2 is a schematic or diagrammatic representation of a refrigerating system equipped according to the present improvements.

Referring now by reference characters to the drawings, the system shown in the diagram of Fig. 2 includes a compressor A, the discharge or high pressure side of which is connected as by a pipe B to a condenser unit C which may be of any usual form, and which may consist of a condenser of usual type, or some combination of condenser and receiver. The unit C is arranged for delivery of the liquid refrigerant such as ammonia, through a pipe D, to an expansion unit E. It will be understood that in the present instance, the expansion unit E may consist of one or any suitable number of cooling coils disposed in the same, or different locations, the present system of control being well adapted for a multiple low-side system embodying a plurality of freezing units. It is preferred in such case to employ a single liquid-receiving portion whose inlet is supplied by the pipe D. The outlet from the expansion unit is connected to a pipe F, directed to the inlet side of the compressor A, and thus the refrigerant completes a circuit of the system.

For purposes of controlling the flow of liquid from the unit C through pipe D and into the expansion unit, I provide an electro-magnetic stop-valve G in the line D, this valve being of any suitable type and so arranged that the valve element is lifted or opened to permit flow through the pipe D when the electro-magnetic structure of the valve is energized, as hereinafter described. Interposed in the same line, and beyond the magnetic valve, is a flow-limiting valve H, which may be of any suitable type, and which is, by preference, provided as a means for establishing the desired maximum flow of refrigerant through the pipe D.

There is disposed, by preference adjacent the expansion unit, a float switch tank I, which is connected to the liquid-containing portion of the expansion unit by means of a pipe J, arranged, normally, to maintain the same level of liquid in the float tank I, as in the expansion unit E. There is further provided a vent tube K having its inlet in the upper portion of the float tank, and its opposite end likewise in the upper portion of the liquid chamber of the expansion unit. The vent tube serves to maintain a uniform vapor pressure in each of the tanks E and I, above their respective bodies of liquid.

There is provided by preference and shown diagrammatically at L, a thermostat in the nature of any usual form of thermally-responsive circuit closing means preferably arranged to close the circuit hereinafter referred to upon attaining approximately a given temperature in the refrigerated enclosure, the device being, by preference and as known in the art, adjustable to different settings according to the different refrigerating temperatures desired.

The electrical control-circuit arrangement employed in the present example is thought to be apparent from Fig. 2, but may briefly be described as consisting of a feeder circuit having as legs the conductors 5 and 6, the side 5 of the line, according to the present showing being connected directly to the magnetic stop-valve G,

and the side 6 being provided with switching means indicated as the thermostat L and with additional switching means within the float tank, as hereinafter described, thence connected to the opposite side of the stop valve G.

Referring now more particularly to Fig. 1, it will be seen that the float tank I is, by preference, of upright, cylindrical form and may be of cast construction, provided with a single removable end plate or head member 7 which may be secured as by bolts, (not shown) to the flanged upper portion of the tank I. Centrally disposed at the opposite ends of the tank I are a pair of bosses 8 provided with central sockets or guide ways for slidably receiving the opposite ends of a float rod 9, to which is affixed a float 10, preferably of hollow metallic construction. The rod 9 is, in the present arrangement, provided with a slotted aperture 11 adapted to accommodate in lost motion engagement, a switch pin 12. This pin extends from one end of a rocking lever 13, supported for movement about a pin 14 carried for example, by the wall of the casing I. The plate 13 serves to carry, in fixed relation, a tube 15 containing a small quantity of mercury, one end of the tube being provided with spaced interior terminals 17 to respective ones of which are connected conductors 18, each constituting a portion of the line 6 as it appears externally of the float tank. Entrance bushings 19 are by preference threadedly mounted in the head portion 7 of the tank, these bushings being formed preferably of insulating material. Extending centrally through each of the bushings 19 is a metal sleeve 20 which serves closely to engage the outside of the conductor in a manner to constitute a fluid-tight joint.

While the operation of the device constructed according to this invention may be fully apparent from the preceding description of its parts, it may be briefly summarized for sake of completeness, as follows:

The operation of compressor A, together with the condensing action of the unit C, creates a flow of liquid refrigerant through the pipe D, into the expansion unit E, as determined, of course, by the opening or closing of the electromagnetic stop valve G, and subject to any restriction of flow that may be imposed by adjustment of valve H. The effect is obviously to maintain liquid refrigerant at certain levels in the expansion unit E, and by means of the pipes J and K at corresponding levels in the float tank I. Under the influence of raising or lowering the level of liquid in tank I, the float 10 and float rod 9 are raised and lowered. With a certain decrease in volume of liquid in tank I, as the liquid is vaporized and subjected to expansion in the unit E, the float 10 is depressed by its own weight so that the upper portion of slot 11 impinges against pin 12 brings the corresponding end of the mercury tube 15 below horizontal position. The weight of the mercury serves further to rotate the mercury switch about pivot 14 until the pin 12 rests in the position appearing in Fig. 1, when the side 6 of the control circuit is closed, insofar as determined by the tank switch. Assuming that the temperature of the refrigerated enclosure is high enough to require further expansion in, and cooling action by the unit E, the thermostat L will move to closed position. The circuit having previously been closed across terminals 17, the electro-magnetic valve C will be energized and opened, permitting flow of refrigerant to the expansion unit. As this flow continues and as freezing progresses, the level of liquid will rise in the cooling unit E, and correspondingly in the tank I. The pin 12 engaging the lower extremity of the slot 11 will then tend to raise the corresponding end of the plate frame 13 to tilt the mercury switch to somewhat beyond horizontal position, moving the mercury by gravity away from the terminals 17 to the opposite end of the tube, causing the pin 12 again to engage the upper or outer end of the slot 11 and leaving the switch in open position, thus deenergizing the electro-magnetic valve, regardless of whether thermostat L is in open or closed position.

Obviously the system and control arrangement is operative without the provision of thermostat L, which may be omitted or shorted out if operating conditions are such that the opening or closing of valve G may be effected solely in accordance with the quantitative flow of liquid to the expansion unit.

I am aware of the fact that it is well known to employ mercury type switches in control circuits of various types; further that it has been known to use a float for purposes of regulating a flow or supply of liquid refrigerant. So far as I am presently aware, however, there has not previously been employed the present combination of a mercury type switch directly float-actuated according to rise and fall of liquid level, and in a common container. The certainty of control and known advantages of a mercury type switch provide, according to the present system, an improved regulation of operation and more reliable automatic control than has heretofore been attained in systems of this type. The present arrangement of float switch assembly within a single container eliminates all glands, stuffing boxes, packing, etc., incident to locating the float inside and the switch outside of the liquid chamber. Except for the disadvantage of necessarily shutting down the system for switch replacements or repairs, the float switch assembly may be mounted in the expansion unit itself, instead of employing the preferred arrangement of a separate float tank.

The fluid tank assembly including the structural combinations described, possesses distinct advantages from the point of view of service access and ease of installation. It will appear that the present arrangement provides a double control, through magnetic valve G, over the flow of refrigerant into the low pressure side of the system, the valve being responsive to cut off the flow of refrigerant according to the open position of either the thermosat L or the tank switch assembly.

From the point of view of convenience of access for any purpose it will appear that the entire float valve assembly may be removed from the head of the tank I simply by removing the bolts (not shown) securing the head or cover 7 to the tank, and withdrawing the entire assembly as a unit from the tank.

To the end of simplifying replacements or repairs it is my preference to provide valves (not shown) in the pipes J and K, which valves may be closed to render the removal of the entire float tank a matter of but a few minutes time and without necessitating any interruption of the system whatever. The arrangement presently described has been found to be durable and practical, and to be particularly adapted for use in multiple low-side systems employing several freezing units, and in other respects to fulfill the several objects noted above.

The detailed nature of the present disclosure is to be understood only as descriptive of a particular preferred embodiment, and not, in any sense, to limit the scope of the invention, since the parts shown, as well as their arrangement and various combinations may be varied substantially within the intendment of the appended claims.

I claim:

1. Refrigerating apparatus including a float-control chamber for an ammonia system of flooded type, and adapted to contain a variable level of refrigerant, a float assembly in said chamber, including a switch having its operating parts sealed in said chamber and its terminals out of contact with the refrigerant, said switch adapted for relating the movements of said float for controlling liquid ammonia supply to said chamber, a switch conductor extending through a chamber wall, and a combined sealing and insulating bushing for said conductor, secured to said wall.

2. Refrigerating apparatus including a compressor, a condenser, an expansion unit, an electrically actuated valve for controlling a flow of refrigerant to the expansion unit, a chamber associated with the expansion unit, a valve-circuit control switch, the movable elements of which are disposed entirely within said chamber, switch conductors extending therefrom through a wall of said chamber, said switch arranged for automatically controlling the energization of said valve, responsively to the quantitative flow of refrigerant from the condenser into said expansion unit, and insulating means about the switch elements and portions of the conductors, arranged to seal said elements and conductor portions against contact with the refrigerant.

3. Refrigerating apparatus including a compressor, a condenser, an expansion unit, an electrically actuated valve for controlling a flow of refrigerant to the expansion unit, a chamber communicating with the expansion unit, a switch disposed in said chamber above the maximum level of refrigerant therein, and arranged in circuit with said electrically actuated valve, connections from said switch, through a wall of the chamber, to said valve, fluid-tight bushings for said connections constructed to insulate the connections from said wall, and to seal the chamber about the connections, and a float in said chamber, operatively related to said switch.

4. Refrigerating apparatus including in combination, a compressor, a condenser, an expansion unit, an electrically actuated valve for controlling a flow of liquid refrigerant to the expansion unit, a chamber communicating with the expansion unit, a float-actuated switch assembly having switch terminals out of contact with the refrigerant, the switch parts all being disposed for operation entirely within said chamber, and arranged for controlling said valve, connections from said switch to said valve, and insulating bushings forming a fluid-tight seal for said connections, where they extend through a wall of said chamber.

5. A refrigeration system including a compressor, a condenser, an expansion unit, an electrically-actuated valve for controlling a flow of refrigerant to the expansion unit, a chamber associated with the expansion unit and containing a liquid refrigerant, a switch of conducting-liquid type mounted for actuation within said chamber and in circuit relation for controlling said valve, thermal-responsive means in similar circuit relation, for controlling said valve according to refrigerating temperatures, and means for actuating said switch responsively to a change in liquid level in said chamber.

6. In a refrigerating system, an expansion unit, an electrically controlled refrigerant valve, a switch assembly including a pressure container therefor connected near its opposite ends with the expansion unit, and thereby subjected to the pressures within the expansion unit, a mercury switch and conductors thereto, disposed entirely within said container, the conductors extending outwardly through the container wall, a float operatively connected with the switch, the switch arranged for relating the position of said valve to the position of the float, and combined insulating and pressure-sealing members for the conductors, threadedly carried by the container wall.

7. In a refrigerating system, a compressor, a condenser, an expansion unit, an electrically energized valve arranged to control flow of refrigerant to the expansion unit, a switch assembly for controlling said valve and arranged for actuation responsively to the quantity of refrigerant in said expansion unit, said assembly being sealed in fluid-tight relation in a part of the expansion unit, and including a conducting-liquid type switch, switch leads extending from the switch through the enclosing structure, a float, a rod operatively associating the float and switch, and combined insulating and sealing members for the switch leads, disposed beyond the liquid zone within the expansion unit.

8. A refrigerant control switch assembly including a fluid-tight container for liquid refrigerant, having an inlet opening and an outlet opening, a float and a mercury switch in said container, means relating the movement of the float for actuating the switch, conductors from the switch to points without the container, and conductor bushings formed of an insulating material, and secured in sealing relation to the wall of the container, and about the associated conductors.

9. In combination in an ammonia refrigerating system, a control-switch assembly including a fluid-tight float tank adapted to be subjected to internal pressure other than atmospheric, said tank having a liquid inlet passage and a vent passage, a mercury switch in said tank, conductor-bushings of insulating material, said bushings being mounted in fluid sealing relation in a wall of the container above the liquid levels therein, conductors from said switch to a point outside of said tank, and a float having operative connection with said switch, said tank having a removable wall portion, the operative portions of the assembly being removable as a unit upon removal of said wall portion.

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