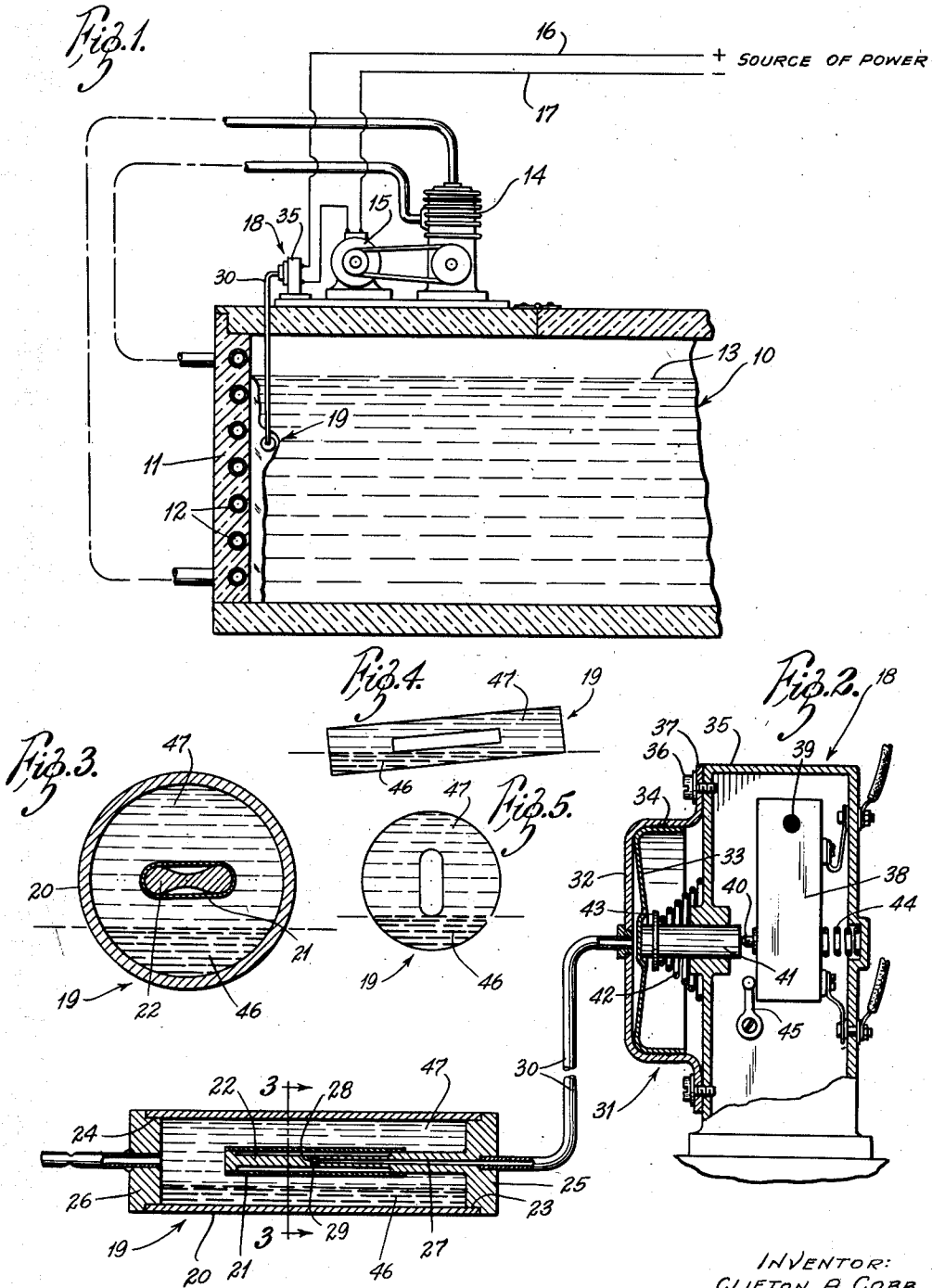


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ICE BANK CONTROLLER
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ICE BANK CONTROLLER

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2 Claims. (Cl. 297—3)

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This invention relates to control devices for controlling the thickness of ice formation in refrigerators or ice makers or the like and more particularly pertains to that class of controllers which utilize the expansion of a freezing liquid as an actuating force.

The present invention is a continuation in part of my co-pending application Serial No. 57,859, filed November 2, 1948, entitled "Ice Bank Controller," now Patent No. 2,561,437, dated July 24, 1951. In this prior application I have shown and described a controller having a temperature sensitive element comprising a relatively thick walled receptacle filled with a freezing liquid and a relatively thin walled collapsible receptacle arranged within the first receptacle and surrounded by and in contact with the freezing liquid. The arrangement further includes a remote expansible element and a fluid conduit connecting the inner collapsible element with the expansible element so as to form a sealed system which is completely filled with a non-freezing motion transmitting liquid.

The present invention has for an object the provision of an ice bank controller having a temperature sensitive element of the above character in which the outer receptacle contains in addition to a freezing liquid a non-freezing liquid which is immiscible therewith and which is in contact with the wall of the inner collapsible element thereby to transmit the force more uniformly to the collapsible member than would occur otherwise as the freezing liquid expands upon freezing.

Another object of the present invention is to provide an ice bank controller having a temperature sensitive element of the above character in which the outer receptacle contains a freezing liquid and a nonfreezing liquid which are immiscible and have different specific gravities and in which the proportions of the outer and inner receptacle and the proportions of the freezing and non-freezing liquids are such that the walls of the inner collapsible element are entirely in contact with the non-freezing liquid irrespective of the position of the temperature sensitive element. Further objects and advantages will appear from the following complete description when read in connection with the accompanying drawing.

In the drawing:

Fig. 1 is a schematic view showing a cooler in part together with a motor driven compressor and refrigerant evaporator coils and a control device constructed in accordance with the present invention associated therewith so as to control the starting and stopping of the compressor, thereby to maintain a predetermined thickness of ice formation on the wall of the cooler.

Fig. 2 is an enlarged view of the control device shown in Fig. 1 in which parts have been shown in section to more clearly illustrate.

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Fig. 3 is an enlarged transverse sectional view taken through the feeler bulb of the control device shown in Fig. 2 and is taken on line 3—3 of Fig. 2.

Figs. 4 and 5 are schematic views indicating the arrangement and proportions of the inner and outer receptacles and the proportions of the freezing and non-freezing liquids.

The reference numeral 10 indicates a cooler shown in part having a wall 11 in which are arranged refrigerant evaporator coils 12. The cooler is substantially filled with water as indicated at 13 and the refrigerant coils connect with a compressor indicated at 14 which is driven by an electric motor 15. A circuit for the motor 15 is provided, comprising the leads 16 and 17 which are connected to a source of power and a control device generally indicated at 18, is interposed in the circuit to effect an off and on control of the operation of the compressor. The control 18 includes a feeler bulb generally indicated at 19 with its position at a predetermined distance from the wall 11 thereby to control the thickness of the ice bank.

A preferred form of the bulb 19 is shown in Figs. 2 and 3 and comprises a round outer metal tube 20 in which is fitted a relatively thin walled inner collapsible metal tube 21. The metal tube 21 may be a flat sided tube as indicated and may have inserted therein a filler bar 22 having concave surfaces opposite the flat sides of the tube. At its outer ends the circular outer tube 20 receives the circular end closing plugs 25 and 26. The end closing plug 25 is shown as being integral with the filler bar 22. It may however be attached to the filler bar in any suitable manner as by welding or soldering. The closing plugs 25 and 26 may be rigidly held in place by soldering or welding.

There is a longitudinal passage 27 in the filler bar 22 extending from one end to approximately the center of its length and transverse passages 28 and 29 intersecting the passage 27 thereby to provide communication between the passage 27 and the opposite spaces which lie between the concave sides of the filler bar and the flat sides of the inner tube 21. The passage 27 extends through the end closing plug 25 and receives at its outer end a capillary tube 30. The other end of the capillary tube 30 communicates with the interior of an expansible chamber generally indicated at 31 which comprises a rigid outer metal cup member 32 and an inner flexible cup member 33. The outer and inner cup members 32 and 33 are attached along their side walls as by continuous welding as indicated at 34. As fluid pressure is applied through the capillary 30 to the space between the bottom walls of the cups, the bottom wall of the inner flexible cup member deflects outward in a well known manner.

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The expansible element 31 is mounted on the side of a casing 35 by attachment screws 36 which pass through a flange 37 on the outer cup member 32. Within the casing 37 there is pivotally mounted a sensitive snap action switching device 38 mounted on a pivot 39 which is supported in the side walls of the casing. The switching device 38 is provided with an actuating plunger 40 and the switch mechanism is arranged so as to open the compressor circuit upon depression of the actuating plunger 40. Slidably fitted in the wall of the casing is a second actuating plunger 41 which bears at one end on the bottom wall of the inner flexible cup member 33 and at its other end on the switch actuating plunger 40.

A relatively strong diaphragm return spring 42 biased between the front casing wall and a flange 43 on the plunger 41, resists expansion of the element 31. A second relatively strong spring 44 biased between the rear wall of the casing and the switch unit 38 provides for over travel movement of the expansible element thereby to protect the switch mechanism, and an adjustable stop 45 is provided to adjust the position of the switch 38 with relation to the plunger 41.

The inner thin walled metal tube 21 is sealed at both ends as by soldering or welding to the filler bar 22 and this inner tube, the capillary 30 and the expansible element 31 form a sealed system which is filled with a suitable motion transmitting liquid such as xylene (ortho) having a relatively low freezing point and relatively low thermal expansion. The outer receptacle 20 contains a suitable freezing liquid 46 which preferably freezes at 32 degrees Fahrenheit such as pure water and a suitable non-freezing liquid 47 such as naphtha which is immiscible therewith and is of different specific gravity. By way of illustration the freezing liquid is shown as the heaviest. The inner thin walled receptacle 21 may be centrally located within the outer receptacle and sufficiently spaced from the side and end walls thereof and the proportions of the freezing and non-freezing liquids therein may be such that the walls of the inner receptacle will always be in contact with the non-freezing liquid irrespective of the position of the assembly as indicated in Figs. 4 and 5. This arrangement is preferred but it is not essential that the entire wall of the inner element be in contact with the non-freezing liquid to achieve some degree of advantage with the present invention. Because as long as the non-freezing liquid is in contact with at least a portion of the wall of the inner element an equalizing effect of expansion will be achieved.

In operation the feeler bulb is placed in the water filled cooler and spaced at the desired distance from the wall or evaporator coil. If the ice bank is not thick enough to touch the bulb in this position, the temperature of the bulb and the freezing liquid therein will be above the freezing point and under these conditions, the expansible element 31 is retracted by the return spring 42 and the bottom of the inner cup member 33 is contiguous with the bottom of the outer cup 32, permitting the switch 38 to close and complete an energizing circuit for the operation of the compressor. As the ice bank thickens under operation of the compressor to a point wherein the feeler bulb is substantially encompassed thereby, the freezing liquid or water within the bulb will begin to freeze.

As this liquid begins to freeze the increased

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volume within the outer receptacle will cause the collapse of the thin walled receptacle 21 and the expansible element 31 will be expanded to actuate switch 38 to an open position thereby stopping the compressor.

It will be seen that a non-freezing liquid cushion is provided between the freezing liquid and the thin collapsible walls of the inner receptacle whereby a uniform force is applied to the walls of the inner receptacle.

The foregoing is intended to be illustrative, not limiting, the scope of the invention being defined in the appended claims.

I claim:

1. An ice detecting bulb for use with a remotely situated fluid pressure operated refrigeration control device having an expansible chamber, said bulb comprising a closed metal outer tube of circular cross section and relatively thick wall, and a closed metal inner tube of relatively thin flexible walls supported centrally within said outer tube, said inner tube being flattened so as to have substantially flat and parallel opposite side walls and rounded edges and being of such size as to be spaced from the side walls of said outer tube, a fluid conduit connecting one end of said inner tube with said expansible chamber, said inner tube, said conduit, and said expansible chamber being filled with a non-freezing motion transmitting liquid, and said outer tube containing an amount of water sufficient to abruptly displace upon freezing, a substantial portion of the liquid in said inner tube, and an amount of non-freezing liquid immiscible with the water to complete the filling of said outer tube.

2. In a device of the class described, an expansible chamber, a remote ice detecting bulb comprising a closed rigid walled outer receptacle, a smaller closed flexible walled inner receptacle supported centrally within said outer receptacle, said inner receptacle having a fluid conduit connected thereto which extends exteriorly of said outer receptacle and is connected at its other end to said expansible chamber, said inner receptacle, said conduit, and said expansible chamber being filled with a non-freezing motion transmitting liquid, said outer receptacle containing sealed therein in sufficient total quantity to fill it, a smaller portion of water, and a larger portion of a non-freezing liquid which is immiscible with water and of different specific gravity than water, said inner receptacle being sufficiently smaller than said outer receptacle and said portion of non-freezing liquid in said outer chamber being sufficiently greater than the portion of water so that the walls of said inner receptacle will be completely in contact with said non-freezing liquid at all times irrespective of the position of said bulb.

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