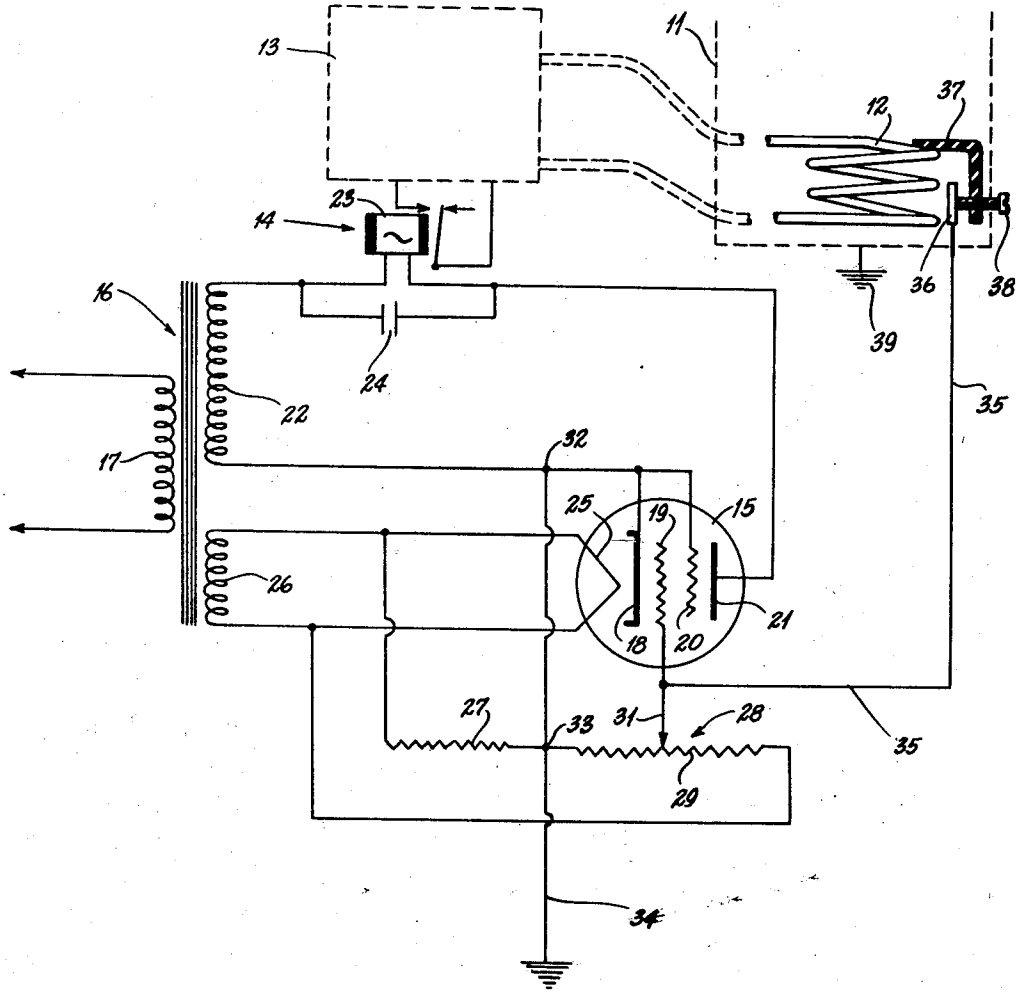
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DEVICE FOR CONTROLLING ICE FORMATION

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DEVICE FOR CONTROLLING ICE FORMATIONS

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This invention pertains to control devices generally and concerns itself more particularly with apparatus for controlling the volumetric degree to which a change in state of a given medium is carried out.

It is a general aim of the invention to provide a control circuit by means of which the degree to which a change in state of a given medium is effected may be controlled, as, for example, water to ice.

It is a further object of the invention to provide a control circuit capable of controlling the degree of a change of state of a given medium, said control circuit utilizing the resistive characteristics of the medium in its changed state.

Still another object of the invention is to provide apparatus for controlling the degree to which a change of state of a given medium is effected by utilizing a portion of the medium in its changed state as an electrode insulator.

More specifically, it is an object of the invention to provide a control device for water coolers refrigerated by means of a refrigerating coil which will provide for an accumulation of ice on said coil to a predetermined amount.

Other objects and advantages will become apparent as the description proceeds, and a more comprehensive understanding of the invention will be afforded from the following detailed description, when considered in conjunction with the accompanying drawing, in which the figure is a schematic circuit diagram of a control device embodying the instant invention.

While the instant invention is not limited to any particular use, it will be described in connection with a beverage cooler unit, it being specifically understood that the invention is not to be limited to this adaptation.

With reference to the figure, a tank 11 is illustrated as taking the form of a beverage cooler in which is carried a refrigerating coil 12 supplied with a coolant by a refrigerating system 13. The latter element may take any of the usual forms and is thought of as comprising a motor-controlled compressor which is turned on and off in accordance with demands for refrigeration by means of a relay device 14.

In the particular application here illustrated, the tank 11 is usually filled with a cooling medium, such as water, and it is frequently desirable to have the coil 12 coated with a certain amount of ice which will aid in carrying the cooling load imposed by the water in the tank, which is used to cool immersed articles

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such as bottled beverages. Since the refrigerating apparatus 13 is set to supply the necessary coolant to the coil 12 to freeze the water in the tank, it is often desirable to control the amount of ice which is to be formed on the coil 12. For the purpose of effecting such control, the instant invention is adaptable.

Here the refrigerating mechanism 13, which in other applications may take the form of any device to be controlled, is operated by the relay 14 under the control of an electronic switching element 15, which may take the form of a tetrode. A control current is supplied to the electronic discharge device 15 by means of a transformer 16 which has its primary winding 17 connected across a suitable source of electric supply. The discharge device 15 has a cathode 18, a control grid 19, a suppressor 20, and a plate 21. The cathode 18 and the plate 21 are connected across a secondary winding 22 of the transformer 16 and are in series with a relay winding 23, forming a part of the relay device 14. A capacitance 24 is connected across the winding 23 to improve the holding characteristics of the relay.

A heating device 25 for the cathode electrode 18 of the discharge device 15 is supplied energy by a secondary winding 26, also forming a part of the transformer 16. Connected across the heating circuit, and in parallel therewith, is a dropping resistance 27 and a potentiometer 28 having its winding 29 in series with the dropping resistor 27. A variable tap 31 of the potentiometer 28 is connected to the control grid 19 of the device 15. The circuit is grounded at points 32 and 33 by means of a line 34. Also, a line 35 is tied to the control grid 19 and connects with an electrode 36 mounted to be in proximity to the coil 12 and insulated therefrom. The electrode 36 is carried in a bracket 37 which is connected by an insulating connection to the coil 12 and is so arranged on a screw 38 as to be moved toward or away from the coil 12.

With the parts arranged as shown, the screw 38 should be made of nonconducting material. Also, that portion of the wire 35 extending into the tank should be protected with waterproof insulation so that only the electrode 36 can make electrical contact with the water in the tank. Thus, the setting of the electrode with respect to the coil 12 determines the amount of ice which will form on the coil, since envelopment of the electrode 36, only, is necessary to shut off the refrigerating system.

Operation

In operation, the tank is grounded at 39, as shown, and the variable arm 31 of the potentiometer 28 is adjusted so as to supply a control voltage on the electrode 19 which is just under a potential necessary to render the discharge device 15 conducting. During the time this adjustment is made, no water is present in the tank. After it is made, the tank is filled with water to immerse the coil and provide a cooling medium for the bottled beverages.

When the aforementioned adjustment is made, the shunt circuit, traceable from the point 33 through the line 34, the ground 39, the tank 11, the electrode 36, and the line 35 back to point 33, is open between the electrode 36 and the tank 11, since no water is present in the tank. When water is introduced into the tank, its relatively high conductivity (in its liquid state) closes the circuit from the electrode 36 to the tank, which effectively shunts out the left-hand portion of the potentiometer winding 29 (to the left of the divider arm 31). With the left section of the potentiometer thus shunted, the potential drop across that section is reduced, and the voltage appearing on the grid 19 is decreased. This causes the discharge device 15 to be conductive, which, in turn, energizes the relay 14 to start the refrigerating system 13. This, in turn, supplies a coolant to the coil 12 and thereafter a coating of ice is formed on the coil. When this coating of ice has reached sufficient proportions to envelop the electrode 36, the high resistive properties of the ice coating the electrode 36 effectively insulate the same to again open the shunt circuit previously described. With this branch of the circuit open, all of the winding 29 of the potentiometer 28 is made operative in the control voltage circuit causing a resultant increase in the potential of the control voltage appearing on the grid 19, whereupon the discharge device 15 is rendered nonconductive, and relay 14 operative to shut off the refrigerating system 13. Thereafter, the system remains static until the ice melts from the electrode 36, whereupon the cycle is repeated.

It will be seen from the foregoing that a coating of ice is maintained on the coil 12, whose volumetric proportions are determined by the position of the electrode 36 with respect to the coil 12. Since the electrode 36 is adjustable relative to the coil by means of the screw 38, it is possible to maintain a coating of ice on the coil 12 sufficient to aid in carrying the cooling load as determined by variable conditions.

While a particular embodiment of the invention has been illustrated and described, it is apparent that many wide variations and changes could be made therein. Accordingly, all such changes and modifications to which the invention is susceptible are included as if described, and the invention is to be limited only by the appended claims.

What is claimed is:

1. In a device of the class described, electrically operable means for changing water to ice, a source of power, control means for said electrically operable device including a circuit connected through the water to be frozen and operative upon the flow of current through the water to render said electrically operable means operative, and upon the decrease in current flow through the water when the same is frozen to render said electrically operable means inoperative.

2. In a device of the class described, a cooling medium, electrically operable means for changing said medium from a first state having relatively high conductivity to a second state having relatively low conductivity, a source of power, an operating circuit for said electrically operable means, a switch in said circuit, said switch automatically moving to an open circuit position when released, and means for controlling said switch including a control circuit connected through said medium, said means being rendered operative to close said switch and hold it closed in response to the flow of current through said medium in said first state and rendered inoperative upon the reduction of the flow of current through said medium in said second state.

3. In a refrigerator having in combination a refrigerant, electrically operable means for causing a change from a liquid to a solid state in said refrigerant, and means for controlling the operation of said electrically operable means including a source of power, a circuit connected through said refrigerant and means connected in said circuit and responsive to the flow of current through said refrigerant when said refrigerant is in said liquid state to render said electrically operable means operative and responsive upon the reduction in the flow of current through said refrigerant when changed to said solid state to render said electrically operable means inoperative.

4. In a control device for use with a refrigerating system having a refrigerating coil immersed in a freezable medium, and means for supplying a coolant to the coil, means for controlling said refrigerating system to maintain a coating of the medium in frozen state on said coil, comprising a relay switch for turning said refrigerating system on and off, a circuit therefor, the circuit including a portion of said medium and utilizing a change in the electrical properties of said medium due to a change in its state from liquid to solid, and the coating of a predetermined thickness of the medium on the coil for controlling the operation of said relay switch.

5. In combination with a water cooling device having a refrigerating system for supplying a coolant to a coil immersed in the water to be cooled, means for controlling said refrigerating system to maintain a coating of ice on said coil to a predetermined amount comprising an electrically operated switch, electronic switching means for operating said switch, and means responsive to changes in the electrical properties of said water in changing from its liquid to solid state for controlling the operation of said electronic switching means.

6. In combination with a water cooling device having a refrigerating system for supplying a coolant to a coil immersed in the water to be cooled, means for controlling said refrigerating system to maintain a coating of ice on said coil to a predetermined amount comprising a switch for turning said system on and off, a relay for operating said switch, circuit means for energizing said relay, an electronic discharge device connected in said circuit means having a control element and operative to energize said circuit means, means for impressing a control voltage on said control element including a resistance, and an electrode means connected to said control voltage impressing means and mounted in proximity to said coil whereby the same is positioned to be enveloped by ice formed on said coil to shunt out a portion of said resistance.

7. Apparatus as claimed in claim 6 including

means for adjusting the position of said electrode means relative to said coil.

8. In a method of producing a predetermined amount of ice adjacent an ice machine in a body of freezable liquid, the steps of operating the machine to produce ice in progressively increasing thickness outwardly from the machine, selecting two datum points between which the ice progressively forms, including the two points in an electrical control circuit, applying a potential between the two points, obtaining a potential drop between the points that increases progressively as the ice forms, and employing said potential drop to regulate the machine and cause it to stop when a predetermined portion of the linear distance between the points is ice.

9 In combination, a member subject to accumulation of ice thereon in increasing thickness, an electric circuit including two terminals spaced by a gap in which the ice accumulates, operated means in the electrical circuit operable to control the formation of the ice, the ice being a component of the electrical circuit and controllining the current flow therein, the circuit being conductive when the ice formation between electrodes is below a predetermined thickness, and becoming less conductive as the thickness increases, and means responsive to the amount of conductivity of the circuit to determine operation of the operated means, whereby when the ice has a predetermined thickness the circuit will be energized to operate the operated means.

10. In combination, a member subject to accumulation of ice thereon in increasing thickness, an electrode spaced from the member by a gap, and constituting a first terminal, a second terminal spaced from the electrode, an electrical circuit including the two terminals one of which is the electrode, and the two terminals being connected through the accumulating ice, the circuit including also an operated means energizable to control the thickness of the ice, and including connections for a source of electrical energy, the circuit being energized when the ice in the gap has only a predetermined thickness, whereby the operation of the operated means is determined by the thickness of the ice.

11. In combination, a member on which ice accumulates, operable means to control the amount of ice produced, a pair of electrical terminals spaced by a gap, the ice accumulating on one of the terminals, an electrical circuit including the operable means, the two terminals, and connections for electrical power, the amount of ice on the electrode changing the electrical characteristics of the gap and hence of the circuit, whereby the operable means is energized when a predetermined amount of ice is present in the gap.

12. In a method of regulating production of frozen liquid outside the coil of an ice machine, from a mass of freezable but unfrozen matter

around the coil, which matter has different electrical characteristics in its two states, the steps of operating a mechanism to change the matter from its unfrozen to its frozen state, selecting datum points between which the matter can be changed in state by said mechanism, obtaining electrical characteristics of the matter between said points that vary progressively with changes in the amount of matter between them that is frozen, rendering a control mechanism responsive to a particular value of the electrical characteristics that represents a predetermined amount of frozen liquid between the datum points, and operating the mechanism by said control.

13. In a method of regulating production of frozen liquid outside the coil of an ice machine, from a mass of freezable but unfrozen material, by a change-of-state mechanism, the matter having different electrical characteristics in its unfrozen state from those in its frozen state, the steps of operating the mechanism, obtaining datum points between which the matter will progressively change state and change the ratio of matter in its first state to matter in its second state, including said points in an electrical control circuit for the mechanism, to put the matter being changed in state, in the control circuit, applying a potential to the circuit, obtaining a potential drop across the matter that is a function of the amount of matter that is frozen, and varies with the amount of matter that is frozen, and rendering the control circuit responsive to a particular potential drop that is representative of a particular amount of frozen matter between the datum points, so as to render the mechanism operative and inoperative when the potential drop reaches a predetermined amount.

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