

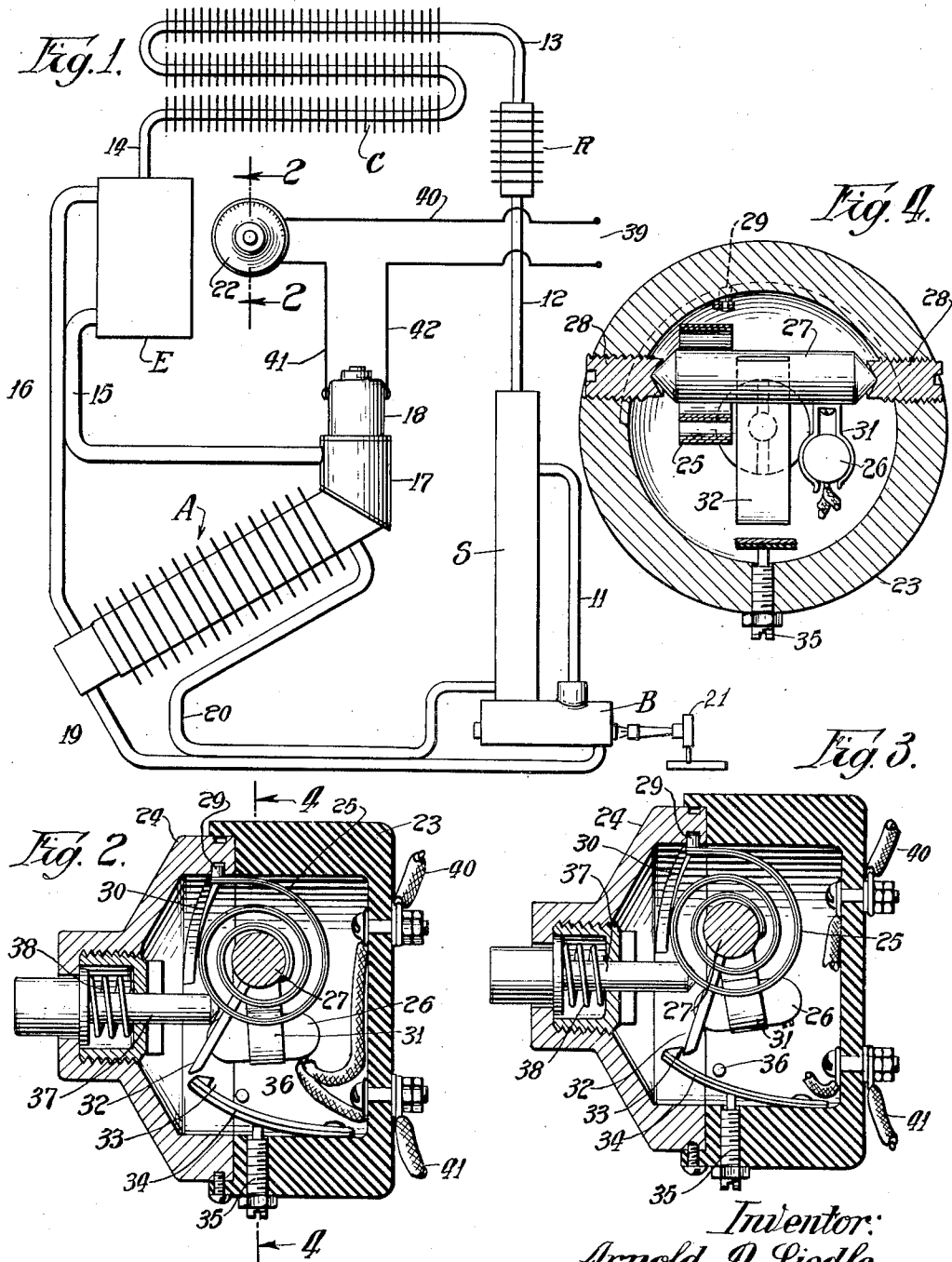
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A. D. SIEDLE

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CONTROL FOR REFRIGERATING SYSTEMS

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Witness:
E. Camperini

Inventor:
Arnold D. Siedle,
By: Harry S. Duvarse
Attorney.

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CONTROL FOR REFRIGERATING SYSTEMS

Arnold D. Siedle, Canton, Ohio, assignor to The Hoover Company, North Canton, Ohio, a corporation of Ohio

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This invention relates to continuous absorption refrigerating systems and more particularly to electrical control apparatus for defrosting such a system.

The invention particularly relates to an absorption refrigerating system involving the use of an inert pressure equalizing medium in which heat is applied to the generator by means of a fluid fuel burner and an electric motor driven gas pump is provided for circulating the inert gas between the evaporator and the absorber.

It is an object of the present invention to provide a novel control system for an absorption refrigerating system which will aid in causing the evaporator to defrost rapidly.

It is a further object of the invention to provide a combined control system in which the operation of the unit is controlled during normal periods by controlling the circulation of the inert gas in the system and in which manual means is combined therewith for placing the control apparatus in defrost position so that after the ice melts off of the evaporator the unit will automatically go back into normal operation.

Other objects and advantages reside in certain novel features of the arrangement and construction of parts as will be apparent from the following description taken in connection with the accompanying drawing in which:

Figure 1 is a diagrammatic representation of a continuous absorption refrigerating system using inert gas and having a gas circulator driven by an electric motor therein, the diagram also illustrating control apparatus for the electric motor associated therewith.

Figure 2 is a cross-sectional view of a control device adapted for use in the control system of the arrangement of Figure 1.

Figure 3 is a similar view of the control device and illustrating the parts on the interior thereof in the defrost position, and

Figure 4 is a transverse cross-sectional view of the defrost control apparatus, the view being taken on the lines 4-4 of Figure 2.

Referring to the drawing in detail and first to the diagram of Figure 1 it will be clear that a continuous absorption refrigerating system is illustrated as consisting of a boiler B, a vapor separation chamber S, a rectifier R, a condenser C, evaporator E and an absorber A, these parts being connected by various conduits as illustrated to form a complete continuous absorption refrigerating system. A vapor lift pump conduit 11 is connected to the top of the boiler B and is adapted to convey absorption liquid and refriger-

ant from the boiler B into the vapor separation chamber S. From the vapor separation chamber S the refrigerant flows through a conduit 12 into the rectifier R and from there through the conduit 13 into the condenser.

After the refrigerant condenses in the condenser C, it flows through the conduit 14 into the evaporator. The evaporator is connected to the absorber by two inert gas conduits 15 and 16 which may be in heat exchange relation, the conduit 16 connecting the top of the evaporator to the bottom of the absorber and the conduit 15 connecting the bottom of the evaporator to the inert gas circulator chamber which may be formed integral with the top of the absorber. By means of the conduits 15 and 16 and the inert gas circulator 17 an inert gas circuit is provided between the evaporator and the absorber. The gas circulator may be of any conventional type such as a centrifugal fan and may be driven by a motor 18 which may be hermetically sealed to the system.

The bottom of the absorber is connected to the boiler by means of the conduit 19 and the lower end of the vapor separation chamber is connected to the top of the absorber by means of the absorption liquid conduit 20. The conduits 19 and 20 may be in heat exchange relation as illustrated. Absorption liquids may be circulated between the boiler and the absorber, the liquids flowing upwardly through the conduit 11 into the vapor separation chamber and then flowing by gravity through the conduit 20, the absorber A and the conduit 19 back to the boiler B. The boiler B may be heated by means of a gas burner 21 an electric cartridge heater, or by any other suitable device.

In accordance with the principles of the present invention it is proposed to regulate the temperature prevailing in the evaporator by controlling the inert gas circulator 17. This may be done by turning the electric motor 18 on and off automatically in response to temperature conditions prevailing in the evaporator. If the heat input to the boiler remains substantially constant, liquid refrigerant will merely be stored in the evaporator, when the inert gas is not circulating and will evaporate rapidly when the inert gas does circulate. Under normal operations of the system therefor the electric motor will be turned on and off at short intervals of time depending upon slight variations in temperature, either in the cabinet with which the unit is associated or in response to slight temperature variations in the evaporator itself.

The control apparatus also includes manually operable means for rendering the normal control apparatus inoperative until the evaporator temperature rises sufficiently to permit all the ice to melt off of it during a defrost period, after which the control apparatus will automatically turn the motor on again.

To this end an electrical control element designated 22 in the arrangement of Figure 1 may be placed either adjacent the evaporator in the cabinet or in a pocket formed in the evaporator itself, the arrangement shown in Figure 1 showing the control element located near the evaporator E.

As best shown in Figures 2, 3 and 4 the electrical control element 22 may include a casing 23 provided with a dial 24 which may be rotated within the casing 23 to adjust the tension upon a spiralled bi-metallic element 25 located within the casing 23 and which controls the position of a mercury contact switch 26. As shown in Figure 4 the bi-metallic element 25 may be mounted upon a shaft 27 supported in suitable bearing pieces 28. The outer end of the spiralled bi-metallic element may be secured to a button 29 shown in Figure 2 which may be positioned within a groove 30 in the dial member 24 so that as the dial is rotated the button 29 is moved back and forth in a line parallel to the axis of the dial so as to adjust the tension upon the thermostatic element 25. The shaft 27 carries a depending arm 31 which carries the mercury switch 26.

In normal operation of the refrigerating system, the bi-metallic element 25 moves the bracket 31 and the switch 26 to the left as viewed in Figure 2 when the temperature adjacent the bi-metallic element 25 rises. This closes the circuit in the mercury switch 26. Upon the bi-metallic strip 25 cooling off the mercury switch is moved to the right as viewed in Figure 2 and the electrical circuit is broken. The mercury tube 26 may be connected in the circuit of the electric motor 18 so that this motor is turned on and off in response to temperature conditions prevailing in or near the evaporator.

For defrosting the evaporator of the continuous absorption system illustrated suitable mechanism is provided for enabling the mercury switch 26 to be placed manually in such a position that the circuit will remain broken until the temperature adjacent the control element rises above a predetermined point after which the control will automatically replace the switch in the position to be automatically controlled by the bi-metallic element 25. To this end a depending arm or lever 32 is secured to the shaft 27 which carries the mercury switch 26. The lever 32 is adapted to be latched behind the catch 33 carried by a defrost bi-metallic element 34 located in the lower part of the casing 23. The bi-metallic strip 34 may be adjustably positioned adjacent the lower end of the lever 32 by means of an adjusting screw 35. A pin 36 may be provided to limit upward movement of the bi-metallic element 34. The bi-metallic element 34 is so designed as to move upwardly against the stopping pin 36 when subjected to a comparatively low temperature and to move downwardly away from the pin 36 when the temperature to which it is subjected rises.

The dial 24 may carry a plunger or defrosting switch element 37 at its central portion which is normally held in the position shown in Figure 2 by means of a coil spring 38. The inner end of the pin 37 abuts against the lever 32 and when the pin is depressed the lever 32 passes beyond the

catch 33 and is held thereby provided the temperature of the bi-metallic element 34 is below a predetermined temperature such for example as 32 degrees Fahrenheit. Upon the lever 32 passing beyond the catch 33 it will be impossible for the mercury switch 26 to close its circuit until the temperature rises sufficiently to enable the bi-metallic element 34 to move the catch 33 downwardly. After this happens lever 32 moves to the position shown in Figure 2 and the mercury switch 26 is then again controlled by the bi-metallic strip 25 which controls the normal operation of the system. In the arrangement illustrated in Figure 2 the mechanism is shown in normal position while in Figure 3 the lever 32 is shown held by the defrost bi-metallic element 34 in defrost position.

It will be obvious to those skilled in the art that it is within the purview of the invention to employ the defrosting mechanism illustrated independently of the normal control system. It has already been proposed to employ a gas burner for heating the boiler of the absorption system and to control the normal operation of the system by regulating the supply of heat to the boiler. The defrost mechanism illustrated may be used in connection with such a system. In that case the mercury switch 26 would be controlled only by the bi-metallic strip 34 and the bi-metallic element 25 might be dispensed with altogether provided the apparatus was controlled for normal operation in some other way.

It is also within the purview of the invention to control the heat supplied to the boiler at the same time that the motor 18 is controlled and one way of accomplishing this would be to connect an electric cartridge heater in parallel with the motor 18 so that the control mechanism controlled both the motor 18 and the electric heater for the boiler at the same time.

An important advantage of the present invention, however, results from the fact that the controls for the system and particularly the defrost control may be independent of the supply of heat to the boiler. Obviously the evaporator can be quickly defrosted if warm fluids can be passed into the evaporator when the inert gas is not circulating therein. Unless the inert gas is circulating the refrigerant will not continue to evaporate in the evaporator and if warm refrigerant liquid is supplied thereto, the ice will be quickly melted off of the evaporator. The present invention provides means for accomplishing this since the application of heat to the boiler may cause the continuous condensation of refrigerant in the condenser and this warm refrigerant may flow into the evaporator without the production of any refrigeration if the inert gas is not circulated.

A further advantage resulting from this system is that almost immediately on the starting up of the inert gas circulation after the defrosting period refrigeration will start inasmuch as the evaporator is already charged with a large quantity of condensed refrigerant. One disadvantage in absorption refrigerators heretofore designed is that when the apparatus is defrosted it takes considerable time for the boiler to be heated up again after the supply of heat to the boiler has been discontinued or diminished to cause the defrosting. For the reasons above noted this disadvantage is overcome by the present invention.

It is obvious that the defrost control elements and the other controls illustrated are intended to show only one way in which the circuit might be

controlled and it is within the purview of the invention to modify these elements or the circuits in various ways without departing from the spirit of the invention or the scope of the annexed claims:

I claim:

1. The combination with an absorption refrigerating system using inert gas and operated by heat and by an electrically operated inert gas circulator of control apparatus for said refrigerating system comprising manually operative means for disconnecting the supply of electricity to the inert gas circulator and automatic temperature responsive means for again connecting the supply of electricity to the inert gas circulator.

2. The combination with an absorption refrigerating system having an evaporator and an electrically driven device for circulating inert gas through the evaporator of defrosting control means for disconnecting the supply of electricity to said electrically driven device and for connecting the supply of electricity to said electrically driven device after the ice has melted off of the evaporator.

3. The combination with the evaporator of an absorption refrigerating system using inert gas, of means for quickly defrosting the evaporator after it has become coated with ice, said means comprising an arrangement for supplying warm liquid to the interior of the evaporator and an arrangement for restricting the circulation of inert gas through the evaporator.

4. In combination, an absorption refrigerating system having a boiler, an evaporator and means for circulating inert gas through the evaporator and a control system for said refrigerating system, said control system being connected to, and arranged to vary only the means for circulating inert gas in the refrigerating system in response to temperature conditions in the refrigerating system.

5. The combination with an absorption refrigeration system of the type using inert gas and driven by heat and an inert gas circulator of control means for said refrigeration system comprising a housing, a switch in said housing operable to control operation of said inert gas circulator, a thermostat operable to open and close said switch in response to demand for refrigeration, a rotary member operable to regulate the action of said thermostat, latch means operable to secure said thermostat and switch in fixed position, reciprocable means mounted in said rotary means and operable to move said thermostat means to latched position and means responsive to abnormal evaporator temperatures operable to release said latching means.

6. That improvement in the art of absorption refrigeration systems involving a source of heat to generate refrigerant vapor and a power-driven means to circulate an inert gas which comprises continuously generating refrigerant vapor, liquefying the vapor so generated, evaporating the liquid into an inert gas, absorbing the vapor, controlling the evaporation of the liquid by regulating the supply of inert gas in response to demand for refrigeration, manually discontinuing the circulation of inert gas while continuing to generate and liquefy vapor to effect defrosting, and automatically resuming the circulation of inert gas when defrosting is completed.

7. The method of defrosting the evaporator of an absorption refrigeration system of the type having a source of heat to generate refrigerant

vapor and a power-driven means to circulate inert gas in the system which includes the steps of manually discontinuing operation of the power-driven circulating means, continuously operating said heat source to generate vapor, liquefying the vapor at atmospheric temperature, discharging the warm liquid into the evaporator, and resuming circulation of the inert gas in response to defrosting of the evaporator.

8. That improvement in the art of refrigeration which includes the steps of expelling refrigerant vapor from solution by the application of heat thereto, liquefying the refrigerant vapor, evaporating the vapor in an evaporating zone into a circulating pressure equalizing medium, absorbing the refrigerant vapor from the pressure equalizing medium by contacting the pressure equalizing medium refrigerant vapor mixture with absorbing solution and regulating the production of refrigeration by regulating the flow of pressure equalizing medium in accord with refrigeration demand.

9. That improvement in the art of refrigeration which includes the steps of expelling refrigerant vapor from solution by the application of heat thereto, liquefying the refrigerant vapor, evaporating the vapor in an evaporating zone into a circulating pressure equalizing medium, absorbing the refrigerant vapor from the pressure equalizing medium by contacting the pressure equalizing medium refrigerant vapor mixture with absorbing solution and regulating the production of refrigeration by regulating the flow of pressure equalizing medium in accord with refrigeration demand without interfering with the continued expulsion and liquefaction of refrigerant.

10. That improvement in the art of refrigeration which includes the steps of expelling refrigerant vapor from solution by the application of heat thereto, liquefying the vapor so expelled, evaporating the liquid into an inert gas, absorbing the refrigerant vapor from the inert gas in an absorbent, manually discontinuing the supply of inert gas to discontinue evaporation of the refrigerant liquid, and resuming inert gas circulation in response to an abnormal temperature condition.

11. That improvement in the art of refrigeration which includes the steps of expelling refrigerant vapor from solution by application of heat, liquefying the vapor, evaporating the liquid into a pressure equalizing medium circulating between an evaporating zone and an absorbing zone, absorbing the vapor of the refrigerant from the pressure equalizing medium in the absorbing zone, discontinuing the circulation of pressure equalizing medium, resuming circulation of the pressure equalizing medium when the evaporating zone reaches a defrosting temperature and continuing to supply liquid refrigerant to the evaporating zone while circulation of the pressure equalizing medium is discontinued.

12. That improvement in the art of refrigeration which includes the steps of expelling refrigerant vapor from solution by application of heat, liquefying the vapor, evaporating the liquid into a pressure equalizing medium circulating between an evaporating zone and an absorbing zone, absorbing the vapor of the refrigerant from the pressure equalizing medium in the absorbing zone, discontinuing the circulation of pressure equalizing medium, resuming circulation of the pressure equalizing medium when the evaporating zone reaches a defrosting temperature and continuing

to supply liquid refrigerant to the evaporating zone while circulation of the pressure equalizing medium is discontinued without interfering with the application of heat to the solution.

- 5 13. The combination with an absorption refrigerating system using inert gas and driven by heat and an electrically operated inert gas circulator, of control means for said refrigerating system comprising means responsive to evaporator temperature operative in one position to cause operation of said inert gas circulator and operative in another position to stop such operation, means for adjusting the operation of said temperature responsive means, manually operative means for causing said thermal responsive means to be latched in position to discontinue operation of said inert gas circulator, and means responsive only to defrosting temperatures of said evaporator operative to unlatch said thermal responsive means.
- 10 14. In combination with an absorption refrigerating apparatus including an evaporator, an absorber, a condenser, a generator, and an electrically operated fluid circulator connected in circuit, a control means for governing the operation of said circulator including a thermostatic means, manually rotatable means for regulating said thermostatic means, reciprocable means for urging said thermostatic means to a position in which said circulator is rendered inoperative, and means for retaining said thermostatic means in said position until said evaporator has defrosted.
- 15 15. In combination a refrigerating system including a cooling unit and a fluid circulating means, control means for said circulating means including a thermostat arranged to be responsive to a temperature condition produced by said cooling unit, a rotary member arranged to regulate the operation of said thermostat, reciprocable means mounted in said rotary member for operating said thermostat to a position to render said circulating means inoperative, and means for re-
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taining said thermostat in such position until said cooling unit has defrosted.

16. Refrigerating apparatus comprising in combination, a cooling unit, means for circulating a fluid through said cooling unit, thermostatic means arranged to govern said circulating means, rotatable means for adjusting said thermostatic means, means for latching said thermostatic means in a defrosting position including a manually reciprocable element mounted in said rotatable means, and said latching means operable to release said thermostatic means when said cooling unit has defrosted.

17. The method of defrosting the evaporator of an absorption refrigerator of the type utilizing an inert gas to equalize pressure differences in the refrigerator, a source of heat to expel refrigerant vapor from solution and power driven means for circulating the inert gas, which comprises the steps of discontinuing the operation of the power driven circulating means until the evaporator has freed itself of frost while simultaneously supplying liquid refrigerant expelled by said heat source to the evaporator to hasten the defrosting thereof.

18. The method of defrosting the evaporator of an absorption refrigerator of the type utilizing an inert gas to equalize pressure differences in the refrigerator, a source of heat to expel refrigerant vapor from solution and a power driven means for circulating the inert gas, which comprises the steps of discontinuing the operation of the power driven circulating means until the evaporator has freed itself of frost, and automatically resuming operation of the power driven circulating means for the inert gas when the evaporator has defrosted to evaporate liquid refrigerant collected in the evaporator during the defrosting period to lower rapidly the evaporator temperature to refrigerating limits.

ARNOLD D. SIEDLE.

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