

Nov. 28, 1939.

W. G. KÖGEL ET AL

2,181,276

REFRIGERATION

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3 Sheets-Sheet 1

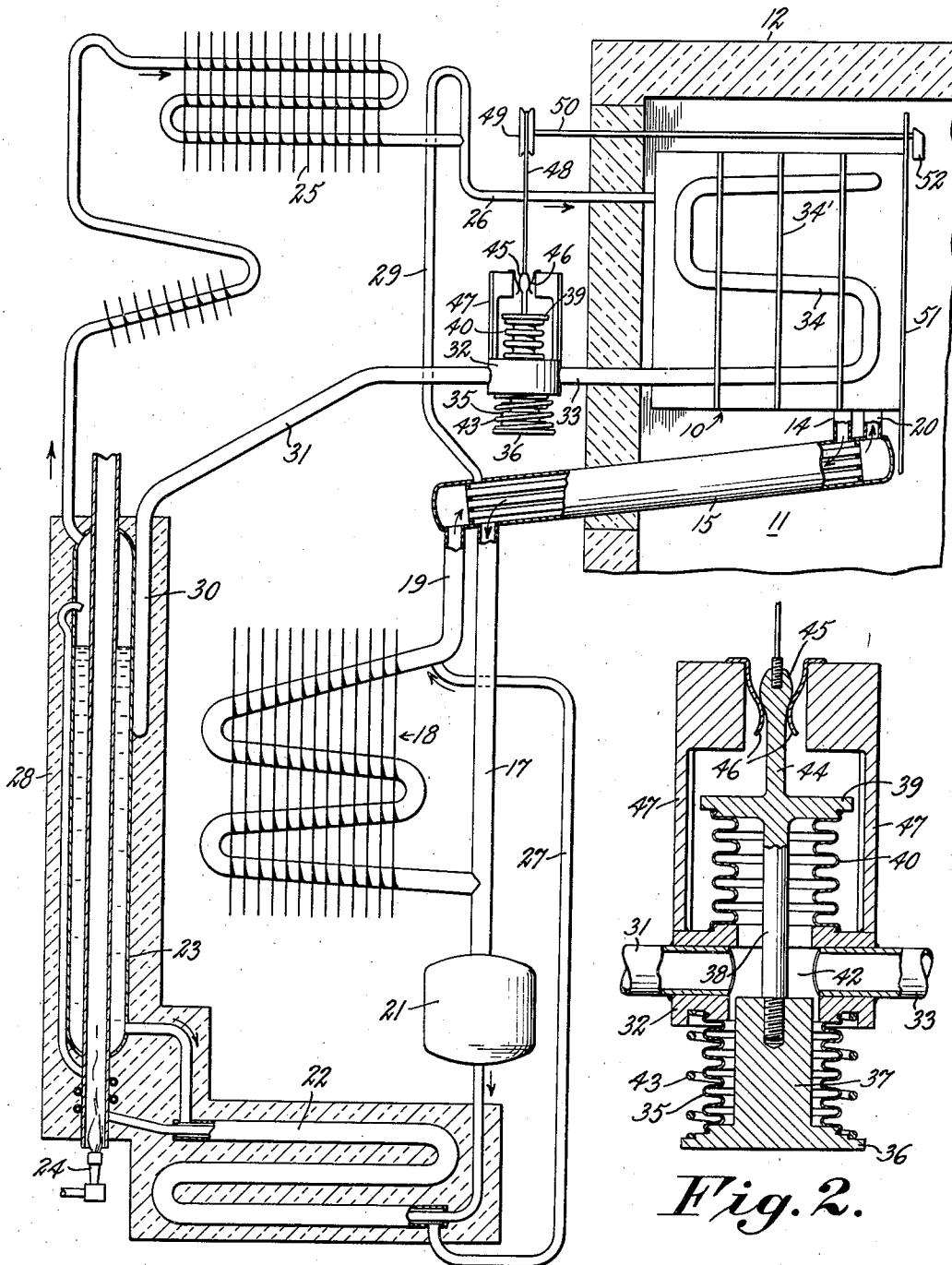


Fig. 1.

Fig. 2.

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3 Sheets-Sheet 2

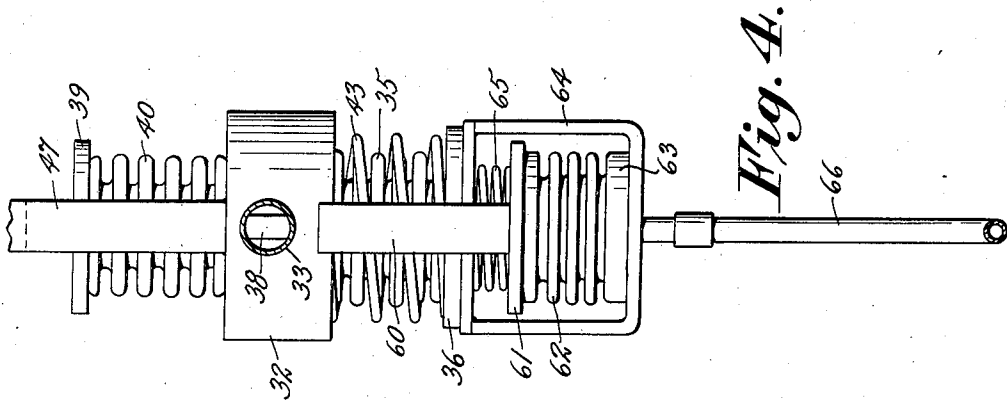


Fig. 4.

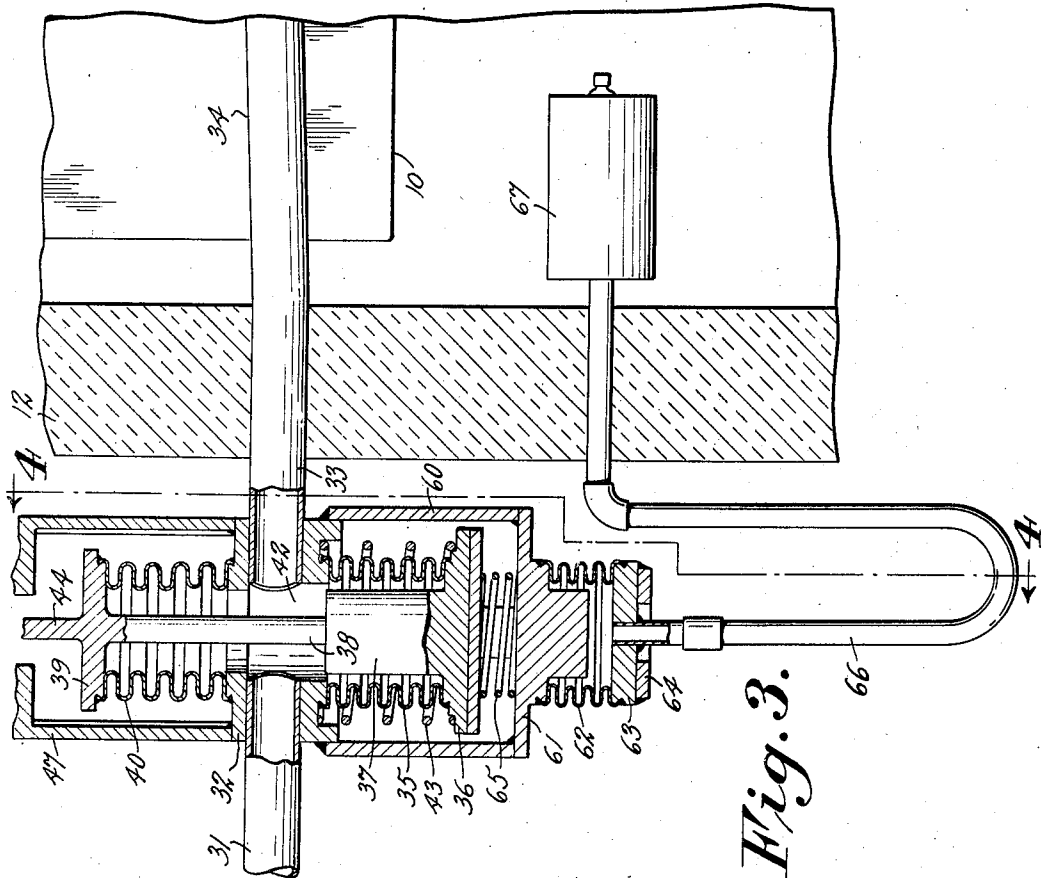


Fig. 3.

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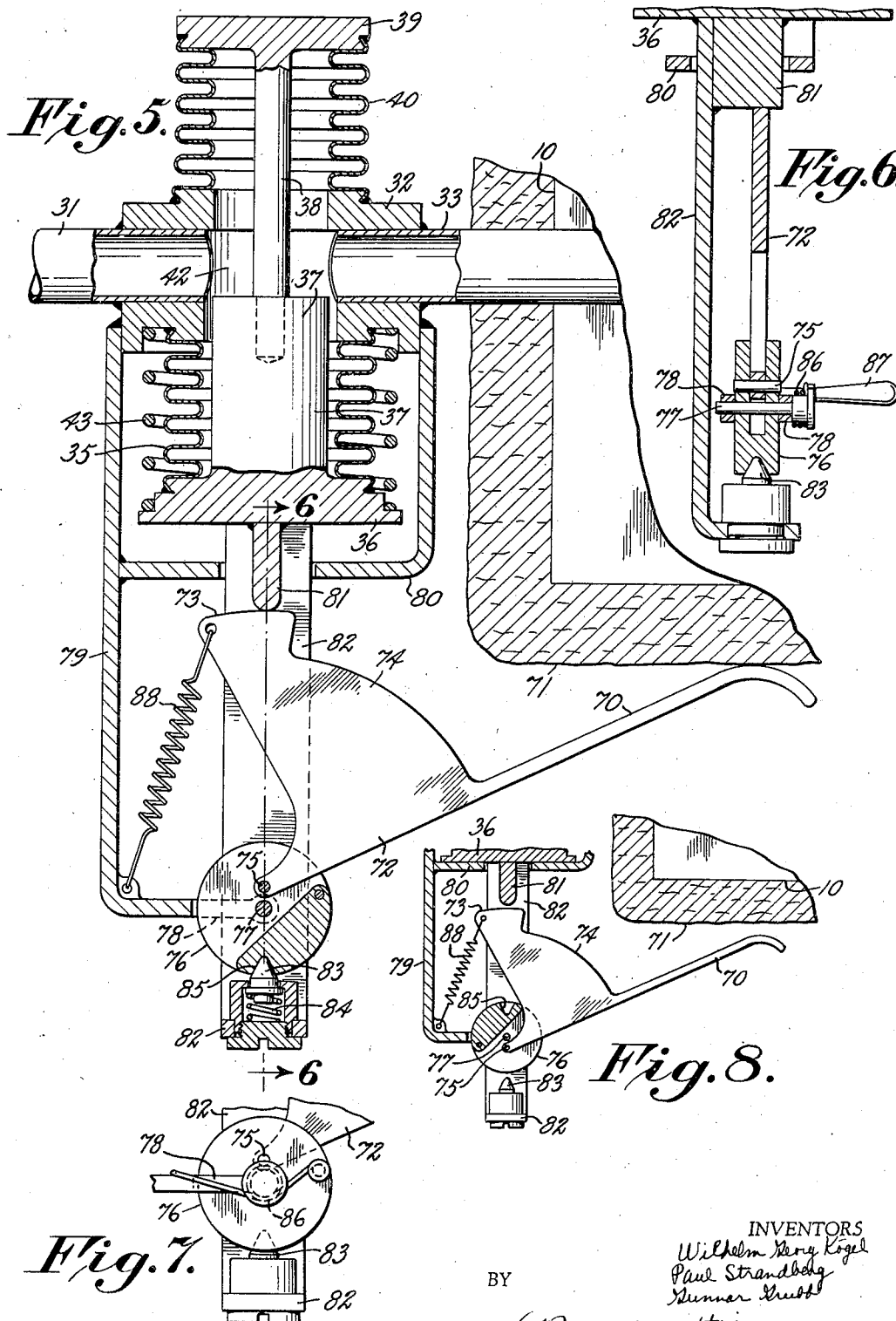
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REFRIGERATION

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3 Sheets-Sheet 3



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2,181,276

REFRIGERATION

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This invention relates to refrigeration, and more particularly to defrosting of a cooling element or evaporator of a refrigeration system.

It is an object of the invention to improve the operation of refrigeration systems by heating a cooling element to cause melting of frost, so that the necessity of modifying the operation of a refrigeration system to effect defrosting is avoided.

Another object of the invention is to utilize heat from a part of a refrigeration system to heat a cooling element thereof to cause rapid melting of frost accumulated on the cooling element.

A further object of the invention is to heat a cooling element to cause melting of frost, and to terminate such heating automatically when the cooling element is substantially defrosted.

A still further object of the invention is to provide a heating system for heating a cooling element which, in addition to defrosting the cooling element, may be effectively utilized to heat an enclosed space in which the cooling element is arranged, so that the enclosed space can be maintained substantially at a desired temperature.

The above and other objects and advantages of the invention will be more fully understood from the following description taken in connection with the accompanying drawings forming a part of this specification, and of which Fig. 1 diagrammatically illustrates a refrigeration system provided with defrosting apparatus embodying the invention; Fig. 2 is an enlarged fragmentary sectional view of a part of the apparatus shown in Fig. 1; Fig. 3 is a fragmentary sectional view illustrating a modification of the apparatus shown in Fig. 1 whereby, in addition to heating the cooling element, the storage space in which it is arranged may be heated to maintain the latter substantially at a desired temperature; Fig. 4 is a view in elevation of the apparatus shown in Fig. 3; Fig. 5 is a fragmentary sectional view illustrating a further modification of the apparatus shown in Fig. 1; Fig. 6 is a sectional view on line 6—6 of Fig. 5; and Figs. 7 and 8 are fragmentary views of the apparatus shown in Fig. 5 to illustrate more clearly parts of the apparatus.

Referring to Fig. 1, the invention is shown in connection with a refrigeration system of a uniform pressure absorption type, generally as described in Patent No. 1,609,334 to von Platen and Munters, in which an auxiliary pressure equalizing gas is employed. It is to be understood, however, that the invention can be employed with other types of refrigeration systems.

The system includes a cooling element or evap-

orator 10 disposed in an enclosed space 11 which may form a food storage compartment of a thermally insulated refrigerator cabinet 12. The refrigerant fluid, such as ammonia, evaporates in the evaporator 10 and diffuses into an inert gas, such as hydrogen, to produce a refrigerating effect. The resulting gaseous mixture of refrigerant and hydrogen flows from evaporator 10 through conduit 14, gas heat exchanger 15, and conduit 17 into an absorber 18. In absorber 18 the refrigerant gas is absorbed by a suitable liquid absorbent, such as water. The inert hydrogen gas is returned to evaporator 10 through conduit 19, the gas heat exchanger 15 and conduit 20; and the enriched absorption liquid is conducted to an accumulation vessel 21, and thence through a liquid heat exchanger 22 to generator 23.

By heating generator 23, as by a gas burner 24, refrigerant is expelled from the absorption liquid, liquefied in an air-cooled condenser 25, and then returned through conduit 26 to evaporator 10 to complete the refrigerating cycle. The weakened absorption liquid from which refrigerant has been expelled is conducted from generator 23 through liquid heat exchanger 22 and conduit 27 into the upper part of absorber 18. The generator 23 and liquid heat exchanger 22 may be embedded in suitable insulating material 28. A conduit 29 is connected to the lower part of condenser 25 and the gas circuit, as at the gas heat exchanger 15, for example, so that any non-condensable gas which may pass into the condenser can flow to the gas circuit and not be trapped in the condenser.

In accordance with this invention the cooling element 10 is independently heated to cause melting of frost that is formed thereon, so that the need for modifying the operation of the refrigeration system to defrost the cooling element is avoided. Although heating of the cooling element may be effected by any suitable source of heat, it is preferred to utilize heat from a part of the refrigeration system to heat the cooling element and thereby cause melting of frost. The heat transfer system for transferring heat from a part of the refrigeration system, such as generator 23, for example, to cooling element 10 includes an evaporation member 30 which is in good heat exchange relation with generator 23 and embedded in the insulating material 28. The evaporation member 30 is connected at its upper end by an inclined conduit 31, casing 32, and conduit 33 to a condenser member 34 which serves as the heating element of evaporator 10. The

condenser member 34 is in the form of a looped coil which may be formed integrally with or secured in any suitable manner to a side wall of evaporator 10. To conduct heat effectively to the inner portions of the layer of frost heat transfer fins 34' are provided at the side of cooling element 10.

The casing 32 is connected to the horizontal ends of conduits 31 and 33. To the lower part of casing 32 is secured an expansible bellows 35 having a lower end plate 36 with which is integrally formed a piston 37. A pin 38 extending upward from piston 37 is secured to an upper end plate 39 of a second expansible bellows 40 which is smaller in diameter than bellows 35. The bellows 40 is secured to the upper part of casing 32, and, together with casing 32 and bellows 35, forms a chamber 42. A spiral spring 43 disposed about bellows 35 is connected or secured at its upper end to casing 32 and is connected or secured at its lower end to end plate 36, so that the weight of piston 37 and pin 38 may be partly or fully counter-balanced.

Extending upward from the upper end plate 39 is a pin 44 having an enlarged head 45 which is adapted to be engaged and held by a pair of leaf springs 46 fixed to a pair of arms or plates 47 which are secured to casing 32. The upper end of pin 44 is connected to a wire 48 which extends upward and is wound about and secured at its end to a pulley 49. The pulley 49 is fixed to a rod 50 which extends through the rear insulated wall of cabinet 12 and an opening in a front plate 51 of the cooling element 10. A lever 52 is secured to the inner end of rod 50 to rotate pulley 49 and thereby raise pin 44 from a lower position to the upper position shown in Fig. 2.

The evaporation member 30, chamber 42, condenser member 34, and connecting conduits 31 and 33 form a hermetically sealed circuit adapted to contain a suitable volatile fluid for transferring heat from generator 23 to cooling element 10. When the refrigeration system is in operation and burner 24 is heating generator 23, liquid in evaporation member 30 is evaporated. The vapor passes upward through conduit 31, chamber 42, and conduit 33 into condenser member 34. The vapor is condensed in member 34 and flows downward through conduit 33 and back to evaporation member 30 where it is again evaporated. It will therefore be understood that an evaporation-condensation circuit has been provided in which the fluid serves as a heat transfer agent which circulates naturally in an active portion of a closed system. The evaporation of liquid in member 30 takes up heat from generator 23, and the condensation of the vapors in member 34 gives up heat to frost when it is formed on cooling element 10, whereby the frost is melted and cooling element 10 is rendered more effective to produce refrigeration.

When the cooling element 10 is substantially defrosted, the pin 44 is below the position shown in Fig. 2, with the upper end of the enlarged head 45 bearing against the lower end of leaf springs 46. In such lower position the expansible bellows 40 is contracted and bellows 35 is elongated with the piston 37 being in its lower position. With piston 37 in its lower position, a maximum quantity of liquid can be held in the lower part of chamber 42 which constitutes an inactive portion of the heat transfer system, and liquid condensate formed in member 34 and flowing toward member 30 is trapped in chamber 42. The

volume of the lower part of chamber 42 is such that, when the enlarged head 45 of pin 44 is bearing against the lower ends of leaf springs 46 and not positively engaged and held by the latter, the condensed vapor is trapped in chamber 42 and cannot flow back to evaporation member 30. Under these conditions whatever liquid there is in member 30 continues to evaporate until member 30 is depleted of liquid, and thereafter no heat is transferred from generator 23 to cooling element 10.

When a layer of frost has formed on cooling element 10 and it is desired to defrost the same, lever 52 in front of cooling element 10 is turned in a clockwise direction whereby rod 50 and pulley 49 are rotated. This causes wire 48 to be wound about pulley 49 and pulls pin 44 upward from its lower position to its upper position shown in Fig. 2. With such upward movement of pin 44, the bellows 40 is expanded and bellows 35 is contracted. This moves piston 37 upward whereby liquid is caused to overflow from chamber 42 or the inactive portion of the system into conduit 31 and flow into evaporation member 30. The liquid is evaporated in member 30 and condensed in member 34 in the active portion of the system, thereby giving up and rejecting heat to frost formed on the cooling element. Liquid formed in member 34 flows back to member 30 and is again evaporated.

When the cooling element 10 is substantially defrosted the pin 44 is caused to move downward to its lower position, as will be presently explained, so that condensate formed in member 34 is trapped in chamber 42 and cannot flow back to evaporation member 30. The liquid in member 30 continues to evaporate until this member is depleted of liquid, whereupon transfer of heat no longer takes place from generator 23 to cooling element 10. When the pin 44 is moved downward the pulley 49 is caused to rotate in a counter-clockwise direction and lever 52 is moved back to its initial position from which it can be subsequently moved to initiate defrosting when a layer of frost has again formed on cooling element 10.

When the cooling element 10 is substantially defrosted and the liquid in the heat transfer system is trapped in the chamber 42 the temperature of the cooling element and condenser member 34 is relatively low, assuming that the refrigeration system is being operated. When the cooling element is coated with a layer of frost and piston 37 is raised to its upper position, vaporization and condensation of the volatile fluid takes place to transfer heat from generator 23 to cooling element 10. With heat being transferred from generator 23 to condenser member 34, the temperature of the condenser member increases to such a value that heat is transferred to the frost and remains at such increased temperature until the cooling element is substantially defrosted. When condenser member 34 is no longer in contact with ice or frost its temperature rises suddenly. This temperature rise of condenser member 34 after cooling element 10 is substantially defrosted is utilized in the embodiment just described to terminate automatically the transfer of heat to cooling element 10, as will now be explained.

The physical characteristics of the volatile fluid selected are preferably such that, when the condenser member 34 is at the increased temperature during defrosting, the pressure existing in the system is substantially at or slightly above atmospheric pressure. If the pressure existing

in the system is substantially equal to atmospheric pressure the forces acting on the upper and lower end plates 36 and 39 are substantially the same and no movement of bellows 35 and 40 will tend to take place. If the predetermined pressure existing in the system is slightly above atmospheric pressure the downward force exerted on lower end plate 36 will be greater than the upward force exerted on upper end plate 39 due to the fact that the latter is smaller in area. The greater this predetermined temperature is above atmospheric pressure, the greater will be the net downward force tending to move pin 44 out of engagement with leaf springs 46. During this period when member 34 is in contact with ice and frost and the heat transfer system is at the predetermined pressure, therefore, the leaf springs 46 should be sufficiently strong to keep pin 44 and piston 37 in the upper position shown in Fig. 2.

When the cooling element is substantially defrosted and condenser member 34 is no longer in contact with ice or frost, the temperature of member 34 rises suddenly. Since the temperature of member 34 is increased, the pressure in the heat transfer system increases to a value above the pressure existing when the member 34 is in contact with ice or frost. The bellows 35 and 40, pin 44 and leaf springs 46 are so arranged that at this increased pressure the net downward force exerted on lower end plate 36, due to the greater diameter of bellows 35, is sufficient to cause bellows 35 to move downward and move the upper end 45 of pin 44 out of engagement with leaf springs 46.

The liquid condensate now formed in condenser member 34 is trapped in chamber 42, as explained above, and liquid cannot flow back to evaporator member 30. When member 30 is depleted of liquid and all of the liquid has accumulated in chamber 42, heat transfer no longer takes place from generator 23 to cooling element 10. When it is again desired to initiate defrosting, lever 52 is turned to raise pin 44 so that it will be engaged and held by leaf springs 46, whereby liquid flows from chamber 42 into member 30 to again effect heating of cooling element 10.

In any case, irrespective of the volatile fluid used, the leaf springs 46 and spiral spring 43 may be of such strength that, during heat transfer with ice formed on cooling element 10, the piston 37 will remain in its upper position; and, when the cooling element is substantially defrosted, the increase in pressure in the system will be effective to move piston 37 downward against the tension of spiral spring 43 and the frictional engagement of leaf springs 46 and pin 44.

Among the volatile fluids that may be used, for example, butane possesses such physical characteristics that it is particularly desirable in a system of the present type. If it is assumed that the refrigeration system is in operation and the cooling element is substantially defrosted and at a temperature of about -10°C. , the pressure existing in the heat transfer system when butane is used is about $.7/\text{kg}/\text{cm}^2$. It is further assumed that substantially all of the air has been removed from the heat transfer system before it is charged with butane. Under these conditions all of the butane is trapped in chamber 42, and the pressure in the system is below atmospheric pressure. If lower end plate 36 is one square cm. greater in area than upper end plate 39 the resultant force acting upward on lower end plate

36 is about 0.3 kg. greater than that acting downward on upper end plate 39. The greater force on lower end plate 36 tends to move pin 44 into engagement with leaf springs 46, and the latter must be of such strength that the elongated head 45 cannot pass upward between the lower ends of the springs.

When cooling element 10 is coated with a layer of frost and piston 37 is moved to its upper position by turning lever 52, evaporation and condensation of butane takes place to cause melting of frost. The temperature of condenser member 34 is now increased to a value sufficient for heat transfer to the frost, as explained above, and the pressure of butane in the heat transfer system for this temperature is about $1.0/\text{kg}/\text{cm}^2$ and substantially equal to atmospheric pressure. Due to the fact that the pressures within and outside the system are substantially equal no displacement or movement of the bellows 35 and 40 takes place. When member 34 is no longer in contact with ice or frost, however, and it is assumed that the temperature of condenser member 34 further increases to about $+10^{\circ}\text{C.}$, the pressure of butane in the system is about $1.5/\text{kg}/\text{cm}^2$ and exceeds atmospheric pressure by about $0.5/\text{kg}/\text{cm}^2$. Since it has been assumed that plate 36 is one square cm. greater in area than plate 39, there is a net downward force of about 0.5 kg. acting on plate 36. The leaf springs 46 are of such strength that this force is effective to permit pin 44 to move downward and out of engagement with the springs, whereby chamber 42 will be sufficiently large to trap liquid butane and prevent butane from flowing back to the evaporation member 30. The leaf springs 46 in any particular case may be so shaped that a greater force is required to move pin 44 in one direction than in the other direction.

It will now be understood that heat may be supplied to cooling element 10 to effect defrosting without disturbing the operation of the refrigeration system. With such an arrangement it is not necessary to suspend or reduce the refrigerating effect produced by cooling element 10 during a defrosting period. Further, defrosting can be effected very rapidly because heat is conducted directly to the cooling element, the heat transfer system preferably being so constructed and arranged that a rapid rate of heat transfer is effected.

In addition to supplying heat to cooling element 10 to effect defrosting, the heat transfer system also may be arranged to supply heat to the thermally insulated space 11 to maintain the latter substantially at a desired temperature. This is particularly desirable when the source of heat is more or less difficult to regulate. Such a modification of the embodiment just described is illustrated in Figs. 3 and 4 with parts similar to those shown in Figs. 1 and 2 indicated by the same reference numerals.

In Figs. 3 and 4 the upper ends of a U-shaped bracket 60 are secured to the casing 32. The lower part 61 of bracket 60 serves as an upper end plate for an expansible bellows 62. The bellows 62 is provided with a lower end plate 63 which is fixed to the lower part of a rectangular frame 64. The frame 64 is at right angles to bracket 60 and is secured at its upper part to lower end plate 36 of bellows 35. A spiral spring 65 is interposed between the upper part of frame 64 and lower part of bracket 60. To the lower end plate 63 is connected one end of a flexible

tube 66 which is connected at its other end to a thermal bulb 67 located in the thermally insulated space 11. The bellows 62, tube 66, and bulb 67 constitute an expansible fluid thermostat containing a volatile fluid which increases and decreases in volume with corresponding changes of temperature.

When the storage space 11 is at the desired temperature, piston 37 is in its lower position and the liquid in the heat transfer system is held in chamber 42. When the temperature of storage space 11 falls below the desired value, however, the volatile fluid in the expansible fluid thermostat becomes reduced in volume whereby expansible bellows 62 contracts. Since the upper end plate 61 of bellows 62 is immovable due to the fact that it is fixed to the lower part of bracket 60, the contraction of bellows 62 will cause its lower end plate 63 to move upward. With such upward movement of lower end plate 63 the frame 64 is also raised to cause upward movement of lower end plate 36, whereby bellows 35 is contracted and piston 37 is raised. Raising of piston 37 causes liquid to overflow from chamber 42 and pass into evaporation member 30. With liquid in member 30 the transfer of heat takes place from generator 23 to cooling element 10, thereby raising the temperature of storage space 11.

When the storage space tends to rise above the predetermined temperature, the volatile fluid in the expansible fluid thermostat increases in volume to cause the lower end plate 63 to move downward and carry with it the frame 64. Downward movement of frame 64 lowers end plate 36 of bellows 35 whereby the latter is expanded and piston 37 is lowered, thereby trapping liquid condensate in chamber 42 and preventing flow thereof into evaporation member 30. When member 30 is depleted of liquid, transfer of heat from generator 23 to storage space 11 no longer takes place.

Instead of automatically terminating the supply of heat to cooling element 10 in accordance with an increase in pressure in the heat transfer system, a control mechanism may be provided whereby defrosting is terminated in accordance with the position of a movable contact arm or member which is urged against and contacts the coating or layer of frost during defrosting. Referring to Figs. 5 to 8 inclusive, such control mechanism may include a lever or contact arm 70 which is arranged during defrosting to contact a layer of frost 71 formed on cooling element 10. The arm 70 may be formed integrally with an arcuate-shaped plate 72 having one part 73 of greater radius than another part 74. The plate 72 is eccentrically pivoted at 75 to a disk 76 which is secured to a pin 77. The pin 77 is journaled in the forked arms 78 of a depending bracket 79 which is secured at its upper end to a casing 80. The casing 80 serves as a housing for the expansible bellows 35 and is provided with an opening at its lower end through which extends a contact member 81 secured to lower end plate 36. The contact member 81 is arranged to bear against the curved parts 73 and 74 of plate 72 and is urged downward by the spiral spring 43. To the lower end plate 36 of bellows 35 is also secured a downward extending bracket 82 having a short horizontal arm on which is mounted a pin 83. The pin 83 is urged or biased upward by a spring 84 and is adapted to fit into a recess 85 in disk 76 to prevent rotation of the latter.

A coil spring 86, which is disposed about an enlarged end of pin 77, is connected at one end to disk 76 and at its other end to one of the arms 78 of bracket 79. The spring 86 is so arranged about pin 77 that it is effective to move disk 76 in a clockwise direction when pin 83 is moved downward and out of recess 85. A crank 87 is secured to pin 77 for turning disk 76. To keep arm 70 bearing against the layer of frost 71 during defrosting, the plate is caused to move in a counter-clockwise direction by a coil spring 88 having one end connected to plate 72 and the other end connected to bracket 79.

When it is desired to initiate defrosting the parts of the control mechanism are moved into the position shown in Fig. 5, as will be presently explained. In this position the piston 37 is in its upper position and liquid overflows from chamber 42 into evaporation member 30, whereupon transfer of heat to cooling element 10 takes place. As the frost on cooling element 10 melts and decreases in thickness, coil spring 88 is moving plate 72 in a counter-clockwise direction so that the end of arm 70 is constantly contacting the melting frost. This counter-clockwise movement of plate 72 continues until the part 74 thereof moves under the projecting member 81, whereupon the latter suddenly moves downward from part 73 to part 74 due to the tension of coil spring 43. When this occurs the cooling element is substantially defrosted and plate 72 has turned in a counter-clockwise direction such a distance that the end of arm 70 is contacting a side of cooling element 10. The downward movement of projecting member 81 moves piston 37 to its lower position so that liquid condensate is trapped in chamber 42 and cannot flow into evaporation member 30, whereupon transfer of heat to cooling element 10 no longer takes place.

When projecting member 81 moves downward bracket 82 is also moved downward whereby pin 83 moves out of recess 85 in disk 76. With pin 83 no longer locking disk 76 in position, the coil spring 86 is effective to rotate disk 76 in a clockwise direction to the position shown in Fig. 8. The parts of the control mechanism are so proportioned and arranged that arm 70 is moved away from the cooling element 10 a considerable distance so that there will be no danger of the contact arm freezing fast to the layer of frost that is subsequently formed on the cooling element. With such counter-clockwise movement of disk 76 the plate 72, due to the fact that it is eccentrically pivoted on disk 76, can move downward a sufficient distance to assume the position shown in Fig. 8 with part 73 directly beneath the downward projecting member 81.

When it is again desired to initiate defrosting of cooling element 10, crank 87 is turned in a counter-clockwise direction to put spring 86 under tension and also locate recess 85 directly above the locking pin 83. The bracket 82 is then moved upward so that pin 83 will lock disk 76 in position and also force projecting member 81 upward, whereupon piston 37 is raised and liquid will overflow into evaporation member 30. When bracket 82 is moved from the lower position shown in Fig. 8 to the upper position shown in Fig. 6, contact arm 70 is again brought into contact with the layer of frost and spring 88 is put under tension to effect counter-clockwise movement of plate 72 as frost melts and becomes smaller and smaller in thickness on cooling element 10.

Although several embodiments of the invention

have been shown and described, it will be apparent to those skilled in the art that various modifications and changes may be made without departing from the spirit and scope of the invention. It is therefore contemplated to cover all modifications and changes which come within the spirit of the invention, as pointed out in the following claims.

What is claimed is:

1. Apparatus for defrosting a cooling element of a refrigeration system and including a first member associated with a source of heat and another member in thermal relation with the cooling element, means connecting said members to form a closed circuit containing a volatile fluid, said circuit having an active portion in which fluid is adapted to circulate to transfer heat from the source of heat to the cooling element and an inactive portion adapted to contain fluid in a liquid state, and means responsive to the pressure existing in said circuit for controlling the quantity of liquid in said active portion to control the transfer of heat from the source of heat to the cooling element.
2. Apparatus for defrosting a cooling element of a refrigeration system and including a first member associated with a source of heat and another member in thermal relation with the cooling element, means connecting said members to form a closed circuit containing a volatile fluid, said circuit having an active portion in which fluid is adapted to circulate to transfer heat from the source of heat to the cooling element and an inactive portion adapted to contain fluid in a liquid state, and means including a movable member adapted during heat transfer to said cooling element to bear against a diminishing layer of melting frost on said cooling element for controlling the quantity of liquid in said active portion to control the transfer of heat from the heat source to the cooling element.
3. Apparatus as defined in claim 2, in which said means for controlling the quantity of liquid in said active portion is so constructed and arranged that said movable member is moved away from the surface of the cooling element when the transfer of heat no longer takes place, so that said movable member will not freeze fast to said cooling element.
4. Apparatus for defrosting a cooling element of a refrigeration system and comprising a first member associated with a source of heat and a second member in thermal relation with the cooling element, means connecting said members to form a closed circuit containing a volatile fluid, said circuit having an active portion in which fluid is adapted to circulate to transfer heat from the heat source to the cooling element and an inactive portion adapted to contain fluid in a liquid state, said inactive portion being capable of holding substantially all of the fluid in the circuit, and means for causing liquid to flow from said inactive portion into said active portion so that transfer of heat will take place from the heat source to said cooling element to effect melting of frost formed on the latter, said last-mentioned means being so constructed and arranged that, when said second member is no longer in contact with ice or frost and the pressure in the circuit increases, substantially all of the fluid in the circuit is trapped in said inactive portion whereby transfer of heat no longer takes place from the heat source to said cooling element.
5. In a method of refrigeration attended by formation of frost or ice, that improvement which

consists in melting said frost or ice by conducting heat thereto in a fluid medium, and controlling flow of said medium by pressure of the medium.

6. A method as set forth in claim 5 in which said fluid undergoes vaporization and condensation.

7. A method as set forth in claim 5 in which said fluid is circulated between a place of vaporization and a place of condensation, the latter being in heat transfer relation with the frost or ice, and condensate is withheld from said place of vaporization by increase in pressure of the vapor.

8. In a refrigerator having a cooling surface subject to formation of frost or ice, a fluid heat transfer circuit having a portion in heat exchange relation with said cooling surface for melting said frost or ice, and means for controlling flow of fluid in said circuit responsive to pressure in the circuit.

9. A refrigerator as set forth in claim 8 in which the fluid in said circuit undergoes vaporization and condensation, and said control means causes withholding of condensate from the place of vaporization responsive to increase in pressure.

10. In a refrigeration system including a cooling element subject to formation of frost or ice thereon, means for supplying hot gaseous fluid to melt said frost or ice, and means to control the supply of said fluid responsive to the pressure thereof.

11. Refrigeration apparatus having a high temperature part and a low temperature part, the latter being subject to formation of frost or ice thereon, means forming a path for flow of fluid for conducting heat from said high temperature part to said low temperature part for causing melting of said frost or ice, and means for controlling flow of fluid in said path responsive to pressure of the fluid.

12. An absorption refrigeration system including a generator, a condenser, an evaporator, and an absorber, and operated so that said evaporator is subject to formation of frost or ice, and a controllable vaporization-condensation fluid heat transfer circuit for conducting heat from said generator to said frost in a manner to cause melting thereof when desired.

13. The combination with a refrigeration system having a cooling element subject to formation of frost or ice, of means for transferring heat to said frost or ice at a temperature and rate to cause melting thereof, and fluid pressure operated means for controlling said heat transfer means.

14. In refrigeration apparatus having a thermally insulated space and a cooling element arranged to cool said space and subject to formation of frost or ice, a first member associated with a source of heat and another member associated with said cooling element, conduit means connecting said members to form a closed circuit containing a volatile fluid, said circuit having a first portion in which fluid is adapted to circulate and a second portion adapted to hold fluid in a liquid state, said second portion being capable of holding substantially all of the liquid fluid in the circuit and being arranged to receive liquid from said other member, and means including a control element responsive to a temperature condition affected by said cooling element for causing liquid to flow from said second portion into said first portion whereby transfer of heat takes place from said heat source to said cooling element.

15. An absorption refrigeration system having

a high temperature place of heating where vapors are generated and a low temperature place where heat is abstracted by evaporation of liquid to produce a refrigerating effect, the place of heat abstraction being subject to formation of frost or ice, structure providing several paths of flow for fluid from the place of heating to the place of heat abstraction, one of the paths of flow including a portion in which vaporous fluid from the place of heating is condensed to liquid and from which liquid flows to the place of heat abstraction for evaporation therein, another of the paths of flow being controllable to supply vaporous fluid from the place of heating to the place of heat abstraction when desired, the heat from vaporous fluid at the place of heat abstraction being absorbed by the frost or ice so that heat is transferred to the frost or ice at a temperature above the melting point thereof and at a rate sufficient to cause melting of the frost or ice.

16. An absorption refrigeration system having a high temperature place of heating where vapors are generated and a low temperature place where heat is abstracted by evaporation of liquid to produce a refrigerating effect, the place of heat abstraction being subject to formation of frost or ice, structure providing several paths of flow for fluid from the place of heating to the place of heat abstraction, one of the paths of flow including a portion in which vaporous fluid from the place of heating is condensed to liquid and from which liquid flows to the place of heat abstraction for evaporation therein, another of the paths of flow being adapted to supply vaporous fluid from the place of heating to the place of heat abstraction, the heat from vaporous fluid at the place of heat abstraction being absorbed by the frost or ice so that heat is transferred to the frost or ice at a temperature above the melting point thereof and at a rate sufficient to cause melting of the frost or ice, and means controlling the supply of vaporous fluid to the place of heat abstraction.

17. An absorption refrigeration system having a high temperature place of heating where vapors are generated and a low temperature place where heat is abstracted by evaporation of liquid to produce a refrigerating effect, the place of heat abstraction being subject to formation of frost or ice, structure providing several paths of flow for fluid from the place of heating to the place of heat abstraction, one of the paths of flow including a portion in which vaporous fluid from the place of heating is condensed to liquid and from which liquid flows to the place of heat abstraction for evaporation therein, another of the paths of flow being adapted to supply vaporous fluid from the place of heating to the place of heat abstraction, the heat from vaporous fluid at the place of heat abstraction being absorbed by the frost or ice so that heat is transferred to the frost or ice at a temperature above the melting point thereof and at a rate sufficient to cause melting of the frost or ice, and means responsive to a condition representing substantially a defrosted state of the place of heat abstraction to stop flow of vaporous fluid to the place of heat abstraction.

18. In the art of refrigeration with an absorption refrigerating system including vaporizing fluid at a place of vapor expulsion, condensing the vaporized fluid to liquid at a place of condensation, and flowing liquid from the place of condensation to a place of vaporization for vaporization therein to produce a refrigerating effect,

the place of vaporization being subject to formation of frost or ice, the improvement which consists in addition in vaporizing liquid and flowing the vapors to the place of vaporization, the heat from the vapors being absorbed by the frost or ice so that heat is transferred to the frost or ice at a temperature above the melting point thereof and at a rate sufficient to cause melting of the frost or ice.

19. In the art of refrigeration with an absorption refrigerating system including vaporizing fluid at a place of vapor expulsion, condensing the vaporized fluid to liquid at a place of condensation, and flowing liquid from the place of condensation to a place of vaporization for vaporization therein to produce a refrigerating effect, the place of vaporization being subject to formation of frost or ice, the improvement which consists in addition in heating liquid to form vaporous fluid, flowing the vaporous fluid to the place of vaporization, the heat from the vapors being absorbed by the frost or ice so that heat is transferred to the frost or ice at a temperature above the melting point thereof and at a rate sufficient to cause melting of the frost or ice, and controlling the heating of liquid to control flow of vaporous fluid to the place of vaporization.

20. In the art of refrigeration with an absorption refrigerating system including vaporizing fluid at a place of vapor expulsion, condensing the vaporized fluid to liquid at a place of condensation, and flowing liquid from the place of condensation to a place of vaporization for vaporization therein to produce a refrigerating effect, the place of vaporization being subject to formation of frost or ice, the improvement which consists in addition in flowing vaporized fluid to the place of vaporization, the heat from the vaporized fluid being absorbed by the frost or ice so that heat is transferred to the frost or ice at a temperature above the melting point thereof and at a rate sufficient to cause melting of the frost or ice, accumulating liquid at a place of accumulation in the path of flow of the vaporized fluid to stop flow of the vaporized fluid to the place of vaporization, and removing liquid from the place of accumulation to permit flow of vaporized fluid to the place of vaporization.

21. In the art of refrigeration with an absorption refrigerating system including vaporizing fluid at a place of vapor expulsion, condensing the vaporized fluid to liquid at a place of condensation, and flowing liquid from the place of condensation to a place of vaporization for vaporization therein to produce a refrigerating effect, the place of vaporization being subject to formation of frost or ice, the improvement which consists in addition in vaporizing liquid to form vapors, flowing the vapors to the place of vaporization, and condensing the vapors by absorption of heat by the frost or ice, so that heat is transferred to the frost or ice at a temperature above the melting point thereof and at a rate sufficient to cause melting of the frost or ice.

22. An absorption refrigeration system having a high temperature place of heating where vapors are generated and a low temperature place where heat is abstracted by evaporation of liquid to produce a refrigerating effect, the place of heat abstraction being subject to formation of frost or ice, structure providing several paths of flow for fluid from the place of heating to the place of heat abstraction, one of the paths of flow including a portion in which vaporous fluid from the place of heating is condensed to liquid

and from which liquid flows to the place of heat abstraction for evaporation therein, another of the paths of flow being adapted to supply vaporous fluid from the place of heating to the place of heat abstraction, the heat from vaporous fluid at the place of heat abstraction being absorbed by the frost or ice so that heat is transferred to the frost or ice at a temperature above the melting point thereof and at a rate sufficient to cause melting of the frost or ice, a liquid trap in said other path of flow operative to stop the supply of vaporous fluid to the place of heat abstraction, and means to remove liquid from said trap to cause vaporous fluid to be supplied to the place of heat abstraction.

23. An absorption refrigeration system having a high temperature place of heating where vapors are generated and a low temperature place where heat is abstracted by evaporation of liquid to produce a refrigerating effect, the place of heat abstraction being subject to formation of frost or ice, structure providing several paths of flow for fluid from the place of heating to the place of heat abstraction, one of the paths of flow including a portion in which vaporous fluid from the place of heating is condensed to liquid and from which liquid flows to the place of heat abstraction for evaporation therein, another of the paths of flow being controllable to supply vaporous fluid from the place of heating to the place of heat abstraction when desired, the va-

porous fluid supplied to the place of heat abstraction being condensed by absorption of heat by the frost or ice so that heat is transferred to the frost or ice at a temperature above the melting point thereof and at a rate sufficient to cause melting of the frost or ice.

24. In a refrigerator having a cooling surface subject to formation of frost or ice, a fluid heat transfer circuit in which a heated fluid is adapted to flow and having a portion in heat exchange relation with said cooling surface, the heat from fluid in said portion being absorbed by the frost or ice, so that heat is transferred to the frost or ice at a temperature above the melting point thereof and at a rate sufficient to cause melting of the frost or ice, and means including a movable member adapted during heat transfer to the frost or ice to contact a diminishing layer of melting frost or ice on said cooling surface to control flow of heated fluid in said circuit.

25. The combination as set forth in claim 24 in which said means for controlling flow of heated fluid in said heat transfer circuit is so constructed and arranged that said movable member is moved away from the surface of said cooling element when heated fluid no longer flows in said circuit to said portion, so that said movable member will not freeze fast to said cooling surface.

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