

Nov. 28, 1939.

E. S. LYNGER

2,181,376

REFRIGERATION

Filed June 17, 1937

4 Sheets-Sheet 1

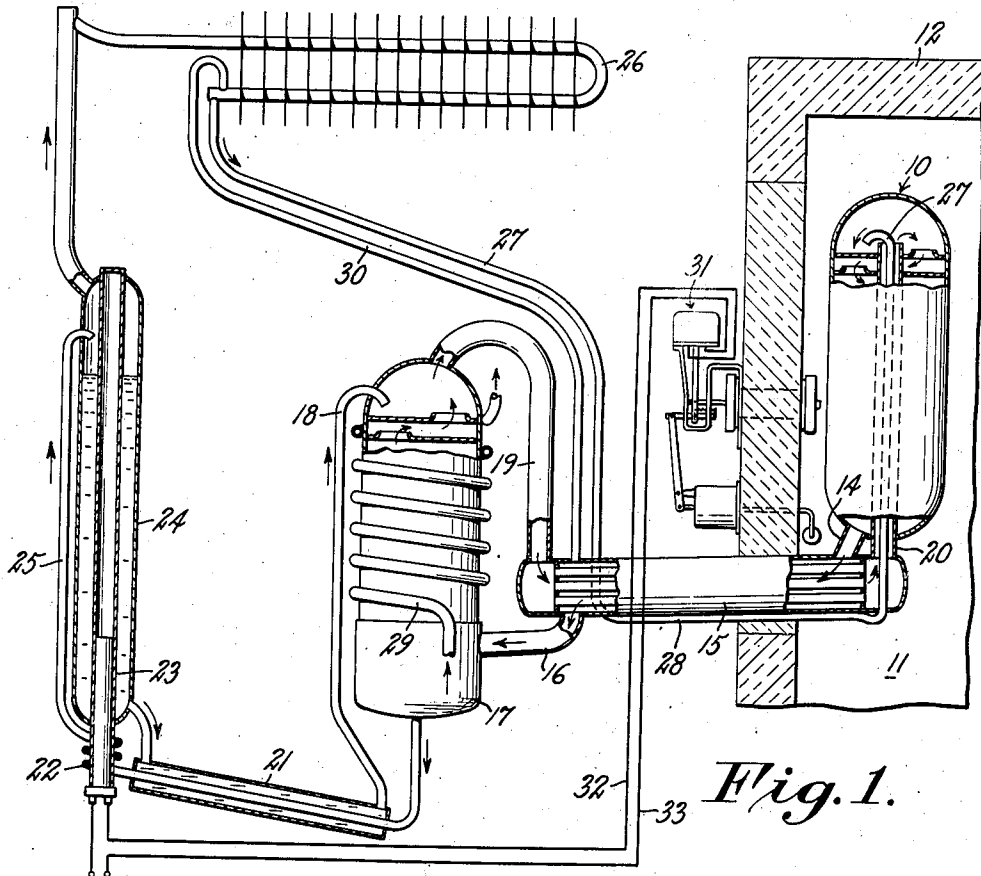


Fig. 1.

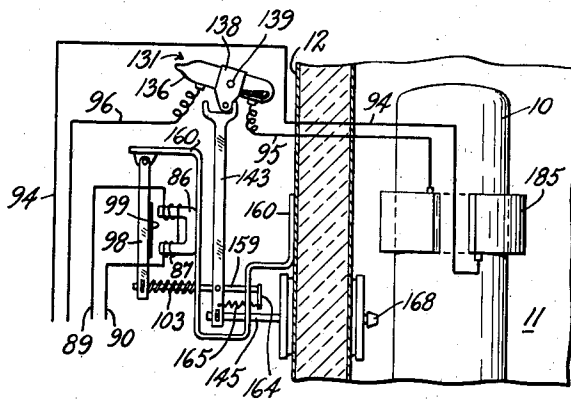


Fig. 4.

BY

INVENTOR.
Erik Sigfrid Lynger
Eaton & Under
his ATTORNEY.

Nov. 28, 1939.

E. S. LYNGER

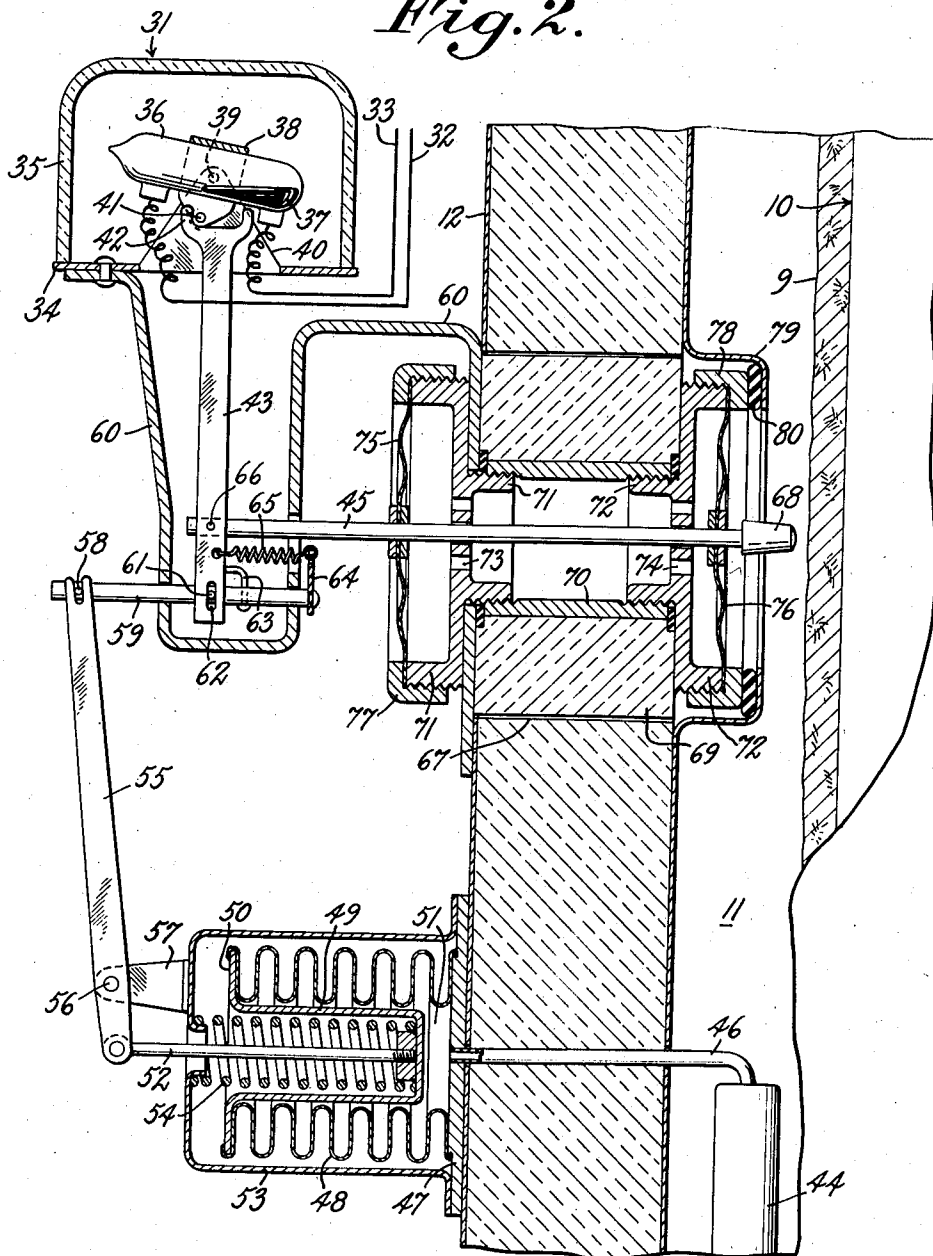
2,181,376

REFRIGERATION

Filed June 17, 1937

4 Sheets-Sheet 2

Fig. 2.



BY

INVENTOR.
Erik Sigfrid Lynger
his ATTORNEY.

Nov. 28, 1939.

E. S. LYNGER

2,181,376

REFRIGERATION

Filed June 17, 1937

4 Sheets-Sheet 3

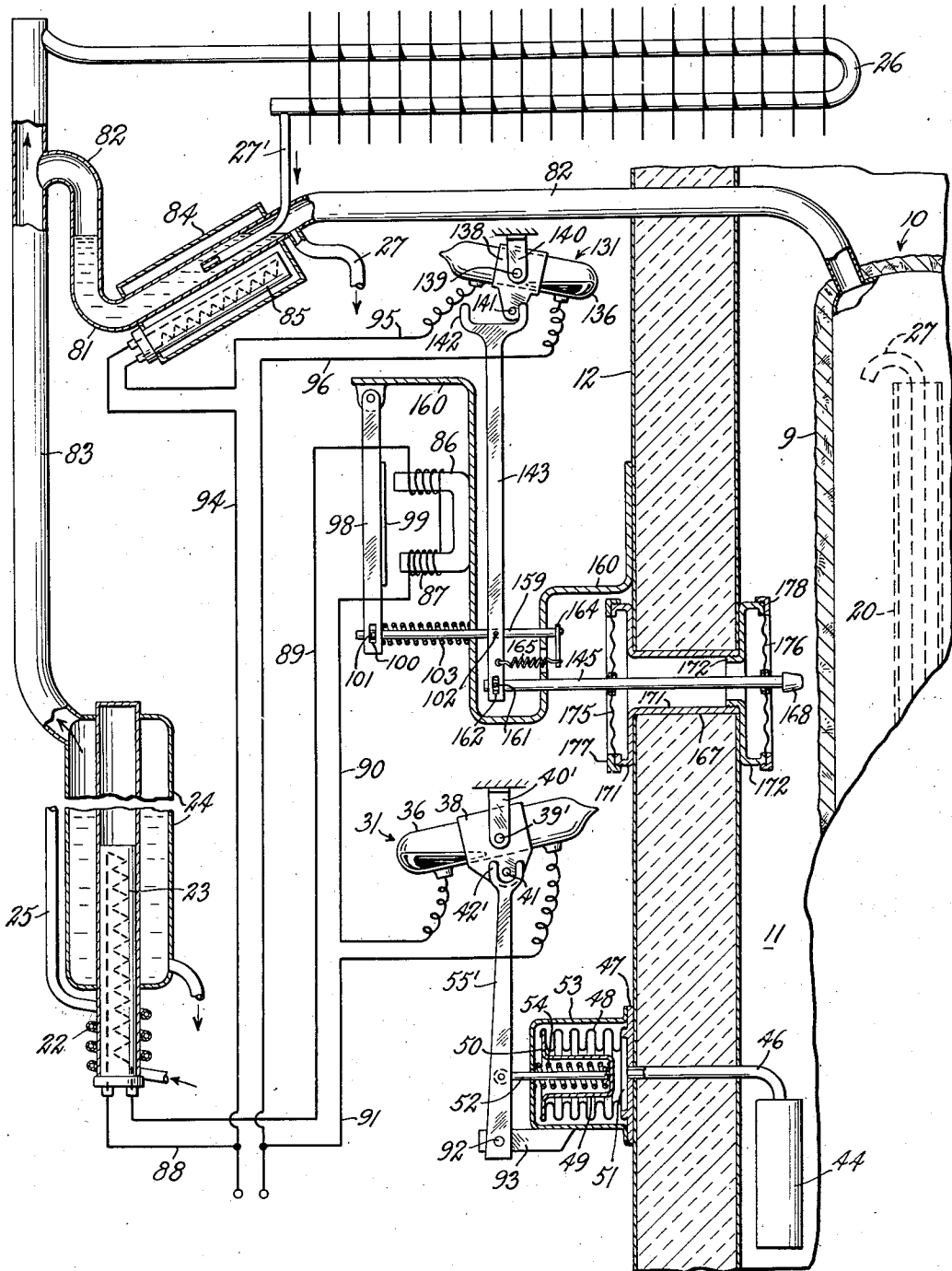


Fig. 3.

BY

INVENTOR.
Erik Sigfrid Lynger
E. J. Fenander
his ATTORNEY.

Nov. 28, 1939.

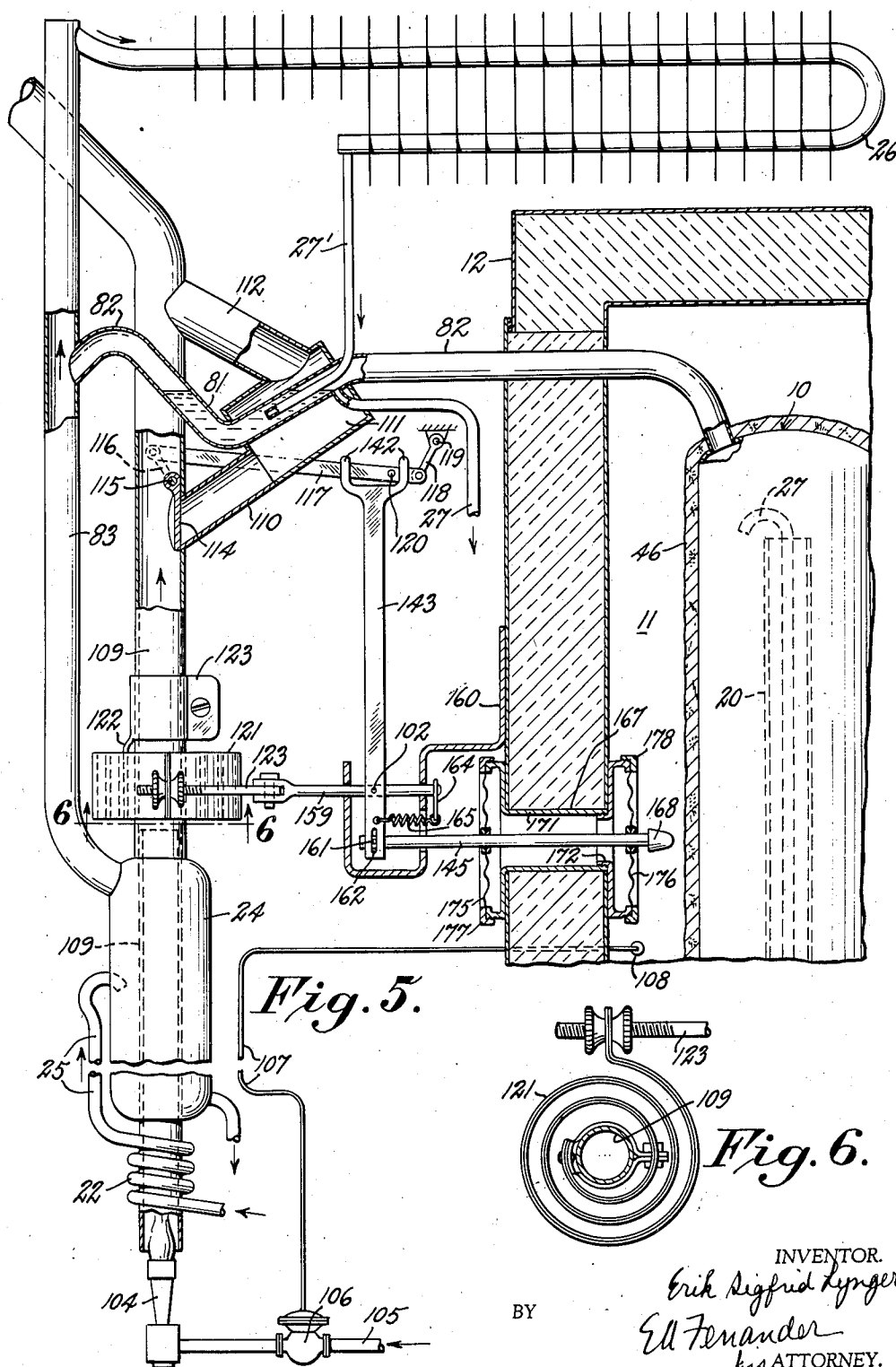
E. S. LYNGER

2,181,376

REFRIGERATION

Filed June 17, 1937

4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE

2,181,376

REFRIGERATION

Erik Sigfrid Lynger, Stockholm, Sweden, assignor, by mesne assignments, to Servel, Inc., New York, N. Y., a corporation of Delaware

Application June 17, 1937, Serial No. 148,709
In Germany July 10, 1936

17 Claims. (Cl. 62-5)

My invention relates to refrigeration, and more particularly to control of refrigeration apparatus.

It is an object of my invention to provide an improved control for refrigerators to initiate defrosting, the control being operative to instigate and terminate automatically the operation required to effect defrosting. I accomplish this by providing a control element which is moved from time to time toward a region of a cooling element or evaporator where frost or ice accumulates thereon, the movement of the control element preferably being automatically effected by a variable operating condition of the refrigerator. Among the variable operating conditions which may be effectively utilized to cause intermittent movement or probing of the control element, for example, are the temperature of the space being cooled or the temperature of a part of the refrigeration system which varies with sufficient regularity.

Another object of my invention is to utilize such a control element with a device which controls the operation of a refrigeration system, the element preferably being arranged in such a manner that the normal operation of the control device is modified to the extent that the refrigerating effect is reduced when a layer of frost of predetermined thickness has accumulated on the cooling element.

A further object of my invention is to provide such a control element to instigate defrosting by heating a cooling element, such heating preferably being effected without disturbing the operation of the refrigeration system.

A still further object of my invention is to effect defrosting by passing hot gases in a refrigeration system through a cooling element or evaporator on which frost has accumulated.

The above and other objects and advantages of my invention will be more fully understood from the following description taken in conjunction with the accompanying drawings forming a part of this specification, and of which Fig. 1 diagrammatically illustrates a refrigeration system provided with control embodying my invention; Fig. 2 is an enlarged vertical sectional view illustrating more clearly the control shown in Fig. 1; Fig. 3 is a modification of the control shown in Figs. 1 and 2 whereby defrosting is effected by passing hot gases through a cooling element; Fig. 4 diagrammatically illustrates control similar to that shown in Fig. 3 in which frost is melted by heating a cooling element without disturbing the operation of the refrigeration system; Fig. 5 is a further modification in which

a variable operating condition of a part of the refrigeration system is utilized to automatically effect defrosting; and Fig. 6 is a sectional view taken at line 6-6 of Fig. 5 to illustrate parts of the control more clearly.

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

The system includes a cooling element or evaporator 10 disposed in an enclosed space 11 which may form a food storage compartment of a thermally insulated cabinet 12. A 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 gas mixture of ammonia and hydrogen flows from the evaporator 10 through a conduit 14, gas heat exchanger 15, and conduit 16 into an absorber 17. In absorber 17 ammonia vapor is absorbed by a suitable liquid absorbent, such as water, which enters through a conduit 18. The hydrogen, which is practically insoluble and weak in ammonia, is returned to the upper part of the evaporator 10 through a conduit 19, the gas heat exchanger 15, and a vertical conduit 20; and the enriched absorption liquid is conducted from absorber 17 through a liquid heat exchanger 21 to a coil 22 which is disposed about an electrical heating element 23 extending into the lower part of a generator 24.

By heating coil 22, ammonia vapor and absorption liquid are raised by vapor-lift action through conduit 25 to the upper part of generator 24. Liberated ammonia vapor entering the generator 24 through conduit 25, as well as ammonia vapor expelled from solution in the generator, flows upward into an air-cooled condenser 26. The ammonia vapor is liquefied in condenser 26 and returned to evaporator 10 through conduit 27 to complete the refrigerating cycle. The conduit 27 is in heat exchange relation with the passage of the heat exchanger 15 through which enriched gas flows from evaporator 10 to absorber 17, as indicated at 28, and extends into the upper part of evaporator 10 within conduit 20.

The weakened absorption liquid from which ammonia has been expelled is conducted from generator 24 through liquid heat exchanger 21 and conduit 18 into the upper part of the absorber. The heat liberated with absorption of

ammonia vapor in absorber 17 is transferred to a cooling medium which flows through a coil 29 which is disposed about and in thermal relation with the absorber. A conduit 30 is connected to the lower part of condenser 26 and to 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 into the gas circuit and not be trapped in the condenser.

The heating element 23, which is connected to a source of electrical supply and serves as the source of energy for the refrigeration system, is controlled by a mercoid switch 31 which is connected in series relation with the heating element by conductors 32 and 33. Referring more particularly to Fig. 2, the switch 31 is provided with a base plate 34 and a removable cover 35 within which is disposed a bulb 36. The bulb 36 contains a body of mercury 37 and is provided with two spaced depending parts to which are connected the conductors 32 and 33. The bulb 36 is fixed to an inverted U-shaped member 38 which is pivotally mounted at 39 to spaced brackets 40 secured to the base plate 34. The inverted U-shaped member 38 and bulb 36 carried thereby rock about the pivot 39, the electrical circuit being open with the bulb in the position shown in Fig. 2 and the circuit being closed or completed with the bulb tilted when the left-hand part thereof is in the down position and the right-hand part thereof is in the up position.

In order to rock the bulb 36 about the pivot 39 to connect and disconnect the heating element 23 to and from the source of electrical supply, a pin 41 is secured to the side walls of the inverted U-shaped member 38. The pin 41 is in the path of movement of the bifurcated arms 42 of a lever 43 which extends vertically downward through an opening in the base plate 34.

In accordance with my invention the lever 43 and bulb 36 of the switch 31 are controlled in response to a thermal element 44 disposed in the space 11, and this normal control is automatically modified by a control or probing member 45 when a layer of frost of predetermined thickness has accumulated on cooling element 10. The probing member 45 is associated with the thermal element 44 whereby the member 45 is automatically moved from time to time toward a region of the cooling element 10 with changes in temperature of the space 11.

The mechanism connecting the lever 43, thermal element 44 and probing member 45, to effect control of the refrigeration system and also instigate defrosting, includes a capillary tube 46 connected to thermal element 44. The tube 46 extends through an insulated wall of cabinet 12 and is connected to a plate 47 to which is secured one end of an expansible bellows 48. Within the bellows 48 is disposed a sleeve 49 having the flanged outer end 50 thereof secured to the opposite end of the bellows. The chamber 51 defined by the closed sleeve 49 and bellows 48, tube 46 and thermal element 44 constitute an expansible fluid thermostat which is filled with a suitable volatile fluid which increases and decreases in volume with corresponding changes of temperature.

The movements of bellows 48 with changes of temperature in space 11 are transmitted to lever 43 and probing member 45 by a rod 52 having one end thereof fixed to the inner end of sleeve 49. The rod 52 extends through an opening in a cover member 53 which is mounted on base plate 47, and a coil spring 54 is disposed about rod 52 and

bears against the inner end of sleeve 49 and cover member 53. The rod 52 is pivotally connected to the lower end of a vertical lever 55 which is pivoted at 56 to a bracket 57 fixed to cover member 53. The upper end of lever 55 is forked to receive a pin 58 at the outer end of a horizontally movable rod 59.

The rod 59 is journaled in openings formed in a bracket 60 which is U-shaped with one arm bent back upon itself and mounted on the cabinet 12 and the other arm extending upward and serving as a support for switch 31. The rod 59 is provided with a pin 61 which extends into an elongated slot 62 formed in the lower end of lever 43. A pin 63 is fixed to lever 43 and extends downward on the opposite side of rod 59 from the lever 43 to maintain pin 61 in slot 62. To the inner end of rod 59 is rigidly secured a small plate 64 which in turn is connected by a coil spring 65 to the lever 43 at a point above slot 62.

The mechanism thus far described connects the expansible fluid thermostat and the switch 31, with the lever 43 in effect forming a continuation of lever 55. The switch 31 is normally controlled in response to the temperature of space 11, therefore, to increase or decrease the refrigerating effect produced by cooling element 10.

To modify the normal control of switch 31 when a layer of frost of predetermined thickness has accumulated on cooling element 10, the outer end of probing member 45 is pivotally connected at 66 to the lever 43. Probing member 45 extends through an opening 67 in an insulated wall of cabinet 12 and at its inner end is provided with an enlarged head 68 which is preferably formed of rubber or other suitable material. The opening 67 is partly filled with suitable insulating material 69 which is retained in position by an annular sleeve 70.

To the ends of sleeve 70 are fixed collars 71 and 72 having central openings through which the probing member 45 extends. The collars 71 and 72 are provided with additional openings 73 and 74 and are enlarged at their outer ends. Resilient diaphragms 75 and 76 are secured to probing member 45 and their peripheral edges are secured to the collars 71 and 72 by hollow cap members 77 and 78. The hermetically closed space between the diaphragms 75 and 76 may be filled with dry air or suitable liquid, and the space between the cap member 78 and inner wall member 79 of the cabinet 12 is preferably sealed by a gasket 80.

The operation of the control just described is substantially as follows: Assuming that switch 31 is in its circuit open position shown in Fig. 2 and cooling element 10 is substantially defrosted or only covered with a thin layer of frost, the switch 31 will be moved to its circuit closing position when the space 11 tends to rise above a desired low temperature. In such case the volatile fluid of the expansible fluid thermostat increases in volume and causes bellows 48 to expand. With expansion of bellows 48, rod 52 is moved outward by sleeve 49, and lever 55 is rotated about pivot 56 in a clockwise direction to cause horizontal movement of rod 59 toward the cabinet 12. Due to the provision of the pin and slot connection 61 and 62, lever 43 is also moved toward cabinet 10 whereby movement is imparted to probing member 45.

The lever 43 is prevented from rotating under these conditions by the plate 64 and coil spring 65. The mechanism is so arranged that, when the cooling element 10 is substantially defrosted, the probing member 45 will freely move toward

the cooling element a distance to permit sufficient lateral displacement of lever 43 whereby the left-hand bifurcated arm 42 of the lever will contact pin 41 and rock member 38 and bulb 36. With the bulb 36 rocked and tilted so that it is in its circuit closing position, the heating element 23 will be connected to the source of electrical supply and the refrigeration system will operate in the manner described above to produce refrigeration in space 11.

When the space 11 tends to fall below the desired low temperature, the volatile fluid in the expansible fluid thermostat becomes reduced in volume, whereby the bellows 48 contracts and spring 54 becomes effective to move rod 52 toward the cabinet 12. With such movement of rod 52, lever 55 is rotated in a counter-clockwise direction to cause horizontal movement of rod 59 away from the cabinet 12. This produces lateral movement of lever 43 away from cabinet 12 so that the right-hand bifurcated arm 42 will contact and move pin 41 and cause member 38 and bulb 36 to rock back to the position shown in Fig. 2. With the bulb 36 now in its circuit open position, the heating element 23 will be disconnected from the source of electrical supply and the refrigerating effect produced by cooling element 10 will tend to maintain the space 11 at the desired low temperature.

It will now be understood that switch 31 is controlled in response to a temperature condition affected by cooling element 10, and that with changes in temperature in space 11 the probing member 45 is automatically moved from time to time toward a region of the cooling element. When a layer of frost 9 of predetermined thickness has formed on the cooling element 10 and defrosting is desired, the above described operation is automatically modified in the following manner. When space 11 tends to rise above the desired low temperature, rod 59 is moved toward cabinet 12 and probing member 45 is moved toward cooling element 10 in the same manner as explained above. Due to the formation of frost on cooling element 10, however, the movement of probing member 45 is stopped as soon as the enlarged head 68 contacts the layer of frost. The rod 59 continues to move toward cabinet 10 with the result that lever 43 is rotated on its pivot 66 in a counter-clockwise direction. With such rotation of lever 43 the left-hand arm 42 at the upper end of the lever is prevented from moving pin 41 and tilting bulb 36 from the circuit open position shown in Fig. 2 to its circuit closing position, as in the normal operation explained above. Even though the space 11 is tending to rise above the desired low temperature, therefore, the refrigerating effect is not increased in the normal manner, thereby permitting the temperature of cooling element 10 to increase and allow melting of frost. Under these conditions the spring 66 is under tension and is constantly urging the enlarged head 68 of probing member 45 to bear against the layer of frost.

With melting of frost the probing member 45 is moved toward cooling element 10, and, when the cooling element is substantially defrosted, the movement of the probing member has rotated lever 43 sufficiently in a clockwise direction about the pin 61 to cause the left-hand arm 42 of lever 43 to move pin 41 and rock bulb 36 from its circuit open position to its circuit closing position. The heating element 23 will now be connected to the source of electrical supply and the cooling element 10 will again produce a refrigerating

effect to lower the temperature of space 11. By melting the frost accumulated on cooling element 10, the latter is rendered more effective to produce refrigeration.

In Fig. 3 I have shown a modification in which 5
refrosting is effected by passing hot gases in the refrigeration system through the cooling element. In order to simplify the drawings parts of the system in Fig. 3, which are similar to those in Fig. 1, have been omitted, these parts including the gas heat exchanger 15, absorber 17, liquid 10
heat exchanger 21, and connections therebetween. The parts of the system which are shown in Fig. 3 and similar to those illustrated in Fig. 1 are designated by the same reference numerals. 15

In Fig. 3 the lower part of condenser 26 is connected to a conduit 27' which extends downward into a U-shaped trap 81 formed in a conduit 82. The conduit 27 for conducting liquid ammonia to the upper part of cooling element 10 is 20
connected to one arm of trap 81. One end of conduit 82 is connected to vertical conduit 83 through which ammonia vapor flows upward from generator 24 to condenser 26, and the other end thereof is connected to the upper part of cooling 25
element 10. One arm of trap 81 is provided with a jacket 84 which may contain a suitable liquid adapted to be heated by an electrical heating element 85.

During normal operation of the refrigeration 30
system liquid ammonia collects in trap 81 whereby ammonia vapor flowing in conduit 83 passes in the usual manner into condenser 26 in which it is liquefied. The liquid ammonia flows through conduit 27' to trap 81 and thence through conduit 35
27 into the upper part of cooling element 10 where it evaporates and diffuses into hydrogen entering through conduit 20. When it is desired to defrost cooling element 10, the heating element 85 is connected to a source of electrical supply to 40
heat the liquid in jacket 84. By evaporating the liquid in trap 81, the liquid seal in conduit 82 is quickly broken whereby ammonia vapor flowing upward in conduit 83 passes through conduit 82 directly into the cooling element 10. The ammonia vapor entering the cooling element heats 45
up the latter and effectively melts frost which has formed on its surfaces.

The heating element 85 may be controlled by a probing member 145 in a manner similar to 50
that shown in Fig. 1. The control shown in Fig. 3 differs from that illustrated in Fig. 1 in that the probing member 145 does not modify the operation of the switch 31 which controls the generator heating element 23. In this modification the intermittent opening and closing of the 55
electrical circuit associated with switch 31 is utilized to energize from time to time a magnet 86 to cause movement of probing member 145 toward the cooling element 10. 60

In Fig. 3 it will be seen that heating element 23, the windings 87 of magnet 86, and switch 31 are connected in series relation by conductors 88, 89, 90, and 91 to the source of electrical supply. The inverted U-shaped member 38 carrying bulb 65
36 is pivoted at 39' to a bracket 40' which is supported in any suitable manner. The pin 41 secured to the sides of member 38 is adapted to receive the bifurcated arms 42' formed at the upper end of a lever 55' which is pivoted at 92 at 70
its lower end to a bracket 93 fixed to the cover member 53.

The probing member 145 extends through an opening 167 in the insulated wall of cabinet 12 and is fixed to resilient diaphragms 175 and 176. 75

The diaphragms 175 and 176 are secured at their peripheral edges to collars 171 and 172 by hollow cap members 177 and 178, the collar 171 extending through the opening and serving as a sleeve member. The outer end of probing member 145 is provided with a pin 161 which extends into a slot 162 formed at the lower end of lever 143. The lever 143 at its upper end is provided with bifurcated arms 142 for rocking a switch 131 similar to the switch 31 shown in Fig. 1. The member 138 carrying bulb 136 is pivoted at 139 to a bracket 140 which is supported in any suitable manner. The switch 131 is connected in series relation with heating element 85 by conductors 94, 95, and 96 to the source of electrical supply.

The magnet 86 is fixed to a U-shaped bracket 160 which in turn may be supported on the cabinet 12. To one arm of the bracket 160 is pivotally connected the downward extending lever 98 to which is fixed an armature 99 adapted to cooperate with magnet 86. The lower end of lever 98 is provided with a slot 100 to receive a pin 101 at the outer end of a horizontally movable rod 159. The rod 159 is journaled in openings in bracket 160 and intermediate its ends is pivotally connected at 102 to lever 143. To the inner end of rod 159 is rigidly secured a plate 164 which in turn is connected by a coil spring 165 to the lever 143 below the pivot 102. A spring 103 is arranged about rod 159 between the lever 98 and one arm of bracket 160 to retract the lever 98 from magnet 86 when the latter is deenergized.

The operation of the modification just described is substantially as follows: With changes in temperature of space 11 the volatile fluid in the expansible fluid thermostat increases or becomes reduced in volume, whereby rod 52 and lever 55' are moved to cause bulb 36 to rock either to a circuit open or closing position. When the space 11 tends to rise above a desired low temperature, bulb 36 is moved from the position shown in Fig. 3, which may be assumed to be a circuit open position, to a circuit closing position, whereby heating element 23 is connected to the source of electrical supply and the refrigerating effect produced by cooling element 10 is increased. When the space 11 tends to fall below the desired low temperature, the bulb 36 is moved to its circuit open position whereby heating element 23 is disconnected from the source of electrical supply and the refrigerating effect produced in space 11 is reduced.

Each time switch 31 is moved to its circuit closing position the windings 87 of magnet 86 are energized whereby the armature 99 and lever 98 are attracted toward the magnet. The energization of the magnet causes rod 159 to move toward the right and impart movement to lever 143 and probing member 145. Assuming that cooling element 10 is substantially defrosted and probing member 145 can freely move toward cooling element 10, lever 143 will not rotate and is only displaced laterally. The parts of the control mechanism are so arranged that, with only parallel displacement of lever 143, the left-hand bifurcated arm 142 will not contact pin 141 whereby switch 131 will remain in its circuit open position.

When switch 31 is moved to its circuit open position magnet 86 is deenergized and spring 103 becomes effective to retract lever 98 and armature 99 from magnet 86. This produces lateral movement of lever 143 away from cabinet 12 and probing member 145 is moved away from

cooling element 10. With changes in temperature of space 11 and substantially no frost on cooling element 10, therefore, probing member 145 is moved from time to time toward cooling element 10 with intermittent energization of magnet 86, and switch 131 remains in its circuit open position whereby heating element 85 is disconnected from the source of electrical supply. Under these conditions the trap 81 is filled with liquid ammonia and no hot gases can pass into cooling element 10 through conduit 82.

When magnet 86 is energized and a layer of frost 9 of predetermined thickness has formed on cooling element 10, the above described operation is automatically modified in the following manner: While the rod 159 will move toward the cabinet 12 as before, the movement of probing member 145 toward cooling element 10 is stopped as soon as the enlarged head 168 contacts the layer of frost. Since rod 159 continues to move toward the cabinet 12, lever 143 rotates in a clockwise direction about the pin and slot connection 161 and 162. The lever 143 rotates sufficiently for the left-hand bifurcated arm 142 to contact pin 141 and cause bulb 136 to rock from its circuit open position shown in Fig. 3 to its circuit closing position. With switch 131 moved to its circuit closing position heating element 85 is connected to the source of electrical supply and liquid ammonia in trap 81 is evaporated. When the liquid seal in conduit 82 is broken, ammonia vapor flowing upward through conduit 83 can pass through conduit 82 and flow directly into cooling element 10 to heat the latter and cause melting of frost accumulated thereon.

With cooling element 10 at an increased temperature the space 11 will rise above the desired low temperature, so that switch 31 remains in its closed position and both heating element 23 and magnet 86 will be energized. The operation of the refrigeration system is not suspended, therefore, as far as expulsion of ammonia vapor in generator 24 is concerned. With armature 99 attracted by magnet 86 and rod 159 moved as far as possible toward cabinet 12, the tension of spring 165 is increased whereby probing member 145 is constantly urged toward the right with the enlarged head 168 bearing against the frost. With melting of frost probing member 145 is moved toward cooling element 10, and, when the cooling element is substantially defrosted, lever 143 will be moved in a counter-clockwise direction about pivot 102 a distance sufficient for the right-hand bifurcated arm 142 to contact pin 141 and rock bulb 136 to its circuit open position. With switch 131 in its circuit open position, heating element 85 is disconnected from the source of electrical supply and liquid ammonia in condenser 26 will collect in trap 81 to provide the liquid seal and prevent further flow of ammonia vapor through conduit 82 to the upper part of cooling element 10.

Since the space 11 will be above the desired low temperature at the termination of the defrosting period, switch 31 remains in its closed position and the refrigeration system will operate in the normal manner, whereby a refrigerating effect will be produced by the cooling element. When the space 11 tends to fall below the desired low temperature, switch 31 is moved to its circuit open position whereby heating element 23 is disconnected from the source of electrical supply, the windings 87 of magnet 86 are deenergized, and probing member 145 is moved away from cooling element 10.

Instead of employing heating element 85 to evaporate liquid ammonia in conduit 82 to permit hot gases to pass directly into the cooling element, this heating element may be employed directly to heat the cooling element. Such a modification is shown in Fig. 4 which illustrates part of the control just described in connection with Fig. 3, similar parts being designated by the same reference numerals. The heating element 85, which corresponds to the heating element 85 in Fig. 3, is only shown diagrammatically and is in thermal relation with cooling element 10. The refrigeration system associated with cooling element 10 may be the same as that shown in Fig. 1. As in Fig. 3, probing member 145 is moved toward cooling element 10 each time switch 31 is closed and magnet 35 is energized. When cooling element 10 is substantially defrosted, switch 131 remains in its open position and heating element 85 is disconnected from the source of electrical supply. When a layer of frost of predetermined thickness has formed on cooling element 10, movement of probing member 145 stops as soon as it contacts the frost, and, as described above in connection with Fig. 3, switch 131 is closed and heating element 85 is connected to the source of electrical supply. Sufficient heating is produced by heating element 85 to raise cooling element 10 above 0° C. to cause melting of frost formed thereon. With the cooling element 10 substantially defrosted, switch 131 is moved to its circuit open position and heating element 85 is disconnected from the source of electrical supply.

While defrosting is taking place, switch 31 is closed and heating element 23 is energized so that defrosting is effected without disturbing the operation of the refrigeration system. When the defrosting operation is terminated, therefore, the cooling element will become immediately effective to produce refrigeration in space 11. With this arrangement defrosting can be effected very rapidly because heat is conducted directly to the cooling element 10.

In Figs. 5 and 6 I have shown a further modification in which a variable operating condition of a part of the refrigeration system is utilized to impart movement from time to time to probing member 145. The refrigeration system in Fig. 5 is generally the same as that shown in Fig. 3 with similar parts designated by the same reference numerals, and differs therefrom in that a gas burner 104 serves as a source of energy for the system instead of electrical heating element 23.

A suitable combustible gas is delivered through conduit 105 to burner 104, the flow of gas being controlled by a valve diagrammatically indicated at 106. The valve 106 is controlled by an expansible fluid thermostat which includes a capillary tube 107 and a thermal element 108 disposed in space 11. When the space 11 tends to rise above a desired low temperature, the expansible fluid thermostat causes the valve 106 to open to increase the flow of gas to burner 104; and, conversely, when the temperature of space 11 tends to fall below the desired low temperature, the thermostat causes the valve 106 to close to reduce the flow of gas to burner 104.

The burner flame projects into the lower end of a flue 109 which extends upwardly through generator 24. The upper part of flue 109 is provided with a by-pass including conduit 110, jacket 111 arranged about one arm of trap 81, and conduit 112. The flow of combustion gases through the by-pass is controlled by a valve 114 which is

preferably curved to the shape of the flue to effectively close the lower end of conduit 110.

The valve 114 is pivotally supported within flue 109 by a pin 115 which extends outside the flue. To the pin 115 is fixed an arm 116 which in turn is pivotally connected to one end of a lever 117. The opposite end of lever 117 is pivotally connected to a link member 118 which is pivoted at 119 to a suitable support. The lever 117 is provided with a pin 120 which is in the path of movement of the bifurcated arms 142 at the upper end of lever 143.

Above the generator 24 is provided a spiral-shaped bi-metallic strip 121 which is arranged about flue 109. The inner end of strip 121 is secured to a downward depending arm 122 of a bracket 123 which is fastened to flue 109. To the outer end of strip 121 is secured one end of a rod 123 which is pivotally connected at its other end to rod 159.

The operation of the control shown in Fig. 5 is substantially as follows: With the flow of gas to burner 104 varying with changes of temperature in space 11, the size of the burner flame increases and decreases and hence the temperature of flue 109 varies. When the flow of gas to burner 104 is reduced, for example, the temperature of flue 109 and heating of bi-metallic strip 121 are reduced. The bi-metallic strip 121 with less heating is arranged to cause movement of rod 123 toward cabinet 12. This imparts movement to rod 159, lever 143, and probing member 145 in the same manner as described above in connection with the control shown in Fig. 3. Conversely, when the flow of gas to burner 104 is increased, the temperature of flue 109 and heating of bi-metallic strip 121 are increased. With increased heating of strip 121 the bi-metallic strip is arranged to cause movement of rod 123 away from cabinet 12.

With cooling element 10 substantially defrosted, the lateral displacement of lever 143 with variations of flue temperature takes place without affecting the valve 114; that is, the left-hand bifurcated arm 142 of lever 143 does not contact pin 120 on lever 117 to move valve 114 from its closed position shown in Fig. 5. When a layer of frost of predetermined thickness has formed on cooling element 10, however, and the heating of bi-metallic strip 121 is reduced by lowering of the flue temperature, the movement imparted to rod 159 renders the control mechanism operative to open valve 114 and permit combustion gases to flow through the by-pass and cause heating of liquid ammonia in trap 81. As in Fig. 3, this is effected by the limited movement of probing member 145 due to its contacting the frost. After movement of probing member 145 has stopped, the rod 159 continues to move toward cabinet 12 whereby lever 143 rotates in a clockwise direction about the pin and slot connection 101 and 102. The rotating movement of lever 143 is sufficient to cause the left-hand bifurcated arm 142 to contact pin 120 and move lever 117 toward cabinet 12. This movement of lever 117 lifts valve 114 from its closed position to an open position.

When the liquid seal in trap 81 is broken by heating due to flow of combustion gases through the by-pass, ammonia vapor enters cooling element 10 through conduit 82 to cause melting of frost. The probing member 145 is constantly bearing against the frost due to the tension in spring 165, and, when the cooling element is substantially defrosted and lever 143 has rotated a sufficient distance in a counter-clockwise direc-

tion, the right-hand bifurcated arm 142 contacts pin 120 and moves lever 117 away from cabinet 12 to cause valve 114 to move to its closed position. This shuts off the flow of combustion gases through the by-pass and liquid ammonia from condenser 26 again collects in trap 81 to provide a liquid seal, whereby normal operation of the refrigeration system is resumed.

By providing a probing member of the character described, defrosting is instigated automatically when the need for defrosting arises and is also automatically terminated when defrosting is completed. Since the probing member is automatically moved from time to time toward a region of the cooling element in response to a variable operating condition of the refrigerator, it is not necessary to provide mechanism to predetermine the operation of the refrigerator and adjust any controls to effect such predetermined operation. Instead of utilizing variations in temperature of the space being cooled or the temperature of the generator flue to effect movement of the probing member, any variable operating condition may be employed, such as, for example, variations in temperature of the absorber, condenser, or the refrigerant itself.

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. Refrigeration apparatus of a continuous absorption type including a cooling element, a generator having a flue, a source of heat for said generator, a device for controlling the source of heat, structure including a member movable toward the cooling element to instigate defrosting when a layer of frost of predetermined thickness has formed on the cooling element, and means for causing said member to move automatically from time to time toward said cooling element with changes of temperature of said flue.

2. Refrigeration apparatus including a cooling element, a member movable toward and away from a region of said cooling element, a thermostat responsive to the variable temperature condition for causing movement of said member from time to time, and means controlled by said member to cause defrosting of said cooling element when said member is moved toward said cooling element and a layer of frost of predetermined thickness has formed thereon.

3. A refrigerating system of a continuous absorption type including a generator, condenser, evaporator and connections therebetween for circulation of refrigerant from said generator through said condenser and into said evaporator, a conduit connected to permit refrigerant to pass from said generator to said evaporator and by-pass said condenser, a trap in said conduit adapted to receive liquid refrigerant from said condenser to provide a seal, and means for heating said trap to evaporate liquid therein and permit flow of refrigerant through said conduit from said generator to said evaporator.

4. In a refrigeration system having a cooling element capable of producing a refrigerating effect, the improvement which consists in heating the cooling element to cause melting of frost formed thereon, controlling such heating by a

member adapted to probe from time to time a region of the cooling element upon which frost is normally formed, and imparting movement to said probing member with changes in a variable operating condition of the refrigeration system.

5. In a refrigerating system of a continuous absorption type including a generator, condenser, evaporator and connections therebetween for conducting vaporous refrigerant fluid from said generator to said condenser and liquid refrigerant fluid from said condenser to said evaporator, means including a trap to by-pass vaporous refrigerant fluid around said condenser from said generator into said evaporator, said trap receiving and holding liquid refrigerant fluid to close said by-pass, and means to reduce the amount of liquid held in said trap to open said by-pass.

6. In a refrigeration system of a continuous absorption type including a generator, condenser, evaporator and connections therebetween for conducting vaporous refrigerant fluid from said generator to said condenser and liquid refrigerant fluid from the latter to said evaporator, means including a trap to by-pass vaporous refrigerant fluid around said condenser from said generator to said evaporator, said trap being connected to receive liquid in the system to prevent flow of vaporous refrigerant fluid therethrough, and said trap permitting flow of vaporous refrigerant fluid therethrough when liquid is removed therefrom.

7. A method of refrigerating with a system in which liquid refrigerant fluid evaporates in a place of evaporation in the presence of an inert gas, which includes flowing vaporous refrigerant fluid to a place of accumulation and thence to the place of evaporation, flowing vaporous refrigerant fluid to a place of condensation, flowing liquid refrigerant fluid from the place of condensation to the place of accumulation and also to the place of evaporation, and controlling the amount of liquid held in said place of accumulation to permit or prevent flow of vaporous refrigerant fluid therethrough to said place of evaporation.

8. A refrigerating system including a cooling element, and a device operative when a predetermined layer of frost has accumulated on said cooling element to cause flow of hot vaporous fluid in the system into said cooling element to melt frost on the latter.

9. A method of refrigeration which includes maintaining a supply of vaporous refrigerant fluid, condensing vapor from said supply to liquid, evaporating the condensed liquid to produce a refrigerating effect, maintaining a heat source, and utilizing heat from said source to cause transfer of vapor from said supply into the presence of said evaporating liquid to cause rapid rise in temperature and melting of any frost which may have been formed due to said refrigerating effect.

10. A method of refrigeration as set forth in claim 9 which also includes controlling said transfer of vapor by liquid valve action, and carrying out said action by application of said heat to a body of liquid.

11. A method of refrigeration as set forth in claim 9 which also includes forming a body of liquid utilizing said condensed refrigerant fluid, and applying said heat to vaporize said body of liquid to instigate said transfer of vapor.

12. A method of refrigeration which includes maintaining a supply of vaporous refrigerant fluid, condensing to liquid vapor from said supply, evaporating condensed liquid to produce a refrigerating effect.

erating effect, trapping liquid, and releasing the trapped liquid to cause transfer of vapor from said supply into the presence of evaporating condensed liquid to cause rapid rise in temperature and melting of any frost which may have been formed due to said refrigerating effect.

13. A method of refrigeration as set forth in claim 12 in which the liquid which is trapped is some of the liquid formed by said condensation.

14. A refrigeration system including a source of vaporous refrigerant fluid, a condenser in which said vaporous refrigerant fluid is liquefied, an evaporator connected to receive said liquefied refrigerant, and a heat operated device for controlling flow of vapor from said source of supply to said evaporator.

15. A refrigeration system including a source of supply of vaporous refrigerant fluid, a condenser, an evaporator, a liquid trap, means for filling and emptying said trap with liquid, and a conduit including said trap for conducting

vapor from said supply to said evaporator when the trap is open.

16. A refrigeration system including a source of vaporous refrigerant fluid, a condenser, an evaporator, a conduit including a liquid trap for conducting vapor from said source to said evaporator, means for supplying liquid to said trap, and means for heating said trap to expel liquid therefrom and thereby control flow of vapor through said conduit.

17. A method of refrigeration which includes evaporating liquid refrigerant at a low vapor pressure to produce refrigeration, creating said low vapor pressure by absorption of refrigerant fluid vapor into an absorbent, expelling refrigerant fluid vapor from said absorbent, condensing expelled vapor to provide liquid for said evaporation step, and intermittently raising said low vapor pressure by introducing expelled vapor directly from its place of expulsion into the presence of liquid refrigerant fluid to be evaporated.

ERIK SIGFRID LYNGER.