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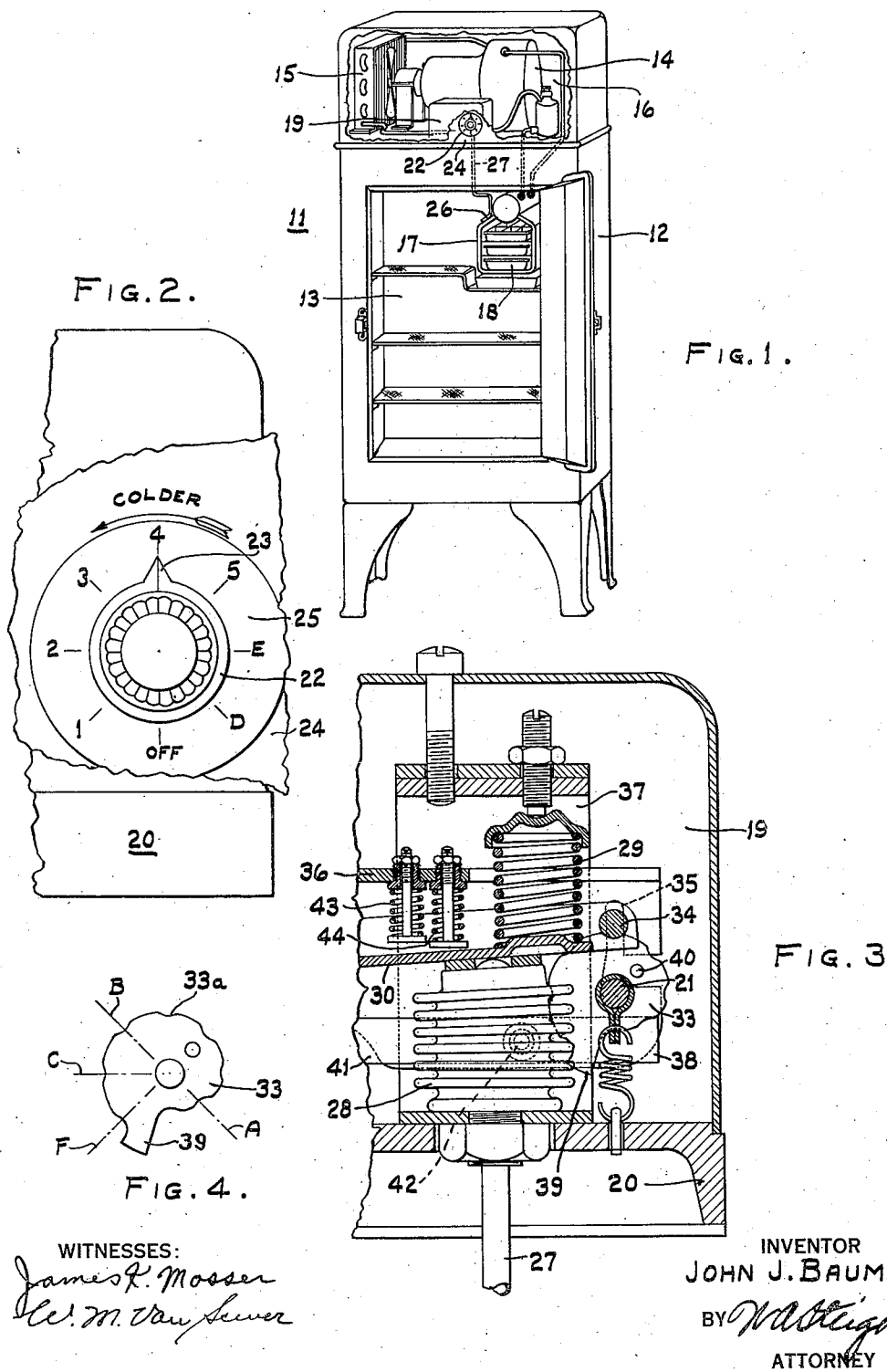
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2,035,291

REFRIGERATOR CONTROL APPARATUS

Filed Oct. 25, 1933

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

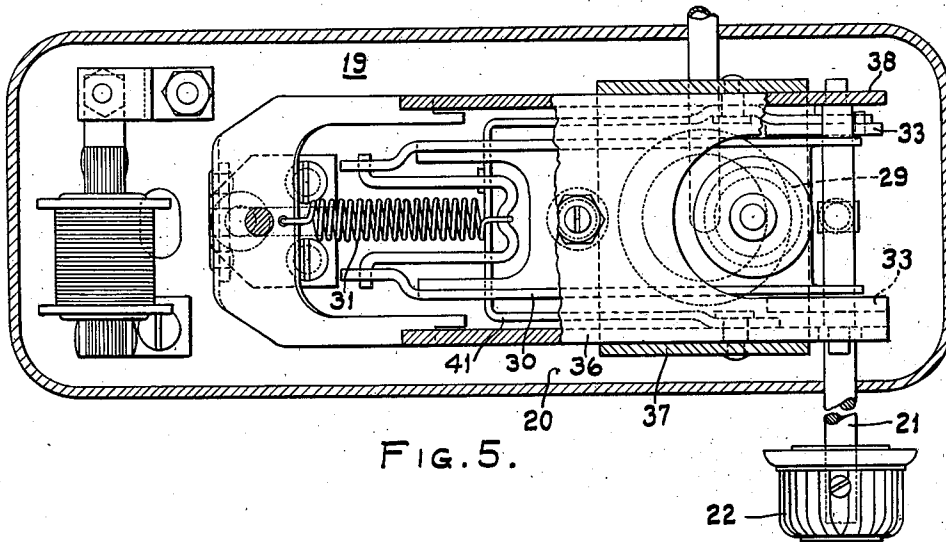


FIG. 5.

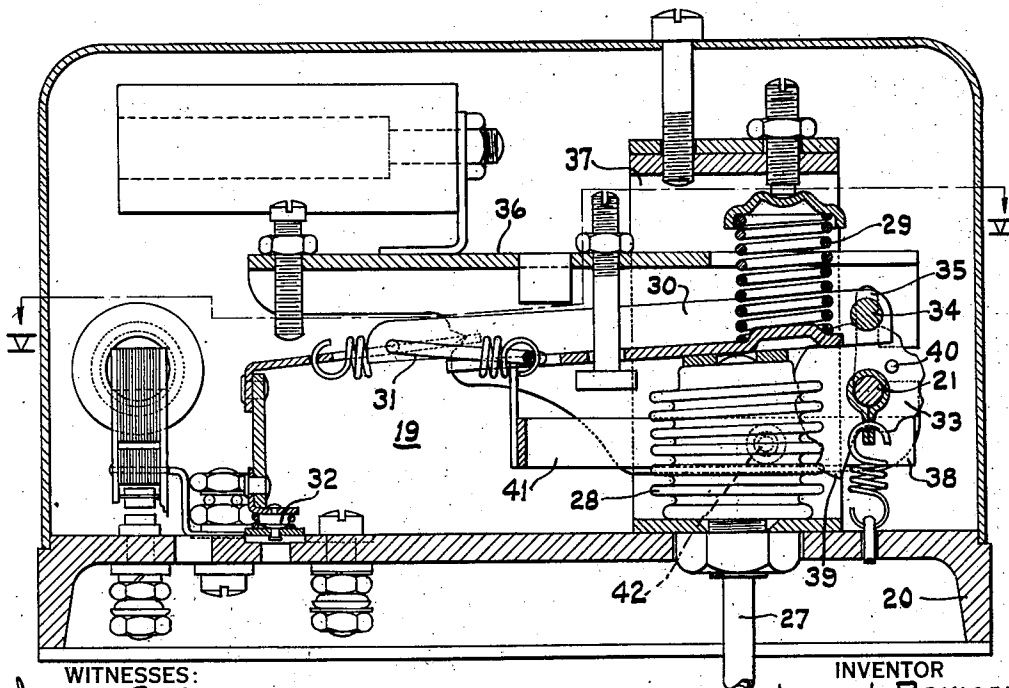


FIG. 6.

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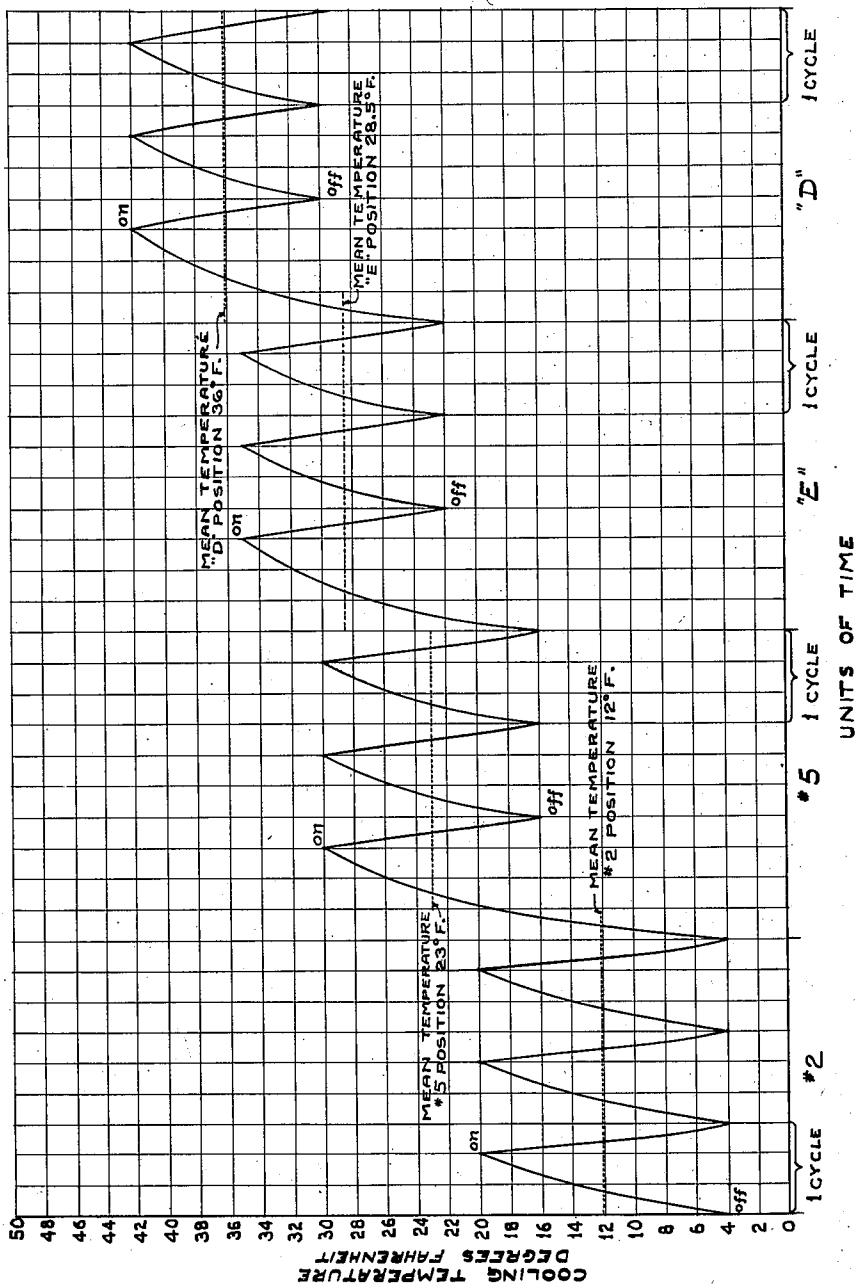
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FIG. 7.



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REFRIGERATOR CONTROL APPARATUS

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6 Claims. (Cl. 62—4)

My invention relates to refrigerator control apparatus for use primarily with domestic or small commercial refrigerators.

It is an object of my invention to provide a novel refrigerator control which will operate refrigerating apparatus to obtain various temperature conditions within a refrigerator other than the heretofore "usual" evaporator fast liquid freezing temperatures and food compartment food preserving temperatures.

It is another object of my invention to provide a control apparatus which, in addition to the control of the aforesaid usual operation of the refrigerating apparatus to maintain temperatures sufficiently low to freeze ice quickly in the evaporator, preserve foodstuffs in the cabinet and incidentally accumulate frost on the evaporator, may effect operation of the refrigerating apparatus to obtain evaporator temperatures sufficiently low to maintain frozen liquids in the evaporator in the solid state, to freeze ice slowly, to prevent the addition of frost to the evaporator to maintain a relatively high humidity in the cabinet and preserve foodstuffs in the cabinet.

It is yet another object of my invention to provide such a control apparatus which also may effect operation of the refrigerating apparatus to obtain temperatures in the evaporator sufficiently low to preserve foodstuffs in the refrigerator cabinet but sufficiently high to positively melt frost from the evaporator.

It is still another object of my invention to provide a single control apparatus for obtaining at will the above conditions in a refrigerator, by manual operation of a single readily accessible adjusting device.

It is a further object of my invention to provide a temperature control mechanism having associated therewith a manually adjustable means for obtaining various temperatures, and an indicating means for determining the setting of the adjustable means.

These and other objects are effected by my invention, as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 shows a complete refrigeration apparatus, parts thereof being broken away for the sake of clearness;

Fig. 2 is an enlarged partial view of a control knob for operating my control apparatus and having an indicating means associated therewith;

Fig. 3 is a fragmentary view of one embodiment of my control apparatus;

Fig. 4 is a side view of the adjustable eccentric device used in my control mechanism;

Fig. 5 is a sectional view taken on line V—V of Fig. 6;

Fig. 6 is a sectional view of the control mechanism shown in Fig. 5; and

Fig. 7 is a graph showing the various temperatures attained in a refrigerator operating in accordance with my control on continuous operating cycles.

Referring specifically to the drawings, numeral 11 designates generally a complete refrigeration apparatus including a cabinet 12 provided with a food compartment 13, and having associated therewith a refrigerating apparatus including a motor compressor unit 14 and a condenser 15 disposed in a machinery compartment 16 of the cabinet 12. An evaporator or cooling unit 17, preferably formed of sheet metal to provide a partially enclosed freezing compartment 18 for freezing liquids or desserts, is disposed in the food compartment 13. The evaporator, condenser and compressor are connected together by suitable refrigerant conduits and valves, as is well understood in the art. A control mechanism 19 supported on a single stationary supporting mechanism 20, is disposed in the machinery compartment 16. A shaft 21 having a knob 22 for adjusting the control mechanism 19, and provided with a pointer 23 on the outer end thereof, extends through a panel 24 of the machinery compartment 16, which panel has a lettered dial 25 associated with the pointer 23. A bulb 26, filled with an expansible gas, is mounted on or adjacent to the cooling unit 17, and a conduit 27 extends from the bulb 26 to the control mechanism 19 to operate the same in response to cooling unit temperatures, as hereinafter described.

Referring now to Figs. 5 and 6 for a detailed description of one embodiment of my control mechanism, numeral 28 designates a syphon bellows connected to the pipe 27 and, therefore, it expands and contracts with the gas in the bulb 26 in response to temperature changes at the evaporator 17. A spring 29 opposes the force of the bellows. Movement of the bellows due to slight changes in pressure of the gas therein in response to changes in evaporator temperature, is transmitted to a switch operating lever 30, which in turn operates a snap switch 31 to open and close contacts 32.

A pair of eccentrics 33 bear on a pin 34 slidably

mounted in a slot 35 formed in a rigid member 36 supported from the base 20 through a supporting member 37. The pin 34 is connected to the switch operating lever 30. The eccentric 33 is fixedly mounted on the shaft 21 which shaft is rotatably mounted on a cradle 38 and, as hereinbefore stated, extends through the panel 24 and has a knob 22 mounted thereon.

As the knob is turned in a counterclockwise direction, the shaft 21 and eccentric 33 are also rotated counterclockwise, and, because of the shape of the eccentric, the pin 34 is lowered in the slot 35 thus lowering the right end of the switch operating lever 30. As the right end of the lever is lowered, the lever is rotated about the bellows 28 as a pivot by the force of the spring 29 and left end of the lever 30 is raised. It is therefore necessary for the bellows 28 to expand a less distance in order to cause closure of the contacts 32. The motor compressor unit 14 will therefore operate to obtain a lower temperature in the evaporator.

If the control is set on the #2 position, the unit 14 cycles between the evaporator temperatures, for example, of 4° F., at which temperature the switch opens, and 20° F., at which temperature the switch closes, the mean evaporator temperature therefore, being 12° F.

When the eccentric 33 is rotated to the furthest counterclockwise position, as determined by a stop 39 on the eccentric engaging with the pin 34, the bellows 28 is unable to contact sufficiently to drop the switch lever 30 to the point where the snap switch 31 operates to open the contacts 32. The motor-compressor unit 14 will, therefore, operate continuously regardless of cooling unit temperature.

Similarly, if the knob 22, shaft 21 and eccentric 33 are turned in a clockwise direction, the bellows 28 must expand a greater distance to close the contacts 32, the motor-compressor unit 14, therefore, operating less, whereby a higher temperature is obtained in the evaporator 17.

If the control is set on the #5 position, the unit 14 cycles between the evaporator temperatures of, for example, 16° F., at which temperature the switch opens, and 30° F., at which temperature the switch closes, the mean evaporator temperature, therefore, being 23° F.

When the eccentric 33 is rotated to the furthest clockwise position, designated at 1 in Fig. 2, as determined by the stop 39 on the eccentric engaging with the pin 34, a projection 40 on the eccentric 33 engages a lever 41, pivoted at 42 to raise the left end of the lever 41. The end of the lever 41 engages the switch operating lever 30 to prevent it from dropping a sufficient distance to operate snap switch 31 to close the contacts 32. Regardless of evaporator temperature, therefore, the motor-compressor unit will remain inactive, and the food compartment temperature may approximate room temperature. This adjustable mechanism provides a range of temperature therefore from "continuous running" to "continuous off". Positions 1 to 5 on the dial 25, corresponding to respective depressions 33a in the eccentric 33 in the space from A to B, operate the motor-compressor unit 14 to freeze liquids placed in the freezing chamber 18 and to preserve foodstuffs at mean evaporator temperatures of, for example, from 12° F. to 23° F. Frost is incidentally accumulated on the evaporator because the evaporator temperature is below the dew point temperature of the air within the box,

moisture therefore condensing and freezing on the evaporator.

The two positions of adjustment prior to the off position of the control mechanism are marked "E" and "D" on the dial 25 and correspond to the depressions of the eccentric shown at B to C and C to F respectively (Fig. 4). At the E position, the lever is in such a position that the evaporator temperatures at which the motor-compressor unit 14 turns off and on are sufficiently low to maintain liquids in the solid state in the freezing chamber 18 and, under average conditions, temperatures low enough to freeze ice in the chamber 18 over a period of time. The "off" and "on" temperatures of the evaporator when the control is at the E position range are, for example, from 22° F. to 35° F., as shown in the graph, Fig. 7, the mean evaporator temperature being 28.5° F.

The freezing chamber 18 is obviously lower in temperature than the remainder of the food compartment because it is partially shielded from rapid air circulation induced by the cold evaporator 17. However, the temperatures obtained over large areas of the evaporator, by cycling of the motor-compressor unit at the reduced rate obtained by placing the control knob 22 at E, are not sufficiently low to add frost thereto since the temperatures of large surfaces of the evaporator are above the freezing point of the moisture in the air within the food compartment 13.

It has been found that an "on" temperature of 35° F. and an off position of 22° F., giving a mean temperature of 28.5° F., is capable of attaining the desired results. This is partly due to the fact that the refrigerating mechanism runs about one-third of the time. Therefore, about twice the time is required to start the mechanism after the low temperature limit has been reached as to stop it when the high temperature is reached. The average temperature of the cooling unit is, therefore, somewhat above 28.5° F. These temperatures are, however, given by way of example, and are not considered as limitations.

The E adjustment, therefore, provides for extremely economic and satisfactory operation of a mechanical refrigerator. Liquids are maintained in a solid state in the freezing space and may be frozen therein over a period of time. Food is preserved in the food storage chamber and frost is not added to the evaporator, whereas foods are not dehydrated, since some of the moisture which condenses on the evaporator is again picked up by the air in the refrigerator cabinet. The air is therefore maintained at a fairly high relative humidity of, for example, 60 to 70%, thus approaching ideal refrigeration conditions. At the same time, the refrigerator apparatus is cycling at a comparatively low rate, whereby energy is saved. The refrigerating apparatus may be operated with a control set at the E position at all times except when an extremely low temperature is desired in the food storage compartment or when liquids are to be frozen quickly. All the desirable functions of automatic refrigeration are thereby obtained without the disadvantage of dehydration of food and subsequent excessive frosting of the cooling unit in the refrigerator.

When the control mechanism is set at the D position, the motor-compressor unit 14 continues to cycle but at a slower rate than when operating in the E position. The temperatures of the food compartment 13 and the evaporator 17 are sufficiently high to melt frost from the evaporator

if any has accumulated thereon, while cycling of the motor-compressor unit 14 maintains temperatures in the food compartment 13 sufficiently low to preserve the average foodstuffs. The evaporator 17 is, therefore, defrosted, and, at the same time, food preservation is assured in the case where the user neglects to turn the control knob 22 to end the defrosting period. The successive "off" and "on" temperatures obtained at the evaporator when the control is set at the D position, range, are for example, from 30° F. to 42° F., as shown in the graph, Fig. 7, the mean evaporator temperature, therefore, being 36° F.

The single control knob 25, manually movable, is capable of providing all the adjustments including continuous running operation at 1, fast freezing operation from 2 to 5, economy operation at E, defrosting operation at D and completely inactive at "off".

Referring now to Fig. 3 for a description of the second embodiment of my invention, a portion of a control mechanism is shown which is similar to the control mechanism of Figs. 6 and 7 except that springs 43 and 44 are provided in the rigid member 35 of the control mechanism, the spring 44 being disposed at a lower horizontal level than the spring 43. The spring 44 is so disposed that, when the control knob 25 is set at the E position, and the eccentric moves correspondingly, the left end of the switch operating lever 30 is raised sufficiently that it must overcome the force of the spring 44 before the snap switch 31 closes the contacts 32. The bellows 28 must, therefore, overcome a bias in addition to the bias of the main spring 29 thus providing for switch closing at higher evaporator temperatures. These temperatures correspond to the economy conditions obtained when the control is set at the E position in the first embodiment of my invention.

The other spring 43 is so disposed that, when the control knob 25 is set at the D position and the eccentric moves correspondingly, the left end of the switch lever 30 is raised sufficiently that it must overcome the additional bias of both spring 44 and spring 43, before the snap switch 31 closes the contacts 32, thereby obtaining higher temperatures at the evaporator 17 than obtained either at positions 1 to 5 or E, which temperatures are sufficiently high to defrost the evaporator and sufficiently low to preserve foodstuffs, and correspond to temperatures obtained when the control in the first embodiment of my invention is set at the D position.

The position of the cam 33 when set in the E or D positions in itself provides for high cycling temperatures and high relative humidities, springs 43 and 44 determining the upper temperatures at which cycling will occur.

While I show a single control knob, a single supporting mechanism and a single switch for effecting all the functions of my control apparatus, it is to be understood that my invention is not confined or limited to embodying all of these functions in a single knob, switch or supporting mechanism.

From the foregoing, it will be apparent that I have provided a novel control mechanism for obtaining (1) operation of the refrigerating apparatus to effect quick freezing of liquids, (2) economic operation of the apparatus to maintain a high relative humidity, to preserve liquids in a frozen state and to retard the addition of frost, and (3) operation of the refrigerating apparatus to defrost the apparatus; all three conditions be-

ing at temperatures sufficiently low to preserve foodstuffs in the food storage chamber. In addition, a single manually adjustable control knob is movable to obtain all the aforesaid adjustments as well as to continuous "on" and completely "inactive" adjustments for the refrigerating apparatus.

While I have shown my invention in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In a control mechanism for a refrigerator having a food storage compartment and an evaporator disposed in heat exchange relation therewith and having a space for freezing liquids, the combination of means for operating the refrigerator to obtain various mean evaporator temperatures sufficiently low to freeze liquids in said space, preserve foodstuffs in the food storage compartment, and incidentally accumulate frost on the evaporator, means for operating the refrigerator to obtain a mean evaporator temperature sufficiently low to maintain frozen liquids in said space in the solid stage, to preserve foodstuffs in the food storage compartment, to substantially prevent the addition of frost on the evaporator, and to maintain a high relative humidity in the food storage compartment, and means for operating the refrigerator to obtain a mean evaporator temperature sufficiently low to preserve foodstuffs in the food storage compartment and sufficiently high to melt frost off the evaporator.

2. In a control mechanism for a refrigerator having a food storage compartment and an evaporator disposed in heat exchange relation therewith and having a space for freezing liquids, the combination of means for operating the refrigerator to obtain mean evaporator temperatures sufficiently low to freeze liquids in said space, preserve foodstuffs in the food storage compartment, and incidentally accumulate frost on the evaporator, and means for operating the refrigerator to obtain a mean evaporator temperature sufficiently low to maintain frozen liquids in said space in the solid state, to preserve foodstuffs in the food storage compartment, to substantially prevent the addition of frost on the evaporator, and to maintain a high relative humidity in the food storage compartment.

3. A method of operating a refrigerator for preserving foodstuffs, which refrigerator includes a cabinet and a cooling element disposed therein having a space for freezing liquids, which method comprises cycling the machine to maintain a mean temperature in the cooling element which is sufficiently low to preserve foodstuffs, freeze liquids in said space and incidentally cause frost to accumulate on the cooling element, and selectively cycling the machine to maintain a relatively higher mean temperature in the cooling element, which higher mean temperature is sufficiently low to maintain liquids frozen in said space in substantially the solid state and to preserve foodstuffs in the cabinet, and which higher mean temperature is sufficiently high to substantially prevent the addition of frost to the cooling element and to maintain a high relative humidity in the cabinet.

4. A control mechanism for a refrigerator, which refrigerator includes a food storage com-

partment and a cyclically-operated refrigerating unit embodying a cooling element disposed in the food storage compartment for abstracting heat therefrom and having a space for freezing liquids, the combination of manually operable means readily adjustable to a plurality of positions, and temperature responsive means for starting and stopping the refrigerating unit responsive to one adjustment of said adjustable means for maintaining the cooling element at a mean temperature sufficiently low to freeze liquids in said space, preserve foodstuffs in the food storage compartment and incidentally accumulate frost on the cooling element, and responsive to a second adjustment of said adjustable means for maintaining a relatively higher mean cooling element temperature, which higher temperature is sufficiently low to maintain frozen liquids in said space in the solid state, preserve foodstuffs in the food storage compartment, to substantially prevent the addition of frost to the cooling element, and to maintain a high relative humidity in the food storage compartment.

5. In a control mechanism for a refrigerator, which refrigerator includes a food storage compartment and a cyclically-operated refrigerating unit embodying a cooling element disposed in the food storage compartment for abstracting heat therefrom and having a space for freezing liquids, the combination of manually-operable means readily adjustable to a plurality of positions, and temperature responsive means for starting and stopping the refrigerating unit responsive to one adjustment of said adjustable means for maintaining the cooling element at a mean temperature sufficiently low to freeze liquids in said space, preserve foodstuffs in the food storage compartment and incidentally accumulate frost on the cooling element, and responsive to a second adjustment of the adjustable means for maintaining a relatively higher mean cooling

element temperature sufficiently low to preserve frozen liquids in said space in the solid state, to preserve foodstuffs in the food storage compartment, to substantially prevent the addition of frost to the cooling element, and to maintain a high relative humidity in the food storage compartment, and further responsive to a third adjustment of the adjustable means for maintaining a relatively still higher mean cooling element temperature sufficiently low to preserve foodstuffs in the food storage compartment and sufficiently high to melt frost off the cooling element.

6. In control mechanism for a refrigerator, which refrigerator includes a food storage compartment and a cyclically-operated refrigerating unit embodying a cooling element disposed in the food storage compartment for abstracting heat therefrom and for freezing liquids, the combination of a switch for cycling the refrigerating mechanism, temperature-responsive means for actuating the switch, indicating means embodying a normal operating designation, a defrosting designation and an intermediate distinctive operating designation, and means cooperating with said temperature-responsive means and selectively positionable to said normal operating designation to maintain a mean temperature in the cooling element which is sufficiently low to preserve foods in the food storage compartment and to produce ice in the cooling element and incidentally accumulate frost on the cooling element and also selectively positionable to said distinctive operating designation to maintain a relatively higher temperature in the food storage compartment, which higher temperature is sufficiently low to preserve foodstuffs and sufficiently high to retard the accumulation of frost on the cooling element and maintain a relatively high humidity in the food storage compartment.

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