Sept. 30, 1947. H. M. HERBENER 2,428,311

REFRIGERATOR WITH HOLD-OVER ARRANGEMENT

Filed May 7, 1940 5 Sheets-Sheet 1

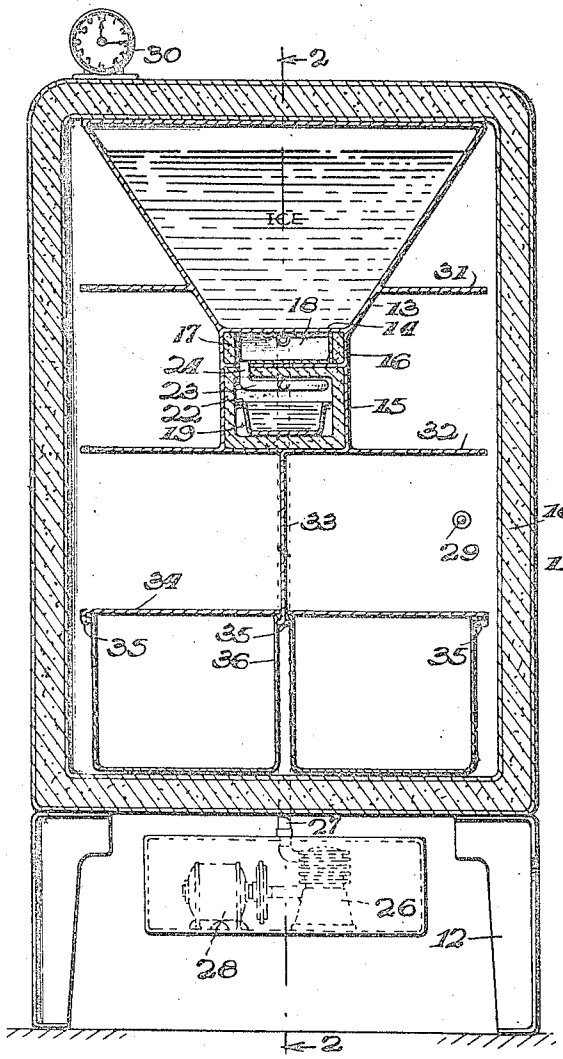


Fig. 1.

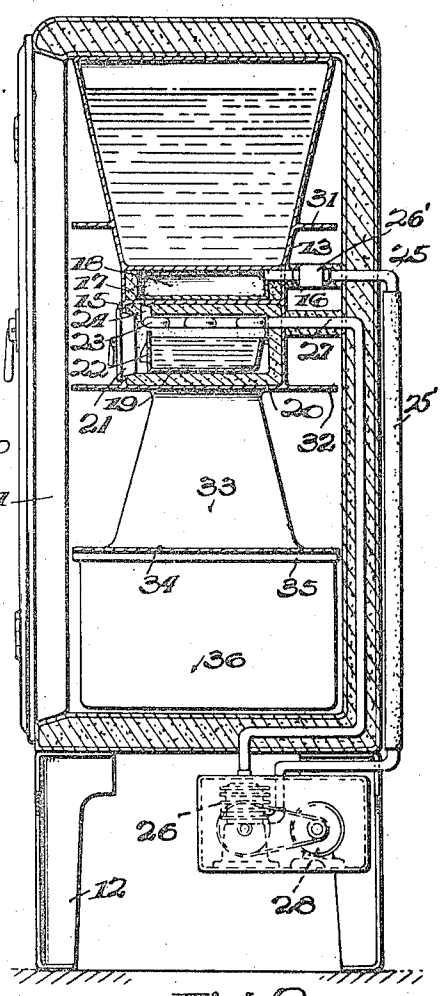


Fig. 2.

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REFRIGERATOR WITH HOLD-OVER ARRANGEMENT

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Fig. 3.

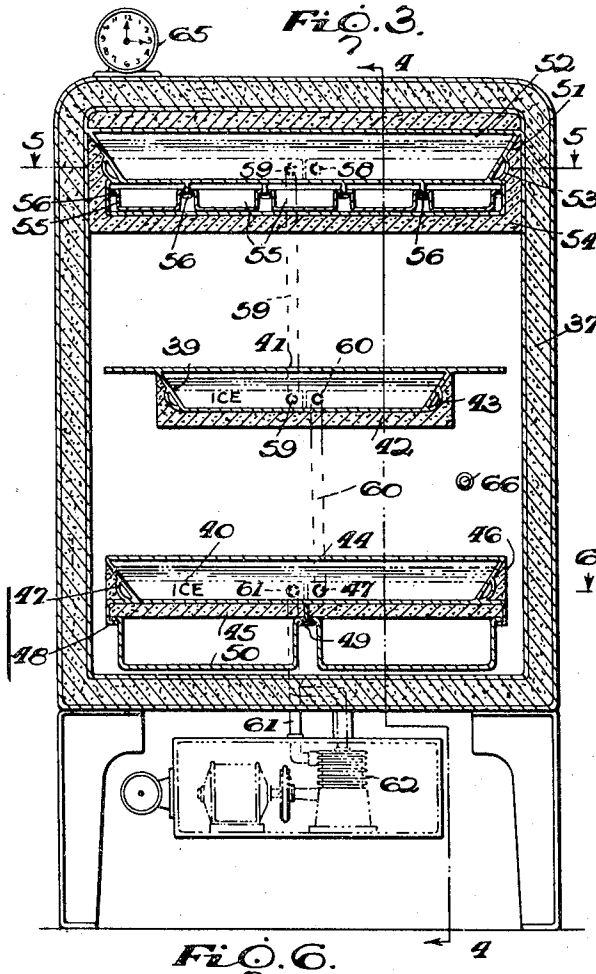


Fig. 4.

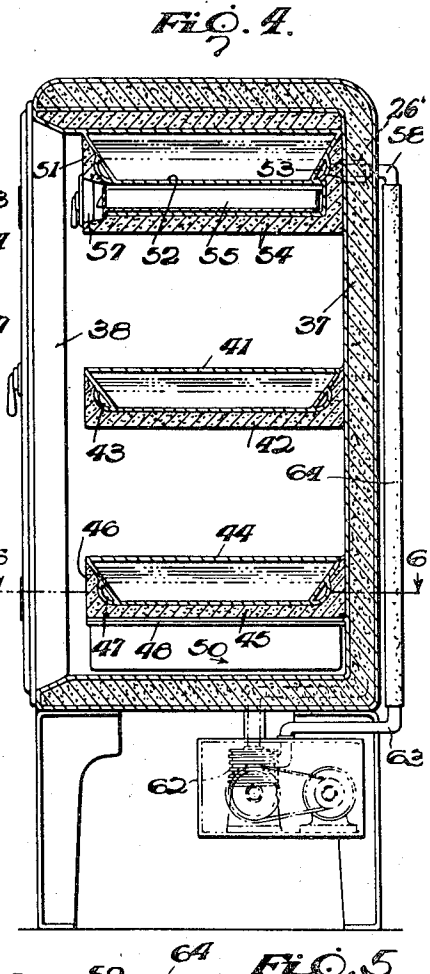


Fig. 6.

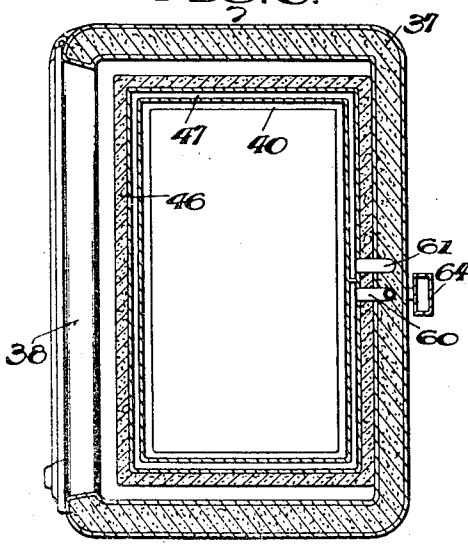
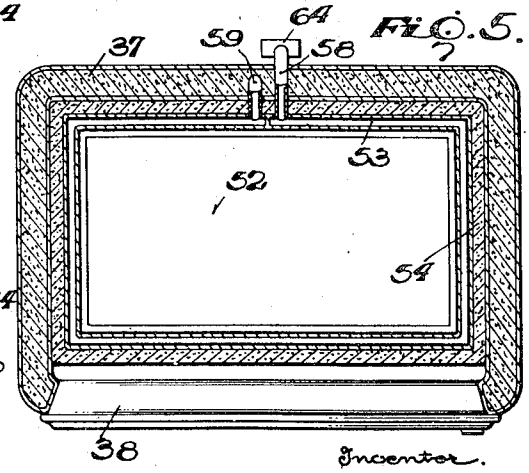


Fig. 5.



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REFRIGERATOR WITH HOLD-OVER ARRANGEMENT

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Fig. 7.

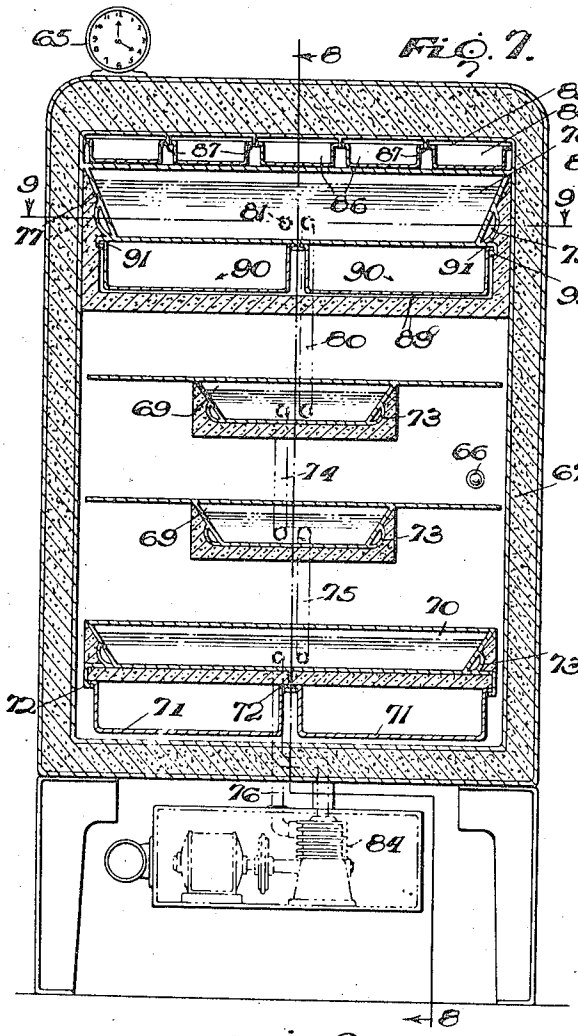


Fig. 8.

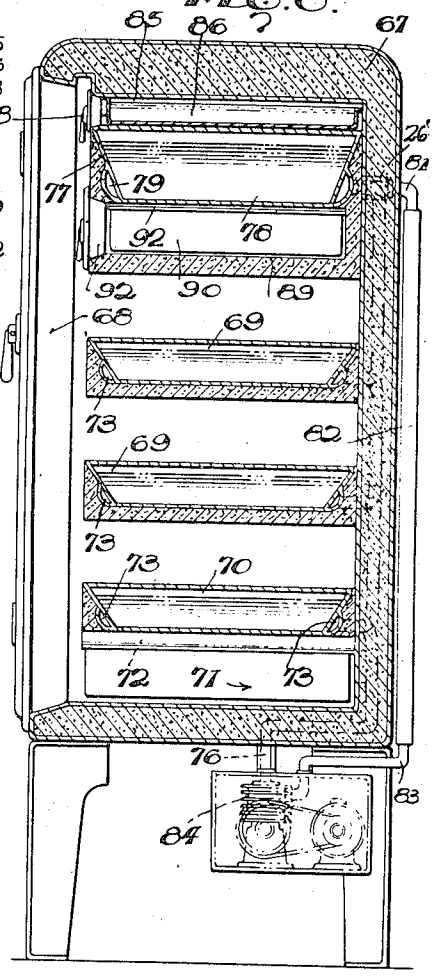


Fig. 9.

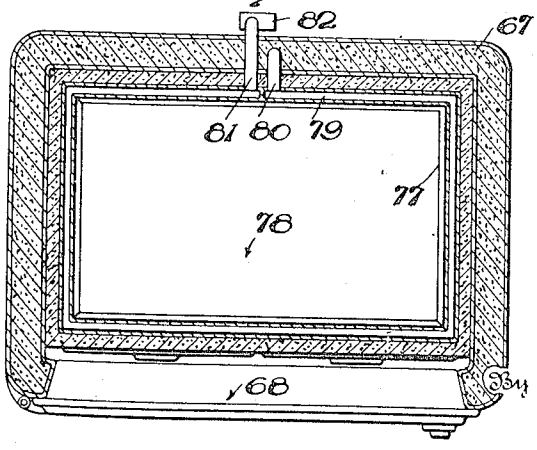
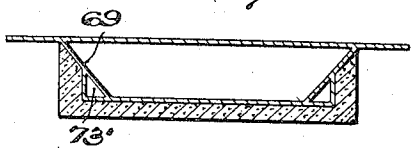


Fig. 10.



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REFRIGERATOR WITH HOLD-OVER ARRANGEMENT

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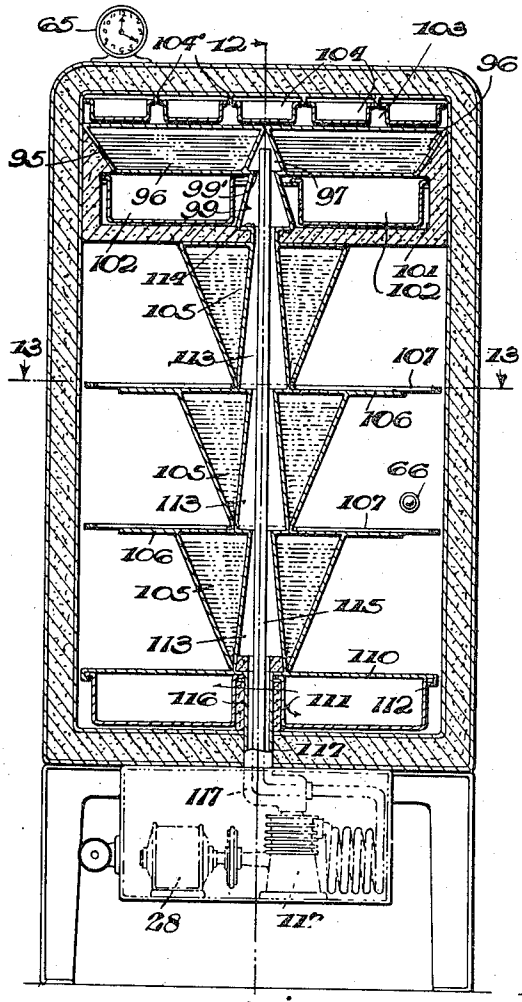


Fig. 11.

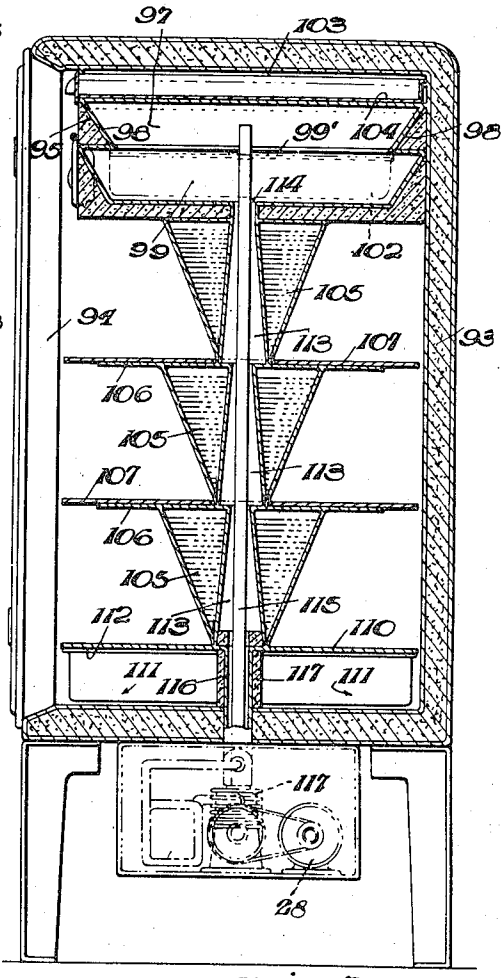


Fig. 12.

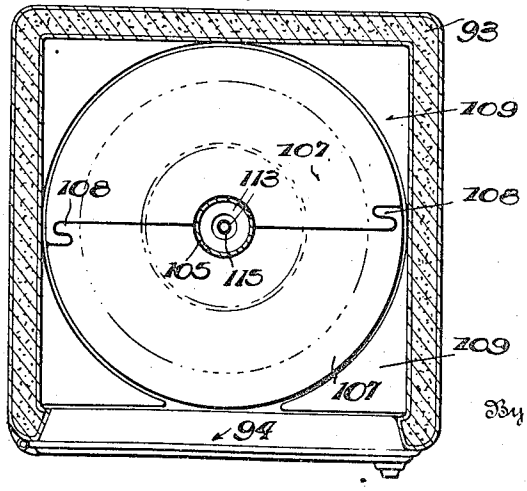


Fig. 13.

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Fig. 14.

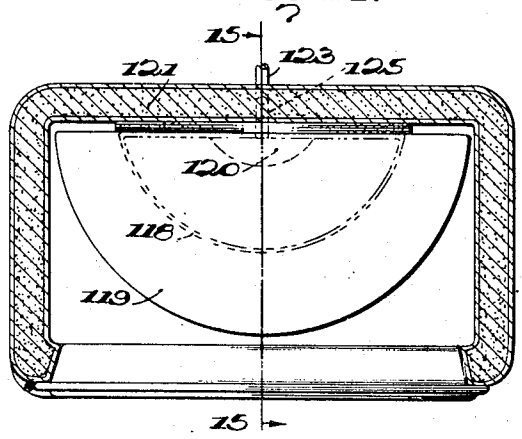


Fig. 15.

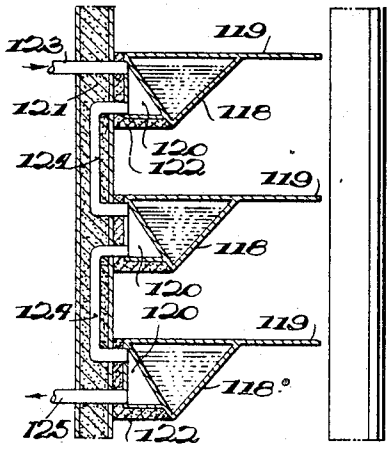


Fig. 16.

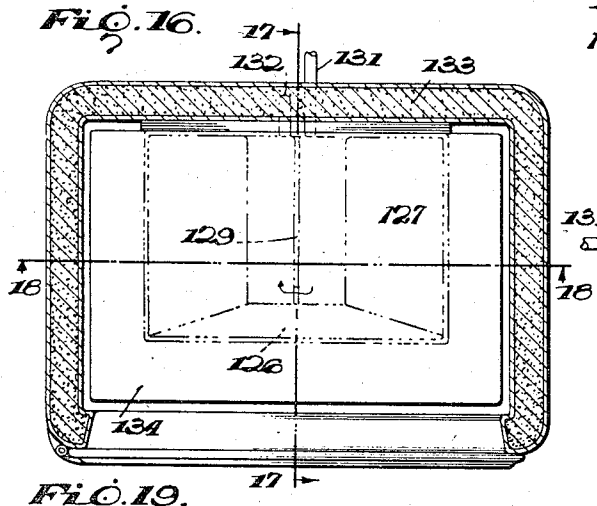


Fig. 17.

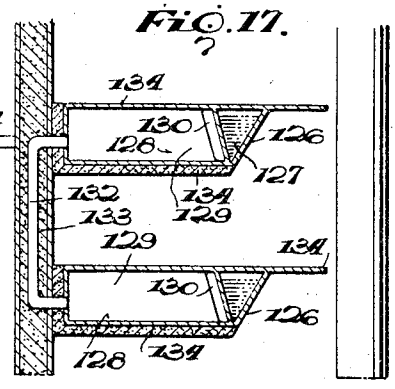


Fig. 19.

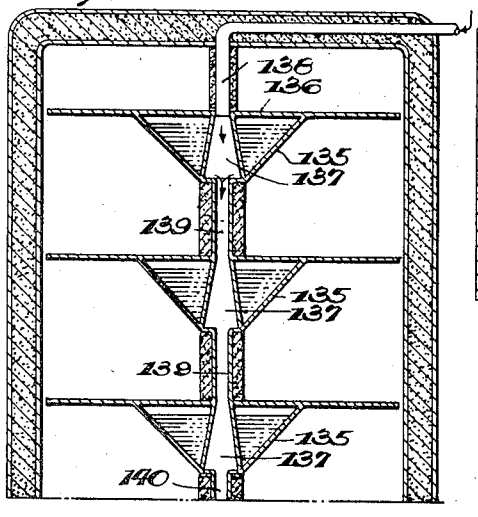
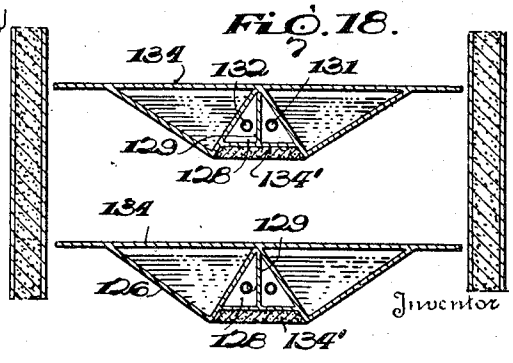


Fig. 18.



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Attorney

Patented Sept. 30, 1947

2,428,311

UNITED STATES PATENT OFFICE

2,428,311

REFRIGERATOR WITH HOLDOVER ARRANGEMENT

Henry M. Herbener, Thomasville, Ga.

Application May 7, 1940, Serial No. 333,855

14 Claims. (Cl. 62—95)

1

My invention relates to refrigerators.

An important object of my invention is to provide a refrigerator possessing the advantages of the ordinary ice refrigerator and avoiding the disadvantages.

A further object of the invention is to provide a mechanical refrigerator which will maintain the perishable food products suitably chilled, without dehydrating them.

A further object of the invention is to provide a mechanical refrigerator which may be operated without defrosting.

A further object of the invention is to provide means for supporting the perishable food products in close relation to the ice or ice water-holding tank or tanks, for effecting a quick and efficient heat exchange.

A further object of the invention is to have the perishable food products supporting element or elements in thermal contact with the ice or ice water-holding tank or tanks, for effecting efficient heat exchange.

A further object of the invention is to provide a plurality of ice or ice water-holding tanks arranged in a longitudinal group in the refrigerator case, so that heat exchange with the food products carried by the various trays may be effected in a more or less uniform manner.

A further object of the invention is to provide a refrigerator having tray or trays which are in thermal contact with the ice or ice water-holding tank or tanks and are spaced from the walls of the refrigerator case to be free from thermal contact therewith.

A further object of the invention is to provide a refrigerator having an ice or ice holding tank so constructed that the food products may be arranged about the same in a surrounding group, with the refrigerant supplying pipe extending generally centrally through the refrigerator case and the tank for effecting efficient heat exchange.

A further object of the invention is to provide hermetically sealed tank or tanks for holding the freezable liquid whereby the same may be used practically indefinitely without being replenished.

A further object of the invention is to provide means whereby the minimum volume of ice may be employed to properly refrigerate food products during a given time, thereby leaving the maximum space available for the reception of the food products.

A further object of the invention is to provide means for holding a relatively large volume of water which is frozen into ice for providing a

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volume of ice of sufficient size to maintain the refrigerator properly chilled during a selected period when the mechanical refrigerating unit is idle.

A further object of the invention is to provide time control means to set the mechanical refrigerating apparatus into action at a selected period, as when current is cheap, to freeze the water in the tank or tanks, and to stop such operation at the end of such period.

A further object of the invention is to provide means to start the freezing action of the water within the tank or tanks when the temperature of the water raises to the melting point or above such melting point and to continue such freezing action until the water is completely frozen and then stop the freezing action when the temperature of the water or ice drops below the freezing temperature.

A further object of the invention is to provide control means to set the mechanical refrigerating apparatus into action at a selected period, as when current is cheap, to freeze the water in the tank or tanks, and to stop such operation at the end of such period, or when the water is completely frozen.

The present application is a continuation in part of my application for Refrigeration apparatus, filed October 28, 1937, Serial No. 171,560.

In the accompanying drawings forming a part of this application and in which like numerals are employed to designate like parts throughout the same,

Figure 1 is a central vertical section through a refrigerator embodying my invention,

Figure 2 is a transverse section taken on line 2—2 of Figure 1,

Figure 3 is a central vertical section through a refrigerator embodying a second form of the invention,

Figure 4 is a transverse section taken on line 4—4 of Figure 3,

Figure 5 is a horizontal section taken on line 5—5 of Figure 3,

Figure 6 is a horizontal section taken on line 6—6 of Figure 4,

Figure 7 is a central vertical section through a refrigerator embodying a third form of the invention,

Figure 8 is a transverse section taken on line 8—8 of Figure 7,

Figure 9 is a horizontal section taken on line 9—9 of Figure 7,

Figure 10 is a vertical section through a modified form of water-holding tank,

Figure 11 is a central vertical section through a refrigerator embodying a fourth form of my invention,

Figure 12 is a transverse section taken on line 12—12 of Figure 11,

Figure 13 is a horizontal section taken on line 13—13 of Figure 11,

Figure 14 is a plan view of a modified form of water-holding tank,

Figure 15 is a vertical section taken on line 15—15 of Figure 14,

Figure 16 is a plan view of a further modified form of water-holding tank,

Figure 17 is a longitudinal section taken on line 17—17 of Figure 16,

Figure 18 is a transverse section taken on line 18—18 of Figure 16,

Figure 19 is a central vertical section through a plurality of modified water-holding tanks.

In Figures 1 and 2, the numeral 10 designates the case of a refrigerator, which is suitably insulated and has a door 11 so that access may be had to the interior of the same. The case may be supported upon legs 12.

Arranged within the case 10, preferably near its top, is a tank 13, formed of heat conducting material, such as metal. This tank is preferably tapered, decreasing in horizontal cross-section downwardly. The tank 13 is preferably hermetically sealed and is fixedly secured within the top of the case by any suitable means. The tank 13 is relatively large, and is preferably of such a size that it will hold a sufficient amount of water, which when frozen into ice, will be sufficient to properly cool perishable products within the case 10 for a considerable length of time, such as throughout the major portion of a day. The tank 13 is maintained at a temperature of substantially 32° F. and this will suitably chill the interior of the case, for providing proper refrigeration for the perishable products, which will be maintained at a temperature of about 40° to 45°, more or less. Since the temperature of the tank 13 does not materially go below 32° F. there is no frosting of the tank 13 and associated elements and therefore no dehydrating of the perishable products within the case 10 and no necessity for defrosting the tank and associated elements. The tank 13 being hermetically sealed, a suitable air space is left at the top of this tank so that the air within the tank will be compressed when the water expands in freezing, the drawings showing the water frozen into ice. Since the tank is hermetically sealed, this expansion during the freezing of the water and the compression of the air, places the water under pressure and the water has a temperature slightly below 32° F. after being frozen. This reduction of temperature below 32° F. should only be slight as it is not desirable that the tank 13 have its temperature reduced considerably below 32° F. The extent of pressure which will be applied to the water due to the expansion of the same during the freezing period will depend upon the size of the air space within the tank, which may be varied, as found advantageous. By using the hermetically sealed tank I obtain all of the advantages inherent in the use of ice in the ordinary ice refrigerator while eliminating the disadvantages, such as drip and the necessity of manual filling and refilling with ice. In accordance with my invention the tank 13 is maintained at substantially the temperature of the ice or ice water

held therein and hence the cooling surface of this ice or ice water is at all times utilized in chilling the interior of the case 10 and this cooling surface is maintained constant and at substantially a constant temperature, for as long as the water in the tank 13 is completely frozen or as long as there is any ice in the water the tank 13 will be maintained at substantially 32° F. In the ordinary ice refrigerator, as the ice melts, the water drains off and the cooling surface of the cake of ice decreases and a point is readily reached at which the cooling surface is insufficient to properly chill the perishable food products, and as a result of this, it is customary to fill an ice box with more ice than is necessary to properly chill the food products by allowing for a sufficient amount of ice remaining after a portion of the same has melted away during the day. Therefore, in my refrigerator an economy in space is effected in the storage tank for holding the ice or ice water.

Further, since the water within the tank 13 is frozen by means of a refrigerating element which may be automatically thrown into action for several hours during each day, the length of time that the ice or ice water within the tank 13 must serve to maintain the interior of the case 10 at the desired lowered temperature is materially reduced, as compared to the time that ice must function in the ordinary ice refrigerator for the same purpose, and hence the size of the tank 13 and the resultant volume of the ice or ice water therein is also further materially reduced with respect to the volume of ice in the ordinary ice refrigerator.

The tank 13 has a bottom 14 and the sides of the tank project downwardly below this bottom for forming a metal housing 15, preferably integral with the tank 13 and in thermal contact therewith. Arranged within the upper portion of the housing 15 is a chamber 16, heat insulated at its sides, ends, and bottom, as shown at 17, but not heat insulated at its top. This chamber 16 receives a cooling or freezing element 18, in the form of an expansion shell or casing, although a coil may be used if so desired. Arranged within the lower portion of the housing 15 is a chamber 19, which is heat insulated at its top, bottom, sides, and ends, and has a door 21 at its front end, so that access may be had to the interior of the same. The heat insulated chamber 19 removably receives and holds a tray 22, for holding water, ice cubes, desserts or the like. A freezing or cooling coil or element 23 is arranged within the heat insulated chamber 19 and is connected with the shell or element 18 by means of a pipe 24. The refrigerant is supplied to the shell 18 through a pipe 25 and this pipe 25 leads to the outlet side of a compressor 26, the intake side of which is connected with a pipe 27, connected with the outlet of the coil 23. The pipe 25 has a coil or condenser 25' connected therein, as is well known. The outlet portion of the pipe 25 has a restrictor 26' connected therein. It is thus seen that the refrigerant first enters the shell or element 18 and expands therein and then passes into the coil 23. The temperature within the shell 18 is below 32° F. and heat from the water within the tank 13 is transmitted to the shell 18 through the bottom 14, the water circulating upwardly within the tank 13 when it is below 39° F. When the water is frozen the refrigerant is cut off from the shell 18 so that the temperature of the tank 13 is not reduced materially below 32° F. The temperature within the heat insulated cham-

ber 19 may be considerably below 32° F. for freezing water into ice cubes or making frozen desserts. Since the chamber 19 is heat insulated this low temperature therein will not, of course, be transmitted to the interior of the case 10 for dehydrating the perishable products.

The compressor is shown as operated by an electric motor 28, the operation of which is automatically controlled by a thermostat 29. The thermostat is so adjusted that when the temperature of the tank 13 goes below 32° F. the circuit is opened to stop the motor 28. When the temperature of the tank 13 goes below 32° the temperature within the case 10 will also drop and will then go below 40° F. or some other predetermined temperature at which time the thermostat 29 will operate to open the circuit and stop the motor. When the temperature of the tank rises to 32° F. as when the ice is melted in whole or part the thermostat is operated to close the circuit. Time control means, including a clock 30 is employed to close the motor circuit at another point, independently of the operation of the thermostat.

The numeral 31 designates a shelf, preferably formed of metal and shown as mounted upon the tank 13 and in thermal contact therewith. The numeral 32 is a similar shelf, preferably formed of metal and mounted upon the housing 15 and in thermal contact therewith and with the tank 13 through the housing 15. Rigidly secured to the bottom of the housing 15 and in thermal contact therewith is a depending plate 33, preferably formed of metal, and carrying a lower shelf 34, preferably formed of metal. The shelf 34 is in thermal contact with the plate 33 and the plate 33 is in thermal contact with the housing 15. The shelf 34 is provided with guides 35, slidably receiving the top edges of receptacles 36, preferably formed of metal. In view of the foregoing description it is thus seen that the shelves 31, 32, and 34 and the receptacles or trays 36 are all in thermal contact with each other and with the tank 13 so that heat may be transmitted from them to the tank by thermal contact, while all of these elements are preferably spaced from all walls of the case 10 so that heat from these walls will not be transmitted to them.

The operation of the apparatus is as follows:

The clock 30 is so adjusted that it will maintain the motor circuit closed at one point during a selected period of the day, which may be that period when current is cheap, such as from midnight to 6 a.m. This period may also be from 2 p.m. to 4 p.m. as some locations have an off-peak rate at this time. With a clock thus adjusted, when the time is reached, the clock will close the motor circuit as stated and if the temperature of the tank 13 is at 32° F. or above the motor circuit will also be closed at another point by the thermostat and this motor circuit will be completely closed and the motor set into action for driving the compressor. Assuming that the ice had practically completely melted in the tank 13, then the thermostat would maintain the circuit closed at its point until the water had been completely frozen after which the temperature of the tank 13 would go below 32° and the thermostat would then automatically stop the motor. The time interval for which the clock maintains the motor circuit closed is ample to completely freeze the water in the tank 13, and the clock is employed to select this time interval during that portion of the day when current is cheap.

Instead of locating the thermostat 29 within the case 10 so that it is operated primarily by the temperature within the case, this thermostat may be mounted directly upon the tank 13 and in thermal contact with the tank so that the motor circuit will be closed by the thermostat when the temperature of the tank reaches 32° F. or above and is opened when the temperature of the tank drops below 32° F.

In Figures 3 to 5 inclusive, I have shown a modified form of the invention. In these figures, the numeral 37 designates the case of a refrigerator, which is suitably insulated and is equipped with a front door 38 whereby access may be had to the interior thereof, as is customary. Arranged within the case 37, preferably in spaced superposed relation are water-holding tanks 39 and 40, which are preferably vertically tapered, and decrease downwardly. These tanks are preferably hermetically sealed for holding water and the level therein indicates the water when frozen. The combined volume of the tanks 39 and 40 is sufficient for holding ice or ice water of a sufficient combined volume to maintain the perishable food products in the case 37 at a proper refrigerating temperature, throughout the major portion of the day. In other words, the combined volume of the tanks 39 and 40 will be equal to the volume of the tank 13 in the first form of the invention. The top 41 of the tank 39 projects beyond the tank 39 and serves as a shelf and this top and tank is preferably spaced from all walls of the case 10 so that heat from these walls will not be transmitted to the tank. The top 41 serves as a shelf for the perishable products thus bringing them into thermal contact with the tank 39. Beneath the top 41, the tank is covered with heat insulation 42 which is suitably rigidly secured to the back wall of the case 37 and constitutes the supporting means for the tank. This insulation encloses a freezing or cooling element or coil 43, preferably formed upon the exterior of the tank 39. The tank 40 has a top 44 serving as a shelf and below this top, the tank is covered by insulation 45, suitably rigidly attached to the back wall of the case 37 and supporting the tank 40. The tank 40 also has its sides covered by insulation 46. A refrigerating or freezing element or coil 47 is formed upon the exterior of the side of the tank 40 and is covered by the insulation 46.

Arranged below the insulation 45 and having thermal contact with the tank 40 are guides 48 and 49, slidably engaging flanges at the top of trays 50. These trays are therefore in thermal contact with the tank 40 and may be removed from the front of the case 37 when the door is open. The tank 40, guides 48, and trays 50 are all out of thermal contact with all walls of the case 37 and are spaced therefrom whereby heat from the case cannot be transmitted to the same.

Arranged in the upper portion of the case 37 is a heat insulated chamber 51, in the upper portion of which is mounted an hermetically sealed tank 52 for holding a liquid having a freezing point below water, such as brine. The tank 52 is vertically tapered and decreases in width downwardly and is provided with a refrigerating or freezing element or coil 53 formed upon its exterior, near its bottom. This coil is covered by the heat insulating material 54. In the lower portion of the heat insulated chamber 51 are trays 55, for receiving water, desserts or the like to be frozen. These trays have flanges at their tops to engage and be supported by guides

56, in thermal contact with the tank 52. The bottom of the trays 55 are preferably out of thermal contact with the bottom wall of the heat insulated chamber. Access may be had to the trays 55 by opening a door 57, as shown.

The numeral 58 designates a pipe which leads into one end of the coil 53 for supplying the refrigerant thereto, and 59 is a pipe receiving the refrigerant from the opposite end of the coil 53 and supplying the same into one end of the coil 43, the opposite end of which discharges into a pipe 60. This pipe 60 discharges the refrigerant into one end of the coil 47, and the opposite end of this coil discharges the refrigerant into a pipe 61. This pipe 61 leads to the intake side of a compressor 62, the outlet side of which is connected with a pipe 63, connected with the usual coil condenser 64, which discharges into the pipe 58.

The numeral 65 designates a clock for closing the motor circuit at one point and maintaining the same closed during a selected portion of the day as between midnight and 6 a. m. The numeral 66 designates a thermostat which will close the motor circuit at another point when the temperature of the tanks 39 and 40 falls below 32° F. and will close the circuit when their temperatures reach 32° F. or above. This thermostat may be adjusted to operate by the temperature within the case 37 or it may have thermal contact with either tank 39 or 40.

In the operation of this form of refrigerator, when the selected portion of the day is reached, the clock 65 closes the motor circuit at one point and the motor is set into action, assuming that the water in the tanks 39 and 40 is melted in whole or in part. The motor continues to run until the water has been completely frozen in the tanks 39 and 40 at which time the temperature of the tanks 39 and 40 will drop below 32° F. and the thermostat 66 will then open the motor circuit and stop the motor. The clock 65 maintains the circuit closed for a sufficient length of time to permit the water in the tanks 39 and 40 to freeze. In this form of the invention, the brine within the tank 52 will freeze and hence this tank will have a temperature below 32° F. and water, desserts or the like within the trays 55 may be frozen within the heat insulated chamber during the operation of the motor or after it is cut off. The chamber 51 is heat insulated from the interior of the case 37 and hence the low temperature within this chamber 51 will not be transmitted to the interior of the case, and therefore the dehydrating of perishable food products within the case will be avoided and no defrosting of the tanks 39 and 40 is necessary.

Attention is now called to Figures 7 to 9 inclusive, wherein the numeral 67 designates the case of a refrigerator, which is suitably insulated, and is equipped with a front door 68. Arranged within the case 67 are water-holding tanks 69 and 70, corresponding to the tanks 39 and 40, Figure 3. The tops of these tanks serve as shelves and these tops are spaced from all walls of the case 67 and have no thermal contact therewith. The tank 70 carries trays 71, having thermal contact therewith and these trays and the guides 72 have no thermal contact with the case 67. Trays 71 correspond to trays 50, Figure 3. The tanks 69 and 70 have refrigerating or freezing elements or coils 73, corresponding to the coils 43 and 47, Figure 3, and connected in series by pipes 74 and 75. The lowermost coil 73 is connected with a pipe 76 which leads to the intake side of the compressor.

Within the upper portion of the case 67 is arranged a heat insulated chamber 77, in the upper portion of which is located an hermetically sealed tank 78, vertically tapered and converging downwardly. This tank holds a liquid having a freezing point below water, such as brine, and the drawings show the liquid as frozen. This tank has a freezing or cooling coil 79, corresponding to the coil 53, Figure 3, and the coil 79 has its outlet end connected with a pipe 80, leading to the inlet end of the coil 73. The inlet end of the coil 79 is connected with a pipe 81, connected with the usual coil condenser 82, connected with a pipe 83, which is connected with the outlet of the compressor 84. Arranged above the brine-holding tank 75 is a space 85, within the heat insulated chamber 77, and this space receives trays 86, having flanges at their tops to engage guides 87. The trays 86 rest upon the top of the tank 78 and have thermal contact therewith and these trays are removed by opening a door 88. The trays may hold water, desserts or the like which are to be frozen. Within the heat insulated chamber 77 beneath the tank 78 there is a space 89 for receiving trays 90, containing frozen foods. The trays 90 are provided at their tops with flanges 91 having engagement with flanges 92 carried by the tank 77. The trays 90 therefore have thermal contact with the tank 78 and the trays 90 may be removed by opening the door 92. The temperature within the chamber 77 is below the freezing point of water and should be about 10° F.

In this form of the invention, the same clock 65, Figures 5 and 3, is employed to close the circuit of the motor and the same thermostat 66 is employed to open and close the motor circuit at another point.

The operation of this form of the refrigerator is the same as that stated in connection with the form shown in Figures 3 to 5 inclusive. In this form of the invention, Figures 7 to 9 inclusive, the trays 86 for holding ice and desserts are arranged above the tank 78 and are in thermal contact therewith and the trays 90 for holding quick frozen foodstuffs are arranged beneath the tank 78 and in thermal contact therewith.

In Figure 10, I have shown a modification of the refrigerating or freezing coil for the water-holding tank which may be illustrated by 69. The coil is designated 73' and is shown as triangular in cross-section instead of curved in cross-section.

In Figures 11 to 13 inclusive, I have shown a further modification of my invention, wherein the numeral 93 designates a case having a front door 94, as usual. The case is suitably insulated.

Arranged within the upper portion of the case 93 is a heat insulated chamber 95, receiving tanks 96, which are hermetically sealed and hold a liquid having a freezing point below water. These tanks are rectangular and are vertically tapered and flare upwardly. A conduit 97 is arranged between these tanks and extends longitudinally of them. This conduit is formed by the side walls of the tanks 96 and has end walls 98. The conduit 97 is inverted V-shaped in cross-section and at its bottom it communicates with a conduit 99, through a slot 99' which is generally inverted V-shaped in cross-section. The conduit 99 extends longitudinally of the tanks 96. The conduits 97 and 99 communicate with each other throughout their entire length by the slot 99'.

Arranged upon opposite sides of the conduit 99, are compartments 101, for receiving trays 102, suspended from and having thermal contact with the tank 96. These trays are designed for holding quick frozen foodstuffs. There is a space or compartment 103 within the heat insulated chamber 95, above the tank 96, and this compartment receives trays 104 for holding water or desserts or the like to be frozen. These trays cooperate with guides 104' and the bottom of these trays have thermal contact with the tank 96.

Arranged within the case 93 below the heat insulated chamber 95 are annular water-holding tanks 105, which are tapered in vertical cross-section, decreasing downwardly. All of these annular tanks 105 are rigidly connected with each other and are preferably suspended from the heat insulated chamber 95. The first two annular tanks 105 from the bottom have their tops extending radially beyond the same to form circular supports 106, upon which are mounted rotatable shelves 107. Each shelf is preferably formed in two segments which interlock at 108 so that they are detachably connected. There are stationary corner shelves 109 arranged at the same level with the shelves 107. The shelves 107 are spaced from and have no thermal contact with the shelves 109 or the walls of the case 93.

Arranged adjacent to the lowermost annular water holding tank 105 is a horizontal shelf 110, preferably rectangular, and having thermal contact with the tank 105. Arranged below the shelf 110 are trays 111 provided at their tops with the flanges for slidably engaging guides 112 formed upon the shelf 110. The trays 111 have thermal contact with the shelf 110 but are preferably spaced from the bottom of the case 93 and therefore have no thermal contact therewith.

The tanks 105 are hermetically sealed and have air spaces at their tops and the ice is indicated by the level therein. The shelves 107 and 110 are preferably spaced from the sides, back, and door of the case 93 and have no thermal contact therewith at their edges. The annular tanks 105 form a vertical passage 113, the upper end of which is in communication with the conduit 97, at a point 114. Extending through the passage 113 is a refrigerant supply pipe 115, having an external diameter smaller than the reduced portions of the passage 113, as shown. The pipe 115 discharges into the conduit 97 and the refrigerant then passes into the conduit 99 and then through the passage 113 externally of the pipe 115. Leading into the lower end of the passage 113, is a return pipe 116, heat insulated as shown at 117. The return pipe 116 discharges into the intake side of a compressor 117 and the supply pipe 115 leads to the outlet side of this compressor. The compressor is operated by the motor 28, and the same clock 65 and thermostat 66 are employed for the same purposes as described in connection with all previous forms of the invention. In view of the foregoing description it will be seen that the annular water-holding tanks 105 are all in thermal contact with each other and the shelves are in thermal contact with the tanks. The combined volume of the tanks 105 are sufficient to hold a combined volume of ice which is sufficient for properly chilling the perishable food products within the case 93 during the period in which the motor circuit is opened by the clock 65, which is ordinarily from midnight to 6 a. m. The annular tanks 105 provide a passage for the refrigerant supply pipe and the refrigerant is returned through this passage to the compressor. By providing a plurality of water holding tanks, the food products are held within the refrigerant case adjacent to these tanks and in thermal contact therewith whereby the food products may be maintained at a lower temperature than the atmosphere within the case 93. The heat insulated chamber 95 contains the brine tank 96, which freezes the brine into ice for freezing ice cubes, desserts and the like and the trays 102 hold frozen food products. The temperature within the heat insulated chamber 95 should be about ten degrees F. and this lower temperature is not transmitted into the interior of the case 93 beneath the heat insulated chamber, whereby the dehydrating of the food products is eliminated and the defrosting of the tanks 105 is also eliminated.

In Figure 14, I have shown a further modification of the invention wherein the numeral 118 designates semi-annular water holding tanks, disposed in spaced relation and preferably superposed. The combined volume of these tanks is such that the combined volume of the ice held therein is sufficient to properly chill the perishable food products during the period that the motor of the compressor is idle. These tanks taper downwardly. The tanks have tops 119 which extend beyond the same and form shelves and are preferably spaced from the walls of the refrigerator case to be free from thermal contact therewith. These shelves of course are in thermal contact with the tanks. At the rear of the tanks 118 are freezing or cooling elements 120 serving as coils that receive the refrigerant. The elements 120 are heat insulated at their backs by the wall of the refrigerator case as shown at 121, and also heat insulated at the bottoms as shown at 122. A refrigerant supply pipe 123 passes through the back of the case and leads into the element 120 and the element 120 discharges the refrigerant through a pipe 124 which leads into the next element 120. A pipe 125 receives the refrigerant from the element 120. The pipe 123 receives the refrigerant from the outlet side of the condenser and the pipe 125 returns it to the intake side of the compressor. Any suitable number of tanks 118 and freezing elements 120 may be used. I contemplate using this form of the invention with the clock and thermostat for opening and closing the circuit.

In Figures 16 to 18 inclusively, I have shown a further modification. In this figure the numeral 126 designates the water-holding tank having a water receiving chamber 127 which is V-shaped in cross-section. The chamber 127 is longitudinally U-shaped forming sides between which is mounted a freezing or cooling element 128, serving as a coil. The chamber 127 extends about the free end of the freezing element 128. The freezing element is provided with a longitudinal partition 129, which divides the freezing element into compartments, connected at their forward ends by an opening 130. The refrigerant is supplied into the rear end of the element 128 through a pipe 131 and discharges from the same through a pipe 132. The pipe 131 leads to the outlet of a condenser and the pipe 132 to the intake of the compressor. Pipes 131 and 132 are heat insulated by being arranged within the back wall of the refrigerator case 133. The element 128 is inverted V-shaped in cross-section and its bottom is heat insulated, as shown at 134. I contemplate using any suitable number of tanks 126 for holding a desired volume of ice to retain the perishable food products suitably chilled through the period wherein the compressor is idle. I also contem-

plate using these tank or tanks in connection with the clock and thermostat as described in connection with the other forms of the invention. The top 134 of the tank serves as a shelf and may extend beyond the same for any suitable distance and is preferably out of contact with the walls of the refrigerator case.

In Figure 19, I have shown a modification of the invention which is somewhat similar to the forms shown in Figures 11 to 13 inclusive. In Figure 19, the numeral 135 designates annular water-holding tanks corresponding to the tanks 105. The tanks 135 have tops 136 extending radially beyond them to form shelves. The tanks 135 are vertically shorter than the tanks 105 and their bottoms are spaced from the next lower shelf. This affords larger storage space on the shelves. The tanks 135 are annular and each tank has an interior or central freezing or cooling element or chamber 137. A refrigerant supply pipe 138 leads into the uppermost freezing element 137 and this freezing element is connected with a pipe 139 which leads into the next freezing element 137. Any number of water-holding tanks 135 and freezing elements may be employed and the lowermost freezing element has an outlet pipe 140 which returns to the intake side of the compressor while the pipe 138 leads to the outlet side of the condenser. The pipes 138, 139, 140 are heat insulated. I contemplate using any number of tanks 135, the combined volume of which are sufficient to produce a volume of ice, in turn sufficient to keep the perishable food products suitably chilled. The shelves 136 have their edges preferably spaced from the walls of the refrigerator case so that they have no thermal contact therewith. I contemplate using the tanks 136 with the clock and thermostat as shown and described in connection with the previous invention. The advantage of the constructions shown in Figures 11 to 13 inclusive and 19 is that the refrigerant is supplied at the center of the refrigerator case and at the center of the water-holding tanks, whereby the maximum heat exchange is effected.

I have shown an electrically operated apparatus for supplying the refrigerant, and this is done for the purpose of illustration only. I contemplate using a flame operated apparatus for producing the refrigerant such as employs burning gas. I contemplate using chemical for operating apparatus to produce the refrigerant. I also contemplate using any form of heat operated apparatus to produce the refrigerant, and it is to be distinctly understood that the invention is not restricted to the type of electrically actuated apparatus, as shown. While it is preferred to use the clock to open and close the circuit, for the purpose stated, yet the clock may be omitted, particularly when the current is supplied intermittently to the customer, as when only available during certain hours of the day. I also contemplate operating my refrigerator intermittently with or without the use of the clock.

In each form of the invention, the pipe which supplies the refrigerant to the freezing element or expansion chamber or to the first of a series of freezing elements connected in series, is provided with a contracted bore or expansion valve, as is customary.

It is to be understood that the forms of my invention herewith shown and described are to be taken as preferred examples of the same, and that various changes in the shape, size, and arrangement of parts may be resorted to, without departing from the spirit of my invention or the scope of the subjoined claims.

Having thus described my invention, what I claim is:

1. A refrigerator comprising a case, heat conducting means within the case and being of such a large size that when it is substantially filled with water and all the water substantially frozen the resultant ice will be of a large volume to properly cool perishable products within the case when the refrigerating mechanism is inactive with respect to its cycle of operation for a substantial period, refrigerating mechanism for substantially freezing all the water within the means, time controlled means to render the freezing mechanism active with respect to its cycle of operation to freeze substantially all the water within the water holding means and to render the refrigerating mechanism inactive with respect to its cycle of operation after such mechanism has operated and the water is substantially completely frozen so that the temperature of the heat conducting means does not go substantially below the freezing point of water, means forming a heat insulated chamber within the case for receiving a receptacle holding water, desserts or the like, and a cooling element within the heat insulated chamber and included in the refrigerating mechanism and serving to freeze the water, desserts or the like.

2. A refrigerator comprising a case, a relatively large water holding heat conducting means arranged within the case and when substantially filled serving to hold a large volume of water, a heat insulated chamber within the case, a receptacle within the heat insulated chamber for holding water or desserts or the like, a tank within the heat insulated chamber and containing a liquid medium which is freezable at a temperature below the freezing point of water, electrically operated refrigerating mechanism adapted when active with respect to its cycle of operation to substantially completely freeze the water within the water holding means and to chill the said liquid medium, said electrically operated refrigerating mechanism being thrown into action with respect to its cycle of operation throughout the minor portion of the day when the current is cheap, the freezing of the water within the water holding means providing a large volume of ice which is capable of retaining the interior of the case suitably chilled for refrigeration purposes while the refrigerating mechanism is inactive with respect to its cycle of operation during the major portion of the day, and time controlled means to render the refrigerating mechanism active with respect to its cycle of operation throughout the minor portion of the day when the current is cheap and to render the same inactive with respect to its cycle of operation at the end of such minor portion.

3. A refrigerator comprising a case, relatively large water holding heat conducting means arranged within the case and adapted when substantially filled with water for holding a large volume of water, a heat insulated chamber within the case, a receptacle within the heat insulated chamber for holding water or desserts or the like, electrically operated refrigerating mechanism adapted when active with respect to its cycle of operation to substantially completely freeze the water within the water holding means and to chill the interior of the heat insulated chamber, said electrically operated refrigerating mechanism being thrown into action with respect to its

cycle of operation only throughout the minor portion of the day when the current is cheap, the substantially complete freezing of the water providing a large volume of ice which is capable of rendering the interior of the case suitably chilled for refrigeration purposes while the refrigerating mechanism is inactive with respect to its cycle of operation, and time controlled means to render the refrigerating mechanism active with respect to its cycle of operation throughout the minor portion of the day when the current is cheap and maintaining the refrigerating mechanism active until substantially all of the water is frozen and then render the refrigerating mechanism inactive with respect to its cycle of operation at the end of such minor portion.

4. A refrigerator comprising a case, relatively large water holding heat conducting means arranged within the case for holding when substantially filled a large volume of water, refrigerating mechanism adapted when rendered active with respect to its cycle of operation to substantially completely freeze the water within the water holding means, the substantially complete freezing of the water providing a large volume of ice which is capable of retaining the interior of the case suitably chilled for refrigeration purposes while the refrigerating mechanism is inactive with respect to its cycle of operation, time controlled means to render the refrigerating mechanism active with respect to its cycle of operation when the selected portion of the day is reached and maintaining the refrigerating mechanism active with respect to its cycle of operation throughout the time of such selected portion for freezing substantially all of the water within the relatively large water holding means and then rendering the refrigerating mechanism inactive with respect to its cycle of operation, and thermostatic means to render the refrigerating mechanism inactive with respect to its cycle of operation when the temperature of the water holding means is reduced substantially below the freezing point of water.

5. A refrigerator comprising a case, a plurality of tanks for holding water arranged within the case and having thermal contact with each other and free from thermal contact with the case, means to freeze the water within the tanks, and shelves having thermal contact with the tanks.

6. A refrigerator comprising a case, a plurality of superposed substantially annular water-holding tanks arranged generally coaxial with relation to each other within the case, and refrigerating means extending generally centrally of the case and of the tanks and serving to supply a refrigerant adjacent to the tanks.

7. A refrigerator comprising a case, a plurality of substantially annular water-holding tanks arranged within the case, means forming refrigerating elements arranged centrally of the annular water-holding tanks, and means for supplying a refrigerant to the refrigerating elements.

8. A refrigerator comprising a case, a plurality of substantially annular water-holding tanks arranged within the case, means forming refrigerating elements arranged centrally of the tanks, the refrigerating elements being connected in series, and means for supplying a refrigerant to one element.

9. A refrigerator comprising a heat insulated case having a food compartment, downwardly tapered heat conducting water holding means arranged within the case to chill the air in the food compartment and of sufficient size to hold enough ice to maintain the food compartment properly chilled for the refrigeration of perishable products for a substantial period, means to initially freeze the lower portion of the water only and progressively freeze the same upwardly, and means for operating the freezing means for a period sufficient to freeze substantially all the water in the water holding means and means to stop the operation of the freezing means when the water holding means is substantially filled with ice.

10. A refrigerator comprising a heat insulated case having a food compartment, downwardly tapered heat conducting water holding means arranged within the case to chill the air in the food compartment and of sufficient size to hold enough ice to maintain the food compartment properly chilled for the refrigeration of perishable products for a substantial period, means to initially freeze the lower portion of the water only and progressively freeze the same upwardly, a heat insulated chamber within the case, and refrigerating means within the heat insulated chamber for freezing water, desserts or the like within the insulated chamber.

11. A refrigerator, comprising a heat insulated case having a food compartment, heat conducting water holding means within the case to chill the air in the food compartment and of sufficient size to hold enough ice to maintain the food compartment properly chilled for the refrigeration of perishable products for a substantial period, means to initially freeze the lower portion of the water only and progressively freeze the same upwardly, means to stop the operation of the freezing means when the water holding means is substantially filled with ice, a heat insulated chamber within the case, and refrigerating means within the heat insulated chamber.

12. A refrigerator, comprising a heat insulated case having a food compartment, heat conducting water holding means within the case to chill the air in the food compartment and of a size to hold enough ice to maintain the food compartment properly chilled for the refrigeration of perishable products for a substantial period, means to initially freeze the lower portion of the water only and progressively freeze the same upwardly, means to stop the operation of the freezing means when the water holding means is substantially filled with ice, a heat insulated chamber associated with the case, heat conducting means within the heat insulated chamber for receiving a liquid freezable medium having a freezing point below water, and refrigerating means within the heat insulated chamber.

13. A refrigerator comprising a heat insulated case having a food compartment, a plurality of downwardly tapered tanks arranged within the case, parts of the tanks serving to chill the air in the food compartment, the combined volume of the tanks being of sufficient size to hold enough ice to maintain the food compartment properly chilled for the refrigeration of perishable products for a substantial period, means to initially freeze the lower portion of the water only in each tank and progressively freeze the same upwardly, the freezing means being insulated from the food compartment, the freezing means when active serving to chill the food compartment through the water or ice.

14. A refrigerator, comprising a heat insulated case having a food compartment, a plurality of substantially horizontal tanks arranged within

the case for holding water or the like, the combined size of the tanks being sufficiently large to hold enough ice to maintain the food compartment properly chilled for the refrigeration of perishable products for a substantial period, and a substantially horizontal refrigerating device in thermal contact with the lower portion of each tank to initially freeze the lower portion of the water and progressively freeze the same upwardly.

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