Dec. 29, 1936. E. RICE, JR 2,065,986

APPARATUS FOR REFRIGERATION

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FIG. 1.

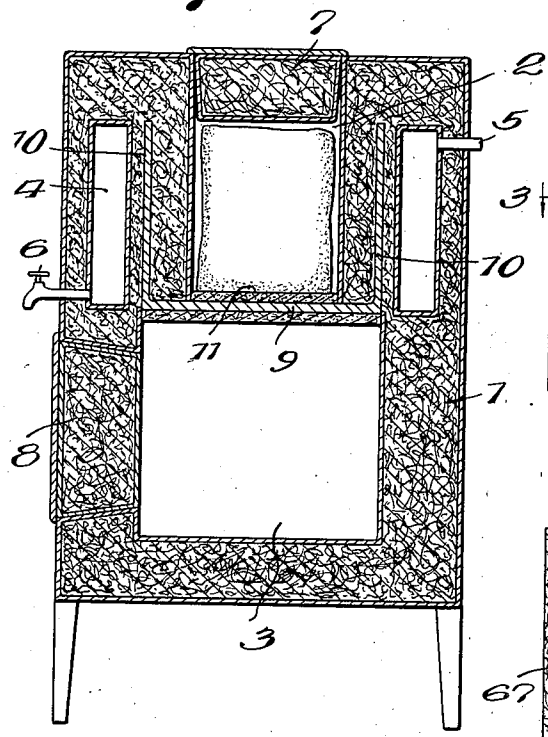


FIG. 2.

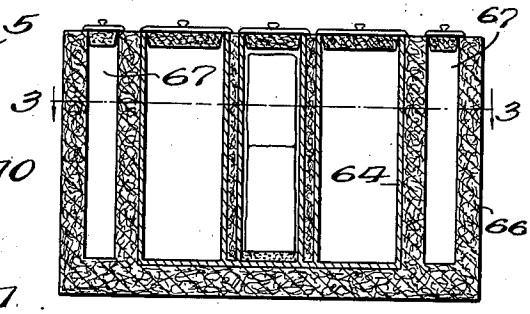
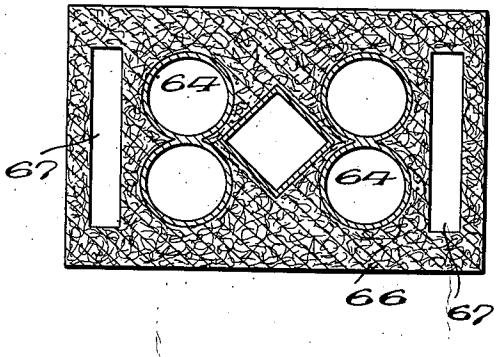


FIG. 3.



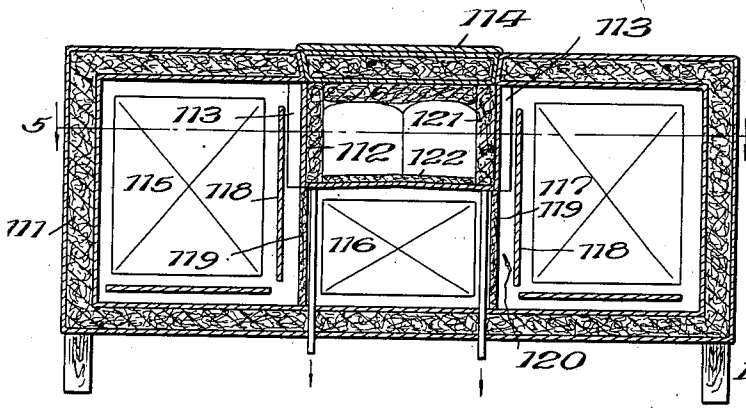


FIG. 4.

Inventor
Edward Rice Jr.

By Pennie Davis Marvin & Edmonds

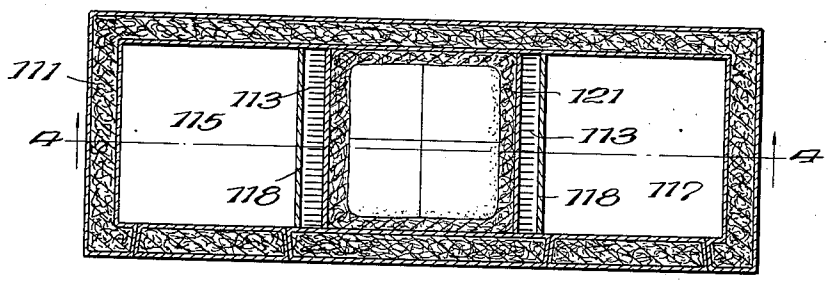
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FIG. 5.



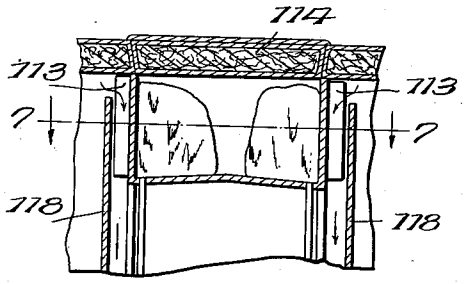


FIG. 6.

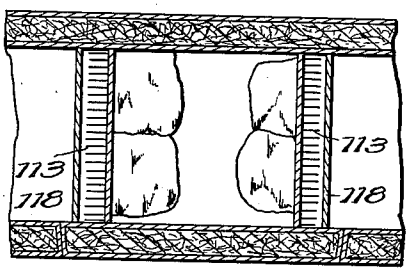


FIG. 7.

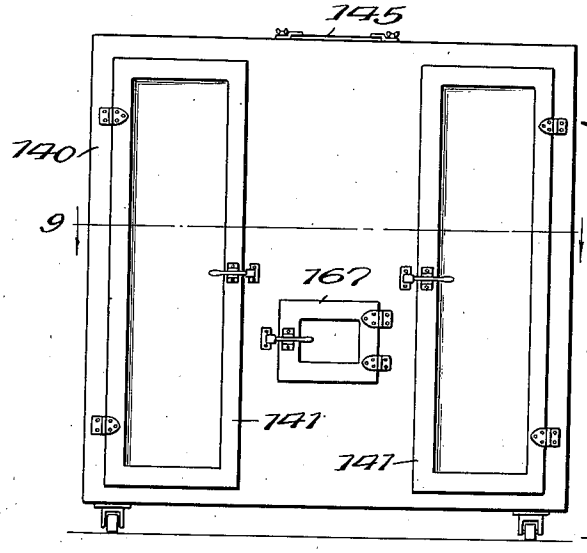


FIG. 8.

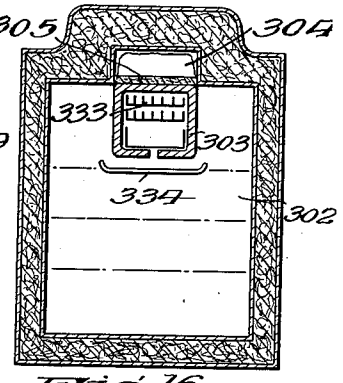


FIG. 16.

Inventor
Edward Rice Jr.

By Pennie Davis Marvin & Edmonds
Attorneys

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FIG. 9

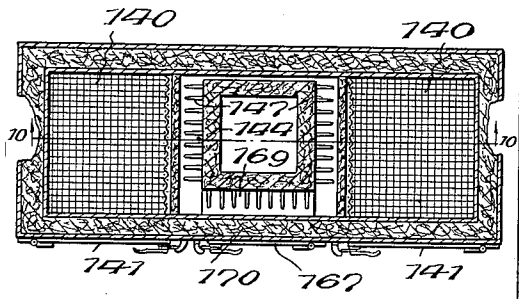


FIG. 10

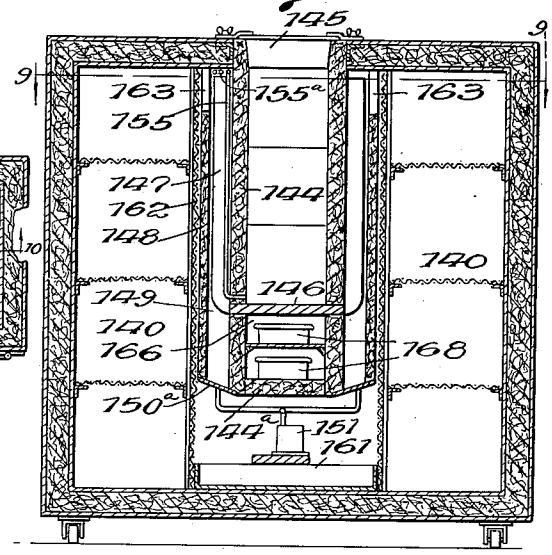
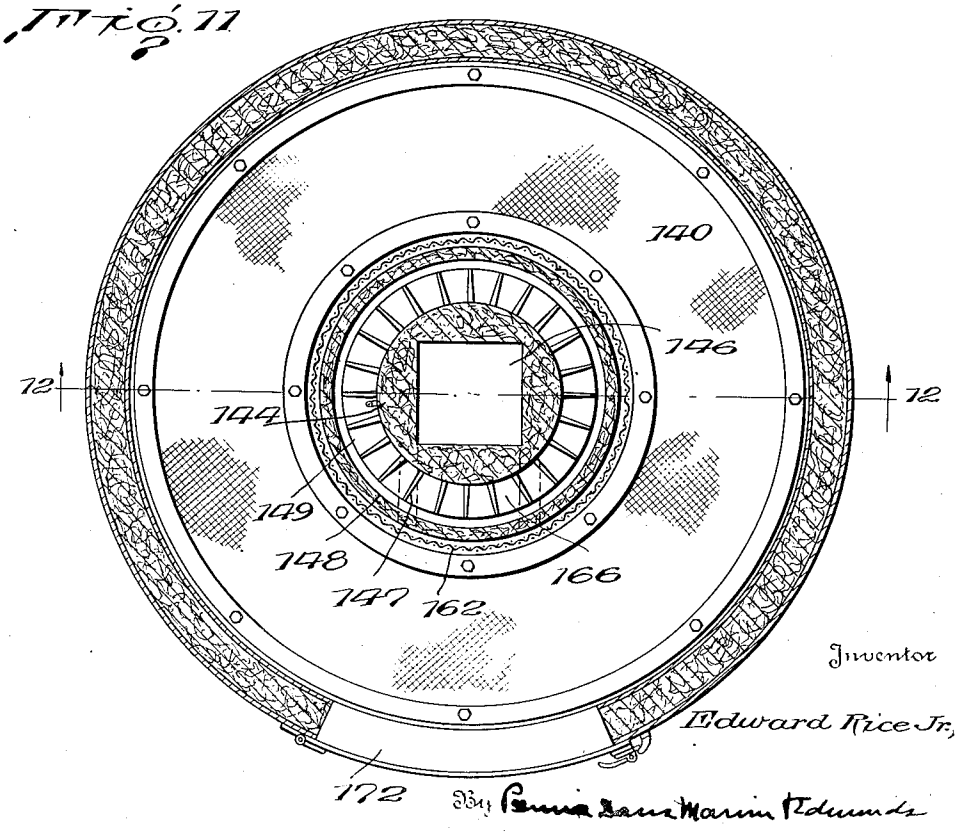


FIG. 11



Inventor

Edward Rice Jr.

By Pennie Davis Marvin & Edmonds

Attorneys

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Fig. 12.

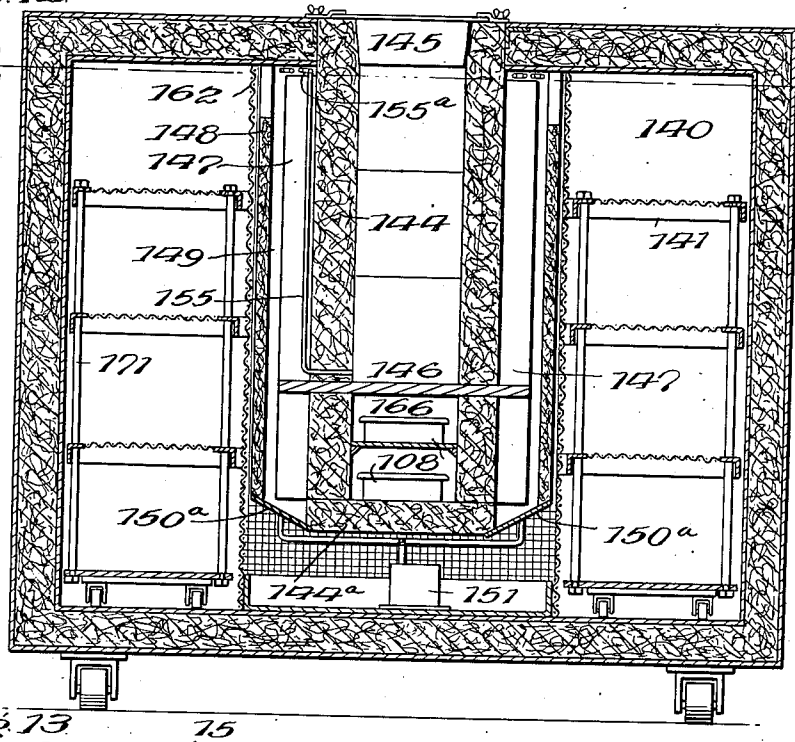
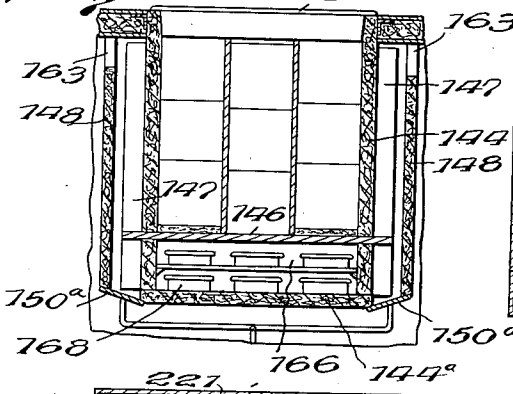


Fig. 13



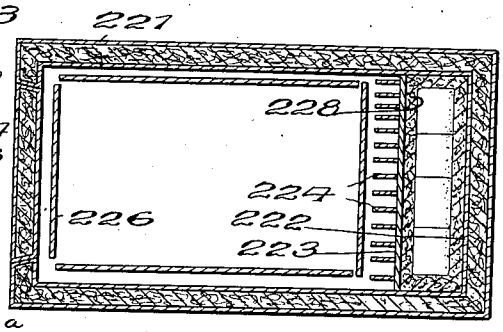


Fig. 14

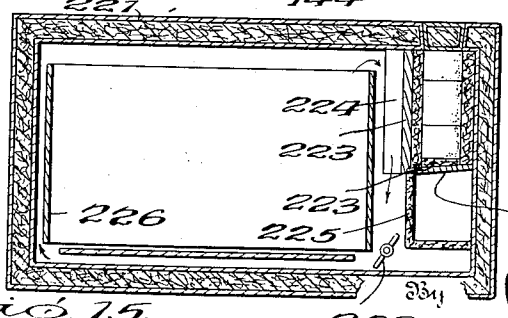


Fig. 15.

Inventor
Edward Rice Jr.,
By Pennie Davis Marvin & Edmonds
Attorneys

Patented Dec. 29, 1936 2,065,986

UNITED STATES PATENT OFFICE

2,065,986

APPARATUS FOR REFRIGERATION

Edward Rice, Jr., New York, N. Y., assignor to International Carbonic, Inc., New York, N. Y., a corporation of Delaware

Application July 3, 1936, Serial No. 88,877
In Canada August 5, 1930

12 Claims. (Cl. 62—91.5)

This invention relates to improvements in means for refrigerating by use of solid refrigerants, such as water ice (solid H_2O), and carbon dioxide ice (solid CO_2).

A principal object of the invention is to provide a refrigerating apparatus in which solid refrigerants shall be more efficient than in prior refrigerating apparatus and shall permit of close regulation of the effective refrigerating temperatures.

Another object of the invention is to provide a refrigerating apparatus to be cooled by solid refrigerants whereby the effective refrigerating temperatures are to a substantial degree independent of the volume of the refrigerant, and to this latter end, the invention contemplates the provision of means for materially increasing the refrigerating efficiency of relatively small quantities of a solid refrigerant.

More specifically, an important object of the invention is the provision of a refrigeration apparatus to be cooled by a solid refrigerant which will produce effective refrigerating temperatures in the refrigerating chamber more closely approximating the melting or subliming temperature of the ice than apparatus heretofore known, and which will maintain such temperatures even when the mass of ice has been reduced to relatively small dimensions.

Still another object of the invention is the provision of a refrigerating apparatus to be cooled by solid refrigerants which will permit a rapid acceleration in the rate of ice meltage or sublimation irrespective of the volume of the refrigerant when the temperatures in the refrigerated area are increased.

A still further object of the invention is the provision of refrigerating apparatus for use with a solid refrigerant in which the principal heat transfer to the refrigerant takes place from the refrigerated space or mass to a conductor of high thermal conductivity and extended surface, and thence conductively to a relatively small surface of the refrigerant through a section of the conductor sufficiently large to transmit the required amount of heat for maintaining a predetermined effective refrigerating temperature.

The invention further contemplates the provision of refrigerating apparatus for use interchangeably with solid CO_2, solid H_2O or other solid refrigerant, in which the principal heat transfer to the solid refrigerant takes place from the refrigerated area or mass to a conductor of high thermal conductivity and extended surface, thence conductively to a relatively small surface of the refrigerant through a section of the conductor of sufficient size to transmit an amount of heat required for maintaining a predetermined effective refrigerating temperature and in which differences in the melting or subliming temperatures of the different refrigerants may be compensated by means of variable conductor resistances placed between the conductor and the refrigerant.

A further object of the invention is the provision of refrigerating apparatus for use with CO_2 "ice" or the like in which the principal heat tranfer from the refrigerating chamber and its contents to the "ice" takes place convectively from the chamber to a conductor of high thermal conductivity, thence conductively to the "ice", and in which means may be provided for regulating the convection currents in such a manner that an approximately constant temperature may be maintained in the refrigerating chamber.

A further object of the invention is to provide such a refrigerating apparatus for use with CO_2 "ice" or the like that a regulated temperature either above or below the freezing temperature of water can be maintained in the principal refrigerating chamber, while in a second chamber the temperature is not exactly regulated, but will always be considerably below the freezing temperature of water as long as the "ice" store is maintained, whereby it is possible to freeze water ice for domestic use.

Still another object of the invention is to provide simple and relatively inexpensive refrigerating units of a character adapted for use in household and other refrigerators employing solid H_2O whereby my invention may be readily available for that class of refrigeration.

The invention further resides in certain novel and advantageous structural features and details and in specific embodiments representing various applications thereof to different classes of refrigeration, all as hereinafter set forth and illustrated in the attached drawings, in which:

Fig. 1 is a sectional view illustrating an embodiment of my invention as applied to a household refrigerator in which there is embodied a liquid cooler.

Fig. 2 is a sectional view illustrating a modification of the embodiment illustrated in Fig. 1.

Fig. 3 is a section on line 3—3 of Fig. 2.

Fig. 4 is a vertical sectional view taken on line 4—4 of Fig. 5 illustrating a table or cabinet type of refrigerator made in accordance with my invention and adapted for use with solid carbon

dioxide or other refrigerant of relatively low melting point.

Fig. 5 is a horizontal sectional view on line 5—5 of Fig. 4.

Fig. 6 is a fragmentary vertical sectional view illustrating a cabinet such as is shown in Figs. 4 and 5 such as may be used with water ice or similar refrigerant of higher melting point.

Fig. 7 is a horizontal section on line 7—7 of Fig. 6.

Fig. 8 is a front elevation of a household refrigerator constructed in accordance with my invention and adapted for making water ice cubes and storage of frozen products.

Fig. 9 is a horizontal sectional view on line 9—9 of Fig. 8.

Fig. 10 is a vertical sectional view on line 10—10 of Fig. 9.

Fig. 11 is a horizontal sectional view on line 11—11 of Fig. 12, illustrating a modification of a structure such as is shown in Figs. 8 to 10 to produce a circular refrigerator having rotating shelves.

Fig. 12 is a vertical sectional view on line 12—12 of Fig. 11.

Fig. 13 is a fragmentary vertical sectional view illustrating a modification of the invention providing a structure similar to that illustrated in Figs. 11 and 12, but having means for controlling the flow of air over the extended heat-absorbing surfaces.

Fig. 14 is a horizontal sectional view of a further modification of the invention.

Fig. 15 is a vertical sectional view through the refrigerator shown in Fig. 14, and

Fig. 16 is a vertical sectional view through a further form of refrigerator having a compartment in which water may be frozen.

Water ice or solid H_2O is more widely used than any other form of refrigerant. One of the principal drawbacks in the prior methods of using this refrigerant or, in fact, any solid refrigerant is that although any given mass of the refrigerant, no matter how small, has a fixed refrigerating value; yet the smaller the mass becomes, the slower its refrigerating action becomes also. This is due to the fact that the heat is usually either entirely or almost entirely brought to the ice convectively either by air or a liquid, and the amount of heat taken up by the refrigerant, other things being equal, depends directly on the amount of the effective surface contact between the refrigerant and the circulating fluid. Obviously as the ice melts, the surface area becomes less and the refrigerating action slower. In the construction of refrigerating apparatus, this feature, heretofore, has been given no consideration, and no effort has been made to compensate for the rapid decrease in efficiency as the refrigerant loses volume and surface area. As a result, a great deal of ice is constantly being used with very indifferent or inferior results.

I have discovered that the principal obstacles to the efficient use of water ice and other solid refrigerants can be largely overcome if the heat from the space or material to be refrigerated is picked up by comparatively extended surfaces of a metal heat conductor, such as copper, aluminum or iron, and transferred through a substantial cross section of the metal conductor directly to a surface of the body of ice with which the metal conductor is either in immediate contact or in suitable conductive relation. I have found that by this method, the ice can be melted at practically a constant rate, thus providing a constant effective refrigerating temperature practically independent of the volume of the refrigerant, and even with extremely small masses of the latter. I have found also that the refrigerant can be melted at an almost inconceivable rate when large amounts of heat are passed over the extended metal surfaces. With a sufficient cross section of the conductor metal, as small as thirty square inches of contact surface with the refrigerant is sufficient to melt enough water ice to keep a good household refrigerator below 50° F. even on the top shelf in the warmest weather; and after the doors have been opened as long as three minutes, this refrigerator will return to its original low temperature within twenty minutes or one-half hour. It is essential in the practice of my invention that the solid refrigerant be maintained in conductive relation with a substantial metal conductor having a suitably extended surface area in the refrigerated space.

While the invention is of importance in conjunction with the use of water ice, it is also of great value in the use of all other solid refrigerants, such as solid carbon dioxide and frozen brine.

It will be understood that for maximum control of refrigeration, with this type of refrigerant it is desirable to limit so far as feasible transfer of heat from the refrigerated space or mass to that passing through the conductor. This can be accomplished by providing adequate insulation preventing transfer by radiation or by other conduction through the selected conductor. By thus establishing a principal and practically sole path of transfer and utilizing in conjunction therewith suitable known resistances, a substantially perfect control may be obtained. This method of control also affords a simple method for providing apparatus suitable for use with refrigerants such as water ice and carbon dioxide ice having widely different melting points. Thus a single refrigerating apparatus can be built that can use as a refrigerant either carbon dioxide or water ice or frozen brine, or in fact, any solid refrigerant, and that can maintain practically any required temperature under constant outside temperature conditions within the limits of the particular refrigerant used by a simple manipulation of a conductor resistance interposed between the conductor and the refrigerant.

With reference to the drawings, in which I have illustrated various specific applications of my invention to different types and classes of refrigeration, and with particular reference to Fig. 1, the reference character 1 designates a refrigerator having a compartment 2 for the solid refrigerant, a compartment or space 3 for the food or other material to be cooled, and a compartment 4 for containing a liquid to be cooled. Liquid may be introduced into the compartment 4 through an inlet 5 and withdrawn therefrom through an outlet 6. Access to compartments 2 and 3 may be had by means of the doors or closures 7 and 8, respectively.

The bottom of the compartment 2 of the solid refrigerant container comprises a cast metal conductor plate 9, preferably of aluminum, copper or some other metal having a high heat conductivity, upon which the solid refrigerant is supported in heat-conductive relation. The metal conductor plate 9 is extended laterally beyond the bottom of the compartment 2 and has plate-like vertical extensions 10 extending up-

wardly and positioned between the refrigerant container 2 and the liquid compartment 4, with which they are in heat-conductive relation. The thickness of the conductor plate 9 and the vertical extensions 10 is such with respect to its thickness and area exposed for heat absorption as to absorb and conduct heat to the solid refrigerant at a rate to maintain them at an effective refrigerating temperature sufficiently low to maintain the desired temperatures in the compartments 3 and 4. A conductor resistance 11 of a desired thickness may be interposed between the refrigerant and the conductor plate 9 to regulate the rate of absorption of heat from the plate 9, and consequently maintain the temperature in the compartments 3 and 4 at any desired value.

In Figs. 2 and 3, I have illustrated a similar type of refrigerating apparatus which in addition includes storage chambers or receptacles 67 embedded in the insulating casing 66 in suitably spaced relation to the sides of the container 64, these compartments 67 being readily kept at a non-freezing temperature and being suitable for holding water or other substances or materials at a relatively low but non-freezing temperature.

In Figs. 4 and 5 I have illustrated a large table or cabinet type of refrigerator adapted for use either with CO_2 ice or water ice and in which provision is made for obtaining in the three separate compartments three different temperatures, when CO_2 ice is used, or of two temperatures when water ice is employed. This refrigerator consists of an outer insulated casing 111 having in the top a chamber for a refrigerator, the opposite sides and the bottom of which are constituted by a conductor 112. The side walls of this conductor are provided with outwardly-projecting fins 113, and the bottom wall is slightly elevated towards the center to create a tendency of the solid refrigerant to move by gravity towards the vertical fin walls. Access to this refrigerating chamber is had through a removable cover 114. Three refrigerating chambers are provided numbered 115, 116, and 117, respectively, the chamber 116 being located directly below the refrigerant chamber. Baffles 118 in the chambers 115 and 117 extend vertically and preferably in contact with the outer edges of the fins 113 whereby a convective circulation is set up in which the air moves downwardly between the fins and against the side walls of the conductor. The chamber 116 is separated from the other chambers by insulating walls 119, and in one or both of the chambers 115 a valve 120, which may be operated manually or automatically from a suitable thermostatic actuator, is provided for controlling the movement of the convection currents downwardly past the walls and fins of the conductor. Where carbon dioxide ice is used, the refrigerant is surrounded in the refrigerating chamber on four sides and the top by suitable insulation 121, while the ice is separated from the bottom of the conductor by means of suitable conductor resistance 122. The temperature in the chamber 116 is controlled by the thickness and character of the conductor resistance, whereas the temperatures in the compartments 115 and 117 are controlled not only by the conductor resistance, but also by the thickness and character of the insulation 121, and may be still further controlled by manipulation of the valve 120.

Figs. 6 and 7 illustrate this same apparatus as used with water ice, it being noted that in this case the insulation 121 and the conductor resistance 122 are removed, the water ice being maintained in contact with the side walls of the conductor by reason of the inclination of the bottom wall after a manner previously set forth.

In Figs. 8, 9, and 10, I have illustrated refrigeration apparatus particularly adapted for household uses and embodying means for producing water ice cubes and for storing frozen products. From an inspection of Fig. 10 it will be noted that the conductor plate 146, which forms the false bottom of the cabinet, instead of being in direct contact with the insulating bottom 144a thereof is in vertical spaced relation thereto, with the result that a compartment 166 is produced therebeneath, which is conductively connected with the "ice" compartment by the plate 146. This compartment 166 is accessible through a door 167 mounted in the wall of chamber 140 and is adapted for the reception of freezing pans 168 for the formation of ice cubes or use in freezing confections or for storing frozen products. The wall of the cabinet is preferably offset inwardly, as at 169, above the door openings, so that the body of the cabinet may be spaced from the front wall 170 of the chamber a sufficient distance to permit the provision of radiation vanes 147 between the cabinet and chamber walls thereabove. In this illustration, where the apparatus is intended for household use and supplies of "ice" are readily available, necessity for a construction permitting more than one column of "ice" is eliminated and the entire supply may rest at its lower end directly upon the plate 146, or upon portable insulation 160 as described above. The ice cube and frozen storage compartment 166 may, however, be conveniently combined with structures embodying several vertical columns of "ice" as suggested in Fig. 13.

In Figs. 11 and 12, the construction of Figs. 8 to 10 is modified to permit its adaptation to a circular refrigerator having rotatable shelving units 171, the rotation of which will bring material stored therein opposite an access door 172, which door also is opposite and gives access to the freezing chamber 166.

It will be noted that in each of the constructions illustrated, the principal heat transfer taking place between the refrigerating chamber and the "ice" in cabinet 144 is obtained through conduction, the conducting element being subject to the action of convection currents passing through the channels provided by the walls 149 and the cabinet. Thermostatic regulation of this passage materially reduces the speed by which the refrigerant is converted and enables the refrigerator to operate over a considerable period with a single filling. Since all gases resulting from reduction of the refrigerant are conducted to the exterior of the refrigerating chamber, they cannot come in contact with food or products stored therein to damage same in any way. By regulating and maintaining automatically the temperature in the storage chamber 140 either above or below 32° F. it is possible to refrigerate a large majority of products, particularly those perishable products that may be damaged by freezing, and thus the uses for this method of refrigeration are numerous. Because of the self-contained nature of the apparatus and its adaptation to small units it is especially useful for transportation purposes.

In Figs. 14 and 15, a refrigerating system is

illustrated suitable for small truck bodies and the like and adapted for refrigeration with practically any type of solid refrigerant. The body **221** in this instance has a chamber **222** at one end and in the upper portion for reception of the refrigerant, the bottom and front wall of this space being constituted by a suitable angular conductor plate **223**, and the said front wall being provided with fins **224** which project into the interior or refrigerated area of the truck. The space directly under the bottom of the conductor plate **223** is enclosed by a partition **225** and constitutes a cold compartment whose temperature may be maintained at a relatively low point. A false wall or baffle **226** is provided in the interior of the body which forms a channel for the circulation of the convection currents, as indicated by the arrows, the circulating air passing downwardly over the upright face of the conductor **223** and between the fins **224**. I also may provide in this instance a valve **227** in the air passage whereby the circulation of air may be controlled either manually or by a suitable thermostat, thereby affording a further control of the interior temperature of the truck. Where, as illustrated, a refrigerant such as solid carbon dioxide is employed, this refrigerant will be surrounded by an insulating sleeve **228** and separated from the bottom of the conductor member by a suitable conductor resistance element **229**. The temperatures may be controlled by regulating the thickness and character of the conductor resistance and of the insulating sleeve **228**. Where water ice is employed, the sleeve **228** and conductor resistance **229** may be eliminated. In this case I also may employ on the top of the truck body a suitable radiation shield similar to the shield **219** shown in Fig. 13.

Fig. 16 illustrates a further form of household refrigerator for using dry ice and having a compartment in which water ice cubes may be made. In this form of the invention the heat conductor **303** is bent around to form four sides of a compartment in which water may be frozen for making ice cubes for domestic use. Suitable means may be provided within compartment **303** for supporting the conventional freezing trays **333**. Drip pan **334** is placed on one of the shelves directly beneath the heat conductor to catch meltage when defrosting. If desired, the outside surfaces of the two vertical conductor walls may be provided with fins to increase the heat absorbing surfaces, similar to the manner shown in Figs. 4 and 5. In this form of the invention the walls which form the compartment in which the water is frozen absorbs heat from the space **302** for food or other material to be cooled as well as from the water contained in the trays. The compartment for the solid refrigerant is formed just above the conductor plate **303** and ice in the compartment is maintained in heat-conductive relation with the upper horizontal wall of the conductor. As in the other forms of the invention, a suitable conductor resistance **305** may be interposed between the solid refrigerant **304** and the upper horizontal portion of the heat conductor **303**, in order to regulate the absorption of heat from the compartment **302** and the space enclosed by the conductor **303**, in order to maintain the temperature in those compartments at the desired value.

In this form of the invention the heat conductor may be formed from a single sheet of relatively thick metal such as aluminum or copper, although if desired, the various extended areas may be welded together. It is most important that the thickness of cross-section be never decreased as the point of heat transfer with the solid refrigerant is approached, as any such decrease in the thickness of the conductor plate would form a "bottleneck" through which the passage of heat would be restricted. Also, it is preferable not to make any joints in the conductor except by welding. If two parts of the copper conductor were soldered together there would be a large drop in temperature across the joint because the solder is a much poorer heat conductor than copper.

This application is a continuation-in-part of my application for "Method and apparatus for refrigeration", filed July 14, 1930, Serial No. 467,999, now Patent No. 2,055,158, which application in turn was filed as a continuation-in-part of my application Serial No. 372,754, filed June 21, 1929; and a continuation-in-part of my application Serial No. 751,391, filed November 3, 1934, for "Refrigeration", which in turn is a division of my application Serial No. 679,435, filed July 7, 1933, now Patent No. 1,980,089.

I claim:

1. A refrigerating apparatus for use with solid refrigerants having a compartment for the solid refrigerant and a plurality of compartments to be refrigerated, a solid metallic heat conductor with which solid refrigerant in the refrigerant compartment is to be maintained in heat-conductive relation, said conductor having extended surfaces for heat absorption from the compartments to be refrigerated, the capacity of said conductor to transmit heat along in the direction of the refrigerant from the extended surfaces exposed for heat absorption being sufficient by reason of its thickness with respect to the heat conductivity of the metal from which it is formed and the area of said extended surfaces exposed for heat absorption to maintain said heat-absorbing surfaces at an effective refrigerating temperature lower than that of the compartment to be refrigerated, and means for maintaining one of said compartments to be refrigerated at a temperature lower than that of another of said compartments to be refrigerated.

2. In refrigerating apparatus for use with solid refrigerants in which separate storage spaces can be maintained at different refrigerating temperatures by the same body of refrigerant, the combination of an insulated space for the material to be stored at the higher temperature; a refrigerant-containing bunker within or adjacent to said insulated space; a solid metallic heat conductor having extended portions for heat absorption from said insulated space, and a smaller portion disposed in the refrigerant bunker and adapted to be maintained in heat-exchange relation with solid refrigerant therein, said conductor forming the principal path of heat transfer between the said insulated space and the refrigerant; and a storage space for the material to be stored at the lower temperature located within the said insulated space, which latter space by reason of its proximity to the said conductor is maintained at a lower temperature than that of the remainder of the insulated space.

3. A refrigerating apparatus for use with solid refrigerants having a compartment for the solid refrigerant and a plurality of compartments to

be refrigerated, a solid metallic heat conductor with which solid refrigerant in the refrigerant compartment is to be maintained in heat-conductive relation, said conductor having extended finned surfaces for heat absorption from the compartments to be refrigerated, the capacity of said conductor to transmit heat along in the direction of the refrigerant from the extended surfaces exposed for heat absorption being sufficient by reason of its thickness with respect to the heat conductivity of the metal from which it is formed and the area of said extended surfaces exposed for heat absorption to maintain said heat-absorbing surfaces at an effective refrigerating temperature lower than that of the compartment to be refrigerated, and means for maintaining one of said compartments to be refrigerated at a temperature lower than that of another of said compartments to be refrigerated.

4. A refrigerating apparatus for use with solid refrigerants having a compartment for the solid refrigerant and a plurality of compartments to be refrigerated, a solid metallic heat conductor with which solid refrigerant in the refrigerant compartment is to be maintained in heat-conductive relation, said conductor having extended surfaces for heat absorption from the compartments to be refrigerated, the capacity of said conductor to transmit heat along in the direction of the refrigerant from the extended surfaces exposed for heat absorption being sufficient by reason of its thickness with respect to the heat conductivity of the metal from which it is formed and the area of said extended surfaces exposed for heat absorption to maintain said heat-absorbing surfaces at an effective refrigerating temperature lower than that of the compartment to be refrigerated, and means for maintaining one of said compartments to be refrigerated at a temperature lower than that of another of said compartments to be refrigerated, the compartment which is to be maintained at said lower temperature being adapted for freezing water, and separated from the refrigerant compartment by said metallic conductor.

5. A refrigerating apparatus for use with solid refrigerants having a compartment for the solid refrigerant and a plurality of compartments to be refrigerated, a solid metallic heat conductor with which solid refrigerant in the refrigerant compartment is to be maintained in heat-conductive relation, said conductor having extended finned surfaces for heat absorption from the compartments to be refrigerated, the capacity of said conductor to transmit heat along in the direction of the refrigerant from the extended surfaces exposed for heat absorption being sufficient by reason of its thickness with respect to the heat conductivity of the metal from which it is formed and the area of said extended surfaces exposed for heat absorption to maintain said heat-absorbing surfaces at an effective refrigerating temperature lower than that of the compartment to be refrigerated, and means for maintaining one of said compartments to be refrigerated at a temperature lower than that of another of said compartments to be refrigerated, the compartment which is to be maintained at the lower temperature being adapted for freezing water, and positioned beneath said refrigerant compartment and separated therefrom by said metallic conductor.

6. A refrigerating apparatus for use with solid refrigerants having a compartment for the solid refrigerant and a plurality of compartments to be refrigerated, a solid metallic heat conductor with which solid refrigerant in the refrigerant compartment is to be maintained in heat-conductive relation, said conductor having extended surfaces for heat absorption from the compartments to be refrigerated, the capacity of said conductor to transmit heat along in the direction of the refrigerant from the extended surfaces exposed for heat absorption being sufficient by reason of its thickness with respect to the heat conductivity of the metal from which it is formed and the area of said extended surfaces exposed for heat absorption to maintain said heat-absorbing surfaces at an effective refrigerating temperature lower than that of the compartment to be refrigerated, and means for maintaining one of said compartments to be refrigerated at a temperature lower than that of another of said compartments to be refrigerated, one of said compartments being a liquid-containing compartment, and means for introducing liquid into and withdrawing it from said liquid compartment.

7. A refrigerating apparatus for use with solid refrigerants having a compartment for the solid refrigerant and a plurality of compartments to be refrigerated, at least some of said compartments to be refrigerated being spaced at different distances from said refrigerant compartment, a solid metallic heat conductor with which solid refrigerant in the refrigerant compartment is to be maintained in heat-conductive relation, said conductor having extended surfaces for heat absorption from the compartments to be refrigerated, the capacity of said conductor to transmit heat along in the direction of the refrigerant from the extended surfaces exposed for heat absorption being sufficient by reason of its thickness with respect to the heat conductivity of the metal from which it is formed and the area of said extended surfaces exposed for heat absorption to maintain said heat-absorbing surfaces at an effective refrigerating temperature lower than that of the compartment to be refrigerated, and means for maintaining one of said compartments to be refrigerated at a temperature lower than that of another of said compartments to be refrigerated.

8. In a household refrigerator, cooled by a solid refrigerant, a solid metallic heat conductor of the character described formed from a thick plate of good heat conducting metal forming the top and two sides of a compartment located in the upper part of the refrigerator, and adapted to serve as a freezing compartment for making water ice cubes and for the storage of frozen materials, the portion of the conductor forming the top of said compartment serving as the bottom of the refrigerant containing space, and the portions of the conductor forming the two sides of the said compartment serving to cool the refrigerator by absorbing heat on their outer metal surfaces.

9. Apparatus for refrigerating by the use of carbon dioxide "ice" comprising a chamber, an insulated cabinet therein and sealed therefrom, a heat conductor having portions disposed interiorly and exteriorly of the cabinet, an insulating wall cooperating with the cabinet to produce a convection channel for the chamber in which the exteriorly-disposed portions of the conductor extend, said conductor dividing the cabinet into two sections, and separate access doors for said sections.

10. Apparatus for refrigerating by the use of

carbon-dioxide "ice" comprising a chamber, an insulated cabinet therein and sealed therefrom, a heat conductor having portions disposed interiorly and exteriorly of the cabinet, an insulating wall cooperating with the cabinet to produce a convection channel for the chamber in which the exteriorly-disposed portions of the conductor extend, said conductor dividing the cabinet into two sections, separate access doors for said sections, and thermostatically-controlled valve means for regulating the passage of air through said convection channel.

11. Apparatus for refrigerating by the use of carbon-dioxide "ice" comprising a chamber, an insulated cabinet therein and sealed therefrom, a heat conductor having portions disposed interiorly and exteriorly of the cabinet, an insulating wall cooperating with the cabinet to produce a convection channel for the chamber in which the exteriorly-disposed portions of the conductor extend, said conductor dividing the cabinet into two sections, separate access doors for said sections, and thermostatically-controlled valve means for regulating the passage of air through said convection channel, said exteriorly-disposed portions including vanes extending upwardly along the sides of the cabinet.

12. A refrigerating apparatus for use with solid refrigerants having a compartment for the solid refrigerant and a plurality of compartments to be refrigerated, a solid metallic heat conductor with which solid refrigerant in the refrigerant compartment is to be maintained in heat-conductive relation, said conductor having extended surfaces for heat absorption from the compartments to be refrigerated, the capacity of said conductor to transmit heat along in the direction of the refrigerant from the extended surfaces exposed for heat absorption being sufficient by reason of its thickness with respect to the heat conductivity of the metal from which it is formed and the area of said extended surfaces exposed for heat absorption to maintain said heat-absorbing surfaces at an effective refrigerating temperature lower than that of the compartment to be refrigerated, and means for maintaining one of said compartments to be refrigerated at a temperature lower than that of another of said compartments to be refrigerated, said refrigerant compartment and the compartments to be refrigerated being vertically extending, and said extended heat-absorbing surfaces forming at least the bottom of said compartments to be refrigerated.

EDWARD RICE, JR.