Aug. 12, 1952 C. L. OLDFATHER 2,606,428

REFRIGERATED CUBE GRID

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Fig. 1.

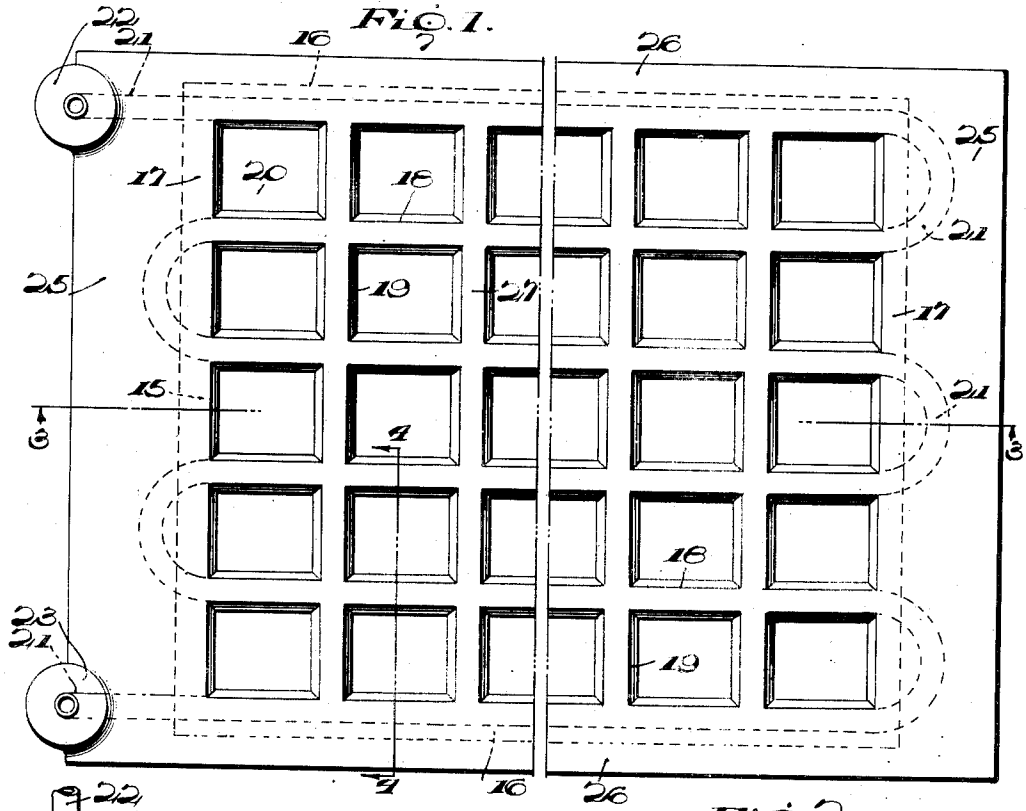


Fig. 2.

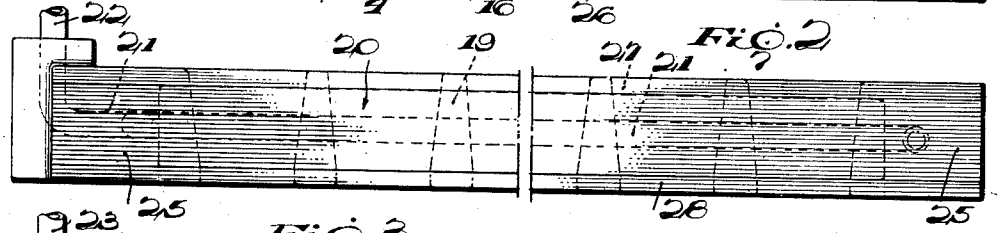


Fig. 3.

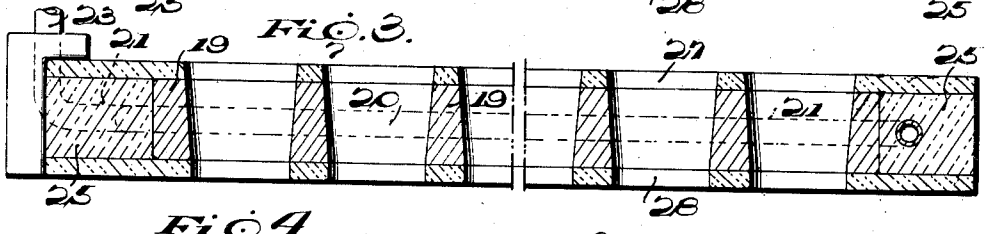


Fig. 4.

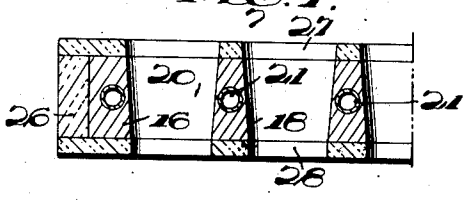
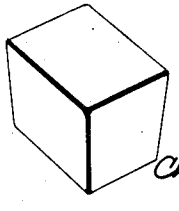


Fig. 5.



INVENTOR

Charles L. Oldfather.

BY Cameron, Kerkam & Sutton

ATTORNEYS

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FIG. 6.

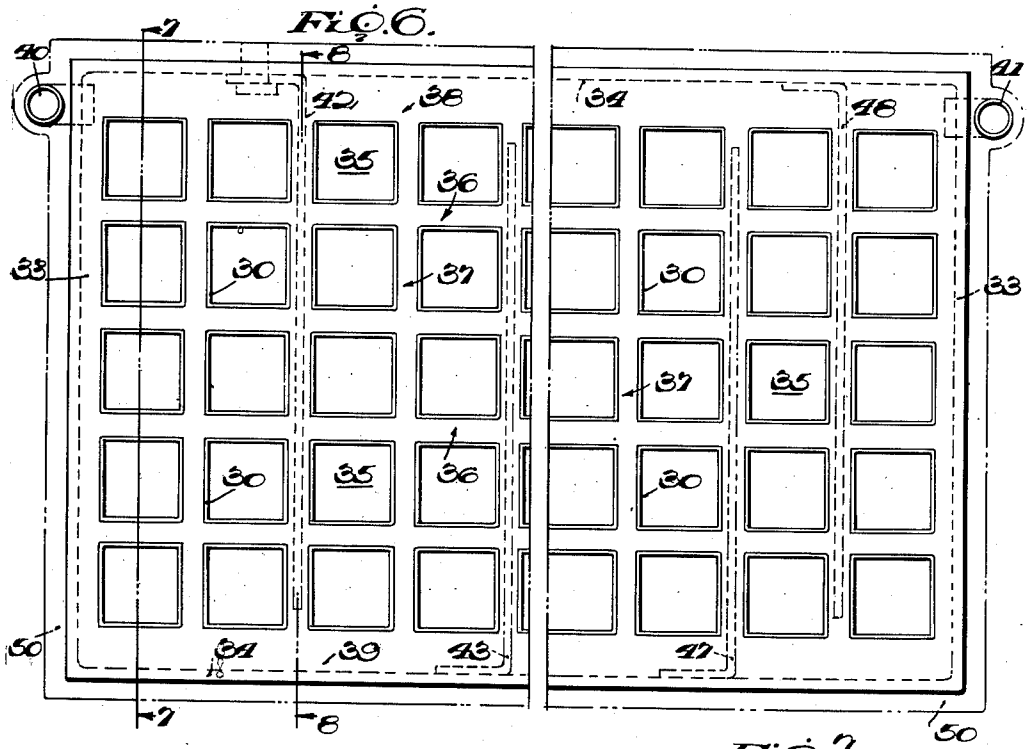


FIG. 7.

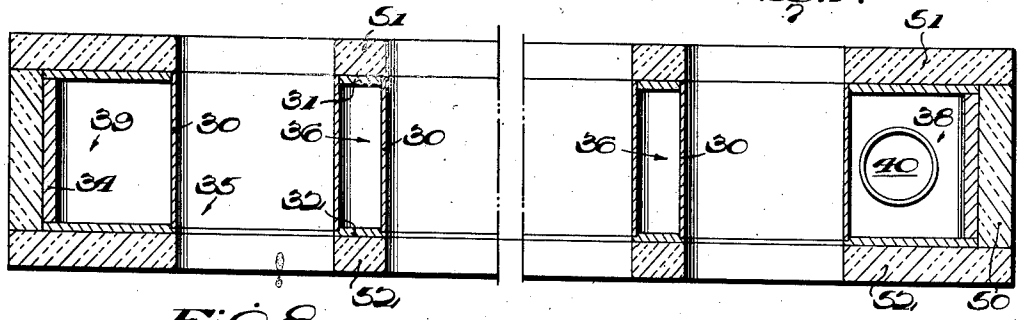
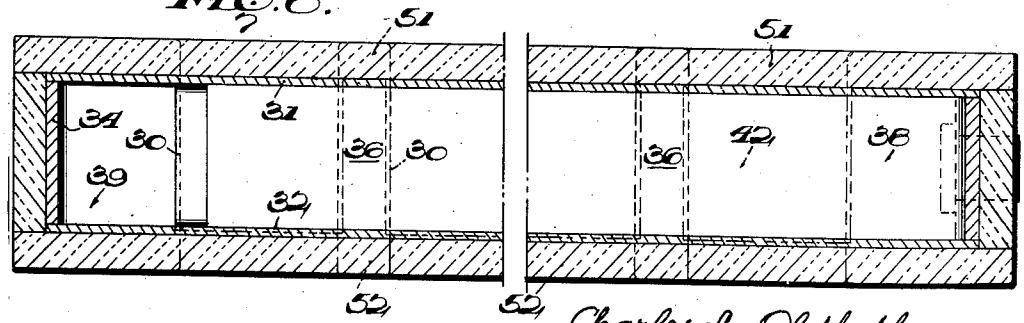


FIG. 8.



Charles L. Oldfather

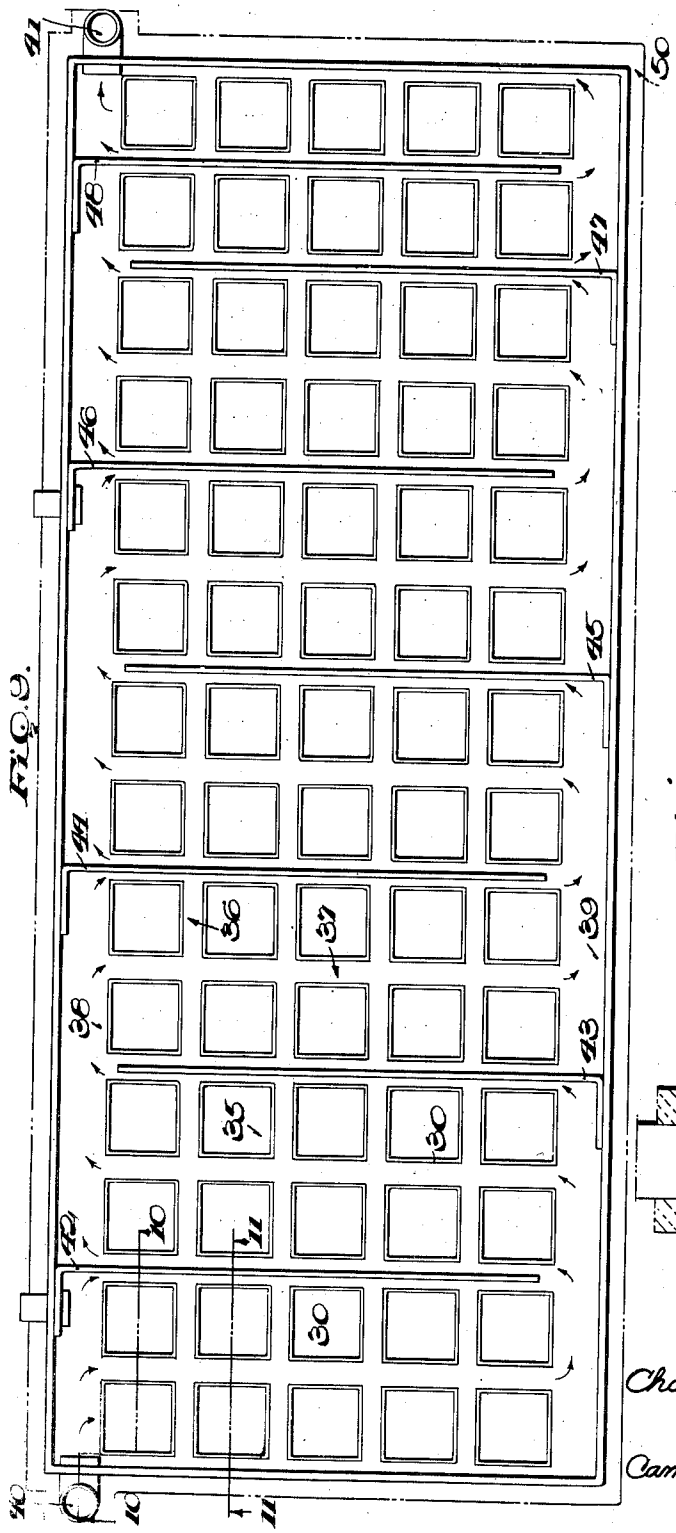
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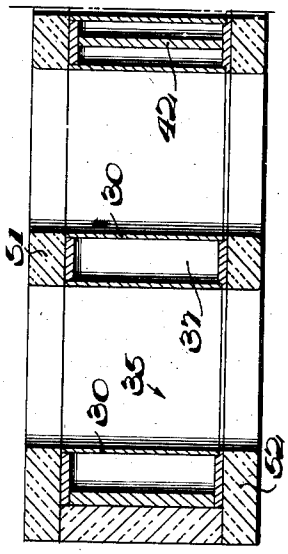
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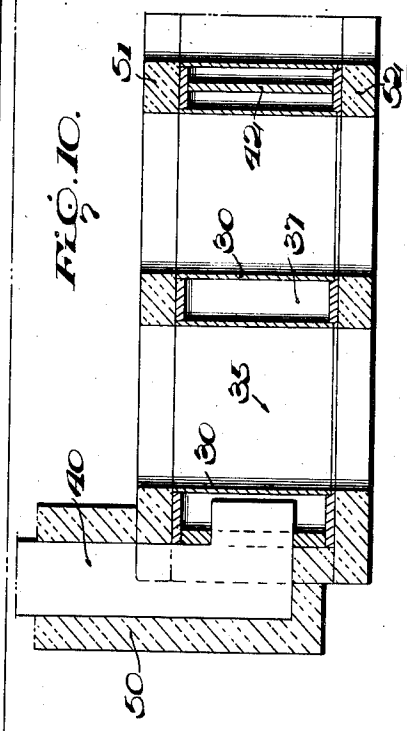
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INVENTOR

Charles L. Oldfather

Cameron, Kerkam & Sutton.

ATTORNEYS

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REFRIGERATED CUBE GRID

Charles L. Oldfather, Seattle, Wash.

Application March 27, 1950, Serial No. 152,171

4 Claims. (Cl. 62—108.5)

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This invention pertains to a grid for the formation of ice cubes which has numerous advantages over trays presently in use. The improved grid structure is particularly designed for the commercial manufacture of ice cubes in which it is of primary importance that the product be completely clear and contain no entrained air or other gases.

It has been common practice in the art to circulate water over a tray containing a cube grid to form the clear cubes. This method of freezing ice cubes has raised many problems, one of which is that the tray is refrigerated on the bottom only, thus only the bottom of each cube is exposed to the effect of the refrigerant, resulting in slower freezing and in other incidental inefficiencies.

The present invention contemplates refrigerating each cube compartment along at least two of its sides to evolve a maximum heat transfer and an even freezing cycle of all the cubes in the grid. The invention further contemplates making use of direct expansion of the refrigerant along either two sides or four sides of each cube cell, thus providing a maximum area for efficient heat transfer and greater assurance of an even freezing cycle, resulting in more inexpensive operation.

In the present invention the refrigerant may be directed about either two sides of each cube cell or about all four sides thereof. The refrigerant may be conducted around the cube cells in the grid by means of appropriate tubing or by passes or channels cast in the grid by any convenient method, the primary consideration being that each cube cell shall be refrigerated equally with all other cube cells to insure an even freezing cycle.

In the present invention the cube grid cells are completely open at both their top and bottom surfaces to facilitate agitation of the water contained in the grid cells to remove trapped air and gases during the freezing process. By virtue of this construction the agitation may be accomplished either by water turbulence or by air stream.

As the refrigerant is circulated only in the walls of the cube cells the ice formation is from the side walls of the cells toward their centers and thus a passage for air or circulation water is maintained centrally of the cube until the entire cube is frozen. It has been usual in the commercial manufacture of clear ice cubes with conventional grids to submerge the tray in an excess of water to provide the necessary turbulence to

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remove entrained gases therefrom. Refrigeration of this excess water has therefore taken place, resulting in considerable wasted energy. With the present cube grid this disadvantage has been eliminated.

It is therefore one object of this invention to provide an improved ice cube grid which will insure an even freezing cycle of all the cubes.

Another object of this invention is to provide such a grid of such structure as to produce completely clear ice with no content of entrained gases.

A further object of this invention is to provide such a grid which is more efficient and whose freezing cycle is shorter than that of trays currently in use.

Other and further objects of this invention will become apparent as this specification proceeds.

Referring to the drawings:

Fig. 1 is a top view of one embodiment of the cube grid, broken through the center;

Fig. 2 is a side view of this embodiment of the invention looking from the outlet side of the grid;

Fig. 3 is a cross sectional view of this embodiment of the invention taken on line 3—3 of Fig. 1;

Fig. 4 is a partial section view of the embodiment of the grid shown in Fig. 1, taken on line 4—4 of Fig. 1;

Fig. 5 is a perspective view of an ice cube as produced by the embodiment of the invention shown in Fig. 1;

Fig. 6 is a vertical plan view of an alternative embodiment of the invention with the top tube sheet removed, broken in the center;

Fig. 7 is a cross sectional view of this embodiment of the invention taken on line 7—7 of Fig. 6 and broken in the center;

Fig. 8 is a cross sectional view of the embodiment of the invention shown in Fig. 6, taken on line 8—8 of Fig. 6 and broken in the center;

Fig. 9 is a vertical plan view of the embodiment of the invention shown in Fig. 6, with the top tube sheet removed, showing the path of flow of the refrigerant through the conduits between the cube compartments and the effect of the baffles therein;

Fig. 10 is a partial section view taken on line 10—10 of Fig. 9; and

Fig. 11 is a partial section view taken on line 11—11 of Fig. 9.

In the embodiment of the invention shown in Figs. 1, 2, 3 and 4, 15 indicates broadly the metal cube grid which may be pressure die cast

of aluminum or an analogous metal and which as shown is preferably rectangular in shape and of greater length than width. Grid 15 is composed broadly of longitudinal side walls 16, end walls 17, intermediate longitudinal walls 18 and intermediate lateral walls 19, which define a series of rectangular, downwardly tapered ice cube chambers 20. Cube grid 15 preferably contains five of the tapered ice chambers 20 across its width and fourteen along its length, making a total of sixty ice chambers in all, however the number of chambers or compartments may be varied at will without departing from the spirit of this invention.

Disposed centrally of longitudinal outer walls 16 and longitudinal inner walls 18, which are appropriately bored or cast to receive it, is a refrigerant tubing 21 which is preferably formed of cadmium plated full annealed steel tubing but which may be of any other appropriate material. As shown in Fig. 1 refrigerant tubing 21 initiates at inlet 22, runs longitudinally the length of longitudinal wall 16, through the center thereof, is then turned and passes back through the center of longitudinal wall 18 and then is turned and passes back and forth through the centers of the balance of the longitudinal walls 18 of the grid to pass through the center of the opposite longitudinal wall 16 of the grid to outlet vent 23. The preferred location of the refrigerant tubing 21 in the longitudinal walls 16 and 18 of the grid is shown in Fig. 4 of the drawing. It will be noted that tubing 21 is so located in the longitudinal walls of grid 15 as to contact the median line of ice pockets 20. Thus, refrigerant entering tubing 21 at inlet duct 22 makes a complete circuit through tubing 21 through the centers of all of the longitudinal walls of grid 15 before leaving the grid at outlet vent 23.

It will be observed from Figs. 2, 3 and 4 of the drawings that the longitudinal walls 16 and 18 and lateral walls 17 and 19 of the grid 15 progressively increase in thickness from their top to their bottom extremities to provide a downward taper to rectangular ice pockets 20.

If desired, in place of tubing 21 a circular refrigerant pass may be cast into the longitudinal walls of grid 15 during the die casting operation.

Grid 15 is preferably insulated at its two longitudinal extremities by insulation layer 25 of rubber or other suitable material and is insulated along its lateral edges by insulation sheets 26 of similar material. These insulating sheets 25 and 26 are preferably bonded to the longitudinal and lateral outer walls of grid 15. The inner longitudinal and lateral walls of grid 15 are preferably insulated top and bottom by strips of rubber or similar insulation 27 and 28 which are appropriately bonded thereto. The provision of these outer insulating coatings over grid 15 eliminates cold loss and greatly increases the efficiency of the grid. It will be noted that refrigerant tubing 21 and inlet and outlet vents 22 and 23 for the refrigerant tubing are appropriately bonded within insulation coatings 25. These coatings and upper and lower coatings 27 and 28 are bonded over grid 15 after refrigerant tube 21 has been inserted longitudinally therethrough. Where open refrigerant passes are cast through the longitudinal walls of grid 15, complementary tubes or passages must be provided in the two terminal insulating coatings 25.

It will therefore be seen that in the embodiment of the invention shown in Figs. 1, 2, 3 and 4 the complete grid structure comprises a rectangular metal grid 15 consisting of rectangularly disposed longitudinal and lateral walls 16, 18 and 17, 19 respectively, which define rectangular ice cube pockets 20 which are open at both their top and bottom extremities and which have a slight downward taper. All external surfaces of the metal grid are appropriately insulated by layers of insulation which are bonded thereto. Therefore, the only metal surfaces of the grid which are not covered by an insulating layer are the four inner walls of each of the ice cube pockets 20, between which the ice cubes are formed.

An alternative embodiment of the invention is shown in Figs. 6–11, inclusive. In this embodiment of the invention the grid instead of being pressure die cast is fabricated from a number of short lengths of square tubing 30, preferably of copper or analogous metal, which are appropriately assembled to form the grid. The preferred method of forming this embodiment of the grid is as follows: Top tube sheet 31 and bottom tube sheet 32 are preferably stamped out of rectangular sheets of copper or analogous material and carry parallel series of square openings stamped therein to the size of square tubing inserts 30. Tubing inserts 30 are then fitted into the square openings in bottom tube sheet 32 in rectangular position with respect thereto and with their bottom edges flush with the lower surface of tube sheet 32. Top tube sheet 31 is then fitted over the upper extremities of square tubing inserts 30, which are fitted into the square openings therein, in such fashion that the upper edges of tubing inserts 30 are flush with the upper surface of top tube sheet 31, which lies in a plane parallel to the plane of bottom tube sheet 32. End walls 33 and longitudinal walls 34 are then inserted between the outer edges of top and bottom tube sheets 31 and 32 and the entire grid assembly is sealed by oven brazing. End walls 33 and longitudinal walls 34 are preferably formed of rectangular pieces of copper or analogous metal.

The grid thus formed comprises a series of ice cells or pockets 35 which are separated by, and whose walls are in contact with, rectangular longitudinal refrigerant channels 36 and lateral refrigerant channels 37. Thus, all four walls of each ice cell 35 are contacted by refrigerant circulating through channels 36 and 37.

It will be noted that upper tube sheet 31 and lower tube sheet 32 are of such width as to provide outer longitudinal refrigerant channels 38 and 39 of substantially twice the width of channels 36 and 37, and extending the entire length of the grid assembly.

It will be further noted that each of cube cells 35 is open at both its top and bottom surfaces.

Inlet tube 40 is shown provided at one corner of the grid structure and preferably comprises a cylindrical tube which is suitably affixed in end wall 33 of the grid and communicates with the interior of the grid. Outlet tube 41 is shown suitably affixed in the opposite end wall 33 of the grid structure and communicating with the interior of the grid at the opposite extremity of outer longitudinal grid channel 38.

A series of staggered baffles 42, 43, 44, 45, 46, 47 and 48 are provided extending laterally across the grid structure through alternate lateral channels 37. Baffles 42—48, as shown, are alternately affixed to opposite side walls 34 of the grid structure and extend from top to bottom of the grid channels 37, but terminate short of

their lateral extremities, in such fashion that longitudinal channels 38 and 39 of the grid structure are alternately open at the extremities of said baffles. Baffles 42—43 are preferably rectangular in shape and are formed of copper or analogous metal. They are designed to prevent short circuiting of the refrigerant in the refrigerant channels, or the bypassing of any of the ice cube pockets 35. Fig. 9 of the drawing illustrates the paths taken by the refrigerant on its course through the channels of the grid structure, from inlet duct 40 through to outlet duct 41. It will be seen that by virtue of these baffles the refrigerant follows a serpentine course through the hollow walls of the grid structure from inlet duct 40 to outlet duct 41, whereby a uniform refrigerating action on each of the ice pockets 35 is produced.

A suitable outer insulating sheet or covering of rubber or other appropriate material is provided over all outer metal surfaces of this embodiment of the grid structure. A layer of durable insulation is prvoided over the outer walls 33 and 34 of the grid structure and is appropriately bonded thereto. A layer of suitable insulation is also bonded or otherwise appropriately affixed over the top and bottom metal surfaces of the grid. Lateral insulation layer 50, top layer 51 and bottom layer 52 provide a complete insulation for all external metal walls of the grid structure and prevent undue cold losses. Inlet tube 40 and outlet tube 41 are appropriately imbedded in lateral insulation strip 50 and the cylindrical tubings leading therefrom are also appropriately insulated.

As in the first embodiment of the invention, ice cells 35 are open at both their top and bottom extremities to facilitate flow of water therethrough and to permit suitable agitation of the contained water to remove occluded air and gases to produce a clear ice cube. The structure of ice cells 35 is clearly shown in Figs. 7, 10 and 11, each comprising a rectangle open at both its top and bottom surfaces.

In this embodiment of the invention it will be noted that the cube grid preferably contains five rectangular ice cells or pockets across its width and fourteen along its length. However, the number of cells may be varied at will without departing from the spirit of the invention.

This embodiment of the invention lends itself readily to economical mass production and obviates many of the manufacturing problems which were previously inherent in the manufacture of grids. The insulating layer applied over all metal surfaces of the grid greatly increases its efficiency, and the internal staggered baffles previously described assure a complete and equalized circulation of the refrigerant fluid about each of the grid cells.

Regardless of which of the embodiments of the invention is used it is preferred that flexible refrigerant lines be affixed to the inlet and outlet ducts of the cube grid so that the grid is a completely closed and easily portable refrigeration circuit. The grid therefore may be moved mechanically into or away from the water tank in which the cubes are frozen. This serves a dual purpose: the water need not be handled or controlled other than by a simple float valve, and the problem of transporting the ice cubes to storage is resolved by allowing the grid to defrost in such manner that the cubes will be guided into the storage space.

The refrigerant which is recommended for use with the novel cube grids is Freon 12, but any other analogous refrigerant may be utilized with equally good results. The average freezing cycle for ice cubes made in conformity with this invention is approximately twenty minutes, which cycle may vary slightly.

Each of the cube grids lends itself readily to economical mass production and by the provision of the refrigerant channels along two or more sides of each individual cube compartment a maximum heat transfer is developed and an even freezing cycle of all cubes is assured. By utilizing these cube grids the refrigerant is literally made an integral part of the freezing grid and in effect constitutes a direct expansion system.

The grids may be defrosted after each freezing cycle by a forced air current, or, if desired, high resistance electric wire may be imbedded in the insulation. A hot gas defrost system may be provided by utilizing the hot gas contained in the compressor unit.

The novel grids are intended to be used with any mechanical refrigeration compressor or with any appropriate absorption unit. Heat is thus taken directly through the cell walls by the circulated refrigerant which eliminates the necessity of using an antifreeze medium and provides a maximum efficiency with a minimum of cold loss.

As the refrigerant passes only about the sides of the cube cells the ice formation is from the walls of the cube cells to the center of the cell and thus a passage for the circulation of air or water is maintained until the entire cube is frozen. This could not be accomplished in a tray unless the bottom were formed of a separate nonconducting material.

The invention is susceptible of numerous embodiments without departing from the spirit thereof. Attention is directed to the appended claims for the limitation of its scope.

What is claimed is:

1. In an ice cube grid, a metal grid body composed of rectangularly disposed and intercommunicating hollow walls, said walls defining a series of open ice pockets in said grid body, a series of staggered baffles alternately affixed to opposite side walls of said grid body and extending laterally through said grid body, a refrigerant inlet communicating with the interior of said grid body, a refrigerant outlet communicating with the interior of said grid body, and an insulating layer covering all external surfaces of said grid body.

2. In an ice cube grid, a metal grid body composed of rectangularly disposed and intercommunicating rectangular hollow walls, said walls defining a series of ice pockets open top and bottom in said grid body, a series of staggered baffles alternately affixed to opposite side walls of said grid body and extending laterally substantially the entire width of said grid body, a refrigerant inlet at one extremity of said grid body communicating with the interior thereof, a refrigerant outlet at the opposite extremity of said grid body communicating with the interior thereof, and an insulating coating covering all external surfaces of said grid body.

3. In an ice cube grid, a metal grid body composed of rectangularly disposed and intercommunicating rectangular hollow walls, said walls defining a series of ice pockets open top and bottom in said grid body, lateral refrigerant channels substantially twice as wide as the space

between said walls extending longitudinally of the grid structure at its lateral edges and communicating with the interior space therein between said walls, a series of staggered baffles alternately affixed to opposite side walls of said grid body and extending laterally substantially the entire width of said grid body, a refrigerant inlet at one extremity of said grid body communicating with the interior thereof, a refrigerant outlet at the opposite extremity of said grid body communicating with the interior thereof, and a rubber insulating coating covering all external surfaces of said grid body.

4. In an ice cube grid, a metal grid body defining rectangular lateral and longitudinal refrigerant channels rectangularly disposed about the sides of a series of ice pockets open top and bottom in said grid body, longitudinal side channels of substantially twice the width of said interior channels extending longitudinally of said grid at each side thereof and communicating with said interior channels, a series of staggered baffles alternately affixed to opposite side walls of said grid body and extending laterally substantially the entire width of said grid body, a refrigerant inlet at one extremity of said grid body communicating with the extremity of one of said longitudinal side channels, a refrigerant outlet at the other extremity of said grid body communicating with the extremity of the other of said longitudinal side channels and a rubber insulating coating covering all external surfaces of said grid body.

CHARLES L. OLDFATHER.

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