United States Patent [19]

Graves

[11] **3,788,089**

[45] **Jan. 29, 1974**

[54] **COMBINATION ICE CUBE MAKER AND REFRIGERATOR**

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[73] Assignee: **U-Line Corporation,** Milwaukee, Wis.

[22] Filed: **Nov. 8, 1971**

[21] Appl. No.: **196,498**

[52] **U.S. Cl.** **62/137,** 62/340, 62/520, 165/135

[51] **Int. Cl.** **F25c 1/04**

[58] **Field of Search** 62/353, 340, 445, 447, 446, 62/344, 383, 453, 384, 520, 526, 137; 165/138, 185, 135

[56] **References Cited**

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R18,685	12/1932	Hull	62/344
2,795,113	6/1957	Wurtz	62/526
2,026,214	12/1935	Chilton	62/353
2,717,505	9/1955	Andersson	62/344
2,801,526	8/1957	Solley, Jr.	62/383

Primary Examiner—William E. Wayner
Assistant Examiner—William E. Tapolcai, Jr.
Attorney, Agent, or Firm—Thomas W. Ehrmann et al.

[57] **ABSTRACT**

A combination ice cube maker and refrigerator includes an insulated compartment having an open front normally closed by a door. An automatic ice cube maker unit is disposed in an upper corner of the compartment and a freezer zone is defined about the ice maker by an L-shaped bracket, the horizontal portion of which defines a shelf and an upright portion of which defines a vertical divider. The refrigerator zone is below and to one side of the bracket. A first stage evaporator is disposed beneath and against the ice cube mold of the automatic ice cube maker unit and a second stage evaporator is positioned above the shelf portion of the bracket and defines a platform for a container which holds ice cubes ejected from the ice cube maker unit. The first stage evaporator is insulated from the freezer zone and the second stage evaporator is partially insulated from the shelf portion of the bracket. The shelf portion of the bracket has a series of openings which permit a controlled passage of cold air to the refrigerator zone beneath the shelf, and the upright portion of the bracket is provided with openings adjacent its top for the circulation of warmer air from the refrigerator zone to the freezer zone. The operation of the refrigeration system which includes the evaporators and the operation of the ice cube maker unit is controlled by a single thermostatic switch which senses the temperature in the mold of the ice maker.

9 Claims, 5 Drawing Figures

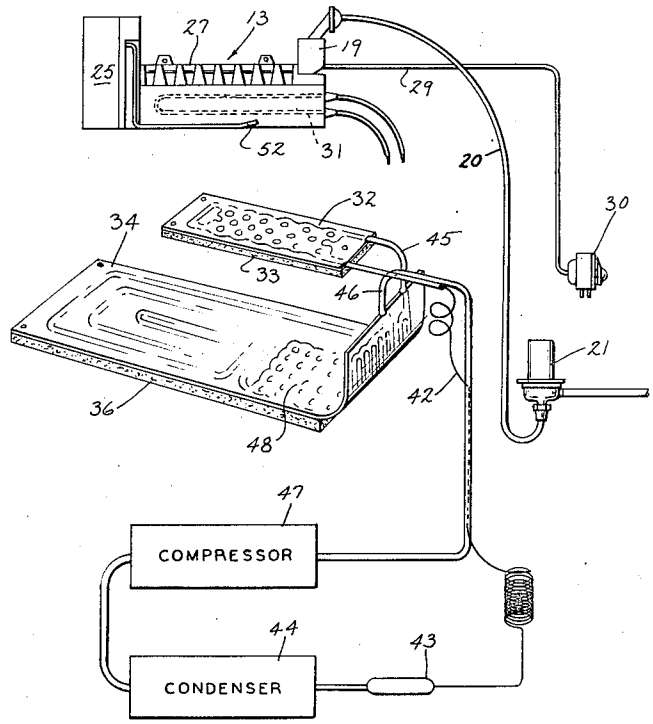


Fig. 1

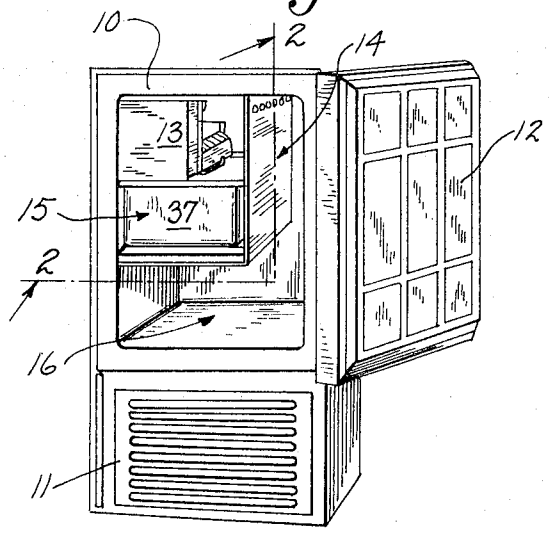


Fig. 3

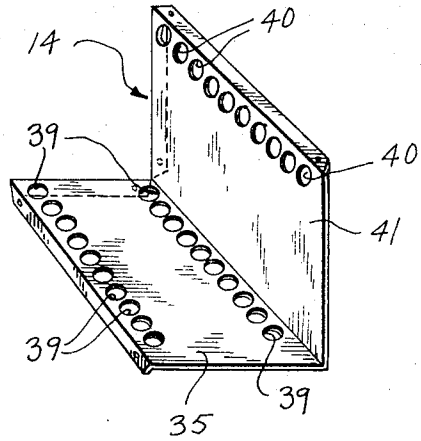


Fig. 2

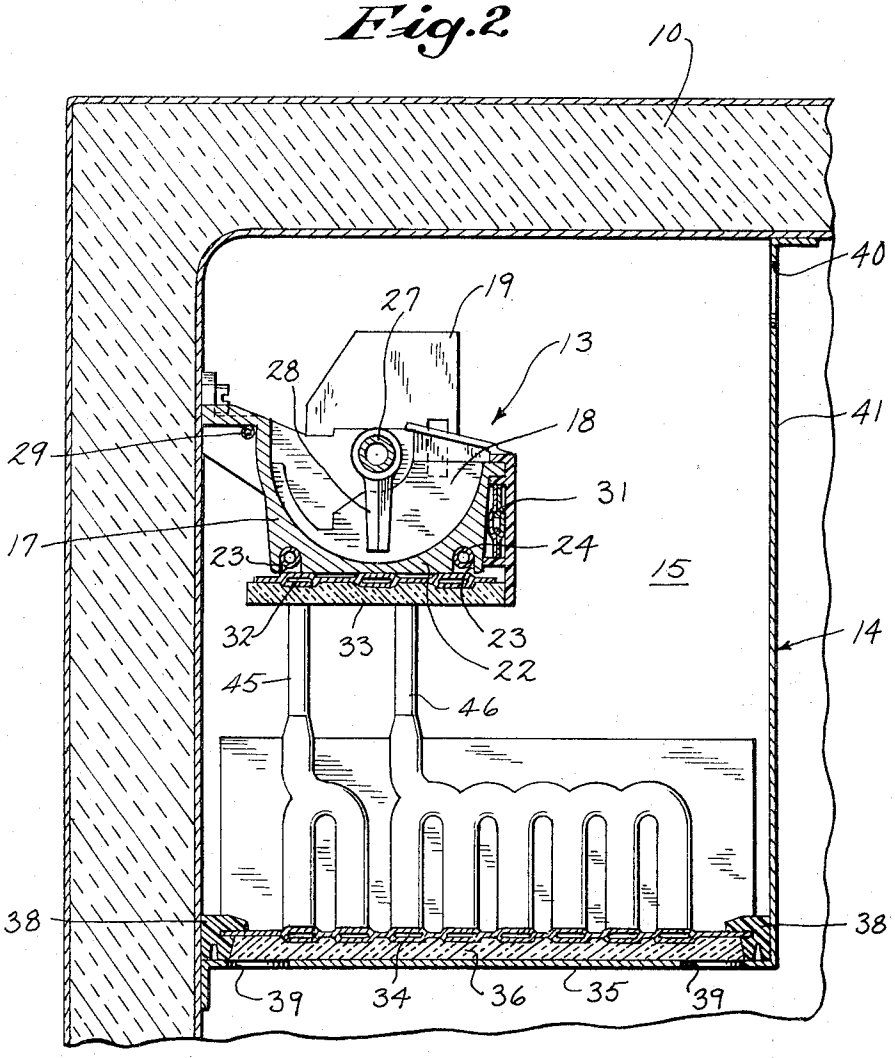


Fig. 4

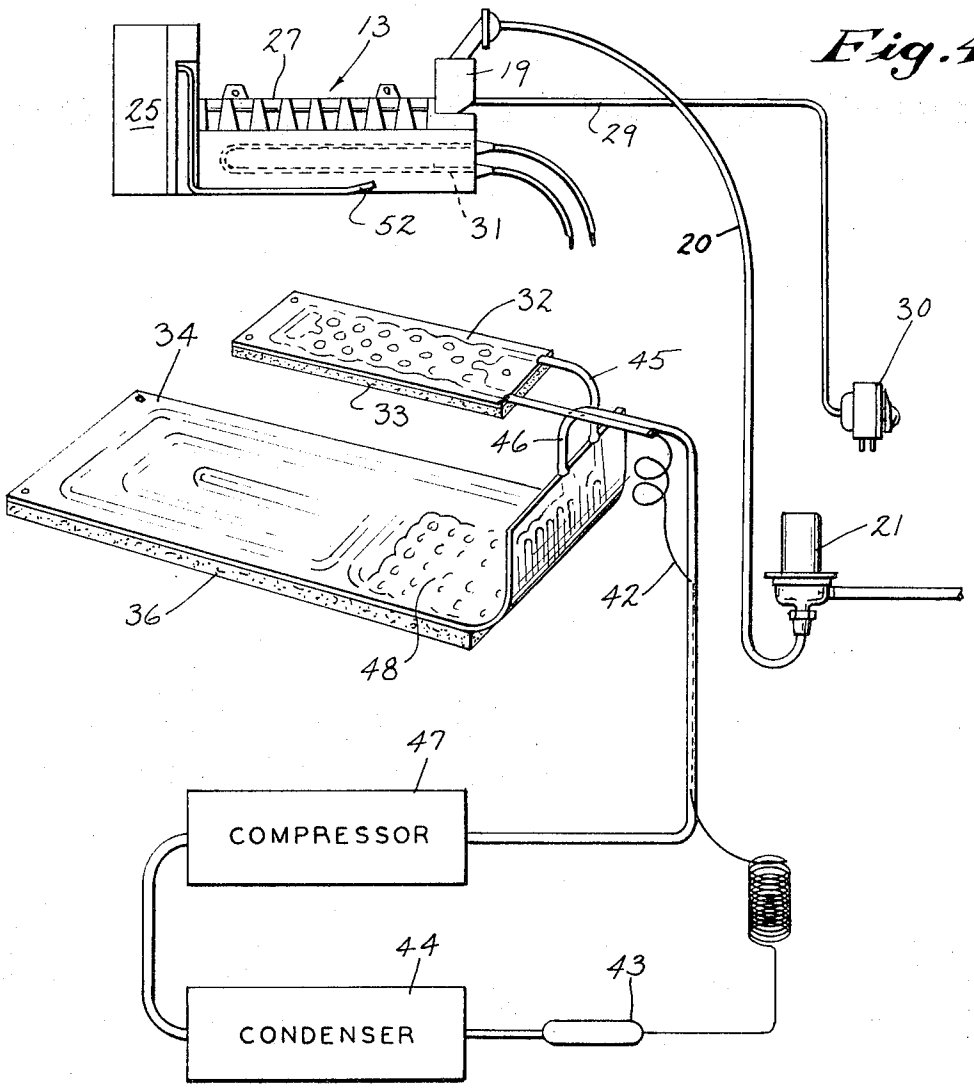
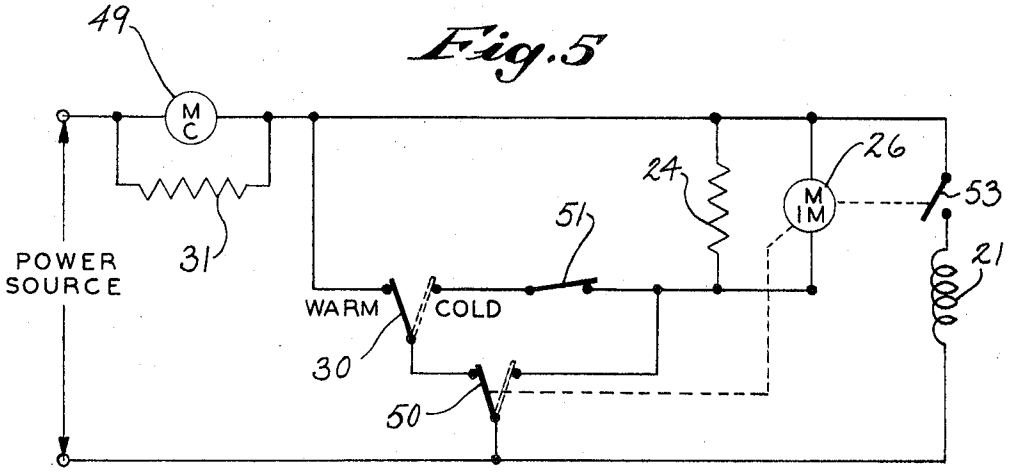

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13
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29
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31
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30
32
34
45
33
46
21
36
42
48
47
COMPRESSOR
44
43
CONDENSER

Fig. 5


49
M C
31
POWER SOURCE
WARM
COLD
30
51
50
24
M IM
26
53
21

COMBINATION ICE CUBE MAKER AND REFRIGERATOR

BACKGROUND OF THE INVENTION

This invention relates to refrigeration, and more particularly to a unitary ice cube maker and refrigerator assembly.

For many years automatic ice cube makers have been used to provide an automatic, continuous supply of ice cubes. Such automatic ice cube maker units have generally been employed within the freezer section of a refrigerator. An example of such use is shown in U.S. Pat. No. 3,280,578, issued Oct. 25, 1966 to W. J. Linstromberg. The ice cube maker unit normally includes an ice cube mold to which a metered water supply is connected for periodic filling of the mold. A refrigeration system is employed to freeze the water so introduced into the mold. A mechanical ejector mechanism is provided to harvest the formed ice cubes from the mold and to eject them to the exterior of the ice maker assembly, where they are normally deposited in a bin or other container. It is also common to employ a feeler arm to sense the level of ice cubes in the bin so that when the bin is full ice cubes are no longer formed and ejected by the ice cube maker unit.

When the automatic ice cube maker unit is employed within the freezer section of a refrigerator, the ice cube maker unit normally utilizes the evaporators of the refrigeration system located in the walls of the freezer section to provide the necessary cooling of the ice cube mold. However, the ice cube mold may be provided with its own evaporator, and when mounted within an insulated storage area having no external source of cooling, the evaporator for the ice cube mold can also function to maintain the necessary temperature within the storage area to maintain the ice cubes so formed. An example of the latter arrangement is shown in U.S. Pat. No. 3,144,078, issued Aug. 11, 1964 to E.T. Morton et al, and assigned to the assignee of this invention. This latter arrangement has proven useful in compact self-contained ice making assemblies which have as their sole function the manufacture and storage of ice cubes.

A need also exists for a self-contained assembly which will both manufacture and store ice cubes automatically and at the same time will provide above-freezing temperatures for the refrigeration of items such as beverages, packaged in either cans or bottles. Such combination ice cube makers and refrigerators find use in the home and in hotel or motel rooms. Of necessity, such units must be compact, and because of that requirement it is not possible to have separate fully insulated freezer compartments and refrigerator compartments. Similarly, it would not be desirable in a unit of such size to have separate refrigeration systems for the freezer compartment and the refrigerator compartment. It therefore has proven difficult to provide within a single insulated compartment both a freezing area where ice cubes can be made and stored, and a closely adjacent refrigeration area maintained at above-freezing temperatures. I have found a combination and arrangement of elements which does accomplish this desirable result.

SUMMARY OF THE INVENTION

The invention comprises the combination, with an enclosed insulated compartment, of an automatic ice cube maker unit disposed within a freezer zone defined by, and separated from a refrigerator zone by, a horizontal shelf and a vertical partition, together with a refrigeration system including a first stage evaporator disposed against the ice cube mold of the ice cube maker unit and insulated from the remainder of the freezer zone, and a second stage evaporator disposed above and partially insulated from the horizontal shelf, with the second stage evaporator forming a platform to support a container for receiving ice cubes ejected from the ice cube maker unit.

The invention further resides in providing openings through the horizontal shelf for the controlled heat transfer from the freezer zone through the shelf to the refrigerator zone, and openings through the upper portion of the vertical partition for the circulation of warmer air from the top of the refrigerator zone into the freezer zone.

It is the principal object of this invention to provide a compact, self-contained ice cube maker and refrigerator assembly including a freezer zone maintained at or below freezing temperature and an adjacent refrigerator zone maintained at above freezing temperature.

It is another object of this invention to provide such a compact assembly having a single refrigeration system and in which the evaporators of the freezing zone also provide the cooling for the refrigerator zone.

It is a further object of this invention to provide such a compact assembly in which a first stage evaporator is employed to cool the ice cube mold and a second stage evaporator, constituting a part of the suction line from the first stage evaporator, is employed to hold stored ice cubes at or below freezing and also to provide the major source of cooling for the refrigerator zone.

It is also an object of this invention to provide such a compact assembly in which the control of the temperature within both the freezer zone and the refrigerator zone is accomplished by sensing the temperature of the ice cube mold of the automatic ice maker unit.

The forgoing and other objects and advantages of the invention will appear in the detailed description which follows, in which the best mode presently contemplated for carrying out the invention is illustrated and described.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in perspective of a combination automatic ice cube maker and refrigerator in accordance with the invention,

FIG. 2 is a view in vertical section through the freezer zone taken in the plane of the line 2—2 of FIG. 1,

FIG. 3 is a view in perspective of a bracket which defines the freezer zone,

FIG. 4 is a view partially schematic and partially in perspective of the refrigeration system forming a part of the invention, and

FIG. 5 is a schematic electrical wiring diagram of the control circuitry of the ice cube maker and refrigerator system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, and particularly to FIG. 1, the assembly includes a free standing housing with an upper insulated compartment 10 and a lower machinery chamber 11. The upper compartment 10 has an

open front which is closed by an insulated door 12. An automatic ice cube maker unit, indicated generally by the numeral 13, is mounted in the upper left hand corner of the compartment 10. A generally L-shaped bracket 14 surrounds and is spaced from the ice cube maker unit 13. The bracket 14 is secured to the top and left side interior walls of the compartment 10, and divides the compartment 10 into a freezer zone 15 and a refrigerator zone 16 disposed beneath and to the right side of the freezer zone 15.

Referring to FIGS. 2 and 4, the automatic ice cube maker unit is a standard commercially available unit which includes a die cast ice cube mold 17 divided by partitions 18 to form independent cavities for the molding and freezing of ice cubes. A rear wall of the ice cube mold 17 supports an inlet 19 having water passages which open into the mold 17. The open end of a water supply line 20 is received within the inlet 19 so that water flowing through the line 20 will be introduced within the individual cavities within the mold 17. Control of the flow through the water supply line 20 is provided by a solenoid operated valve 21 within the line 20. The bottom wall 22 of the mold 17 is provided with a U-shaped groove 23 which receives an electric mold heater 24 which, when energized, warms the mold to loosen the ice cubes formed therein.

A control casing 25 is disposed to the front of the mold 17 and houses controls for the automatic operation of the ice cube maker unit 13, including an electric motor 26 which functions as part of an ejector mechanism. The electric motor 26, when energized, will rotate a shaft 27 extending along the length of the mold 17. The shaft 27 mounts a series of spaced blades 28 which sweep through the individual cavities in the mold 17 during a revolution of the shaft 27 under the driving force of the motor 26.

The ice cube maker unit 13 is modified by the addition of a temperature sensing bulb 29 mounted along the side of the ice cube mold 17 and connected to a thermostatic switch 30. The bulb 29 responds to changes in the temperature on the ice cube mold 17. A stripper heater 21, in the form of a heater wire sandwiched between aluminum foil, is disposed against the outer side of the ice cube maker unit 13 and is employed to control the buildup of frost on the unit 13.

A first stage evaporator 32 is mounted flush with the under side of the ice cube mold 17. The first stage evaporator 32 is insulated from the freezer zone 15 by a block 33 of insulation, preferably formed of expanded polystyrene bead having a density of nine pounds per cubic foot. A second stage evaporator 34 is disposed above a horizontal shelf portion 35 of the bracket 14 and is separated therefrom by a sheet of insulation 36. The second stage evaporator 34 forms a platform to support a container 37 which holds the ice cubes ejected from the ice cube maker unit 13. The sheet of insulation 36 is held between the second stage evaporator 34 and the shelf 35 of the bracket 14 by means of molded spacer strips 38 which receive the edges of the second stage evaporator 34 and rest upon the shelf 35. Such strips 38 are employed on the two sides and the front edge of the second stage evaporator 34 with the front edge strip 38 being joined by screws to the shelf 35. The shelf 35 of the bracket 14 is provided with a row of spaced openings 39 adjacent each lateral edge of the shelf 35. The bracket 14 is also provided with a series of spaced upper openings 40 disposed adjacent the top of a vertical divider portion 41 of the bracket 14.

Referring to FIG. 4, the refrigeration system includes a capillary line 42 leading from a dryer 43 which in turn leads from a condensor 44. The capillary line 42 extends to an inlet to the first stage evaporator 32. An outlet line 45 from the first stage evaporator 32 connects to the inlet of the second stage evaporator 34 and a suction line 46 leads from the outlet of the second stage evaporator 34 to a compressor 47 which in turn is connected to the condensor 44. It will be seen that the second stage evaporator 34 constitutes a wide portion in the suction line leading from the first stage evaporator 32, and the second stage evaporator 34 is preferably provided with an area 48 integrally formed therein to act as an accumulator. The compressor 47 and its motor 49, and the condensor 44 and dryer 43, are mounted in the machinery chamber 11 and the capillary line 42 extends through the suction line 46 for a portion of its travel upward into the insulated compartment 10 to conserve space.

The control of the refrigeration system and of the ice cube maker unit 13, to make and harvest ice cubes and to maintain proper temperatures within the various zones of the assembly, is accomplished by the thermostatic switch 30 which responds to the temperature of the mold 17. Referring to FIG. 5, the thermostatic switch 30 has two positions, a warm position, and a cold position. In FIG. 5 the thermostatic switch 30 is shown in its warm position indicating that the mold temperature has risen above the preselected level for cut-in of the refrigeration system. So long as the container 37 is not full of ice cubes, this condition would be reached by the admission of water into the mold 17. When the thermostatic switch 30 is in its warm position, a circuit is completed across a power source to energize the compressor motor 49 to operate the refrigeration system and also to energize the stripper heater 31. Such circuit is completed through a cam operated holding switch 50 disposed within the casing 25 and responsive to rotation of the ice maker motor 26. The water in the mold will be frozen and the mold temperature will drop below a preselected level thereby moving the switch 30 to its cold position and completing a circuit to energize the ice maker motor 26 and the mold heater 24.

As soon as the ice maker motor 26 starts to rotate, a cam on the motor shaft (not shown) snaps the holding switch 50 to its other position so as to maintain both the ice maker motor 26 and mold heater 24 energized for a completion of the cycle regardless of the position of the thermostatic switch 30 and a bin switch 51. During this stage the ejector blades 28 start to dump the ice cubes from the previous cycle into the storage container 37. As they do so, a sensing arm 52 is lifted up by a cam on the ice maker motor shaft thereby opening the bin switch 51 and the ice cubes from the previous cycle are dumped into the container 37. If the container 37 is full, the sensing are 52 will not be able to be lowered and the bin switch 51 will be held open. If the container 37 is not full, however, the bin switch 51 will close for the next cycle. The blades 28 will continue to turn until they come upon the ice in the mold 17 and when the ice cubes are loosened from the mold 17 by the effect of the mold heater 24, the blades 28 will continue through the mold 17 lifting the cubes in the mold 17 to the top. During this cycle the thermo-

static switch **30** will return to its cold position, but the compressor motor **49** will not be energized because the holding switch **50** will be in its alternate position.

The water charge takes place during the last portion of the rotation of the ice maker motor **26.** A solenoid switch **52** is closed by a cam on the ice maker motor shaft thereby energizing the water line solenoid **21** and opening the valve. At the end of the water fill cycle, the holding switch **50** returns to the normally closed position shown in FIG. **5.** This will cause the compressor motor **49** and stripper heater **31** to again be energized. However, energization of the compressor motor **49** to again operate the refrigeration system will not result in a new cycle of ice cube making if the bin switch **51** is open indicating that the container **37** is full of ice cubes. When the bin switch **51** is open, the refrigeration system will continue to be cycled on and off within the limits of the preselected levels of setting of the thermostatic switch **30** to maintain the proper temperature within the freezer zone **15,** and thereby to also maintain the proper temperatures within the refrigerator zone **16.**

For proper operation it is necessary to maintain the freezer zone **15,** and particularly the area accupied by the container **37,** at or below freezing so that ice cubes formed by the automatic ice maker unit **13** will not melt. Conversely, to function properly as a refrigerator, it is necessary to keep the area beneath the shelf **35** of the bracket **14** at above freezing, and preferably in the range of **36** to **38** degrees F. This will also result in maintaining the portion of the refrigerator zone **16** to the right of the bracket **14** at above freezing and the highest temperatures toward the top of the right hand area will be preferably in the range of 38° to 40° F. For freezing ice cubes, it is necessary that the mold temperature be below zero and preferably at about −5° F. The first stage evaporator **32** has as its primary function the cooling of the mold **17** to freeze ice. The second stage evaporator **34** will be at a somewhat higher temperature than the first stage evaporator because of the heat exchange to the ice mold **17.** The second stage evaporator **34** has as its principal function the maintaining of the stored ice cubes at or below freezing and is also the major source of cooling for the refrigeration zone **16.**

To maintain the refrigerator zone **16** at the proper temperatures, it is necessary to have a controlled heat exchange from the freezer zone **15** through the shelf **35.** This is accomplished by the sheet of insulation **36** and the openings **39** in the shelf **35.** The type of insulation used in the sheet **36** is important to the proper heat transfer. I have found that proper heat transfer is achieved by the use of a polystyrene foam having a density of about 1.75 pounds per cubic foot. The use of such a sheet of insulation **36** which only partially insulates the refrigerator zone **16** beneath the shelf **35** from the freezer zone **15,** together with the lateral openings **39** to spread the main heat transfer areas toward the edges of the shelf **35,** has proven most effective.

The warmer air in the refrigerator zone **16** will rise to the top of the compartment **10** and will circulate into the freezer zone **16** through the openings **40** in the vertical partition **41.** This warmer air will be cooled in the freezer zone **15** by the ice cube mold **17** and by the second stage evaporator **34.** The refrigeration system will cycle on and off as ice cubes are being made and will thereby also provide the cooling to maintain the desired temperatures. After the container **37** is full of ice cubes, the refrigeration system will continue to be activated each time that the temperature within the freezer zone, as reflected by the temperature in the mold **17,** rises above a preselected level. In this manner, the thermostatic switch **30** is always in control of the temperatures in both the freezer and refrigerator zones.

The thickness of the sheet of insulation **36** for proper heat transfer will depend upon the size of the freezer and refrigerator zones and the area of the second stage evaporator. In one assembly in which the compartment **10** was approximately 12 inches wide by 15 inches deep by 15 inches high, I have found that a sheet 5/16 inches thick by 7-½ inches wide and 13-¼ inches long functions satisfactorily.

I claim:

1. An ice cube maker and refrigerator assembly comprising:

an enclosed insulated compartment;

an automatic ice cube maker unit mounted within said compartment toward one side thereof, said ice cube maker unit having an ice cube mold and means for ejecting formed ice cubes from said mold;

a horizontal shelf beneath and spaced from said ice maker unit, and a vertical partition extending upwardly from said shelf, said shelf and partition dividing said compartment into a freezer zone about said ice cube maker unit, and a refrigerator zone;

and a refrigeration system including a first stage evaporator disposed against said mold to cool the mold to form ice cubes therein, said first stage evaporator being insulated from said freezer zone, and a second stage evaporator disposed above and partially insulated from said shelf, said second stage evaporator forming a platform to support a container for receiving ice cubes ejected from said ice cube maker unit and being the major source of cooling for said refrigerator zone, said second stage evaporator being disposed in the suction line from said first stage evaporator to a compressor of said refrigeration system to be at a higher temperature than said first stage evaporator.

2. An ice cube maker and refrigerator assembly comprising:

an enclosed insulated compartment;

an automatic ice cube maker unit mounted within said compartment toward one side thereof, said ice cube maker unit having an ice cube mold and means for ejecting formed ice cubes from said mold;

a horizontal shelf beneath and spaced from said ice maker unit, and a vertical partition extending upwardly from said shelf, said shelf and partition dividing said compartment into a freezer zone about said ice cube maker unit, and a refrigerator zone:

and a refrigeration system including a first stage evaporator disposed against said mold to cool the mold to form ice cubes therein, siad first stage evaporator being insulated from said freezer zone, and a second stage evaporator disposed above and insulated from said shelf by a sheet of polystyrene foam, said second stage evaporator forming a platform to support a container for receiving ice cubes ejected from said ice cube maker unit and being the major source of cooling for said refrigerator zone, said second stage evaporator being disposed in the suction line from said first stage evaporator

to a compressor of said refrigeration system to be at a higher temperature than said first stage evaporator, and wherein said shelf is provided with spaced lateral openings, whereby a limited heat exchange is provided from said freezer zone, through said shelf, and into said refrigerator zone.

3. The assembly of claim 2 wherein said sheet of polystyrene foam has a density of about 1.75 pounds per cubic foot.

4. The assembly of claim 2 wherein said vertical partition is provided with openings adjacent its upper end for the flow of warmer air from said refrigerator zone into said freezer zone.

5. An ice cube maker and refrigerator assembly comprising:

an enclosed insulated compartment;

an automatic ice cube maker unit mounted within said compartment toward one side thereof, said ice cube maker unit having an ice cube mold and means for ejecting formed ice cubes from said mold;

a horizontal shelf beneath and spaced from said ice maker unit, and a vertical partition extending upwardly from said shelf, said shelf and partition dividing said compartment into a freezer zone about said ice cube maker unit, and a refrigerator zone;

a refrigeration system including a first stage evaporator disposed against said mold to cool the mold to form ice cubes therein, said first stage evaporator being insulated from said freezer zone, and a second stage eveaporator disposed above and partially insulated from said shelf, said second stage evaporator forming a platform to support a container for receiving ice cubes ejected from said ice cube maker unit and being the major source of cooling for said refrigerator zone, said second stage evaporator being disposed in the suction line from said first stage evaporator to a compressor of said refrigeration system to be at a higher temperature than said first stage evaporator,

and control means for said refrigeration system including thermostatic switch means responsive to the temperature of said mold and adapted to complete a circuit through a motor for said compressor when the temperature of said mold rises to a preselected level.

6. An ice cube maker and refrigerator assembly comprising:

an insulated compartment having an opening to the interior thereof;

a door normally closing said opening;

an L-shaped bracket having a horizontal portion extending from a side wall of said compartment and a vertical portion extending from said horizontal portion to the top wall of said compartment, said bracket dividing said compartment into a freezer zone within the space described by said bracket and a refrigerator zone beneath and to one side of said bracket;

an automatic ice cube maker unit disposed within said freezer zone and including an ice cube mold whose surface is exposed to said freezer zone and means for ejecting ice cubes from said mold;

a refrigeration system including a first stage evaporation mounted against said mold and insulated from said freezer zone, and a second stage evaporator spaced above said horizontal portion of said bracket and forming a platform for supporting a container for receiving ice cubes ejected from said ice cube maker unit, said second stage evaporator being disposed in the suction line from said first stage evaporator to a compressor of said refrigeration system whereby the second stage evaporator will be at a higher temperature than said first stage evaporator; and

a sheet of insulation disposed between said second stage evaporator and said horizontal portion of said bracket,

said horizontal portion of said bracket having openings adjacent the lateral edges thereof for limited heat transfer between said freezer zone and said refrigerator zone through said sheet of insulation, and said vertical partition having openings adjacent its top edge for the flow of warmer air from said refrigerator zone to said freezer zone, whereby said freezer zone is held at or below freezing temperature while said refrigerator zone is held at above freezing.

7. The assembly of claim 6 wherein said sheet of insulation is formed of polystyrene foam having a density of about 1.75 pounds per cubic foot.

8. The assembly of claim 6 wherein said refrigeration system includes a compressor having a motor, and together with control means for said ice cube maker unit and said refrigeration system, said control means including a thermostatic switch responsive to the temperature of said mold and adapted to complete a circuit through said compressor motor when the mold temperature rises to a preselected level, and adapted to complete a circuit through said ejector means and to open the circuit to said compressor motor when the mold temperature falls to a preselected level.

9. The assembly of claim 8 wherein said ice cube maker unit includes sensing means adapted to sense the level of ice cubes in said container and to prevent the completion of the circuit to said ejector means when said container is full of cubes while permitting the completion of the circuit to said compressor motor, whereby said refrigeration system will continue to function in response to changes in mold temperature.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,788,089 Dated January 29, 1974

Inventor(s) Richard A. Graves

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 42	"21" should be – 31 –
Claim 5, column 7, line 31	"eveaporator" should be – evaporator –

Signed and sealed this 6th day of August 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents