July 5, 1960 A. LEE 2,943,456

ICE CUBE MAKING ADDITION TO DOMESTIC REFRIGERATORS

Filed April 23, 1957 2 Sheets-Sheet 1

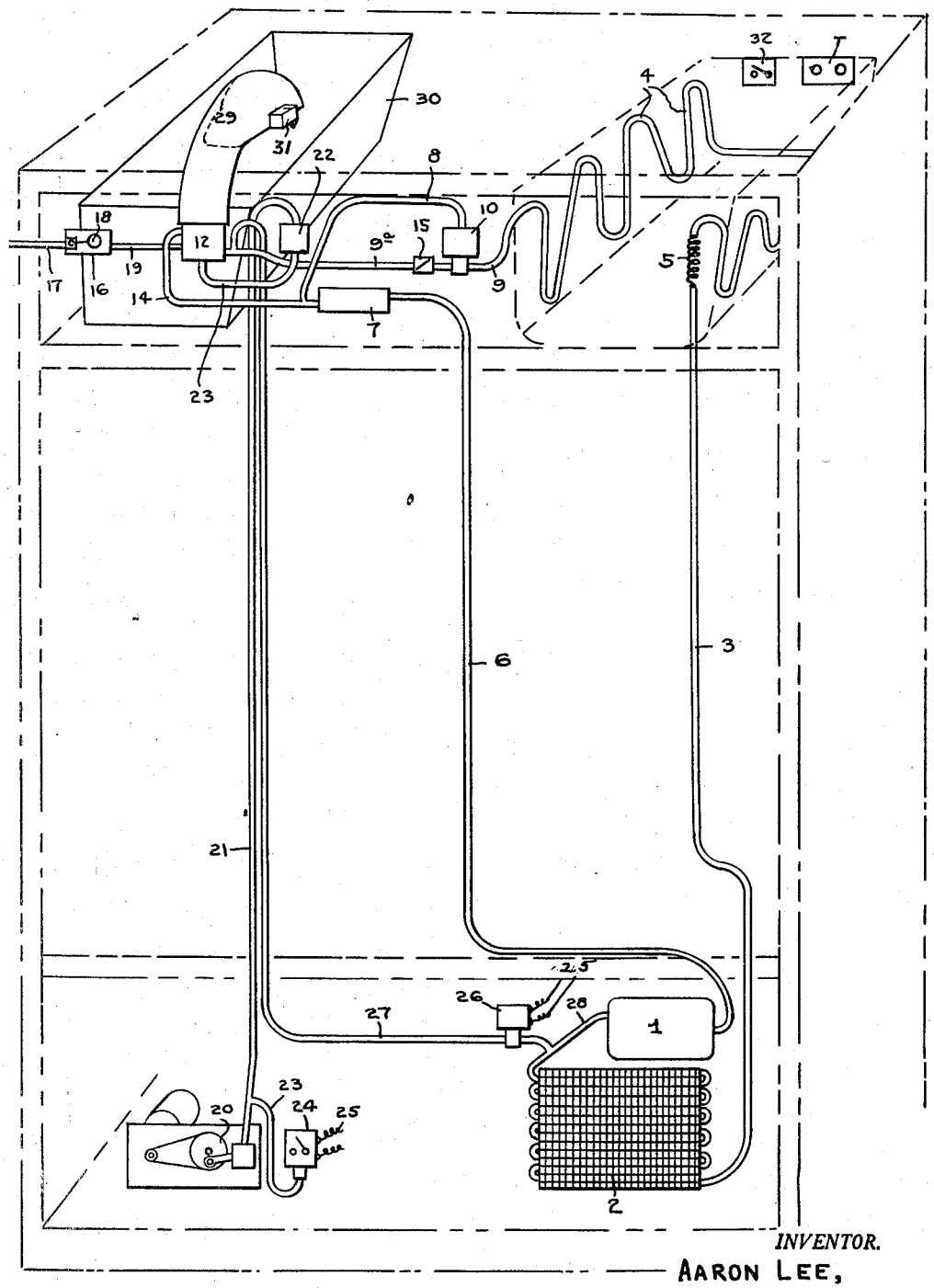

Fig. 1.

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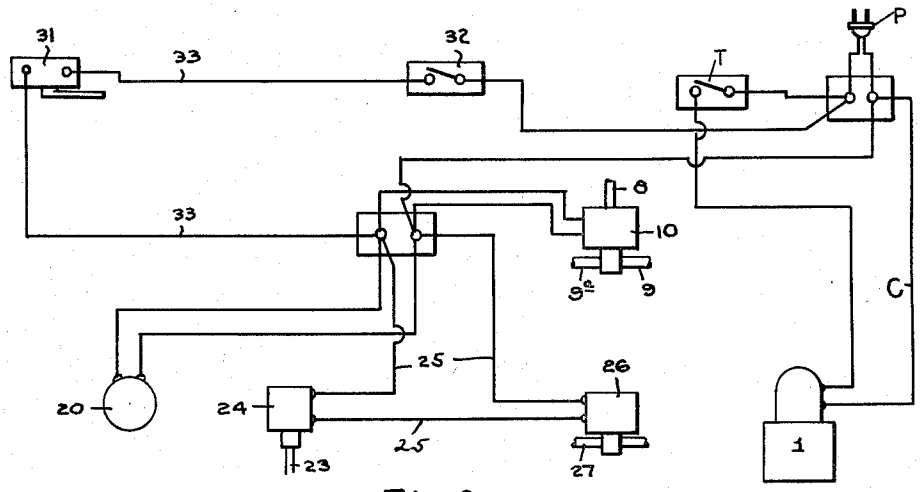

Fig. 2.

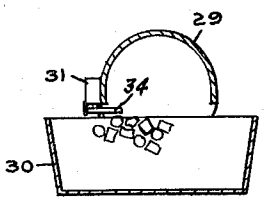

Fig. 3.

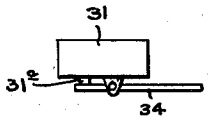

Fig. 4.

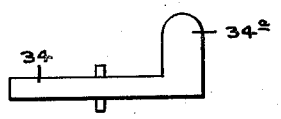

Fig. 5.

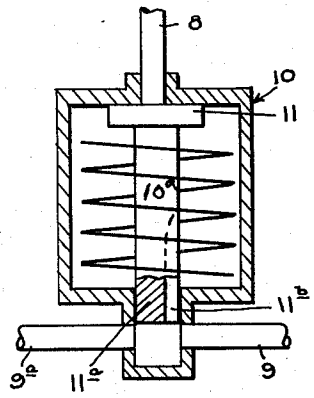

Fig. 6.

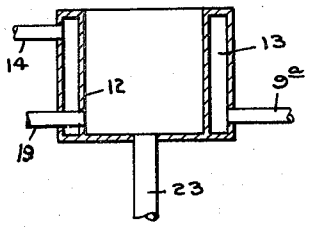

Fig. 7.

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ICE CUBE MAKING ADDITION TO DOMESTIC REFRIGERATORS

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4 Claims. (Cl. 62—138)

This invention relates to ice cube making components for domestic refrigerators.

In its broader aspects the invention contemplates the incorporation in a domestic refrigerator of a freezing cup or like receptacle comprising a water receiving compartment and a refrigerant path therearound disposed in series with the conventional evaporator unit of a domestic refrigerator whereby the refrigerant which passes through the evaporator also passes to and about said freezing cup where it exercises its freezing function and is then returned to the main and conventional refrigerant circuit.

In the accompanying drawings the invention is illustrated in conjunction with a domestic refrigerator of the compressor-condenser type. However the invention is of equal utility in systems of the absorption type. The freezing cup is disposed in auxiliary refrigerant conducting lines that are controlled by valves in such manner that while all the refrigerant which passes to said cup passes through the main evaporator unit of the refrigerator, the conducting lines in which the cup is located may serve to first conduct a refrigerant from the evaporator to said cup to initiate a freezing cycle and then conduct hot gas from the hot gas line of the compressor, to said cup, whereby to initiate a thawing cycle about the cup. During this thawing cycle the evaporator is cut off from the freezing cup auxiliary conducting lines, the refrigerant from the evaporator, during such thawing cycle being returned directly to the suction line accumulator of the conventional refrigerator assembly. In other words, during the thawing cycle the refrigerator functions in just the way it would function if the cube freezing additions of this invention were not present.

In the particular embodiment of the invention chosen for purposes of illustration, I have shown an assembly constructed to freeze a single ice cube, at a time, and to discharge such cubes as they are formed, through a chute, into a collecting pan or bin. The latter may be disposed in the food chilling compartment of the refrigerator or in a freezing compartment thereof.

The term ice cube is used in its generic sense to indicate a relatively small ice body. The body of ice formed may be rectangular or cylindrical in form, or otherwise shaped.

Compressed air means are provided for automatically ejecting the formed cubes from the cup and for this purpose the application shows and describes a compressed air cube ejecting and cycle controlling mechanism substantially like that shown in my copending application, Serial No. 635,643 filed January 28, 1957, now Patent No. 2,921,443 of which this application is a continuation-in-part.

Other features of advantage and improvement will be best understood after a consideration of the accompanying drawings in which:

Fig. 1 is a diagrammatic view illustrating the relationship of the additions of this invention to the refrigerating system of a conventional household refrigerator,

Fig. 2 is a diagrammatic view illustrating the electric circuits that are employed,

Fig. 3 is a cross sectional view of the delivery chute

adjacent the mouth thereof, showing the micro switch, hereinafter described,

Fig. 4 is a side view of the micro switch,

Fig. 5 is a plan view of the control arm of the micro switch,

Fig. 6 is a vertical section, partly diagrammatic, illustrating a solenoid flow control valve, and

Fig. 7 is a vertical section through the freezing cup.

The conventional household refrigerator elements indicated in Figure 1 comprise a compressor **1**, a condenser **2**, the main refrigerant line **3**, leading from the condenser to the main evaporator coil **4** and including in its length a restrictor or capillary coil **5**, and a suction line **6** leading from suction accumulator **7**, back to the compressor. In Fig. 2, P is the conventional supply plug and T the conventional thermostat disposed in the supply circuit C of the compressor. The features which I have added to incorporate an ice cube freezing assembly, the refrigerant from which is that which passes through evaporator coil **4**, includes the two lines **8** and **9—9*a***. Line **8** constitutes a part of the normal return suction line and line **9*a*** constitutes an auxiliary refrigerant line. Flow through these lines **8** and **9—9*a*** is controlled by a conventional solenoid valve that is disposed in valve casing **10**. Line **8** leads from the top of the casing and entrance to said line is shut off by head portion **11** of the solenoid valve core when the latter is energized and is lifted, in a conventional way. Line **9** leads from evaporator coil **4** to the lower portion of the valve casing **10** and line **9*a*** leads from said valve casing to the jacketed freezing cup **12**. Flow of refrigerant through **9—9*a*** is interrupted when the solenoid is deenergized and the valve core drops. At this time the lower stem portion **11*a*** of the valve closes the mouth of the line **9*a***. See Fig. 6. A port **11*b*** in the valve stem leaves the line **9** in communication with the interior of casing **10** at all times. The cube freezing cup or receptacle **12** is surrounded by a jacket **13**, the interior of which constitutes the freezing and thawing unit for the cup. Line **9*a*** leads to said jacket and a line **14** leads from said jacket back to the suction accumulator of and, consequently, to the suction line **6**. A check valve **15** disposed in line **9*a*** opens toward the freezing cup and functions, during the defrosting cycle of said cup, to prevent any of the hot defrosting gases from backing up and reaching the evaporator coil **4**. Thus when the call for ice cubes has been satisfied, as hereinafter described and the flow of refrigerant to the freezing cup has been shut off by the closing of line **9*a***, and the opening of line **8**, the refrigerator may continue its normal operation just as though the cube freezing elements were not present, the refrigerant then passing from coil **4**, through line **8**, accumulator **7** and suction line **6**.

When the line **8** is closed by the energization of the solenoid magnet and auxiliary refrigerrant line **9*a*** is brought into communication with evaporator **4**, refrigerant passes to the interior of jacket **13** to freeze a body of water in cup **12**. This water is supplied from a water pan **16** which receives water from a water line **17**. A float valve **18** maintains a determined level of water in the pan and this water level is established inside the cup **12** by a connecting tube **19**. When a freezing cycle is thus set up about the cup the body of water therein starts to freeze from the outside inwardly toward the center.

The means for maintaining a flow of a small volume of air upwardly through the freezing ice body to cause the same to freeze clear and hard and for forcibly ejecting the ice body from the cup, is disclosed in my copending application above identified. While I prefer to employ the method there disclosed for aerating and ejecting the ice body, I do not limit myself thereto, for it will be clear that the utilization of the main evaporator coil and its associated parts as the source of refrigerant in an ice cube freezing adjunct to a domestic refrigerator is

of a high degree of utility and novelty, irrespective of the means for ejecting the ice and for controlling the freezing and thawing cycles.

The means herein shown for effecting such cycle control and ice ejection comprises a small, low capacity air pump. This may be of the type employed in home aquariums. These pumps run continuously and deliver only enough air to maintain a stream of air bubbles upwardly in an aquarium. Such a pump is indicated at **20** and a line **21** therefrom leads to and delivers air into an air accumulator **22**. A line **23** leads from the bottom of accumulator **22** to the bottom of the freezing cup. During the freezing cycle this air bubbles up through the water in the cup, agitates the water and causes the ice to freeze clear and hard. As the freezing proceeds the hole through the center of the ice body becomes smaller and smaller until it freezes completely closed. The air having no path of escape, builds up in the accumulator **22** and very soon the pressure therein acts through a branch line **23** upon a conventional pressure operated switch **24**, to close an electric circuit **25**, of a hot gas solenoid valve **26**. When this valve is energized by the closing of said circuit it connects a hot gas line **27**, with the conventional hot gas line **28** which leads from compressor **1** to condenser **2**. However, with valve **26** open hot gas passes through line **27** to the line **9***a* and the jacket **13** of cup **12**. Thus a thawing cycle is set up to thaw the ice cube loose from its adhesion to the wall of the cup, it being noted that this thawing cycle is automatically initiated by the rise of pressure which was occasioned by the freezing closed of the hole in the ice body, at the completion of the freezing cycle.

During the thawing cycle air continues to enter the air accumulator so that by the time the ice cube has been thawed loose from the cup, said air is sufficient, both as to volume and pressure to eject the ice body forcibly from the cup, through a chute **29** into a collecting pan **30** or an equivalent bin. This collecting pan may be disposed at any desired place in the refrigerator, such as within the main food receiving compartment or within a freezing compartment, as may be determined by the degree to which it is desired to prevent melting of the said cubes.

It is desirable to provide means for stopping further freezing of ice cubes, when a sufficient quantity has been accumulated and to permit the refrigerator proper to continue its normal action. This is accomplished independently of temperature conditions in the refrigerator by mounting a micro-switch **31** at the mouth of the delivery chute **29** and including this switch in series with a starting switch **32** for the cube freezing unit, in a circuit **33** which supplies power to the pump and the other cube freezing elements. These micro-switches are widely used in the arts. They are characterized by the fact that their control plungers require very little power to move them and that said plungers require very little movement to open or close a circuit.

The plunger **31***a* of the micro-switch is actuated by a pivoted arm **34**, said arm comprising an end part **34***a* which lies in such relation to the cube collecting pan that when the pan is filled and the cubes begin to bank up at the mouth of the chute, a cube soon lands on part **34***a* and depresses the outer end of arm **34**. This actuates the micro-switch to cut off the current and stop further freezing of ice cubes, by stopping the pump and deenergizing the two position solenoid valve which carries head **11**. When no freezing of ice cubes is desired, manual opening of starter switch **32** will accomplish the same result as automatic opening of the micro-switch and the refrigerator will then function as a conventional refrigerator.

While I have stated that I prefer to freeze one cube at a time the invention is not limited thereto since the ice freezing cup or container **12** may be of tubular form and be made long enough to freeze a body of ice of such length that successive portions thereof may be broken off under the force of the ejection by air, as described in my application above referred to. The invention is not limited to the use of hot gases as a thawing medium. It is clear that the closing of an electric circuit such as **25** by the pressure operated switch **24** could be utilized to energize an electric heating coil disposed about the cube freezing cup to thereby carry out the thawing cycle.

It should be understood that with either starting switch **32** or the micro switch open the solenoid valve in casing **10** is deenergized and its core drops by gravity. At all other times this valve is energized to close line **8** and bring lines **9**—**9***a* into communication. When circuit **33** is interrupted, the stopping of the air pump **20** deprives pressure operated switch **24** of operating pressure. Consequently solenoid valve **26** remains closed and no hot gas can pass to the jacket of cup **12**. The main refrigerating mechanism which includes compressor **1** continues in operation though it cycles in the usual way under control of thermostat T.

While the invention has been illustrated in conjunction with a domestic refrigerator of the type comprising a compressor, condenser and evaporator coil, in order to explain the manner of utilizing the hot gases of such a system, it is clear that the idea of providing a cube freezing cup as a component part of a domestic refrigerator and periodically diverting refrigerant from the evaporator line to said cup, is of utility whether the evaporator line be that of a compressor-condenser type mechanism, or one in which circulation of a refrigerant through an evaporator is effected under the action of gas pressures set up without a compressor.

Therefore, it is to be understood that the invention is not limited to the particular arrangement shown but that it includes within its purview whatever changes fairly fall within either the terms or the spirit of the appended claims.

I claim:

1. The combination with a domestic type refrigerator comprising a conventional compressor, condenser, evaporator, main refrigerant line from the compressor to the evaporator, return suction line from evaporator to compressor and hot gas line from compressor to condenser, of an ice cube freezing cup having a jacket therearound, means for feeding water into said cup to a determined level, a valve casing, an auxiliary refrigerant conducting line leading from said valve casing to said jacket, said valve casing being included in the return suction line, a two position valve movable in the valve casing which in one position establishes communication between the evaporator and the return suction line and closes communication between the evaporator and the auxiliary refrigerant line to the jacket and in the other position shuts off communication between the evaporator and the return suction line and establishes communication between the evaporator and the auxiliary refrigerant line to the jacket, to thereby set up a freezing cycle therein.

2. A structure as recited in claim 1 in combination with a hot gas line extension leading from the hot gas line between compressor and condenser to a point of communication with said jacket, a hot gas control valve in the last named hot gas line, the opening of which permits passage of hot gas to said jacket to establish a thawing cycle, an air compressing element, means for delivering the compressed air therefrom to the cup to eject the ice cube from the cup upon completion of the thawing cycle and means acting under the reduced air pressure when the ice is ejected, to actuate the hot gas control valve to interrupt passage of hot gases to said jacket.

3. In a domestic refrigerator comprising a conventional compressor, condenser, evaporator, main refrigerant line to the evaporator, main suction line leading back to the compressor, a cube freezing cup, a jacket around said cup, a two position first solenoid valve comprising a valve casing and movable valve therein, an auxiliary refrigerant

conducting line leading from the jacket to the evaporator and of which line the interior of the valve casing constitutes a part, the interior of said valve casing also constituting a part of the main return suction line from the evaporator to the compressor, said valve when in one position cutting off communication of the evaporator with the main return suction line and establishing communication between the evaporator and the auxiliary refrigerant line to set up a freezing cycle around the cup and when in the other position interrupting communication between the evaporator and the said auxiliary line and establishing communication between the evaporator and its main return suction line, a low capacity air pump, an air accumulator into which said air pump delivers air, an air pipe leading from the accumulator to the bottom of the freezing cup, a normally open air pressure operated electric switch, means for conducting operating pressure to said pressure operated switch from the air pump, a second solenoid valve, an auxiliary hot gas line controlled by said second solenoid valve, an electric circuit in which the pressure operated electric switch and the second solenoid valve are included the solenoid valve being electrically energized under control of said switch, and means connecting the hot gas line to said jacket.

4. An assembly comprising in combination with a conventional domestic refrigerator which includes a main food compartment chilling evaporator; an ice cube freezing cup, means for feeding water at a determined level into said cup, a jacket about said cup and means for alternately

setting up freezing and thawing cycles in said jacket, the means for setting up the freezing cycle including a refrigerant line in series with said evaporator and jacket, valvular means in said refrigerant line which controls communication between said jacket and the evaporator, means for actuating said valvular means to cut off communication between said jacket and evaporator without interrupting the functioning of the evaporator and its associated elements in the normal chilling of the food compartment, means for supplying heat to said jacket to set up a thawing cycle, a control element for said heat supplying means and means actuated under control of the completion of the thawing cycle for actuating the control element to interrupt the heat supply to the jacket.

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