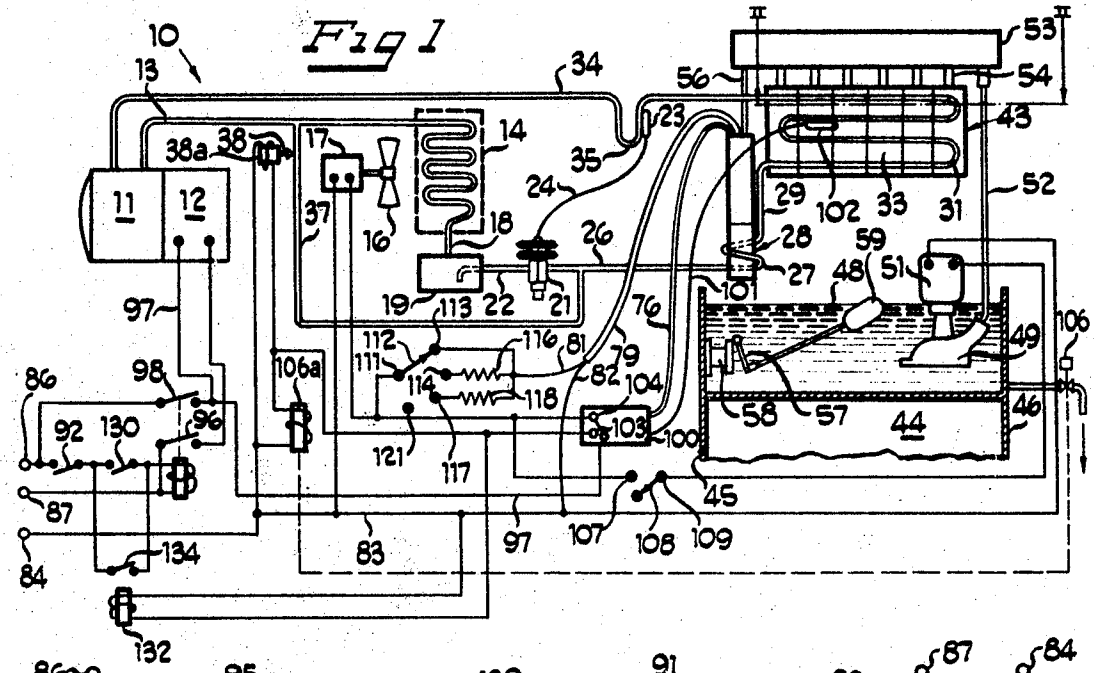
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SELECTIVE CONTROL FOR AN ICE MAKER

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Fig 1



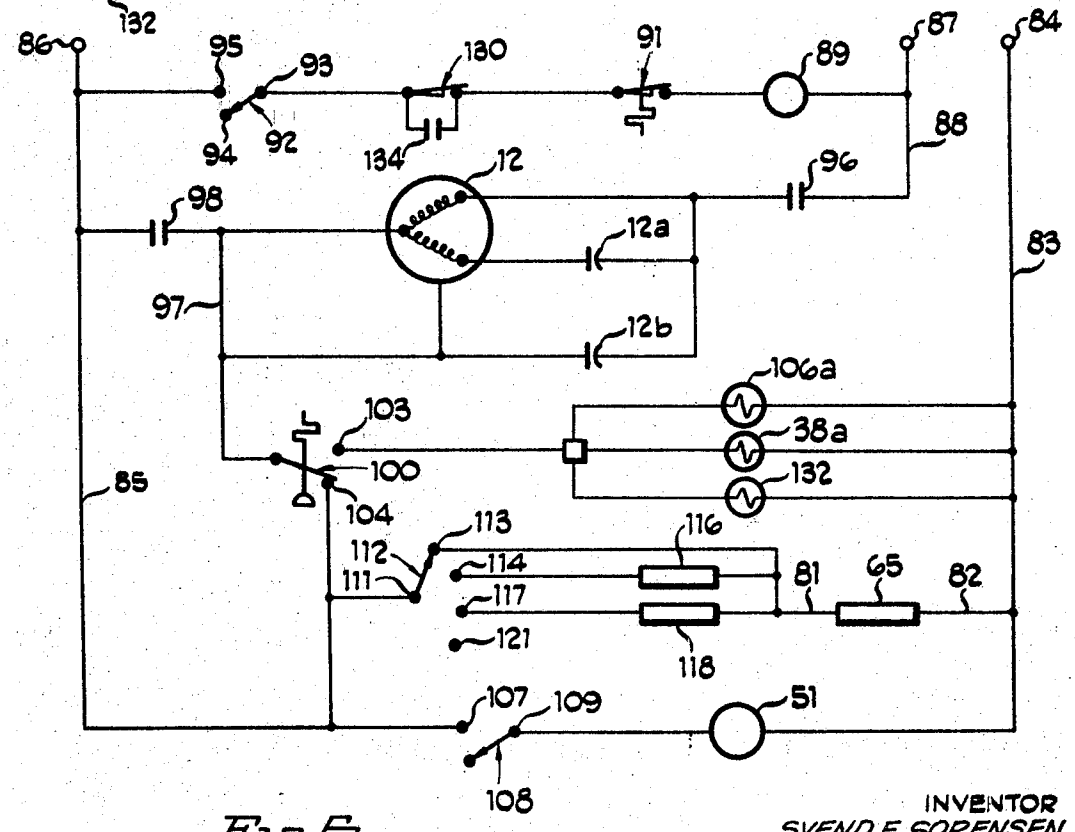




Fig 6

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SELECTIVE CONTROL FOR AN ICE MAKER

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Fig 3

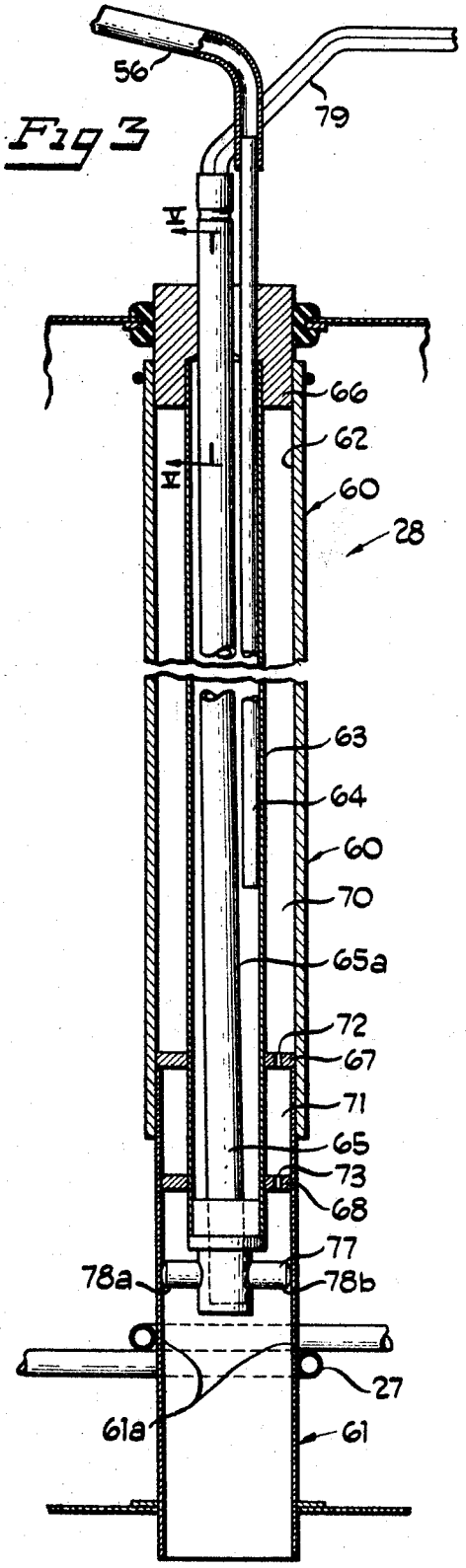



Fig 5

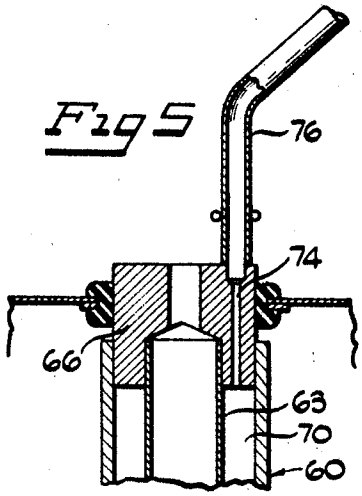
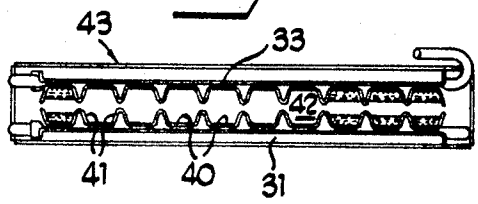



Fig 2



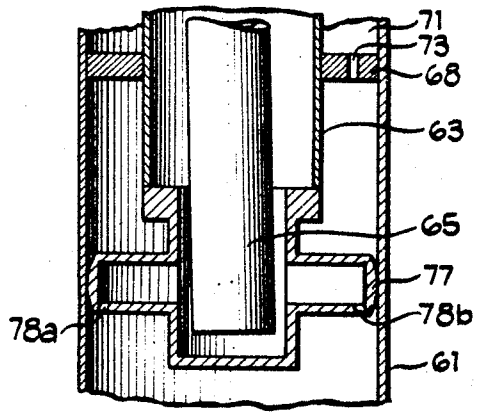




Fig 4

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3,459,005

# SELECTIVE CONTROL FOR AN ICE MAKER

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Int. Cl. F25c 1/06
U.S. Cl. 62—138 13 Claims

## ABSTRACT OF THE DISCLOSURE

An apparatus for making chips or blocks of ice having a selectively variable control for regulating the size of ice chips, wherein during the freezing cycle of the apparatus ice is made in the control tube and the rate of ice formation is varied by a heater which supplies heat thereto. When the ice formed in the control tube blocks the tube, water backs up therein and causes an increase in pressure which triggers a harvest cycle during which the ice blocks are released into a suitable container. When the harvest cycle is completed, a temperature sensitive device switches the apparatus back into the ice freezing cycle.

## Background and summary of the invention

This invention relates to an apparatus for making chips or blocks of ice and more particularly to an apparatus for making chips of ice having a relatively simple, reliable and efficient means for selectively regulating the size of the ice chips made.

Ice makers have been constructed previously which made chips of ice and which automatically released the chips when they obtained a certain size, but these ice makers have been limited because no accurate means has been available for conventiently regulating the size of the ice made. The present invention is designed to overcome these limitations and to provide a relatively inexpensive and reliable control system for an ice making apparatus such that capacity is increased and the size of the chips may be easily, simply and reliably controlled.

A feature of this invention includes the provision of means for selectively regulating the length of time of a freezing cycle of the apparatus.

Another feature of this invention includes the provision of a control ice freezing surface wherein the rate of freezing is selectively adjustable to control the size of the ice chips made by said apparatus.

A still further feature of the invention includes the provision of a heater means for selectively regulating the rate of freezing on said control ice freezing surface.

A still further feature of the invention includes the provision of means for automatically switching said apparatus from the freezing cycle to the harvest cycle and back again.

A specific feature of the invention relates to the construction of a control tube and control means for switching said apparatus from the freezing cycle to the harvest cycle.

This invention contemplates other objects, features and advantages which will become more fully apparent from the following detailed description taken in conjunction with the accompanying drawings which illustrate preferred embodiments.

## Description of the drawings

FIGURE 1 is a diagrammatic view of an ice maker constructed according to the principles of this invention;

FIGURE 2 is a cross sectional view of a portion of the ice chip maker of FIGURE 1, taken along the line II—II thereof;

FIGURE 3 is a cross section view of the control tube shown in diagrammatic form in FIGURE 1;



FIGURE 4 is an enlarged cross sectional view of a portion of the control tube of FIGURE 3;

FIGURE 5 is a cross sectional view of a portion of the control tube of FIGURE 3, taken along the line V—V thereof; and

FIGURE 6 is a diagrammatic view of the electrical circuit for the ice maker of FIGURE 1.

The ice maker constructed according to the principles of this invention, designated generally at **10**, has three main component portions—a refrigerating circuit; a water circuit; and a control circuit.

The refrigerating circuit (see FIGURE 1) comprises a compressor **11** driven by an electric motor **12**, both of which are normally sealed within the same air tight casing to form a hermetic assembly. A hot refrigerant gas line **13** leads from the discharge of the compressor to a condenser **14**, which may be cooled by water but is shown as being cooled by air from a fan **16** driven by electric drive motor **17**. Refrigerant line **18** leads from the condenser to a liquid refrigerant receiver **19**, which connects with refrigerant metering valve **21** by way of a liquid line **22**. Expansion valve **21** may be of any suitable type, but comprises preferably a thermal expansion valve controlled by a bulb **23** connected thereto by way of a capillary **24**, as is well known in the art. A low pressure liquid line **26** leads from valve **21** to a secondary evaporator **27**, which is in direct contact with the outer surface of a control ice-forming tube **28**.

A complete description of the ice forming unit may be found in U.S. Patent 2,983,109, issued to M. G. Leeson on May 9, 1961; so the description which follows has been limited to that which is necessary to understand the operation of the present invention.

From the secondary evaporator **27** a refrigerant line **29** leads to a main or primary evaporator **31**. Evaporator **31** is formed of a plurality of parallel rows of tubing bonded to a plurality of vertical ice-forming elements **33**. The outlet of evaporator **31** is connected to the inlet of compressor **11** through a cold gas suction line **34** having a U-shaped drop leg **35** formed therein. The hot gas bypass connection **37** is controlled by a solenoid operated hot gas defrost valve **38** connecting lines **13** and **26**.

The ice-forming elements **33** (see FIGURE 2) each comprise a vertically extending channel member having an ice-forming surface **40** and in-turned end portions **41** defining hexagonal-like passageways **42** with ice chips being formed opposite one another on opposed surfaces **40** for a maximum of ice chips in a minimum amount of space. It will be appreciated that in such a construction, the evaporator **31** will have parallel rows of tubing thereof suitably bonded on both sides of passageways **42** to form a freezing assembly **43**.

The water circuit of the ice maker **10** serves to circulate water within the assembly **43** and over the surfaces **40** and **41** so that it may be frozen thereto to produce ice. A sump **48** beneath assembly **43** is provided for maintaining a reservoir of water available for this purpose. Pump **49**, driven by an electric motor **51**, has its inlet within the body of water and has its discharge connected to a line **52** leading to a water header **53**, and a plurality of spray nozzles **54** attached thereto, one for each passageway **42**. Water header **53** also has an outlet line **56** leading to control tube **28**. Valve **57** controls the flow of make-up water into the sump **48** through a line **58** connected to any suitable source of water and is automatically operated by a float **59** which maintains an approximately constant level of water within the sump **48**.

The control circuit is provided for rendering the entire operation of the ice maker **10** automatic, including means for initiating the freezing operation of the system wherein the circulated water is frozen into ice chips, means for

automatically terminating the freezing operation and initiating a harvesting operation wherein the bond between the ice chips and the ice forming element **33** is broken and the ice chips fall into the bin **44**, and means for automatically terminating operation of the machine when the ice in bin **44** reaches a certain predetermined level.

Referring now in particular to FIGURES 3–5, an important element in the automatic control circuit of the ice maker **10** is the control tube **28**, which comprises an upper tube portion **60** and lower tubular portion **61** which is surrounded by the coiled refrigerant evaporator **27** to freeze water flowing therethrough. The upper portion **60** may be of a generally cylindrical structure having an inner surface **62**. A cylinder **63** is disposed within the tubular portion **60** and extends down into lower portion **61**. A water pipe **64** and an electric resistance heater **65** extend into cylinder **63** through a stopper **66** which is fitted tightly into the top of the upper tube portion **60** in airtight relation against the inner surface **62** and around the inner cylinder **63**, the heater tube **65***a* and water pipe **64**. Stopper **66** also provides support for the control tube **28**. The ice freezing tube portion **61** is fitted securely into the lower end of the upper portion **60**. Radially extending spacer members **67** and **68** are fitted around the inner cylinder **63** and are effective to center and vertically position the inner cylinder **63** with respect to the tubular portions **60** and **61**. Two air cavities **70** and **71** are formed in the control tube **28** by the stopper **66** and spacers **67** and **68**. Openings **72** and **73** extend through spacers **67** and **68** while a passage **74** in stopper **66** connects the cavity **70** with a larger air tube **76**, so that a continuous air passageway exits from the ice freezing portion **61** through the upper portion **60** and into the air tube **76**. A nozzle **77** having orifices **78***a* and **78***b* is affixed on the lower end of the inner cylinder **63** and is designed to spray water onto the ice freezing surface **61***a* of the tube portion **61**.

The water pipe **64** is connected to the outlet line **56** (FIGURE 1) from the water header **53**, and extends only part of the way down into the inner cylinder **63**. The heater **65** is connected to a heater lead **79** having two electric wires **81** and **82** therein for supplying current to the heater **65**.

The power supply for the unit includes three terminals **84**, **86** and **87**. Two-hundred thirty (230) volts A.C. is applied between terminals **86** and **87** while one-hundred fifteen (115) volts A.C. is applied between terminals **84** and **86**; so that terminal **86** and power line **85** connected thereto acts as a common ground for power lines **83** and **88** connected respectively to terminals **84** and **87**.

Between conductors **85** and **88** are connected, in series, a solenoid **89**, a high pressure cut out switch **91**, a bin switch **130**, and the main on/off switch **92** having a fixed contact **93** and "off" and "on" contacts **94**, **95**. In parallel with the above series connected elements are a normally open switch **96**, controlled by solenoid **89** and connected to one terminal of the compressor motor **12**, and a normally open switch **98**, also controlled by solenoid **89** and connected between power line **85** and the other terminal of compressor motor **12**. Conventional run and start capacitors, **12***a* and **12***b* respectively, are connected into the compressor motor circuit, as is understood by those skilled in the art.

Conductor **97** connects line **85** to one side of a pressure-temperature switch **100**, which is connected to and controlled by air pressure in the air pipe **76** and a capillary tube **101** connected to a temperature sensing means **102** positioned on a portion of the ice freezing assembly **43**. The pressure-temperature switch is preferably combined as a single unit, such as for example, a Robertshaw DS–12 control. The pressure-temperature switch **100** has two alternate contacts **103** and **104**. Closing of contact **103** serves to energize the coil **38***a* of hot gas solenoid valve **38**, the coil **106***a* of water drain solenoid valve **106**, and the coil **132** of a bin switch lock-in relay switch **134**. The latter is operable to close normally open relay switch **134** connected across bin switch **130**. Alternate contact **104** is connected to the "on" contact **107** of switch **108** having one terminal **109** connected to the pump motor **51**. The pump motor switch **108** is controlled simultaneously with, and by the same means as, the main on/off switch **92**, and these switches serve to activate and deactivate the whole ice maker **10**. The terminal **104** of switch **100** is also connected to a fixed contact **111** of a four place heater control switch **112** having a first fixed contact **113** connected to the heater line **81**, a second fixed contact **114** connected through a resistor **116** to the line **81**, a third fixed contact **117** connected through a resistor **118** to the line **81**, and a fourth fixed contact **121** which is an "open" contact.

The bin switch **130** may be mechanically controlled by a mechanism (not shown) which opens switch **130** when the bin **44** is filled to a certain level. The bin switch **130** may also be actuated by a thermostat as in U.S. Patent 2,983,109. As long as the ice maker **10** is turned on, with on/off switches **92** and **108** in the "on" position, the ice maker **10** is operational. If switch **130** is closed, thus indicating a demand for ice, then the ice maker **10** is either in the freezing cycle or the harvesting cycle. Let us assume the ice maker **10** is in the freezing cycle. Pressure-temperature switch **100** is operative to connect the line **97** with the terminal **104**, to activate the water pump motor **51** through switch **108**. The heater **65** is also energized through the switch **112**, which is shown set on the first contact **113**. The hot gas defrost solenoid **38***a*, the drain solenoid **106***a* and the bin switch lock-in relay solenoid **132** are de-energized. It should be noted that the circuit schematic is for a system using a water cooled condenser. In the event an air-cooled system is used, condenser fan motor **17** (FIGURE 1) would be energized at this time.

The compressor **11**, condenser **14**, refrigerant metering valve **21** and the evaporators function in a manner well known in the art to cool the refrigerant evaporators **27** and **31** well below the freezing point; and the evaporators **27** and **31** serve to cool the ice freezing portion **61** of control tube **28** and the ice freezing elements **33** of the apparatus **43** respectively, as has been described earlier. Meanwhile, the pump **49** supplies water to the water header **53** from which it is delivered to the ice freezing surfaces in a manner which has also been described, and ice forms on these surfaces.

During this freezing cycle of the ice maker **10**, the control tube **28** functions in a simple, reliable and efficient manner to regulate the length of time of the freezing cycle and thus the size of the ice chips formed in the ice freezing apparatus **43**. Water is supplied at a relatively constant flow rate via line **56** and pipe **64** into the inner cylinder **63**, from which it is sprayed by the nozzle **77**, through orifices **78***a* and **78***b*, onto the surface of tube portion **61** and frozen thereon. The rate of freezing of the water in tube portion **61** depends upon the temperature of the tube portion and the temperature of the water sprayed thereon. While the water in line **56** is supplied at an inlet temperature of approximately 32° F., the temperature of the water in nozzle **77** is affected by the heater **65**, which supplies heat primarily to the water as it travels through pipe **64** and sits in the lower portion of cylinder **63**. The amount of heat supplied by the heater **65** thus determines the rate of freezing of the water in the tube portion **61**. A 30-watt resistance type heater disposed in the lower part of the tube **65***a* has been found satisfactory for this purpose. Heater means could be disposed in other positions along the tube **65**. As water freezes in tube portion **61**, ice builds up therein; and at a certain point, the ice substantially closes the path through the tube portion **61**. Water from the cylinder **63** then begins to back up or rise in the upper part of the portion **61**, and may even rise up through the openings **73** and **72** into the air passages **70** and air pressure builds up in the passage **70**. Since the air

passages 71 and 70 are connected with portion 61, the increased air pressure is transmitted through these passages and into the air pipe 76, where it is transmitted to the pressure-temperature controlled switch 100. Switch 100 is of a type which is known in the art, and it is operative to react to the increased pressure from pipe 76 to switch the electrical contact of line 97 from the terminal 104 to the terminal 103. The pump 49 and condenser fan motor 17 are thus de-energized and the ice maker 10 is switched into its harvesting cycle.

In the harvesting cycle, the solenoid 38*a* is energized to open valve 38, and the solenoid 196*a* is energized to open its associated drain valve 106. Solenoid 132 also is energized to close normally open lock-in relay switch 134. Hot gas from the compressor 11 is transmitted through open valve 38 through lines 37, 26 and 29 and into the evaporator sections 27 and 31. The ice chips in the apparatus 43 are thus harvested; and the ice in control tube 28 is melted to drop out the bottom of portion 61, because of the heat from the hot gas passing through evaporator 27. The lock-in relay switch 134 assures completion of the harvest cycle. If, for example, bin switch 130 were to open during the harvest cycle, the operation of the whole unit might cease without some means to prevent this occurrence. To assure continuation of the reharvesting, the energized solenoid 132 closes relay switch 134 by-passing switch 130 to keep the circuit closed and the ice maker operating.

When the temperature in the ice freezing apparatus 43 rises above a certain level, the temperature sensing bulb 102 causes the pressure-temperature switch 100 to switch the line 97 from the terminal 103 back to the terminal 104 and the ice maker 10 returns to the freezing cycle. This cycling process continues as long as the ice maker 10 is turned on and the ice in the bin 44 is not high enough to cause switch 130 to open.

The method of regulating the size of the ice chips made by the freezing assembly 43 should now be explained. This regulation is accomplished by regulating the amount of heat output of the heater 65 during the freezing cycle, which controls the rate of freezing in the control tube 28 and thus the length of time required before ice builds up therein and causes the ice maker 10 to switch into the harvesting cycle. As shown in FIGURES 1 and 6, the heater 65 is supplied with power from terminal 104 through the switch 112, which is shown contacting the first fixed contact 113. The switch 112 controls the amount of current supplied to heater 65 and thus the size of the ice chips made. Switch 112 is shown in the first position, wherein the largest amount of current is supplied to heater 65 thus supplying the greatest amount of heat to retard freezing for the longest period of time causing the longest freezing cycle and therefore the largest ice chips, king-sized ice chips. If switch 112 is turned to contact 114, resistor 116 is of a value to cause a decrease in the amount of current to heater 65 and a corresponding decrease in the freezing cycle time. If switch 112 is turned to contact 117, the resistor 118 which has a greater resistance than resistor 116 causes a still further decrease in the current to heater 65 and a still further decrease in the size of ice chips. If switch 112 is turned to contact 121, no heat is produced by heater 65 and the shortest freezing cycle is attained, thereby causing small chips to be made. In this manner, the size of ice chips made by the ice maker 10 is easily, conventiently and reliably controlled in a simple and efficient manner.

It will be understood that modifications and variations may be effected without departing from the spirit and scope of the novel concepts of this invention.

I claim:

1. In an apparatus for making blocks of ice the combination comprising: a first ice freezing surface, a second control ice freezing surface, means for flowing water to be frozen over said first and second ice freezing surfaces, refrigerant evaporator means associated with each of said freezing surfaces to form ice thereon, and control means for selectively regulating the amount of time during which ice is formed on said first ice freezing surface and thereby regulating the size of ice blocks to be produced by the apparatus, said control means including means for selectively regulating the rate of ice formation on said second control ice freezing surface, said means including heater means and means for selectively varying the output thereof to thereby vary the rate of freezing water on said second control ice freezing surface.

2. The combination of claim 1 wherein
said heater means comprises an electric resistance heating element.

3. The combination of claim 2 wherein
said means for selectively varing the output of said heater means includes a plurality of resistance members and switch means for selectively operatively connecting one of said resistance members to said heater means.

4. The combination of claim 1 including
variable resistance means operatively associated with said heater means for varying the heat output thereof whereby the rate of freezing of water on said control surface may be varied to thereby regulate the length of the freezing cycle and thereby the size of ice blocks to be made by said icemaking apparatus.

5. In an apparatus for making blocks of ice the combination comprising:
a first ice freezing surface,
a second control ice freezing surface,
means for flowing water to be frozen over said first and second surfaces,
refrigerant evaporator means associated with each of said freezing surfaces to form ice thereon,
control means for regulating the size of the blocks of ice to be formed on said first freezing surface, including
heater means for controlling the rate of freezing water on said second control ice freezing surface, and
means responsive to the amount of ice formed on said control ice freezing surface to cause said control means to discontinue the freezing operation of said apparatus.

6. The combination of claim 5 wherein
said control means comprises a control tube means,
said second control in freezing surface comprises a portion of said control tube means and said heater means is operatively associated with said control tube means.

7. The combination of claim 6 wherein
said heater means is disposed within said control tube means.

8. The combination of claim 6 wherein
said control tube means includes first and second tube members, said second tube member being disposed within said first tube member, and
said means for flowing water over said second control ice freezing surface includes conduit means extending into said second tube member for discharging water thereinto.

9. The combination of claim 8 wherein
said heater means is disposed within said second tube member and adapted to heat water discharged into said second tube member.

10. The combination of claim 5 wherein
said means responsive to the amount of ice formed on said control ice freezing surface to cause said control means to discontinue the freezing operation of said apparatus includes a pressure sensitive first sensing means responsive to a build-up of air pressure in said control means for terminating the freezing operation and starting the harvesting operation.

11. The combination of claim 10 further including a temperature sensitive second sensing means for terminating the harvesting cycle and reinitiating the freezing cycle.

12. The combination of claim 11 further including means operatively associated with and responsive to said first and second sensing means for controlling the flow or refrigerant through said evaporator means.

13. The combination of claim 5 wherein

said control means includes a generally tubular element,

said second control surface comprising a portion of the inside surface of said tubular element, and

said means responsive to the amount of ice formed on said second control ice freezing surface includes pressure sensitive fire sensing means, and

means for connecting one end of said tubular element to said first sensing means in a substantially airtight relationship so that when the outlet from said tubular element is substantially blocked by the formation of ice on said control surface thus preventing the flow of water therethrough, the pressure in said tubular element rises and is transmitted to said pressure sensitive first sensing means.



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WILLIAM E. WAYNE, Primary Examiner

U.S. Cl. X.R.

62—233

UNITED STATES PATENT OFFICE

# CERTIFICATE OF CORRECTION

Patent No. 3,459,005 August 5, 1969

Svend E. Sorensen

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

Column 6, line 48, "in" should read -- ice --.
Column 7, line 18, "fire" should read -- first --.

Signed and sealed this 30th day of June 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents