Sept. 12, 1961 D. F. SWANSON ET AL 2,999,369

TANDEM PLATE AUTOMATIC ICE CUBE MAKER

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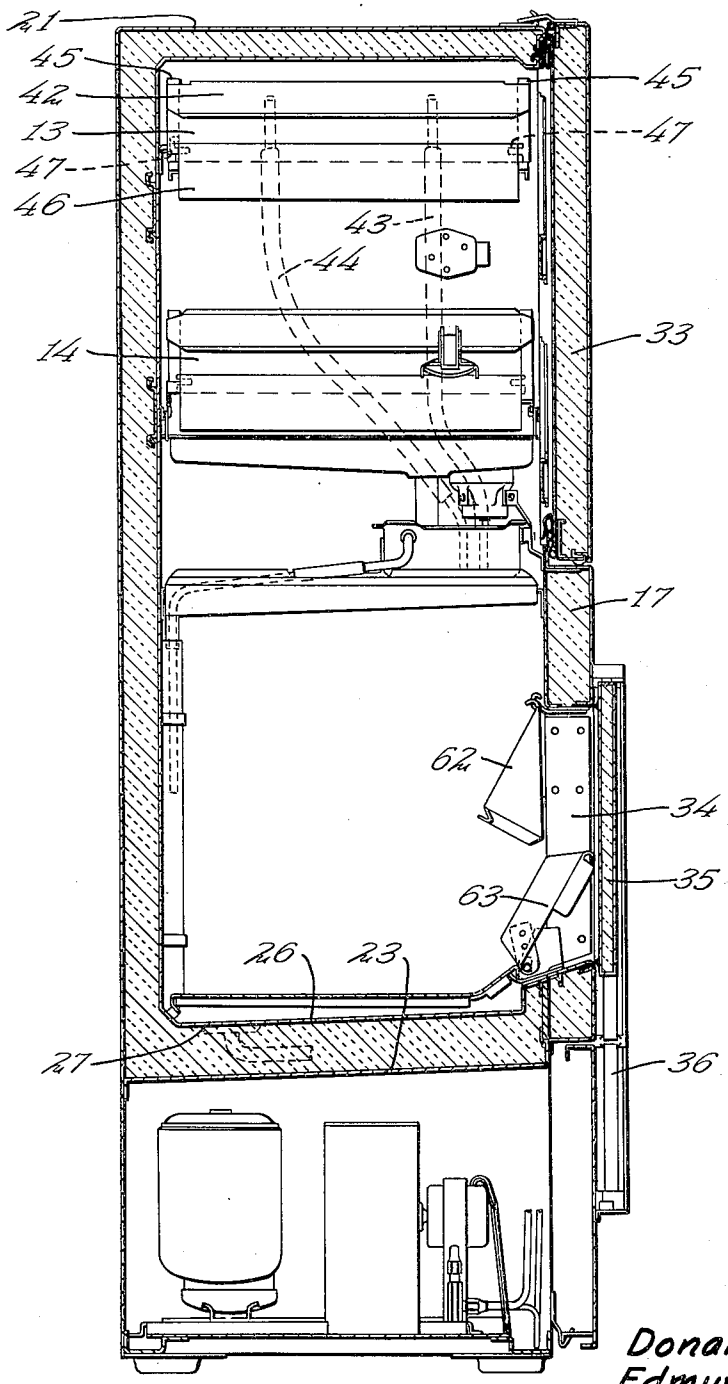


Fig. 1

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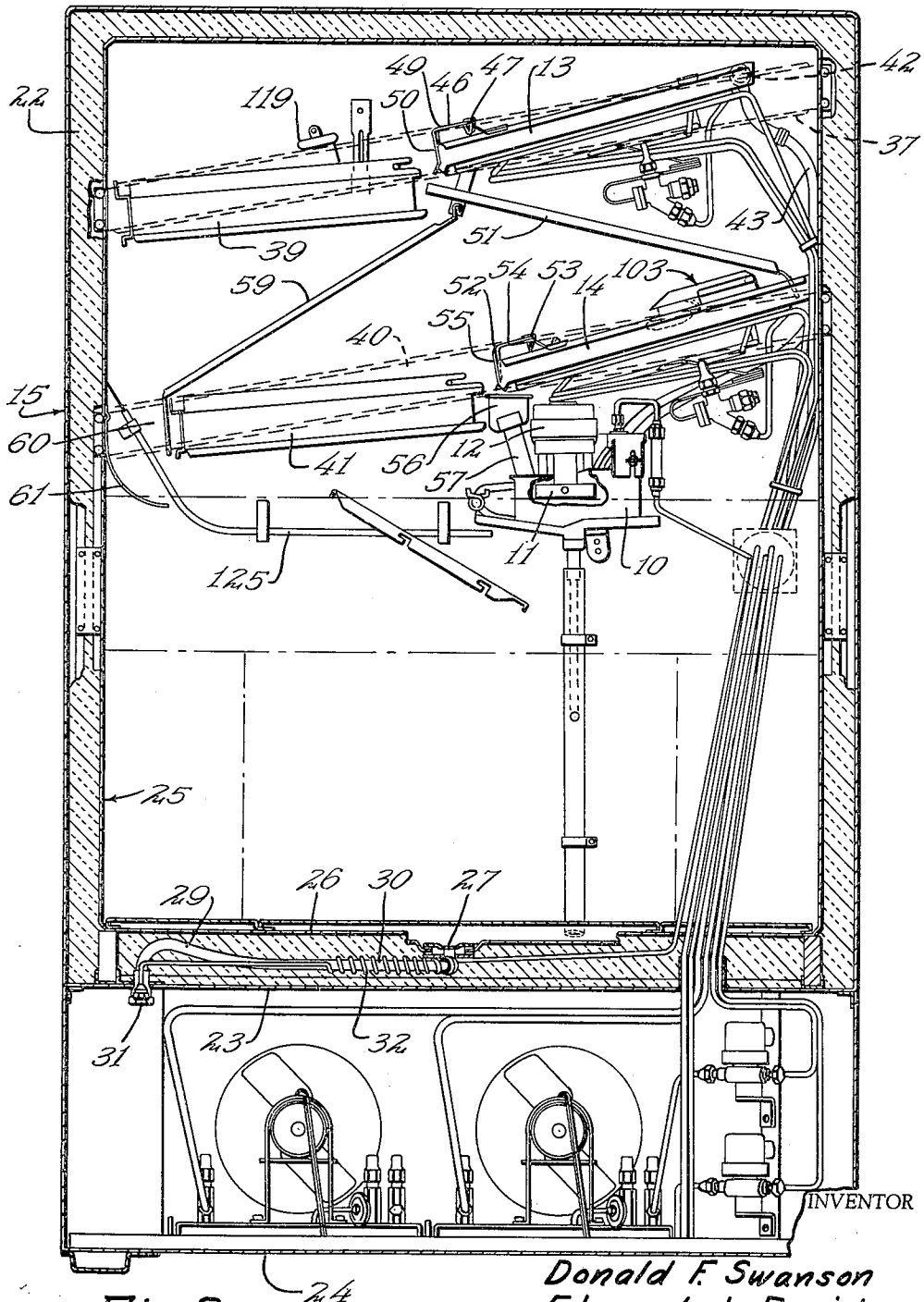


Fig. 2

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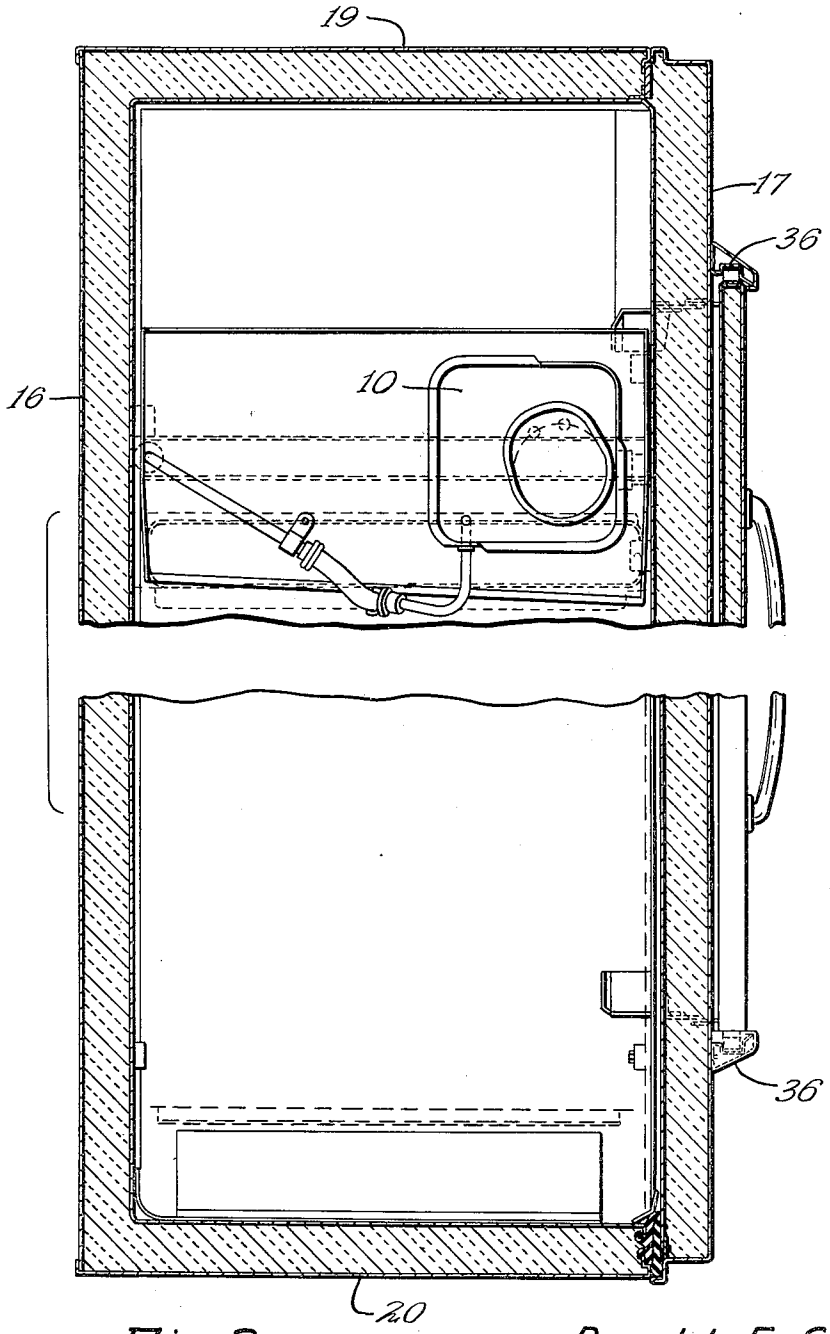


Fig. 3

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TANDEM PLATE AUTOMATIC ICE CUBE MAKER

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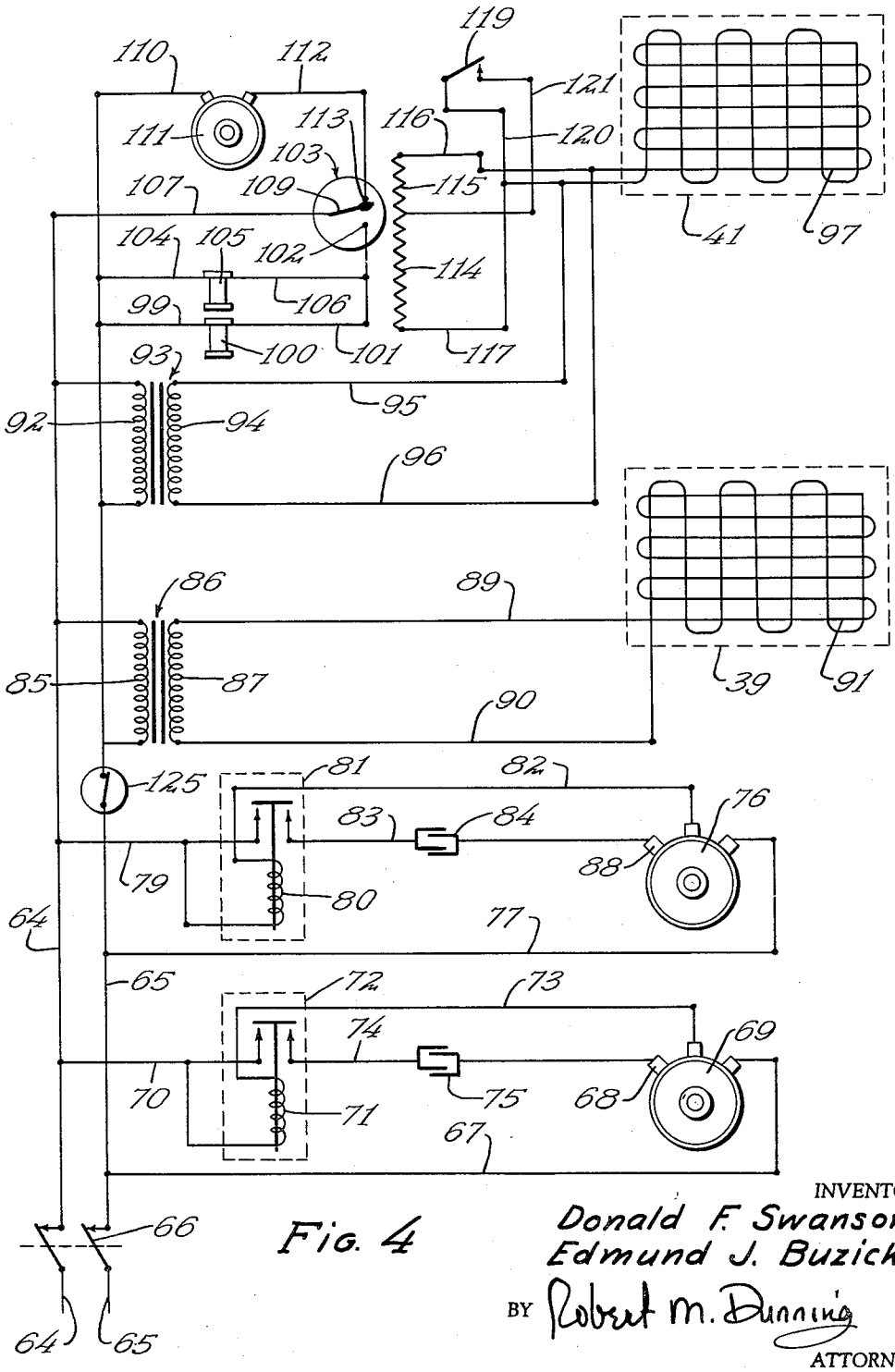


Fig. 4

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2,999,369

TANDEM PLATE AUTOMATIC ICE CUBE MAKER

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Filed June 4, 1956, Ser. No. 589,123
3 Claims. (Cl. 62—320)

This invention relates to a tandem plate automatic ice cube maker and deals particularly with an apparatus for producing a store of ice cubes for future use.

In a previously issued patent, Number 2,682,155, issued June 29, 1954, an ice cube maker was disclosed in which the ice was frozen on an inclined refrigerated plate. When ice of sufficient thickness, has built up upon the surface of this plate, the plate was heated sufficiently to melt the ice therefrom so that the ice could slide onto a series of slab cutting wires. These wires cut the slab into a series of strips and a second set of wires cut the strips into cubes. The cubes fell into a suitable storage bin.

An extremely large number of the devices have been constructed and successfully used. One of the difficulties with the device has been that it could not furnish sufficient ice cubes in certain locations to take care of the need. The present device is designed for use in such circumstances as it enables the production of the cubes to be at least doubled. The present invention deals with the particular means in which this is accomplished.

A feature of the present invention resides in the provision of an ice cube maker having a pair of inclined refrigerated plates arranged in superimposed relationship. Water is pumped from a suitable reservoir to flow over the surface of the uppermost of the two plates. The water passing over this plate is deflected by suitable means to the upper edge of the next plate. The water than flows over the next inclined plate and back to the reservoir. The advantage of this arrangement is that water which is not frozen on the upper plate will be cooled by contact with this plate or with the ice overlying the plate and is therefore more likely to freeze on the lower of the two plates. In other words, all of the water which is pumped by the pumping element and which flows through the completed cycle and back to the reservoir has by that time been substantially cooled by contact with two freezing plates or with the ice overlying these plates.

A feature of the present invention lies in the fact that with the particular water circulating system employed, the pumping element does not have to pump much more liquid than would be necessary to freeze a slab of ice upon a single plate. It will be understood that only a small proportion of the water flowing over the plate at any one time is frozen thereupon. In order to build up a slab of ice upon the refrigerated plate, it is necessary to pump a continuous stream of water over the surface of the plate or over the ice built up thereupon. By deflecting the overflow from the first plate to pass over the second refrigerated plate, the water which is in circulation is much more quickly cooled than would otherwise be practical as approximately the same volume of water flows over two refrigerated surfaces rather than a single surface. Thus, while twice the amount of ice is frozen, the amount of water which is being circulated is little if any greater than that which must be circulated over a single plate.

A further feature of the present invention resides in the provision of a baffle which extends beneath the ice cube cutting element of the uppermost cube forming unit and which directs the ice cubes which are cut by the upper unit around the end of the lower unit. Thus the danger of the injury to the lower unit by the force of ice cubes dropping upon this lower unit from the upper one is eliminated.

A further feature of the present invention resides in the

fact that one unit, if desired, may be slightly offset from a position directly above the other, so that the cubes may be more readily guided from the upper cutting unit into the storage bin.

These and other objects and novel features of the present invention will be more clearly and fully set forth in the following specification and claims.

In the drawings forming a part of the specification:

FIGURE 1 is a vertical sectional view through the ice cube machine, the section being taken substantially centrally through the apparatus between the freezing plates and the ice cube cutting elements.

FIGURE 2 is a sectional view on a vertical plane through the ice cube machine, portions thereof being broken away so that the general arrangement of the parts therein may be illustrated.

FIGURE 3 is a horizontal sectional view through the apparatus, the view being taken beneath the ice cube freezing and cutting apparatus and above the pump element.

FIGURE 4 is a wiring diagram of the apparatus.

The details of construction of the refrigerated freezing plate and the ice cube cutting mechanism are not shown in the present application. However, in general, it may be said that these units are similar to those indicated in Patent No. 2,682,155, previously referred to and in an application for patent filed by Russell W. Ayres and Donald F. Swanson as Serial Number 306,096 filed August 25, 1952. Thus, the details of these elements are not believed of prime importance in the present application.

The water circulating system includes a reservoir 10 having a pump 11 therein, the pump being driven by a pump motor 12. The reservoir 10 and pump unit 11 are supported below the level of the refrigerated plates 13 and 14 which are supported in inclined relation within the cabinet which is indicated in general by the numeral 15.

The cabinet 15 is generally rectangular in shape and includes a rear wall 16, a front wall 17, and parallel side walls 19 and 20. A top wall 21 closes the upper extremity of the cabinet. All of the side walls of the cabinet as well as the top wall thereof, are insulated, the cabinet having an outer sheathing and inner lining, and insulation such as 22 therebetween.

A partition 23 extends across the cabinet along a substantially horizontal plane spaced from the bottom 24 of the cabinet. The liner 25 of the cabinet which is indicated in general by the numeral 25 includes a bottom panel 26 which is parallel to and spaced upwardly from, the partition 23. Actually both the partition 23 and the liner bottom 26 slope slightly toward the rear of the cabinet so that liquid within the liner will drain toward a suitable drain 27. As in the previous construction, the drain pipe 29 has a low point 30 between the liner drain 27 and the drain outlet 31 and this low part of the drain is preferably encircled by one or both of the capillary tubes 32 forming a part of the refrigerant system. The liquid draining from the refrigerator cabinet is at a low temperature and tends to reduce the temperature of the refrigerant in the capillary tube or tubes.

As is indicated in FIGURE 1 of the drawings, the upper front portion of the front wall 17 comprises a removable generally rectangular panel 33, which may be removed when desired to provide access to the freezing plates and cutting mechanism. Normally, this panel 33 remains locked in place. It should also be noted from FIGURE 1 and FIGURE 2 of the drawings that a door opening 34 is provided terminating slightly above the level of the liner bottom 26, this opening being closed by a door 35. The door 35 is vertically slidably supported in opposed tracks such as 36 so that the ice cubes which build up within the body of the refrigerator may

be withdrawn. The interior of the cabinet forms a well into which the ice cubes drop and the door 35 may be opened to permit removal of the cubes.

The upper freezing plate 13 is supported by parallel spaced supporting brackets 37 which also form a support for the upper ice cube cutting unit 39. A similar pair of inclined brackets 40 acts as a support for the lower freezing plate 14 as well as the lower slab cutting unit 41. As is indicated in the drawings, the cutting unit is usually supported at a lesser angle to the horizontal plane than the freezing plate 13 and the freezing plate 14.

A transversely extending manifold 42 extends transversely along the upper edge of the upper freezing plate 13 and water to be frozen is supplied thereto by a pair of tubular conduits 43 and 44 leading from twin outlets in the pump unit 11. Thus, the operation of the pump acts to pump water into the transverse manifold 42 which spreads the water in a thin film over the entire width of the upper refrigerating plate 13. This plate is provided with raised sides 45 which prevent the liquid from spilling from the sides of the plate. The undersurface of the plate is in contact with an evaporator coil which will be later described. A deflector 46 is hingedly connected along aligned transversely extending pivots 47 and extends transversely across the lower end of the upper freezing plate 13. This deflector 46 is generally L-shaped in form and is hingedly connected along one edge thereof. One portion 49 of the deflector 46 extends generally parallel to, and above the level of, the plate 13. The other angularly related portion 50 extends downwardly against the end of the freezing plate. The deflector is so constructed and pivotally supported that it will be swung upwardly by the force of a slab of ice sliding from the freezing plate 13. However, at all other times the deflector extends closely adjacent to the lower end of the inclined plate to direct liquid downwardly from this lower end and onto an inclined baffle 51.

The baffle 51 is inclined at an angle to the horizontal and is directed toward the upper end of the lower freezing plate 14. Thus liquid flowing from the lower end of the plate 13 will be guided by the baffle 51 onto the upper end of the lower plate 14 so as to flow over this lower plate 14 in a thin film.

The lower plate 14 is also provided with a baffle 52 which is hingedly secured along aligned horizontal pivots 53. The baffle 52 includes a first portion 54 which extends substantially parallel to the surface of the plate 14 and a right angular portion 55 which is designed to extend closely against the lower edge of the plate 14. This baffle 52 normally deflects the liquid flowing over the surface of the plate 14 into the transversely extending trough 56 which is connected to a tubular member 57 leading into the reservoir 10. Thus after the liquid has circulated over both plates, it is returned to the reservoir for recirculation.

The cutting units 39 and 41 are similar in form and are similar to those illustrated in the patent application above referred to. Each cutting unit includes a series of parallel resistance wires designed to engage the undersurface of a slab of ice resting thereupon and to cut the slab into a series of strips. Each cutting unit also includes a series of right angularly extending resistance wires which cuts the strips into cubes.

A baffle 59 is provided between the front and rear walls of the cabinet extending on an angle from a point beneath the upper end of the baffle 51 to a point adjoining the extremity of the cutting unit 41. As will be noted in FIGURE 2 of the drawings, the upper freezing plate 13 and cutting unit 39 are somewhat off-set from a point directly above the corresponding freezing plate and cutting unit of the lower set. Thus a space 60 is provided between the forward end of the baffle 59 and the wall 22 of the cabinet through which ice may drop into the lower portion or well part of the cabinet.

A curved baffle 61 is attached to the wall 22 of the cabinet and is inclined downwardly and toward the opposit wall. This baffle 61 is designed to spread the ice cubes from the upper ice cube cutting mechanism through the body of the ice cube storage compartment and to prevent all of the ice cubes from the upper cutter mechanism 39 from dropping along the compartment wall 22. As the ice cubes from the lower cutting unit 41 may drop directly downwardly from this cutting unit, the cubes are spread fairly evenly in the storage compartment. Suitable baffles 62 and 63 partially enclose the door opening 34 in elevated position of the door 35 and prevent the ice cubes from piling against the inner surface of this door. This baffle arrangement is not a part of the present invention.

The wiring diagram of the apparatus is shown in FIGURE 4 of the drawings. The line wires 64 and 65 are controlled by a switch 66 by means of which the current may be disconnected from the apparatus. The line wire 65 is connected by a conductor 67 to one terminal of a capacitor start compressor motor 69. A second conductor 70 leads from the line wire 64 through the coil 71 of a magnetic starter switch 72, the other terminal of which is connected by a conductor 73 to the running coil of the motor 69. During the initial operation of the motor 69, the coil 71 is energized to close the starting switch 72, closing a second circuit through a conductor 74 and a capacitor 75 to a supplemental starting coil 69, the other terminal of which is also connected to the conductor 67.

A similar circuit is provided for a second compressor motor 76. A line wire 77 connects the line wire 65 to one terminal of the motor coils of the motor 76. A second conductor 79 is connected to the line wire 64 and leads to the coil 80 of a starting switch 81. The other terminal of the starting switch coil 80 is connected by conductor 82 to the second terminal of the running coil of the motor 76. During the initial operation of the motor 76, the switch 81 is closed, closing a second circuit through a conductor 83 and a capacitor 84 to the starting coil 88 of the motor 76.

The primary coil 85 of a transformer 86 is connected between the line wires 64 and 65. The secondary coil 87 of this transformer is connected by conductors 89 and 90 to the resistance wires 91 which form the upper cutting unit 39. The wires 91 may be formed in several sections connected in parallel if desired to lower the applied voltage to the resistance wires.

The primary coil 92 of a second transformer 93 is connected between the line wires 64 and 65. The secondary coil 94 of this transformer 93 is connected by line wires 95 and 96 to the resistance wires 97 which form the lower cutting unit 41. As in the lower cutting unit, the resistance wires may be connected in several parallel sections to lower the applied voltage.

The line wire 65 is connected by a conductor 99 to a solenoid valve 100, the other terminal of which is connected by conductor 101 to a terminal 102 of a thermostat 103. A similar conductor 104 connects the line wire 65 to a solenoid valve 105, the other terminal of which is connected by conductor 106 to the thermostat terminal 102. The other line wire 64 is connected by a conductor 107 to the arm 109 of the thermostatic switch.

The line wire 65 is also connected by a conductor 110 to the pump motor 111. The other terminal of the pump motor 111 is connected by a conductor 112 to a second terminal 113 of the thermostat 103. The thermostat arm 109 may selectively engage either the terminal 113 or the terminal 102 depending upon the temperature.

A heating coil 114 and a second heating coil 115 are arranged in series between a first conductor 116 leading to the conductor 96 and a second conductor 117 leading to the conductor 95. The conductors 95 and 96 are continuously supplied with low voltage current through the transformer 93. The coils 114 and 115 are in heat trans-

fer relation with the casing of the thermostat **103** so as to provide a gentle heat to this thermostat which raises somewhat the range of temperatures between which the thermostat **103** operates. A switch **119** is connected by one conductor **120** to the conductor **95** and by a second conductor **121** to a point between the heating coils **114** and **115**. When the switch **119** is closed, the heating coil **114** is shorted up thereby applying the entire voltage to the coil **115**. As a result, the temperature increases materially holding the thermostat arm **109** against the terminal **102**.

The operation of the apparatus will now be described. When the main switch **66** is closed, the compressor motors **69** and **76** are energized, the starting switches **72** and **81** temporarily closing supplemental starting coils to simplify this operation. An ice level thermostate **125** in one of the line wires such as the line wire **65** is normally closed thereby closing the circuit to the transformers **86** and **93**. As a result, the resistance wires **91** and **97** in the cutter units **39** and **41** are energized and these wires are heated.

The thermostat **103** is normally in contact with the terminal **113** when there is no slab of ice upon the lower freezing plate **14**. This thermostat **103** is mounted above the level of the lower freezing plate **14** and comes into heat transfer relation with the cold water passing over the slab of ice on this lower freezing plate when a sufficient thickness of ice is built up thereupon. Accordingly, the circuit is closed through the thermostat **103** from the line wires **64** and **65** and conductors **107, 110, 112** and the thermostat arm **109** to the pump motor **111**. Accordingly, the pump motor starts operation and directs a stream of water over the upper freezing plate **13**.

The water flowing over the upper freezing plate, is directed by the baffle **51** to the upper edge of the lower freezing plate **14**. The water flows down this plate **14** and drains into the collecting trough **56** which is connected to the water reservoir **10**. Water is maintained at the proper level in this reservoir **10** by a suitable float operated inlet valve connected to a source of water supply.

The circulation of water over the two plates continues until the plates build up a proper thickness of ice thereupon. The thickness of the slab of ice build upon the plates may be regulated by adjusting the position of the thermostat **103** relative to the lower freezing plate. During this operation, the gentle heat from the heating coils **114** and **115** holds the thermostat arm in engagement with the terminal **113**.

When the water passing over the slab of ice on the lower freezing plate **14** reaches a predetermined thickness, the direct contact between the thermostat **103** and the water flowing over the ice causes the thermostat arm **109** to swing into engagement with the terminal **102**. This action breaks the circuit to the pump motor **111** and closes circuits to the solenoid valves **100** and **105** through the thermostat arm **109** and the terminal **102**. As a result, the solenoid valves **100** and **105** are actuated.

Actuation of these solenoid valves opens a by-pass in the refrigeration circuit and permits the hot refrigerant gas to flow through the evaporator coils in heat transfer relation with the plates **13** and **14**. As a result, these refrigerating plates are heated until the slabs of ice thereupon melt from the surface and slide down onto the respective cutting units.

As is indicated in FIGURE 2 of the drawings, the switch **119** is located above the upper cutting unit **39**. This arrangement has a particular advantage. The switch **119** is actuated by a slab of ice sliding from the upper freezing plate **13** onto the upper cutting unit **39**. When the ice is upon the cutting unit **39**, the switch **119** is closed thus short circuiting a part of the heating coil unit and applying all of the available voltage to the heating element **115**, thereby quickly heating the thermostat. This causes the arm **109** to move into engagement with the terminal **113**, starting a new cycle of operation.

During movement of the ice from either freezing plate to the corresponding cutting unit, the ice engages the hinged baffle **46** or **54** and swings this baffle temporarily out of the way. As soon as the slab of ice has left the freezing plate, this baffle swings back into its normal position.

One of the advantages of the construction described lies in the fact that usually the slab of ice will be frozen on the lower freezing plate **14** more quickly than upon the upper freezing plate due to the fact that the water is initially cooled by passing over the plate **13**. For this reason, the thermostat **103** is mounted in position over the lower freezing plate **14**. When the hot refrigerant gas is passed through the evaporator coils in heat exchange relation with these freezing plates, the slab of ice may normally slide from the freezing plate **14** before it slides from the plate **13**. If the ice from the lower plate **14** slides onto the cutter unit **41** in advance of the time the slab slides from the upper plate **13** onto the cutter unit **39**, the closing of the switch **119** causes a new cycle to start and both freezing plates are in condition to receive liquid. On the other hand, in the event the ice from the upper plate **13** should slide onto the upper cutting unit **39** before the ice from the plate **14** slides onto the cutting unit **41**, the switch **119** will be closed and the thermostat **103** will be heated to start a new cycle. However, if the ice still remains on the lower freezing plate **14**, the water flowing over the slab of ice on this plate at the start of the new cycle, and cooled from engagement with the upper freezing plate **13**, will contact the thermostat **103** and will nullify the effect of the heating element. As a result, the cycle will stop and additional hot refrigerant gas will be passed through the evaporator coils. This operation will continue until the ice is removed from both of the plates.

The ice is cut by the cutting units **39** and **41** and drops into the storage bin until this bin becomes substantially filled with ice cubes. At this time, the thermostat **125** may operate to open the circuit to the cutting unit and to the circulating pump until a sufficient number of the ice cubes have been removed to permit the thermostatic switch **125** to again close. During this time, the compressor motors continue in operation to maintain a low temperature in the ice cube machine so that the cubes in the bin will not thaw.

In accordance with the patent statutes, I have described the principles of construction and operation of the ice cube making apparatus, and while an attempt has been made to disclose the best embodiment thereof, it should be understood that obvious changes may be made within the scope of the following claims without departing from the spirit of the invention.

We claim:

1. An ice cube making apparatus including a pair of inclined substantially parallel freezing plates arranged with one above the level of the other, ice cube cutting means positioned adjacent to the lower end of said plates to receive slabs of ice sliding from said plates, water circulating means, said water circulating means including a pump having an inlet and an outlet, means connecting the outlet of said pump with the upper end of the upper of said refrigerator plates, and means guiding liquid from the lower edge of the upper plate to the upper edge of said lower plate.

2. In an ice cube maker, apparatus comprising: a first ice cube forming device including first inclined plate means for forming a first slab of ice, first cutting means at the lower end of the plate means for cutting the slab delivered from the plate means into cubes; a second ice cube forming device including second plate means inclined in the same direction as the first plate means and spaced subjacent the first plate means for forming a second slab of ice, second cutting means spaced subjacent the first cutting means at the lower end of the second plate means for cutting the second slab of ice delivered from the second plate means into cubes; means for delivering water

to the upper end of the first inclined plate means for flow downwardly thereover; and means for delivering water from the lower end of the first inclined plate means to the upper end of the second inclined plate means for flow downwardly thereover.

3. An ice cube making apparatus including a pair of inclined substantially parallel freezing plates arranged with one above the level of the other, ice cube cutting means positioned adjacent to the lower end of said plates to receive slabs of ice sliding from said plates, water circulating means, said water circulating means including a pump having an inlet and an outlet, means connecting the outlet of said pump with the upper end of the upper of said refrigerator plates, means guiding liquid from adjacent the lower edge of the upper plate to the upper edge of said lower plate, liquid collecting means positioned to receive liquid flowing from the lower edge of the lower plate, means connecting the liquid collecting means to the inlet of said pump, and a baffle extending

across the lower end of the upper refrigerating plate to deflect water downwardly onto the means guiding the liquid to the upper edge of the lower plate.

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