March 2, 1965

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3,171,267

ICE CUBE MAKING MACHINE HAVING REMOVABLE ICE CUBE MOLDS

Filed July 1, 1963

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3 Sheets-Sheet 3

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This invention is concerned with an ice cube making machine, and is particularly concerned with a machine for making ice cubes of different sizes and configurations in a single machine.

It is concerned with a type of ice cube making machine wherein the cubes are frozen in a form over which water is circulated. The cubes are caused to turn loose from the mold cavities in the cubes by circulating a hot refrigerant fluid through the evaporator to warm the ice cubes sufficiently to cause them to turn loose from the cavities and float to the surface of the water circulated over the form, from whence they are floated over a weir and then deposited in a storage bin.

Heretofore commercial type ice cube making machines have been known, having forms therein which were rigidly secured to the machine, and it was only possible to make one size and shape of ice cubes therein.

The present invention contemplates a commercial type ice cube making machine which has readily removable and replaceable mold trays employed therein so that a multiplicity of forms and shapes of ice cubes can be made in a single machine by simply changing the removable trays. The removable trays are made of lightweight, non-absorbative, non-conducting material, such as styrofoam plastic, so that they are very light to handle and easy to place in the water circulating pan and to remove therefrom.

The water circulating and evaporator pan in which the ice cubes are frozen, has evaporator pipes secured to the bottom thereof, or embedded in the material of the bottom, and is flat and comparatively shallow so that it is easily accessible for replacing the mold forms.

The whole assembly is compact, simple and economical to manufacture, and provides an ice cube making machine which is very versatile and compact, yet produces large quantities of ice cubes in a given period of time.

It is, therefore, a primary object of the invention to provide an ice cube making machine having easily removable mold form trays, whereby a multiplicity of forms, sizes and shapes of cubes can be made in a single machine.

A still further object of the invention is to provide an ice cube making machine, having an evaporator pan through which water is continuously circulated, with means to automatically turn the ice cubes loose from the forms when frozen to be floated over a weir in the side or the pan and deposited in a bin, as the water is returned to a storage container.

Still another object of the invention is to provide in an ice cube making machine, means for continuously circulating water through an evaporator pan wherein the mold forms are situated, and means to control the level of the water within the water reservoir.

Still another object of the invention is to provide in an ice cube making machine of the type hereinbefore indicated, an evaporator pan, having a removable mold disposed therein, wherein the evaporator coils are disposed under or within the bottom of the pan, and

grooves or corrugations are formed in the upper surface of the bottom of the pan to prevent vacuum from forming underneath the cubes to thereby permit them to readily turn loose from the forms, when subjected to a temperature above freezing.

A still further object of the invention is to provide a special removable tray to be placed in the evaporator pan of an ice cube making machine wherein the mold forms therein are made of non-absorbent, non-conducting material, and wherein the mold forms are lined on the inner side with a readily heat conductive material such as copper, and wherein the cavities of the mold forms are exposed directly to the upper surface of the bottom of the evaporator pan to allow ready heat exchange between the water in the forms and the evaporator coil surface.

Still another object of the invention is to provide means for automatically by-passing the condenser and capillary tube or expansion valve in the refrigeration circuit of an ice cube making machine, to cause hot, compressed, refrigerant fluid to be circulated through the evaporator coils to thereby introduce heat to the ice within the cavities of the mold forms, to cause the ice cubes to turn loose from the mold forms and float to the surface of the circulating water in the pan, to thereby permit the ice to be separated from the water and deposited in a storage bin as it floats over a weir.

Other and further objects of the invention will become apparent upon reading the detailed specification hereinafter following, and by referring to the drawings annexed hereto.

Suitable embodiments of the invention are shown in the attached drawings, wherein:

FIGURE I is a perspective view, partially cut away, of the ice making machine, showing the refrigeration and water circulating apparatus in association with the evaporator pan in which is disposed one embodiment of the mold form;

FIGURE II is an enlarged fragmentary perspective view of the weir and separator grate, water return trough and conduit;

FIGURE III is a diagrammatic view of the refrigeration circuit employed in the ice cube making machine;

FIGURE IV is a schematic view of the electrical circuit employed in the ice cube making machine;

FIGURE V is a perspective view of one form of cube forming tray;

FIGURE VI is a perspective view of a modified form of cube forming tray;

FIGURE VII is a perspective view of still another modified form of cube forming tray;

FIGURE VIII is a cross-sectional, elevational view taken on the line VIII—VIII of FIGURE V;

FIGURE IX is a cross-sectional, elevational view taken on the line IX—IX of FIGURE VI;

FIGURE X is a cross-sectional, elevational view taken along the line X—X of FIGURE VII;

FIGURE XI is a top plan view of one of the cube forming sockets in the tray of FIGURE V;

FIGURE XII is a top plan view of one of the cube forming sockets in the tray of FIGURE VII;

FIGURE XIII is a top plan view of one of the cube forming sockets of the tray of FIGURE XIV;

FIGURE XIV is a perspective view of a typical ice cube formed in the tray of FIGURE V;
FIGURE XV is a perspective view of a typical ice cube formed in the tray of FIGURE VI; and FIGURE XVI is a perspective view of a typical ice cube formed in the tray of FIGURE VIII. Numerical references are employed to designate the various parts shown in the drawings, and like numerals indicate like parts throughout the various figures of the drawings.

The numeral 1 indicates a general housing for the ice cube forming machine which generally includes an ice making section 2 and a storage bin 3 formed by transverse wall 3b. The storage bin 3 has a closable cover 3a thereon.

The refrigeration section 2 includes a compressor and driving motor generally indicated at 4, a condenser 5, and a motor and fan 6 for the condenser.

The condensed refrigeration fluid is passed from the condenser 5 through the liquid line 49, through the dryer and capillary tube (shown only in schematic view of FIGURE III) and through the evaporator coils or conduits 6.

As shown, the evaporator coils 6 are soldered or otherwise suitable attached to the lower side of the bottom 7 of the evaporator and water circulation pan 8. However, it will be understood that the evaporator coils 6 could be made integrally, and embedded into, the bottom of the pan 7. Bottom 7 of pan 8 is made of suitable heat conducting material such as copper.

The pan bottom 7 preferably has channels, grooves or corrugations 7a formed on the upper surface thereof so as to permit circulation of water under the mold trays, hereinafter described, for ready heat transfer between the cube sockets therein. The grooves 7a also prevent vacuum formation under the cube sockets 7b which would prevent the ice cubes from readily turning loose from the upper surface of the evaporator pan bottom 7.

Water may be continuously circulated through the pan 8 from a water reservoir 9. The water reservoir 9 is supplied with water through a supply pipe 10 which is controlled by a float valve 11, operated by a float 12, so as to control the level of the water in the reservoir 9.

Water is circulated from the water reservoir 9 by means of a pump 13, which forces the water through a circulating pipe 14 and discharges it with some considerable force into the pan 8 and the water is discharged thereinto in such quantity as to cause water to continuously flow over the weir 15 at the opposite edge of the pan 8.

A continuous stream or movement of water passes through the pan 8 and flows over the weir 15, and the water falls through the grate 16 into the water collection trough 17 from which it flows back into the water reservoir 9 through the return conduit 18.

The grate 16 consists of spaced parallel rod-like members which extend from the upper side of the weir 15 to the upper, outer wall of the collection trough 17.

As will be hereinafter described, the spaces between the grate rods 16 are so arranged that ice cubes formed in the sockets of the cube forming trays will not pass between the rods of the grate 16 as the ice cubes are floated over the weir 15. Thus the ice cubes slide over the tops of the rods 16 and into the collection bin 3. Thereby the ice cubes are separated from the water, and are deposited in the storage bin 3 as the water flows back to the reservoir 9.

Removable cube forming trays, such as indicated at 19, are disposed in the pan 8. The removable cube forming trays, typical ones of which are shown at 19, 23 and 27, are made of non-absorbent, non-conductive material. A suitable material is "styrofoam" plastic material, which is a light cellular form of plastic material, which is non-absorbent and non-heat conducting.

As shown in FIGURE I, and as illustrated in FIGURE V, one form of the removable cube forming tray consists of a tray made of such non-absorbent, non-heat conducting material, which has substantially frusto-conical shaped cube forming sockets 20 therein. The sockets 20 are lined on the inner side by a frusto-conical shaped sleeve liner 21 preferably made of a readily heat conducting material such as copper. The frusto-conical shape of the sleeve 21 and the opening formed in the tray 19, provides a downwardly tapered wall or draft 22, which permits the ice cubes to turn loose from the form when subjected to heat in the manner hereinafter described.

The ice cube forming sockets shown in FIGURE V, VIII and XVI makes cubes of the shape indicated at 31 in FIGURE XIV.

Another modified form of tray 23 is shown in FIGURE VI which is made of the same material as the tray 19, and is arranged to make half-cylindrical shaped ice cubes indicated at 32 in FIGURE XIV.

As shown in FIGURE IX, the sockets in the tray body 23 are semi-cylindrical in shape and are lined on the inner side by a semi-cylindrical shaped cup or liner 25 made of heat conducting material, such as copper.

An elongated passage 26 is formed through the lower wall of the tray body 23, and registers with opening 25a formed through the bottom of the shell 25, so that the water within the cups or sockets 24 has direct communication with the evaporator surface 7 for heat exchanging between the water within the shells 25 and the evaporator surface 7.

Still another form of cube forming tray is indicated at 27 in FIGURE VII, said tray having a body portion formed of non-absorbent, non-conducting material, as indicated above with reference to the tray 19. Said tray 27 has sockets with frusto-pyramidal shaped passages therein indicated at 28.

As shown in FIGURE X, the passages 28 are lined on the inner side by a frusto-pyramidal shaped liner made of heat conducting material such as copper, indicated at 29, and includes downwardly tapered walls 30 to provide suitable draft to permit the ready release of ice cubes from the sockets in the manner hereinafter described.

It will be noted that the passages 28 are open at the lower end to permit direct exposure of water therein to the evaporator surface 7 for heat exchange therebetween. The channels or corrugations 7a in the upper surface of the evaporator surface 7 permit free circulation of water under the tray and also prevent the formation of a vacuum below the lower ends of the ice cubes formed therein, which would prevent ready release of the ice cubes from the sockets upon being subjected to heat, as hereinafter described.

The cube formed in the frusto-pyramidal shaped passages 28 is indicated at 33 in FIGURE XVI.

The tray forms illustrated herein are illustrative of some of the many different shapes of ice cubes which may be formed in the machine, and illustrates the versatility thereof, which permits many different shapes and sizes of ice cubes to be formed therein by simply exchanging trays having different sizes and shapes of cube forming sockets therein.

The trays 19, 23 or 27 are laid loosely into the bottom of the pan 8, overlying the evaporator bottom 7, and they may be quickly placed therein and quickly removed therefrom without the necessity of disengaging retaining members.

FIGURE III illustrates the refrigeration circuit employed with the machine wherein hot refrigerant fluid is pumped from the compressor 4 to the condenser 5 where it is cooled. The refrigeration fluid leaves the condenser 5 as a warm liquid through the line 50. The refrigerating fluid which is the refrigeration fluid is passed through a strainer and dryer 34, to remove any moisture or foreign matter therefrom that might be in the system. The fluid then enters the restricted capillary tube 35 which restricts the flow thereof, reducing the pressure thereof as it enters the evaporator coils 6. The refrigerating fluid in the evaporator coils drops the temperature thereof, causing it to pick up heat from the water within the sockets of the cube forming trays, forming ice cubes in
said sockets. The cool low pressure gas is returned from evaporator 6 by means of the suction line 39 to the compressor to repeat the cycle.

The condenser of the main control thermostat 37 extends into the pan 8 and is just even with the top of one of the sockets in the ice cube forming trays. By connecting the liquid line 36 to the suction line 39, allowing the liquid to flow by the condenser coil 36 and returning it to the system through the by-pass line 38, the main control thermostat 37 will stop the cycle at the point where the liquid line contacts the cold solenoid valve 36, thereby opening the valve and allowing the hot refrigerant fluid from the compressor 4 to pass through the by-pass line 38 to the condenser coil 36 and returning the hot refrigerant fluid through the condenser coil 36, thereby raising the temperature of the water within the pan 8, quickly causing the ice cubes formed in the sockets of the cube forming tray to melt sufficiently to turn loose from the sockets and float to the surface of the water passing through the pan 8. The ice cubes float on the surface of the water, which is in continuous motion, and over the weir 15 where the ice cubes slide over the grate 16 into the bin 3. The water flows through the grate 16 into the collection trough 17 and back into the water reservoir 9 through the return conduit 18.

The electrical circuit for operating the various components of the refrigerant and water circulating unit is shown schematically in FIGURE IV.

It will be seen from said schematic drawing that the compressor 4 and the motor of the water pump 13 run continuously until cut off by the bin control thermostat 41, when the storage bin is full and the ice contacts the probe of the thermocouple 41.

The main control thermostat 37 has alternate contacts therein which alternately connect the fan motor 5a and solenoid coil 36 in the circuit. The fan motor 5a for the condenser fan is connected from the line to the contact as when the contact of the solenoid of the thermostat 37 moves from contact a to contact b upon being subjected to predetermined drop in temperature by contacting ice formed in one of the sockets of the cube forming tray.

As explained above, when the solenoid coil 36 is energized, the solenoid valve controlled thereby, opens the by-pass line 38 and allows hot gas to circulate through the evaporator coils 6 to cause ice cubes to turn loose from the sockets in the cube forming trays. After a predetermined lapse of time, the contact of the control thermostat 37 moves back to contact a, starts the fan motor 5a and allows solenoid valve 36 to close, thus directing the fluid through the condenser and through the freezing cycle.

When the bin 3 is filled with ice, the ice contacts the thermocouple 41, and the contact of the bin thermostat is caused to open, thereby stopping the water pump and the compressor, and stopping the freezing cycle.

It will thus be seen that I have provided apparatus for performing the functions and objects set forth above, and have provided an ice cube making machine in which various sizes and forms of ice cubes may be made in a single machine by changing the ice cube forming trays therein, wherein the ice cubes are released from the forms automatically and floated over a weir and deposited in a bin; there is continuous circulation of water through the ice forming pan to provide water for freezing and for also floating the ice cubes out of the pan and over the weir in the side thereof. I have provided an automatic and continuous system for making ice cubes which is automatically turned off when the storage compartment thereof is filled and wherein there is no danger of freezing up and if it is frozen up the evaporator coils and other mechanism thereof are not damaged in any respect. The machine may be made in very compact form and can be made relatively inexpensively.

Having described my invention, I claim:

1. In a device of the class described; a pan having upstanding sides; evaporator coils arranged in the bottom of the pan; means to circulate water through the pan; a weir at one side of the pan; a trough under the weir; a grate extending diagonally from the weir to the upper edge of the outer wall of the trough; a tray made of non-absorptive, heat insulating material arranged to be laid in the pan on the bottom thereof; sockets in the tray having openings in the bottoms thereof communicating with the upper surface of the bottom of the pan; liners in the ice cube forming trays; the water circulating means having openings in the bottoms thereof communicating with the upper surface of the bottom of the pan; means to circulate expanded refrigerant fluid through the evaporator coils to form ice cubes in the sockets; and means to circulate compressed refrigerant fluid through the evaporator coils after the ice cubes have formed therein to cause the ice cubes to melt sufficiently to turn loose from the sockets; the water circulation means being arranged to maintain the level of the water in the pan sufficient to cover the tray and continuously overflow the weir so that released ice cubes may be floated over the weir and separated from the water by the grate.

2. The combination called for in claim 1 wherein indentations are formed in the upper surface of the bottom of the pan.

3. The combination called for in claim 1 wherein the sockets have downwardly converging walls therein, and the liners therein are corresponding in shape.

4. The combination called for in claim 1 wherein the sockets are frusto-conical in shape and the liners therein are corresponding in shape.

5. The combination called for in claim 1 wherein the sockets are semi-cylindrical in shape and the liners therein are corresponding in shape.

6. The combination called for in claim 1 wherein the sockets are semi-cylindrical in shape and the liners therein are corresponding in shape.

7. In a device of the class described; a pan having upstanding sides; evaporator coils arranged in the bottom of the pan; means to circulate water through the pan; a cut-out portion in one side of the pan through which the water flows; a water receiving receptacle adjacent the cut-out portion arranged to receive water flowing over the edge of the cut-out portion; a grate extending diagonally from the lower edge of the cut-out portion to the outer upper edge of the receptacle; a tray made of non-absorptive, heat insulating material arranged to be disposed on the bottom of the pan, the sockets in the tray having openings in the bottoms thereof communicating with the upper surface of the bottom of the pan; liners in the sockets made of heat conducting material with the bottoms thereof communicating with the upper surface of the bottom of the pan; means to circulate expanded refrigerant fluid through the evaporator coils to form ice cubes in the sockets; and means to periodically apply sufficient heat to the ice cubes to cause them to melt sufficiently to turn loose from the sockets; the water circulating means being arranged to maintain the level of the water in the pan sufficient to cover the tray and continuously overflow the cut-out portion so that released ice cubes may be floated over the cut-out portion and separated from the water by the grate.

8. In a device of the class described; a pan having upstanding sides; evaporator coils arranged in the bottom of the pan; means to circulate water through the pan; a tray made of non-absorptive, heat insulating material arranged to be disposed on the bottom of the pan; sockets in the tray having openings in the bottoms thereof communicating with the upper surface of the bottom of the pan; liners in the sockets made of heat conducting material with the bottoms thereof communicating with the upper surface of the bottom of the pan; means to circulate expanded refrigerant fluid through the evaporator coils to form ice cubes in the sockets; and means to periodically apply sufficient heat to the ice cubes to cause them to melt sufficiently to turn loose from the sockets; the water circulating means being arranged to maintain the level of the water in the pan sufficient to cover the
trays as it is continuously circulated thereover, whereby
the released ice cubes may be floated on the surface of
the water; and means to separate the ice cubes from the
water as the water is circulated through the pan.

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