Jan. 17, 1956 A. L. MURDOCK 2,730,865

AUTOMATIC ICE MAKING APPARATUS

Filed Feb. 26, 1952 2 Sheets-Sheet 1

Fig. 1

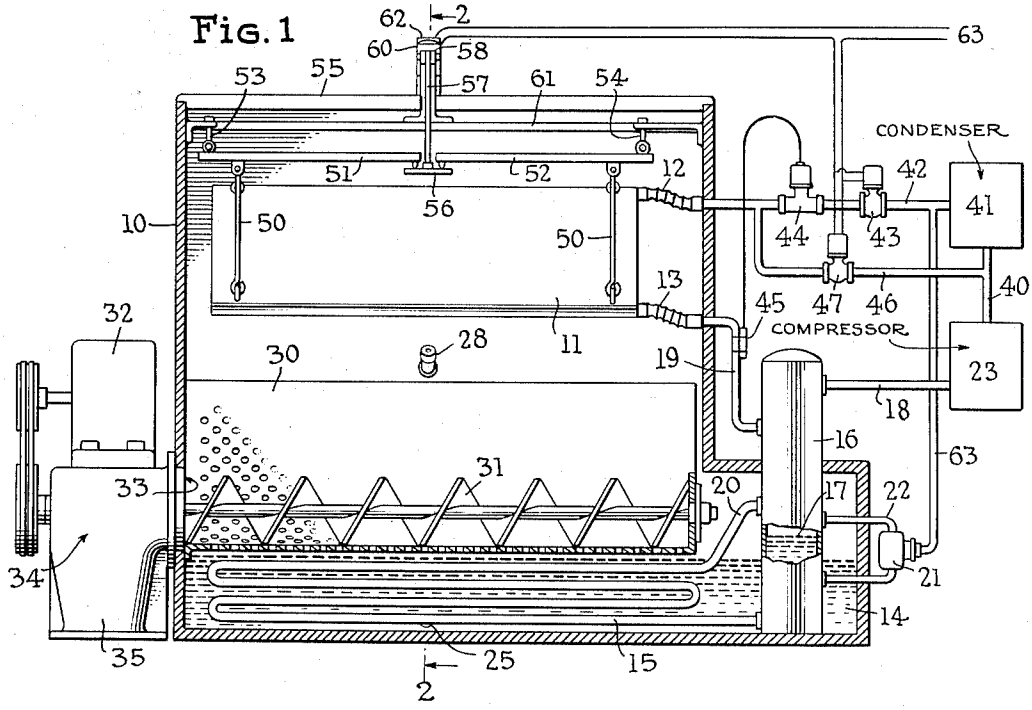


Fig. 3

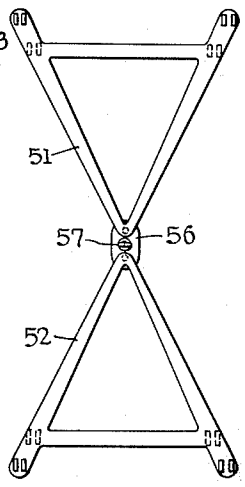
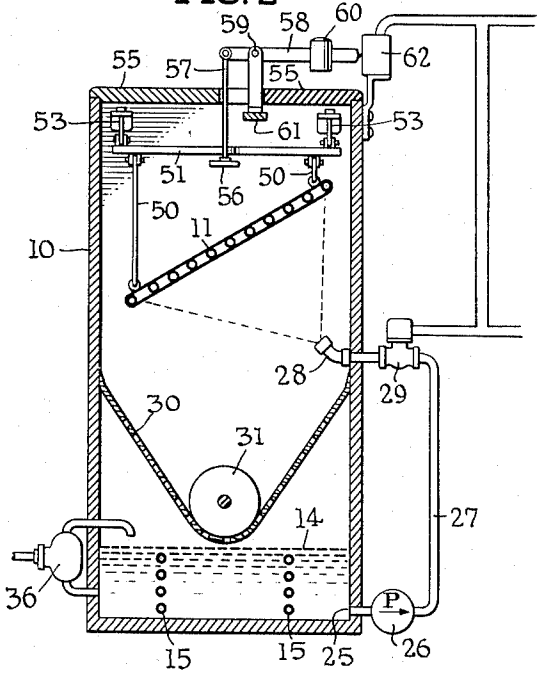


Fig. 2



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Jan. 17, 1956 A. L. MURDOCK 2,730,865

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Filed Feb. 26, 1952 2 Sheets-Sheet 2

Fig. 4

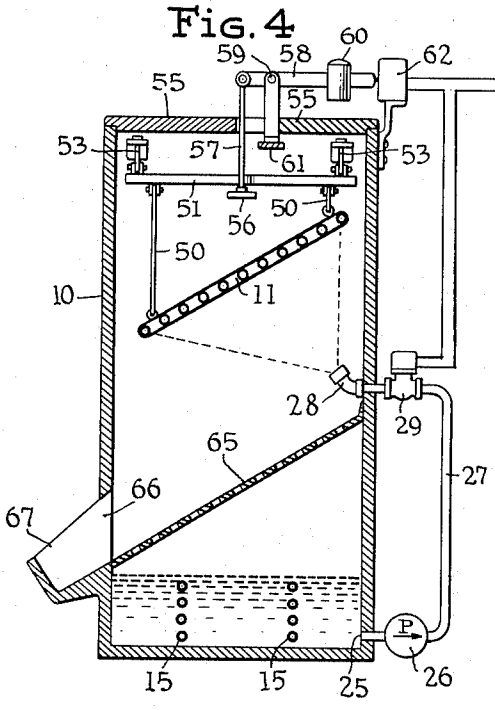


Fig. 5

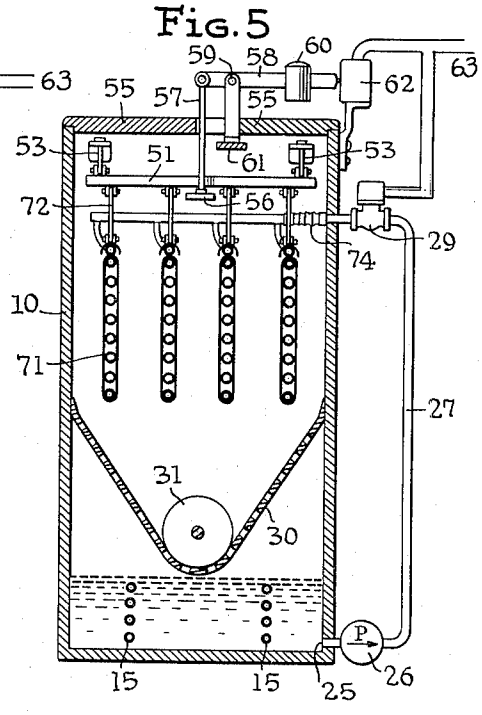


Fig. 6

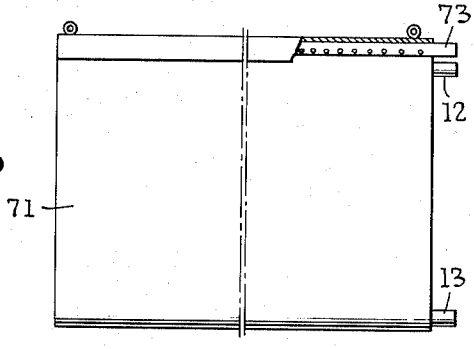


Fig. 7

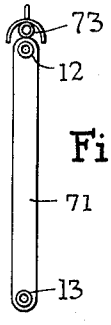


Fig. 8

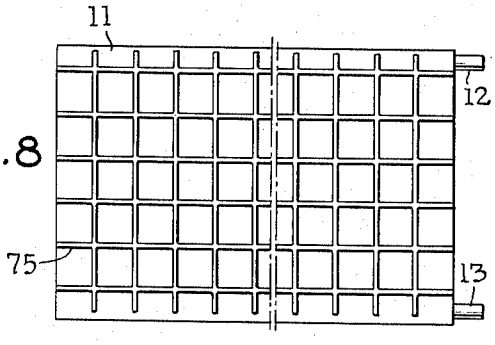
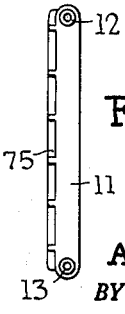


Fig. 9



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2,730,865

Patented Jan. 17, 1956

2,730,865

AUTOMATIC ICE MAKING APPARATUS

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Application February 26, 1952, Serial No. 273,379

7 Claims. (Cl. 62—2)

This invention relates to ice making machines and more particularly to an improved automatic machine for making ice and handling the same.

Automatic ice machines for making flake ice and for making ice cubes are well known. Most of these are constructed on the principle of forming a sheet of ice on a revolving drum or in divided pans, and operate on a time cycle in which the ice is scraped or loosened from the drum or dumped from the pans after a fixed time interval. It is known that the thickness of ice formed in a given time interval varies in accordance with variations in the temperature of the water used and the temperature of refrigerated surface upon which the ice is formed.

It is an object of this invention to provide an automatic ice making machine in which the weight of the ice produced in one cycle of the machine is maintained constant.

It is a further object of this invention to provide an automatic ice making machine in which the length of the freezing cycle is controlled by the weight of the ice produced.

It is another object of this invention to provide an automatic ice making machine in which ice is formed on one or more suspended and refrigerated plates upon which cold water is caused to impinge and freeze.

Numerous other objects and advantages of the invention will be readily apparent to those skilled in the art from the following detailed description of preferred embodiments of the invention illustrated in the accompanying drawings, wherein:

Figure 1 is a sectional view, partly diagrammatic, of a preferred form of the automatic ice making machine of this invention;

Figure 2 is a sectional view taken on line 2—2 of Figure 1;

Figure 3 is a plan view of the freeze plate supporting linkage shown in Figures 1 and 2;

Figure 4 is a sectional view similar to Figure 2 but illustrating a modified form of ice making machine;

Figure 5 is a sectional view of another modification of the automatic ice making machine shown in Figures 1 and 2;

Figure 6 is a side elevational view of one of the freezing plates shown in Figure 5;

Figure 7 is an end elevation of the freeze plate shown in Figure 6;

Figure 8 is an elevational view of a modified form of freeze plate adapted for use in any of the automatic ice making machines illustrated herein; and,

Figure 9 is an end elevation of the modified freeze plate shown in Figure 8.

Referring to Figure 1 for the purposes of illustration, the ice making machine is provided with a casing designated by the numeral 10. The casing 10 may be thermally insulated. A hollow freezing plate 11 is suspended in the upper part of the casing 10. The hollow plate 11 is provided with a flexible inlet conduit 12 for the admission of a fluid refrigerant, and is provided with

a flexible outlet conduit 13 for the exhaust of expended refrigerant. The hollow plate 11 may have a zigzag internal cooling coil therein connected to the inlet 12 and outlet 13. The lower part of casing 10 forms a reservoir for cold water 14, and may be provided with a cooling coil 15 through which liquid refrigerant flows to cool the water 14. At one end of the water reservoir 14 is a closed casing forming a suction trap 16. The suction trap 16 is adapted to contain liquid refrigerant 17 in its lower portion. The upper portion of trap 16 is connected by a conduit 18 to the inlet or suction side of a conventional refrigerant compressor 23, and is also connected to the plate outlet conduit 13 by connection 19, and to the cooling coil 15 by connection 20. A conventional float-control inlet valve 21 is provided to control the inlet 22 of liquid refrigerant to the trap 16 for maintaining a constant level of liquid refrigerant in the trap 16.

At the bottom of water reservoir 14 is a cold water outlet 25 connected to a pump 26 which pumps cold water through conduit 27 to a spray nozzle 28 through which cold water is directed against the lower surface of freezing plate 11. A solenoid-operated valve 29 is provided in the conduit 27. A V-shaped perforated ice collector or hopper plate 30 is supported within the casing 10 above the level of the cold water 14, and may be provided in its lower portion with a conveyor screw 31 driven by a motor 32 at the end of the casing 10. The casing 10 is provided with an outlet aperture 33 at the end of the conveyor 31 and through which ice may be delivered to an ice crusher 34 on the conveyor shaft, the ice being discharged downward through a delivery opening 35. The crusher 34 may be eliminated in installations where ice crushing is not required. The ice collecting plates 30 are perforated in order that any cold water dripping from the freezing plate 11 may flow back to the cold water reservoir 14 for recirculation. The level of the cold water in reservoir 14 may be maintained constant by an atuomatic float-controlled water inlet valve 36.

The high pressure side of compressor 23 is connected by conduit 40 to a conventional condenser 41. Liquid refrigerant from condenser 41 flows through conduit 42 to the flexible inlet connection 12 for the freeze plate 11. A solenoid-operated cut-off valve 43 and an expansion valve 44 are provided in conduit 42. The expansion valve 44 may be variable and be controlled by a thermal control device 45 responsive to the temperature of refrigerant in the outlet connection 13. A hot gas by-pass conduit 46 extends from the conduit 40 through a solenoid-operated valve 47 to the conduit 42 between expansion valve 44 and the inlet connection 12. The by-pass 46 is provided to permit the introduction of hot refrigerant gases into the cooling coil in freeze plate 11 momentarily when it is desired to release the ice frozen on the plate 11.

The support of the freeze plate 11 within the casing 10 will now be described. The plate 11 is preferably suspended by four links or cables 50, one attached to each corner of the plate 11. The upper ends of the links 50 are secured to horizontal beam members 51 and 52, shown best in Figure 3. The outer ends of the beams 51 and 52 are suspended by links 53 and 54, respectively, secured to brackets mounted on the casing 10. The adjacent ends of the beams 51 and 52 rest upon a connecting member 56, which in turn is suspended by a link 57 extending upward through the removable cover 55 to the end of a scale beam 58. The scale beam 58 is pivotally supported by a pivot 59 carried by a horizontal bar 61 mounted in the casing 10. The beam 58 is provided with an adjustable weight 60. The weight 60 is slidable along the beam 58 to counterbalance the weight of the beams 51 and 52, and the freeze plate 11 and to provide overbalance in

an amount equal to the desired weight of ice to be formed on freeze plate **11** during each freezing cycle of operation. The beam **58** is connected to operate a switch mechanism **62** which latter is connected to supply line **63** and controls the operation of the solenoid valves **29**, **43**, and **47**, heretofore described.

The operation of the automatic ice making machine illustrated in Figures 1, 2 and 3 will now be described. The refrigeration apparatus including compressor **23** and condenser **41** and controls therefor may be conventional. Refrigerants such as ammonia, Freon, and the like may be used, as will be obvious to those skilled in the refrigeration art. The water **14** to be made into ice is stored in the tank forming the bottom of casing **10**. The water **14** is precooled by the cooling pipes **15** containing liquid refrigerant **17** from the trap chamber **16**. The pipes **15** are spaced well apart so that any ice forming on the pipes will not prevent the flow of water over and between the pipes. The water thus cooled, is pumped by pump **26** to the nozzle **28** which directs it against the lower side of freeze plate **11**. The freeze plate **11** is refrigerated to freezing temperatures by the flow of refrigerant through the expansion valve **44** into the hollow plate **11**. The spent refrigerant passes out of the plate **11** through the lower connection **13** and into the trap chamber **16**. Gaseous refrigerant is drawn from the upper part of trap **16** through conduit **18** into the compressor **23** for recycling in the system. The level of liquid refrigerant maintained in the bottom of trap **16** is controlled by a conventional float valve **21** admitting liquid refrigerant from the line **63** to the trap inlet **22**. When ice has frozen on the freeze plate **11** to the desired weight of ice, the weight of the ice causes the plate to move downward overbalancing the adjustable counterweight on beam **58** and causing the switch mechanism **62** to function. Switch mechanism **62** then closes the valve **43** to stop the flow of refrigerant to the plate, opens the valve **47** to permit the flow of hot refrigerant gases to the freeze plate, and closes the valve **29** to cut off the flow of cold water to the spray nozzle **28**. The admission of hot gas to the plate **11** quickly causes the ice formed thereon to drop off onto the perforated hopper **30** and conveyor **31** which moves the ice to the crusher **34**, or to a suitable storage container if desired. Any water unfrozen by the plate **11** or formed during the thawing step passes downward through the perforations in the hopper **30** and back to the water storage space in the bottom of the casing **10**. As soon as the ice has dropped off from the plate **11**, the adjustable weight **60** raises the plate **11**, and operates the switch mechanism **62** to cut off the hot gas valve **47**, open the refrigerant valve **43**, and open the cold water spray valve **29**, to start the formation of more ice on the plate. The thawing operation is relatively rapid and the amount of hot gas introduced into the plate **11** and the trap **16** is small and not enough to unbalance the system. The expansion valve **44** may be controlled by mechanism **45** responsive to the temperature of the freeze plate exhaust **13** to maintain the desired freeze temperature of the plate **11**. The water supply valve **36** operates automatically to maintain the water level constant. The motor **32** operating the ice discharge conveyor **31** may be operated periodically on a time cycle, or may be operated only when ice is desired, or may be controlled automatically to discharge ice only after a desired quantity of ice has been formed. When ice drops from the freeze plate **11** onto the hopper **30** and conveyor **31**, it may break into pieces of satisfactory size and eliminate the need for the crusher **34** in certain installations. It will be noted that by adjustment of the position of the balance weight **60** on the scale beam **58**, the ice making may be controlled to form ice of most any desired thickness before the switch mechanism **62** functions automatically to control the thawing cycle.

In the modified form of automatic ice making machine shown in Figure 4, the details are the same as in the Figure 1 machine except that the hopper and conveyor are replaced by a sloping perforated plate **65** which serves to permit the ice to slide by gravity to discharge opening **66** and into an accessible open bin **67** for use.

In the modification shown in Figure 5, a plurality of vertical freeze plates **71** are used instead of a single inclined plate **11**. Each plate **71** is suspended from the beam members **51** and **52** by links or cables **72**, so that the weight of ice formed on the plates **71** will operate the switch mechanism **62** when a desired weight of ice has been formed. In this modification, each vertical plate **71** is provided with a horizontal water distribution conduit **73** along its upper edge, the conduits **73** being perforated to flow water down both side surfaces of each plate **71** for freezing. The spray nozzle **28** of the preferred modification is not used, and the conduits **73** are connected together and through a flexible conduit **74** to the water control valve **29**. The plates **71** are provided with an internal refrigerant coil and with refrigerant inlet and outlet flexible connections **12** and **13** such as provided for freeze plate **11**.

As illustrated in Figures 8 and 9, the freeze plate **11** may be provided with a grid-like lower surface **75** formed by spaced ridges dividing the surface into small rectangles. When the sheet of ice formed on this surface drops from the freeze plate downward to the hopper **30** or to inclined plate **65**, it tends to break up into cubes or squares of ice of regular size and shape. It will be apparent to those skilled in the art that a grid surface shaped to promote ice breakage into squares, triangles, strips, or the like may be easily substituted on any of the freeze plates illustrated.

This invention contemplates the use of various forms of weighing mechanisms, switch mechanisms, solenoid valves, and the like, as it will be readily apparent to the skilled refrigeration mechanic that many such substitutions and variations are possible within the scope of the following claims.

What I claim is:

1. In automatic ice making apparatus, the combination comprising, a housing, a refrigerated hollow plate member adapted to freeze water applied to the lower outer surface of said member, a pivotally mounted linkage in the upper portion of said housing and having said hollow plate member suspended therefrom, a cold water reservoir in the bottom of said housing, pump means to apply water from said reservoir to the lower surface of said plate member, refrigerating means to cool said member, switch means engaged by said linkage for cutting off said refrigerating means upon formation of a predetermined weight of ice upon said member, and a perforate hopper within said housing below said member and above said water reservoir for collecting ice formed on said member.

2. In automatic ice making apparatus, the combination comprising, a housing, a refrigerated hollow plate member adapted to freeze water applied to the lower outer surface of said member, a pivotally mounted scale beam type linkage at the upper end of said housing, means suspending said plate member from said linkage in a position inclined with respect to a horizontal plane, nozzle means to spray water against the lower outer surface of said plate member, refrigerating means to cool said plate member, and means connected to said plate member supporting linkage, to said refrigerating means, and to said water spray means to cut off said refrigerating means and spray means upon formation of a predetermined weight of ice upon said plate member.

3. In automatic ice making apparatus, the combination comprising, a hollow plate member, counterbalanced linkage means for supporting said plate member, inlet and outlet conduits connected to said plate member, a valve connected to said inlet conduit for admitting a refrigerant to said plate member, a second valve connected to said inlet conduit for admitting a relatively hot gas to said plate member, means for directing water against an outer surface of said plate, and means controlled by said linkage for closing said refrigerant valve and opening said

hot gas valve upon formation of a predetermined weight of ice upon said plate member.

4. Automatic ice making apparatus comprising in combination, a housing, a hollow plate member adapted to freeze water applied to the surface of said member, counterbalanced linkage means at the upper portion of said housing for supporting said plate member, a cold water reservoir in the lower portion of said housing, a pump connected to said reservoir for delivering water from said reservoir to said plate member, refrigerating means including a compressor and a condenser, a liquid refrigerant trap chamber extending into said water reservoir, a cooling conduit in said water reservoir connected with said trap chamber, conduits connecting the upper portion of said trap chamber with said plate member and with the inlet of said compressor, a conduit connecting the outlet of said compressor to said condenser, a conduit connecting said condenser to said plate member and having a cut-off valve and an expansion valve therein, a conduit connecting the outlet of said compressor with said plate member and having a cut-off valve therein, and means operated by said linkage and connected to control both of said cut-off valves, whereby upon formation of a predetermined weight of ice on said plate member said first cut-off valve is closed to stop the flow of cool refrigerant to said plate member and said second cut-off valve is opened to admit relatively hot refrigerant from said compressor to said plate member to release ice from the surface of said plate member.

5. In automatic ice making apparatus of the character defined in claim 1, said perforate hopper being flat and inclined with respect to a horizontal plane and having its lower portion aligned with a bin outside of said housing.

6. In automatic ice making apparatus, the combination comprising, a reservoir for cold water, a hollow plate member, a conduit for directing cold water from said reservoir against the surface of said hollow plate member, a refrigerant supply conduit connected to said hollow plate member, a valve in said cold water conduit, a valve in said refrigerant supply conduit, a balanced linkage

supporting said hollow plate member above the level of water in said reservoir, and valve control means engaged by said linkage and connected to both of said valves to close both of said valves upon formation of a predetermined weight of ice upon the surface of said plate member.

7. In automatic ice making apparatus, the combination comprising, a reservoir for cold water, a hollow plate member, a conduit for directing cold water from said reservoir against the surface of said hollow plate member, a refrigerant supply conduit connected to said hollow plate member, a valve in said cold water conduit, a valve in said refrigerant supply conduit, a balanced linkage supporting said hollow plate member above the level of water in said reservoir and in a position inclined with respect to a horizontal plane, a nozzle on said cold water supply conduit for directing cold water against the lower outer surface of said inclined plate member, a perforate sheet positioned between said inclined plate and the surface of the cold water in said reservoir, said perforate sheet also being supported in a position inclined with respect to a horizontal plane to direct ice falling from said plate member to one side of said reservoir, and valve control means engaged by said linkage and connected to both of said valves to close both of said valves upon formation of a predetermined weight of ice upon the surface of said plate member.

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