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3,045,445

ICE MAKING

Filed Dec. 19, 1960

2 Sheets-Sheet 1

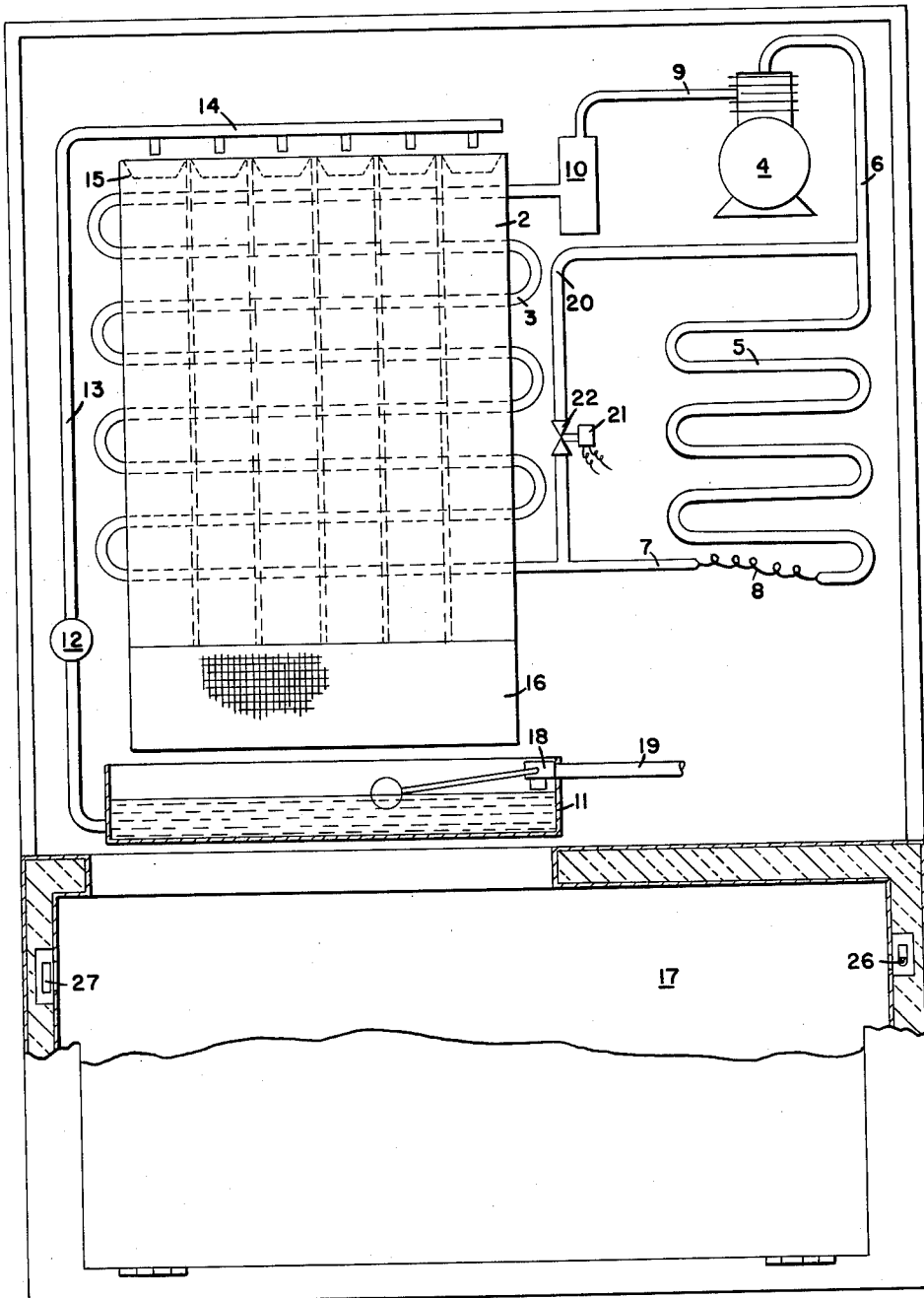


FIG. 1

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2 Sheets-Sheet 2

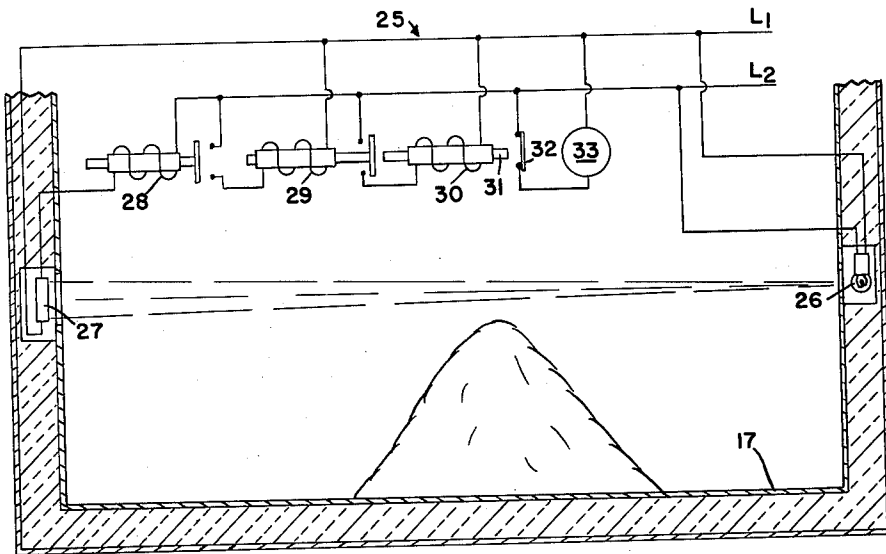


FIG. 2

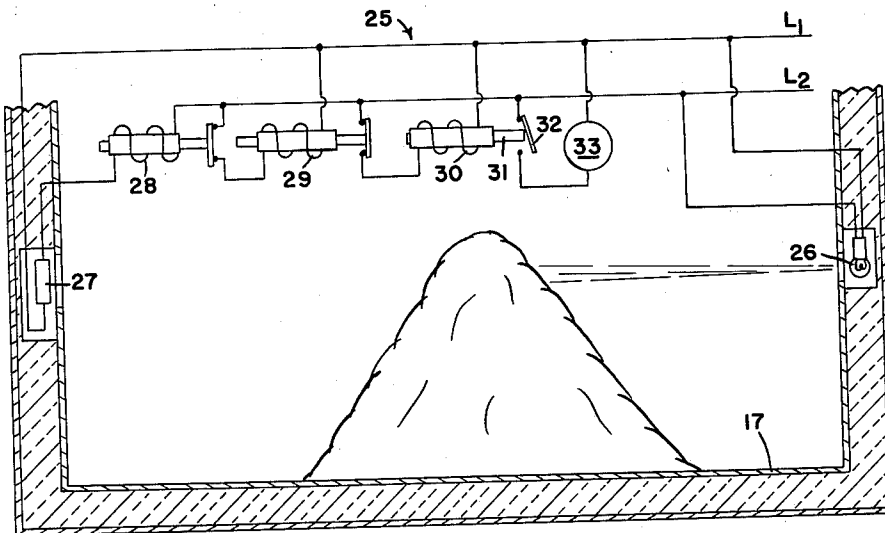


FIG. 3

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1

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5 Claims. (Cl. 62-137)

This invention relates generally to ice making apparatus and more particularly, to an ice making apparatus wherein ice is alternately formed and harvested in a predetermined cyclical manner, the ice forming apparatus having means for controlling the level of ice accumulation in a storage bin in which the ice is periodically deposited.

Still more specifically, this invention relates to a control means for deenergizing the ice making apparatus when a predetermined quantity of ice is available for use in the storage bunker. Though the control means contemplated by this invention may be used in different forms of ice making apparatus, it is particularly suited for use in automatic ice making equipment having an ice forming compartment and a storage compartment in communication therewith. Within the ice forming compartment are a plurality of tubular members, open at both ends. The tubular members are provided with refrigerated inner surfaces over which water is continuously circulated. During operation of the ice making apparatus, portions of the circulated water are formed into ice, and subsequently harvested. The harvested ice passes by gravity into a storage compartment and remains there until removed by the consumer.

As is apparent, the quantity of ice which can be received in the storage container is limited by the capacity of the container, hence it is necessary to provide control means for effecting cessation of delivery of ice from the ice forming compartment. Heretofore, it has been suggested that a thermostatic sensing element capable of actuating a switch in the circuit of the compressor motor of the refrigeration system be employed.

Once the ice in the storage compartment builds up to the extent that portions thereof engage the thermostatic sensing element and so lower its temperature, a switch is opened to deenergize the compressor motor and terminate operation of the ice making apparatus.

The use of a thermostatic sensing element has sometimes proven inadequate in that the sensing element must be set extremely close to a freezing temperature and is subject to premature tripping by cold water splash, cold air drafts, or inadvertent ice pile up by the operator during ice removal. Additionally, barometric conditions result in a variation in effectiveness of the thermostatic element. The delicate nature of the capillary tube conventionally employed also presents problems.

It is with these problems and desiderata in mind that the present ice making apparatus having improved control means for limiting the level of ice accumulations in the ice storage bunker of the ice making apparatus has been evolved. The ice making apparatus is provided with control means responsive primarily to the presence of ice accumulations and not subject to being activated by extraneous influences such as water splash, temperature and humidity conditions, or ice removal or deposit.

It is accordingly a primary object of this invention to provide an ice making apparatus having an improved control for limiting ice accumulations in the ice storage container in such apparatus.

Another object of the invention is to provide ice making apparatus with control means for limiting ice accumulations, with the control means not subject to barometric conditions.

A further object of the invention is to provide ice making apparatus having control means for limiting ice ac-

2

cumulations with the control means not subject to premature actuation by cold water splash, ice removal, or the like.

An additional object of the invention is to provide ice making apparatus having ice sensing control means which respond relatively fast to accumulations of given ice quantities.

It is an additional object of this invention to provide an ice making apparatus with an ice sensing control for limiting ice accumulations in the ice storage container, with the control being relatively simple in production, economical in manufacture and maintenance, and relatively foolproof in operation.

These and other objects of the invention which will become hereafter apparent are attained by provision in an ice making apparatus of a control arranged in the ice storage container in which ice is retained until consumed, the novel control terminating operation of the ice making apparatus when a predetermined quantity of ice is deposited in the storage container. The novel control means acting to determine and limit the quantity of ice received by said storage means comprise energy sensitive means, such as a photo-electric cell, positioned in the storage means with said energy sensitive means arranged to receive energy such as light from energy emitting means, such as a light source, directing a beam above the point of maximum desired ice accumulation in the storage means. The photo-electric cell is series coupled to a normally closed relay which may be encased therewith in a common housing. A time delay relay, with normally open contacts, a pull-type reset solenoid, and a normally closed momentary contact type switch are arranged across the line to which the photo-electric cell and normally closed relay are connected. In use, the aforescribed components are arranged to control the energization of the ice making apparatus, so that the detection of a given quantity of ice in the ice storage bin or bunker results in termination of operation of the ice making apparatus. A sustained interruption of the light beam emanating from the light source deenergizes the relay in series with the light cell closing its contacts. Thereupon, the solenoid is energized to open the contacts of the momentary contact switch, thus breaking the circuit to the compressor in the refrigeration system.

A primary feature of the invention resides in the fact that the time delay relay prevents termination of the ice supply by extraneous light beam interruption such as might be caused by water splash from the ice forming means into the ice storage bunker or by the action of an operator in removing ice from the storage bunker. Only upon the occurrence of a sustained light beam interruption, such as would occur upon the accumulation of a given quantity of ice, is the control circuit activated to render the refrigeration system inoperative.

The specific details of a preferred embodiment of the invention and their mode of functioning will be made most manifest and particularly pointed out in clear, concise and exact terms in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a diagrammatic view of the ice making apparatus of the present invention including a portion of the control system thereof;

FIGURE 2 is a schematic wiring diagram showing a preferred circuit arrangement of the components of the novel control system with less than a predetermined quantity of ice in the storage bin; and

FIGURE 3 is a schematic wiring diagram showing a preferred circuit arrangement of the components of the control system with a predetermined quantity of ice in the storage bin.

Referring more particularly to the drawings, there is shown in FIGURE 1 an arrangement embodying my in-

vention. A plurality of ice forming members 2 are shown surrounded by evaporator coil 3 of a refrigeration system including compressor 4 and condenser 5 connected to the compressor by discharge line 6. Refrigerant is supplied to evaporator coil 3 from condenser 5 through line 7, which contains a capillary tube 8 for metering refrigerant to the evaporator coil. Other expansion means may be provided, if desired. At the other end of the evaporator coil, there is a suction line 9 which conducts the gaseous refrigerant to the compressor 4. Accumulator 10, in line 9, acts as a reservoir for unevaporated liquid refrigerant en route to the compressor.

The condenser 5 may be of the air-cooled or of the liquid-cooled type, as desired.

The means for supplying water to be frozen includes tank or reservoir 11 and pump 12 for feeding water from the tank through line 13 to header 14 disposed above the ice forming members 2. The header has a plurality of openings therein permitting the water to enter the ice forming members 2 via dispersion plates 15. A deflection grid or screen 23 is located beneath the ice forming members at an angle thereto so as to permit water to pass by gravity into tank 11 while guiding the ice to storage bunker or bin 17.

In order to maintain a predetermined amount of water in the supply tank 11 when the ice making apparatus is in operation, a float-controlled valve 18 is shown connected to a supply line 19.

During the freezing cycle water is circulated from the tank into the refrigerated ice forming members 2, where part of the water is formed into ice and the remainder is returned to the tank by gravity. The water returning to the tank has been reduced in temperature by passing through the refrigerated ice making members. Inasmuch as pure water is frozen initially, the water returning to the tank has a substantially high mineral content and suitable means (not shown) may be provided for removing this water periodically from the tank.

After the ice has been formed completely in the ice forming members 2, the water which is being introduced from the header into the ice forming members is caused to overflow due to the presence of the ice which restricts further passage of the water to actuate a control arrangement (not shown). The particular control means preferably employed is shown in Patent No. 2,755,098, granted December 25, 1956. The control means energizes a solenoid 21, which in turn opens bypass valve 22 in the bypass line 20. The bypass line is connected between the discharge line 6 of compressor 4 and the evaporator coil feed line 7. When bypass valve 22 opens, relatively hot gaseous refrigerant flows directly to the evaporator coil from the compressor 4 so as to cause a thawing action in the ice making members 2, which removes the ice therefrom.

Referring now more particularly to FIGURES 2 and 3, the control system 25 determining the quantity of ice received in storage bunker 17 is seen to comprise a light source 26 arranged on one side of the bunker or bin 17. This light source 26 is of a conventional type and is here schematically shown as an incandescent lamp, but it will be understood by those skilled in the art that any form of light source may be utilized. It will also be appreciated that any emitter of energy may be substituted within the scope of the invention.

Energy sensitive means here shown as light sensitive means in the form of photo-electric cell 27 are arranged on a wall of storage bunker 17 opposite to that of the radiant energy source in a position such that the energy beam emitted will pass in a path above the point of maximum desired ice accumulation. Photo-electric cell 27 is arranged in series with relay 28 having normally closed contacts, and the series coupled relay 28 and cell 27 are placed across the power supply lines L_1 and L_2 .

Time delay relay 29 is coupled to relay 28 so that upon deenergization of relay 28 its contacts will assume their

normally closed position permitting current to flow to relay 29, which after a preselected time interval will have its normally open contacts closed.

A pull-type reset solenoid 30 is coupled for energization by the closing of the time delay relay contacts, and armature 31 of the solenoid is coupled to the arm of momentary contact switch 32. Switch 32 is arranged in the power supply circuit of the mechanism supplying ice to the storage bunker, which in this instance is shown schematically as compressor motor 33 in the refrigeration circuit of the ice making apparatus.

During the operation of the automatic ice making apparatus, quantities of ice are alternately formed and harvested in the manner described above. It will be obvious that a substantial amount of ice will be collected in bunker 17. The control for limiting ice accumulations in the ice storage bunker is arranged in combination with the ice storage bunker or bin 17 so that the energy emitted in the form of a light beam from the energy emitting means here shown as comprising light source 26 will be passed over the point of maximum desired accumulation of ice in the bin 17. Energy sensitive means in the form of photo-electric cell 27 are arranged to be impinged on by the energy emitted by the light source 26, thereby permitting current to flow through relay 28 with the result that the relay contacts remain open. With the contacts of relay 28 open, time delay relay 29 and solenoid 30 are not energized so long as light falls on the photo-electric cell 27. Switch 32 under these conditions remains closed and the compressor motor 33 remains energized to continue the production of ice. Upon the accumulation of ice in bin 17 to a point where there will be sustained interruption of the light beam, photo-electric cell 27 interrupts the flow of current through relay 28, thereby permitting the relay contacts to assume their normally closed position. If these normally closed contacts remain closed for a period sufficient to permit time delay relay 29 to actuate solenoid 30, the armature 31 of solenoid 30 which is coupled to momentary contact switch 32, permits the opening of switch 32 breaking the circuit to compressor motor 33 and discontinuing the production and delivery of ice.

It will be observed that periodic interruption of the energy beam such as might occur due to momentary build-ups of ice in the bin during deposit or removal of the ice, or interruptions due to water splash, do not result in a cessation of delivery of ice to the bunker, since the time delay does not permit actuation of solenoid 30.

It will further be apparent that though switch 32 has been described as connected to control the operation of compressor motor 33, that the switch 28 may be arranged to interrupt current flow to either ice delivery apparatus or ice forming apparatus.

It is thus seen that an ice making apparatus has been provided with simple, effective means for limiting ice accumulations in the storage bin or bunker thereof. Extraneous factors such as cold water splash, cold air drafts, or barometric variations, which sometimes adversely affected the operation of previous ice making apparatus, do not influence the operation of the present ice making apparatus.

The above disclosure has been given by way of illustration and elucidation, and not by way of limitation, and it is desired to protect all embodiments of the herein disclosed inventive concept within the scope of the appended claims.

I claim:

1. In an ice making apparatus, the combination of means for forming ice, means for harvesting the formed ice, a storage bin placed below the ice forming means for collecting the harvested ice, and means responsive to the collection of a predetermined supply of ice in the storage bin for discontinuing operation of the apparatus, said discontinuing means comprising energy emitting means arranged in the storage bin to pass a beam of energy in a path above the point of maximum desired ice accumula-

tion in said storage bin, energy sensitive means arranged in the storage bin, and time delay means coupled to said energy sensitive means to delay the response thereof to the interruption of the energy beam emitted by said energy emitting means, whereby upon interruption of the energy beam emitted by said energy emitting means by the harvested ice, said energy sensitive means will be actuated to discontinue operation of the apparatus.

2. In an ice making apparatus, the combination of ice forming means, means for supplying water to be frozen to said ice forming means, means for freezing a portion of the water and for harvesting the formed ice, an ice storage bunker for collecting the ice, and control means including an ice level control for limiting the level of accumulation of ice in said ice storage bunker, said control means comprising a circuit coupled to a source of electrical power, said ice level control comprising energy emitting means arranged on one side of the storage bunker to emit an energy beam in a path across the area in which ice is accumulated in the storage bunker, the path lying at a level immediately above the point of maximum desired ice accumulation, energy sensitive means arranged on a side of the storage bunker opposite to the side on which said energy emitting means are arranged, switch means in said circuit actuated by said energy sensitive means to deactivate the ice making apparatus upon the interruption of the energy beam by an accumulation of ice in the storage bunker above a desired level, and time delay means coupled to said energy sensitive means to delay the actuation of said switch means, whereby momentary interruptions of the energy beam by water splash or the like will not deactivate the ice making apparatus.

3. A method for operating an ice making apparatus comprising forming and harvesting ice, collecting harvested ice in a storage bunker, emitting an energy beam from one side of the bunker along a path across the area in which the ice is accumulated in the bunker, the path lying immediately above the point of maximum desired ice accumulation, sensing the energy beam at the side of the bunker opposite to the side from which it was emitted and switching off the flow of power to the ice making apparatus upon the interruption of the energy beam by an accumulation of ice in the storage bunker above a desired level, the switching off of the flow of power being delayed for a fixed time interval after interruption of the energy beam whereby momentary interruptions of the energy beam by water splash or the like will not deactivate the ice making apparatus.

4. In an ice making apparatus, the combination of means for forming ice, means for harvesting the formed ice, a storage bunker for receiving the harvested ice and ice level control means for limiting the level of accumula-

tion of ice in the ice storage bunker, said control means comprising energy emitting means arranged on one side of the storage bunker to emit an energy beam in a path across the area in which ice is accumulated in the bunker, the path lying at a level immediately above the point of maximum desired ice accumulation, energy sensitive means are arranged on a side of the storage bunker opposite to the side on which said energy emitting means are arranged, relay means coupled to said energy sensitive means for actuation thereby, time delay means between said energy sensitive means and said relay means to delay the actuation of said relay means by said energy sensitive means, and switch means activated by said relay means controlling the powering of the ice making apparatus.

5. In ice making apparatus, the combination of ice forming members, means for supplying water to said ice forming members, means for forming ice on the forming members and for harvesting formed ice from the forming members, an ice storage bin for collecting formed ice, and a control for limiting the ice accumulations in the bin, said control comprising a photoelectric cell mounted on a wall of the bin, a light source directing a ray of light against said photo-electric cell along a path immediately above the maximum height of desired ice accumulation, a circuit coupling said photo-electric cell to the forming and harvesting means, said circuit being actuated when said photo-electric cell is impinged on by the light beam from said light source to permit operation of the forming and harvesting means, and being actuated to discontinue operation of the forming and harvesting means upon interruption of the light beam, said circuit comprising a relay with normally closed contacts which are maintained open when the photo-electric cell is impinged on by the light beam; a time delay relay coupled to said relay to delay the passage of current through a circuit comprising the normally closed contacts; a solenoid in the circuit controlled by the time delay relay; and a normally closed switch controlling the actuation of the means for forming and harvesting ice, said switch coupled to said solenoid for movement between a forming and harvesting means actuating position and deactuating position.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,045,445

July 24, 1962

David' E. MacLeod

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, lines 10 and 11, for "predetermine" read
-- predetermined --; column 6, line 7, strike out "are".

Signed and sealed this 4th day of December 1962.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents