Mar. 3, 1925. 1,528,043

G. L. BENNETT

METHOD OR ART OF AND APPARATUS FOR MAKING ICE

Filed Feb. 17, 1921

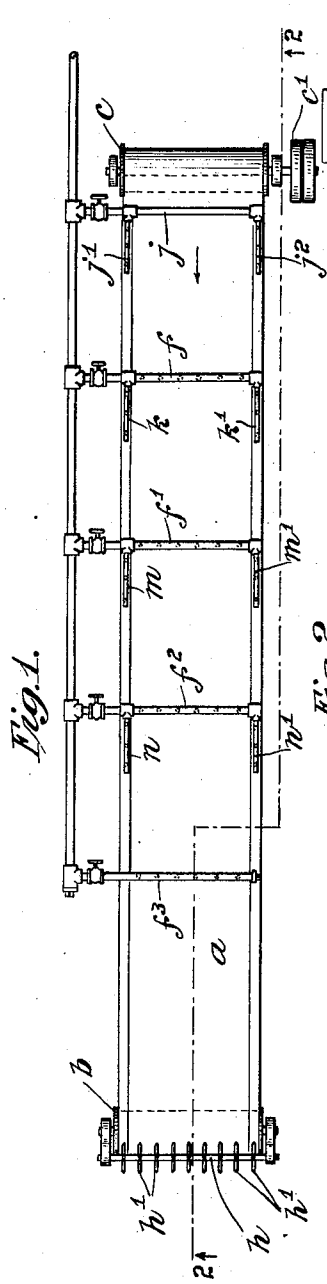

Fig. 1.

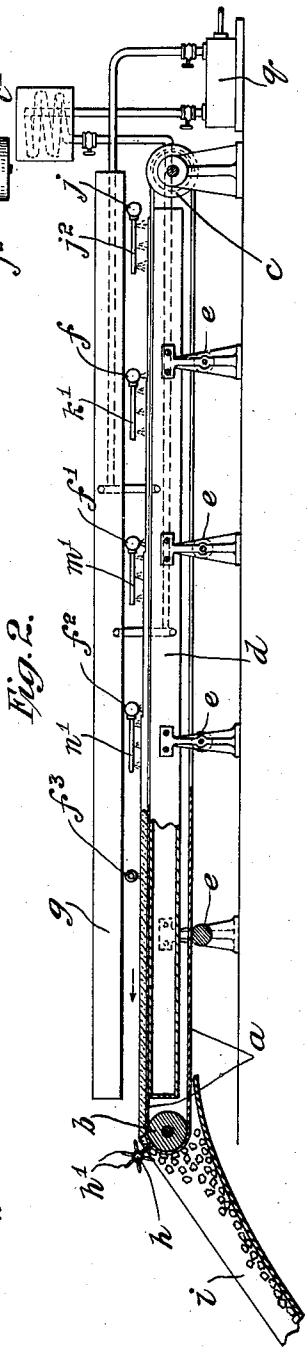

Fig. 2.

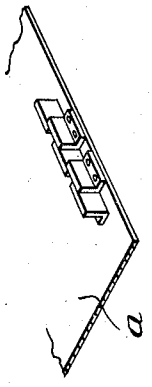

Fig. 5.

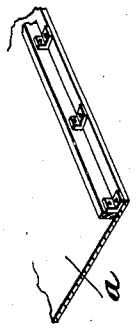

Fig. 4.

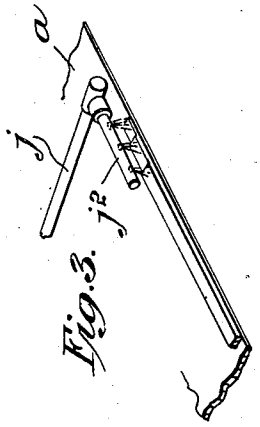

Fig. 3.

George L. Bennett
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Patented Mar. 3, 1925.

1,528,043

UNITED STATES PATENT OFFICE.

GEORGE L. BENNETT, OF HASTINGS-ON-HUDSON, NEW YORK.

METHOD OR ART OF AND APPARATUS FOR MAKING ICE.

Application filed February 17, 1921. Serial No. 445,624.

To all whom it may concern:

Be it known that I, GEORGE L. BENNETT, a citizen of the United States, residing at Hastings-on-Hudson, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Methods or Art of and Apparatus for Making Ice, of which the following is a specification, reference being had therein to the accompanying drawings, which form a part thereof.

My invention relates to a method or art of, and apparatus for, making ice, and more particularly to the production of broken ice, as distinguished from cake ice or plate ice.

By the method or art of my invention, I am enabled to rapidly congeal water and bring a sheet of ice thus produced to a thickness which will make it suitable for use in certain industries such as the production of ice cream, the preservation of fish and other foodstuff, and for table use in restaurants, the ice thus produced being fairly clear. The method or art of my invention is capable of continuously producing ice of this quality, and involves the delivery of the water to be frozen under conditions which will cause the rapid and uniform absorption of the heat unit therein by the refrigerating medium.

In the practice of said method or art, I use an apparatus embodying therein a slowly travelling member which, while continuously subjected to the action of a refrigerating agent or mechanism, will have formed thereon a sheet of ice of gradually or progressively increased thickness, thus permitting the freezing of the sheet of ice of the ultimate desired thickness, in succeeding stages, while avoiding the presence thereon of a sufficient volume of water at any time to interfere with the rapid congealing of the water at each stage during which the water is being flowed thereon.

The ice is formed upon an endless continuous travelling belt, and when the ice has attained the desired thickness, it is automatically separated from this belt and brought within the operative range of breakers, which will separate it into lumps of a size suitable for the ultimate use to which the ice is to be put.

The invention consists primarily in a method or art of making ice consisting in slowly flowing water in succeeding stages upon a heat conductive member while subjecting said member to the action of a refrigerating medium, whereby a sheet of ice of increasing thickness is progressively formed, and in an apparatus by which said method or art may be practiced to continuously produce ice, all as hereinafter set forth and described, and more particularly pointed out in the claims hereto appended.

Referring to the drawings,

Fig. 1 is a plan view of an ice making apparatus for practicing the method or art of my invention, with the upper refrigerator tank removed;

Fig. 2 is a section on the line 2—2 of Fig. 1; and

Figs. 3, 4 and 5 are detailed perspective views of different methods of forming the edge dams.

Like letters refer to like parts throughout the several views.

In the practice of the method or art of my invention, I employ a heat conductive sheet such as an endless thin metal belt, which has continuous movement imparted thereto. The upper reach of this belt passes in close juxtaposition to a suitable refrigeration tank so that said belt will be within a low temperature zone which will cause any water delivered upon the belt to be rapidly congealed.

During the movement of said belt, I flow upon same, at different stages of such movement, a small volume of water divided into a plurality of minute streams, this water congealing sufficiently rapidly to retain it upon the belt, or if desired, ice dams may be formed along the opposite edges of the belt so as to confine the water subsequently flowed thereonto within the limits prescribed by said dams, and thus permit a greater volume of water to be flowed than might be otherwise possible.

By flowing water upon said belt in different succeeding stages, I may progressively build up the sheet of ice upon the belt until it has attained the desired thickness, this sheet being separated from the belt and discharged therefrom after it has left the low temperature zone, preferably by imparting to the belt a sharp bend sufficient to overcome the bond between the lower face of the ice and the belt. As the sheet of ice leaves the belt, it will be broken into small particles

by reason of the violence of the separation of the ice from the belt, although mechanical means supplementing this action will ensure greater uniformity in the size of the different pieces.

It is essential, in the practice of the method or art of my invention, to flow the water to be converted into ice, upon said belt at intervals of sufficient length to permit a complete solidification of the water previously flowed upon the belt, so as to limit the thickness of the mass from which the heat units must be extracted.

By using a refrigerating tank below the belt, I can readily and rapidly build up ice of from one-half to three-quarters of an inch in thickness, although I am enabled to secure much clearer ice by using refrigerating tanks both above and below the upper reach of the belt.

Referring more particularly to the apparatus for carrying on the said method or art, which is shown in the accompanying drawings, *a* represents a thin sheet metal endless conveyer belt passing about the pulleys *b* and *c* at opposite ends thereof respectively. The pulley *c* is driven from any desired source of power through the pulley *c'*, the speed of said pulley being very low so as to impart a slow traverse to the belt *a*. The upper reach of the belt *a* rests upon a suitable refrigerating mechanism such as the direct expansion tank *d* which will serve to hold the belt flat and cause the absorption of heat units from the water delivered to the top reach of said belt, the high heat conductivity of the belt facilitating this transfer of heat from matter on the belt to the ammonia contained in the tank *d*.

A considerable number of idler return pulleys *e* are provided for supporting the lower reach of the belt.

Extending above and substantially across the top reach of the belt *a* are a sequence of water supply pipes *f*, *f'*, f^2 and f^3, spaced a sufficient distance apart to permit the water flowed onto the top reach of the belt thereby to freeze before a fresh supply of water is flowed thereonto. The various pipes *f* to f^3 should be properly insulated to ensure continuity of the flow of water therethrough to the belt.

By providing delivery pipes spaced apart as described, water is flowed upon corresponding portions of the belt in succeeding stages, although each of the pipes *f* to f^3 has a continuous flow of water therethrough to the belt, this flowing of the water in distinct stages resulting from the movement of the belt relative to the various supply pipes.

Each of the pipes *f* to f^3 is provided with spaced slow flowing nozzles presented toward the top reach of the belt *a* with the two-fold object of limiting the volume of water being delivered, and causing its delivery to a restricted area, so that it may, by diffusion, cover a certain limited area upon the belt at a shallow depth which will ensure the rapid congealing of the water.

The low conductivity of ice, when a single refrigerating tank *d* is employed, will have a tendency to produce a cloudy or snow ice and make the freezing during the later stages in the building up of the sheet of ice upon the belt, slower. I, therefore, prefer to provide a second refrigerating tank *g* positioned above the top reach of the belt, which will ensure greater uniformity in the freezing operation and produce a clearer ice.

The diameter of the pulley *b* should be as small as is consistent with the material used in the belt, so as to ensure a sharp bend as the upper reach passes about said pulley, thus separating the bottom of the sheet of ice from the belt to automatically remove the ice from the belt, this action having a tendency to break the ice, although preferably I provide independently acting breaker means as the shaft *h* carrying a plurality of radially extending pick blades *h'* terminating adjacent the surface of the belt and adapted, by engagement with the ice as it is stripped therefrom, to break it into small particles.

While the shaft *h* may be power-driven, if desired, the engagement of the picks thereof with the sheet of ice may be relied upon to develop sufficient power in said pick or breaker mechanism to reduce the ice to pieces of the desired commercial bulk.

Beyond the pulley *b* is a chute *i* into which the broken ice will fall, and by which it will be conveyed to a storage tank, not shown in the drawings.

In order to prevent the overflowing of the water as it is flowed upon the belt *a*, dams are formed along the opposite edges of said belt, it being possible to provide means whereby ice dams will be formed while the belt is in motion, or to secure to said belt, dams of a flexible or yieldable nature to permit the belt to pass about the pulleys *b* and *c*.

Troughing of the belt is impracticable by reason of the low flexibility thereof and the difficulty of uniformly freezing water flowed thereonto when there is a varying depth thereof upon the belt.

Referring more particularly to the mechanism employed for forming ice dams at the edges of the belt *a*, which is illustrated in Figs. 1 to 3 of the drawings, I provide a pipe *j* adjacent the pulley *b* having branches extending above and adjacent the opposite edges of the belt *a*, said branches having small outlet openings therein so that water in small volume will drip upon or be de-

livered to adjacent the edges of the belt, said nozzles being in advance of the first supply pipe f, so that these side dams will be formed upon the belt before any water is flowed thereonto from said pipe f. The branch pipes referred to are indicated at j' and j^2 respectively.

The supply pipes f, f' and f^2 are provided with similarly constructed and arranged branch pipes k—k', m—m' and n—n' so that after each flowing of water within the space defined by the dams formed during the preceding dam forming operation, said dams will be built up to the desired height prior to the next flowing of water upon said belt. Since after any portion of the belt passes below the supply pipe f^3, the ice will have attained the desired thickness upon the belt a, no branch pipes are provided in connection with said pipe f^3.

To secure the desired results, the water will be flowed upon the belt a either by the supply pipes or by the dam forming device, in streams of small volume and low velocity in order to ensure the rapid congealing thereof.

In lieu of the formation of the dams by means of the discharge of water adjacent the edges of the belt a, I may equip the opposite edges of said belt with continuous flexible dams o of soft rubber or other similar material which will not resist the bending action of the belt, or may form said side dams of a plurality of short lapping sections p having a sufficiently close fit to retard or prevent the flowing of water therebetween, these sections being of a length to permit the belt to take the desired curvature in passing about the pulleys b and c.

The ammonia is circulated in the tanks d and g by means of a suitable compressor shown conventionally at q.

In the operation of the herein described apparatus, after the liquid ammonia or other refrigerating medium has been delivered to the tanks d and g power is applied to the pulleys c to impart travel at a slow speed to the belt a. The valve controlling the flow of water through the pipe j is then opened, the water flowing from the branch pipes j' and j^2 congealing with sufficient rapidity to form a thin ridge or dam along the opposite edges of the top reach of said belt. The low temperature zone upon opposite sides of the belt a will congeal this water sufficiently rapidly to prevent any substantial volume thereof flowing from the belt.

The water feed pipes f, f', f^2 and f^3 are then opened successively, the valve to the pipe f being opened after the portion of the belt a having the side dams formed thereon, has passed this pipe. The water flowing upon the upper reach of the belt a between the dams thus formed will rapidly congeal the branch pipes k—k' increasing the height of the dams to above the level of the ice sheet formed upon the belt from the water discharged thereupon from the supply pipe f. This operation is repeated at the supply pipes f' and f^2 so that when the forward edge of the ice coated belt passes under the pipe f^3, the side edges thereof will be raised above the top level of the ice sheet. With the forms of dams shown in Figs. 4 to 5 of the drawings, the strip o or plates p are relied upon to prevent the water flowing from the top reach of the belt.

To secure the desired rapid congealing of the water flowed upon the belt, the water before being delivered to the various pipes f, f', f^2, f^3 and j should be cooled to approximately 32° F., so as to ensure the rapid solidification thereof while in the low temperature zone.

By spacing the supply pipes apart as shown, and by using slow running streams of water, the water flowed upon the belt by each of said pipes will be completely solidified before the portion of the belt containing same reaches the succeeding nozzles in the direction of movement of the belt, so that although the various nozzles act continuously so far as the flowing of the water is concerned, there is an application of this water to the belt in succeeding stages by reason of the spacing of the supply pipes.

When the belt a reaches the pulley b, the bending of said belt in following the pulley will break it away from the ice, which will be projected into engagement with the picks carried by the shaft h, the thrust of said ice upon said picks causing them to rotate, and succeeding picks engaging succeeding portions of the ice, to break it into small pieces which will drop into the chute and be conveyed to the point of storage.

It is essential that the water be flowed slowly upon the belt while maintained at a low temperature, and that the thickness of the ice be progressively increased, the depth of each flow ranging preferably from one-eighth to three-sixteenths of an inch.

It is not my intention to limit the invention to the precise details of construction shown in the accompanying drawings, it being apparent that such may be varied without departing from the spirit and scope of the invention.

Having described the invention, what I claim as new and desire to have protected by Letters Patent, is:—

1. A method or art of making ice consisting in slowly and continuously flowing water in succeeding stages upon spaced portions of a heat conductive member, and imparting slow travel to said heat absorptive member to bring every portion of said member in co-relation to each stage of flowing water, while subjecting said member to the

action of a refrigerating medium whereby a continuous sheet of ice of increasing thickness is progressively formed.

2. A method or art of making ice consisting in imparting slow travel to a non-absorptive member, through a low temperature zone, and forming ice in a sheet of progressively increasing thickness upon said member by flowing water upon said member and the ice formed thereupon at different intervals of its movement while passing through said low temperature zone.

3. An ice making apparatus embodying therein an endless member, refrigerator means adjacent thereto, means whereby traverse at low speed, is imparted to said member, and a plurality of water supply pipes arranged to flow water upon said member, said member passing said pipes successively, whereby a sheet of ice of progressively increasing thickness is formed thereon.

4. An ice making apparatus embodying therein an endless member, refrigerator means above and below said member, means whereby traverse at low speed, is imparted to said member, and a plurality of water supply pipes arranged to flow water upon said member, said member passing said pipes successively, whereby a sheet of ice of progressively increasing thickness is formed thereon.

5. An ice making apparatus embodying therein an endless metal belt, means whereby power may be applied to said belt to impart traverse at low speed thereto, refrigeration means affording a low temperature zone adjacent the top reach of said belt, means within said low temperature zone for maintaining said belt substantially flat and a plurality of water supply pipes above and projecting across said belt, said pipes being spaced apart in the direction of movement of said belt whereby all portions of said belt will have water flowed thereupon in succeeding stages and a sheet of ice of progressively increasing thickness will be formed on said belt.

6. An ice making apparatus embodying therein an endless metal belt, rollers about which said belt passes, means whereby power may be applied to said belt to impart traverse at low speed thereto, refrigeration means affording a low temperature zone adjacent the top reach of said belt, a plurality of water supply pipes above and projecting across said belt, said pipes being spaced apart in the direction of movement of said belt whereby all portions of said belt will have water flowed thereupon in succeeding stages and a sheet of ice of progressively increasing thickness will be formed on said belt, means within said low temperature zone for maintaining said belt substantially flat and a breaker mechanism adjacent one of said rollers adapted to reduce the ice sheet to small lumps substantially simultaneously with its separation from said belt, as said belt passes about said roller.

7. An ice making apparatus embodying therein an endless metal belt, means whereby power may be applied to said belt to impart traverse at low speed thereto, refrigeration tanks above and below the top reach of said belt affording a low temperature zone adjacent the top reach of said belt, said refrigeration tank below the top reach of said belt supporting said reach substantially flat and a plurality of water supply pipes above and projecting across said belt, between same and the refrigeration tank above said belt, said pipes being spaced apart in the direction of movement of said belt whereby all portions of said belt will have water flowed thereupon in succeeding stages and a sheet of ice of progressively increasing thickness will be formed on said belt.

8. An ice making apparatus embodying therein an endless metal belt, rollers about which said belt passes, means whereby power may be applied to said belt to impart traverse at low speed thereto, refrigeration tanks above and below the top reach of said belt affording a low temperature zone adjacent the top reach of said belt, the refrigerating tank below the top reach of said belt supporting said reach substantially flat, a plurality of water supply pipes above and projecting across said belt between same and the refrigeration tank above said belt, said pipes being spaced apart in the direction of movement of said belt whereby all portions of said belt will have water flowed thereupon in succeeding stages and a sheet of ice of progressively increasing thickness will be formed on said belt, and a breaker mechanism adjacent one of said rollers adapted to reduce the ice sheet to small lumps substantially simultaneously with its separation from said belt, as said belt passes about said roller.

9. An ice making apparatus embodying therein an endless member, refrigerator means adjacent thereto, means whereby traverse at low speed, is imparted to said member, a plurality of water supply pipes arranged to flow water upon said member, said member passing said pipes successively, whereby a sheet of ice of progressively increasing thickness is formed thereon, and means whereby water flowed upon said member will be confined thereupon until it has congealed.

10. An ice making apparatus embodying therein an endless metal belt, means whereby power may be applied to said belt to impart traverse at low speed thereto, refrigeration means affording a low temperature zone adjacent the top reach of said belt, a plurality of water supply pipes above

and projecting across said belt, said pipes being spaced apart in the direction of movement of said belt whereby all portions of said belt will have water flowed thereupon in succeeding stages and a sheet of ice of progressively increasing thickness will be formed on said belt, means for maintaining said belt substantially flat while adjacent said refrigeration means, and means whereby water flowed upon said belt will be confined thereupon until it has congealed.

11. An ice making apparatus embodying therein an endless metal belt, means whereby power may be applied to said belt to impart traverse at low speed thereto, refrigeration means affording a low temperature zone adjacent the top reach of said belt, a plurality of water supply pipes above and projecting across said belt, said pipes being spaced apart in the direction of movement of said belt whereby all portions of said belt will have water flowed thereupon in succeeding stages and a sheet of ice of progressively increasing thickness will be formed on said belt, and means in advance of each of said supply pipes, whereby water in small volume will be delivered adjacent the opposite edges of said belt to form ice dams of progressively increased height as the belt progresses with relation to said supply pipes.

12. An ice making apparatus embodying therein an endless metal belt, rollers about which said belt passes, means whereby power may be applied to said belt to impart traverse at low speed thereto, refrigeration means affording a low temperature zone adjacent the top reach of said belt, a plurality of water supply pipes above and projecting across said belt, said pipes being spaced apart in the direction of movement of said belt whereby all portions of said belt will have water flowed thereupon in succeeding stages and a sheet of ice of progressively increasing thickness will be formed on said belt, means in advance of each of said supply pipes, whereby water in small volume will be delivered adjacent the opposite edges of said belt to form ice dams of progressively increased height as the belt progresses with relation to said supply pipes, and a breaker mechanism adjacent one of said rollers adapted to reduce the ice sheet to small lumps substantially simultaneously with its separation from said belt, as said belt passes about said roller.

In witness whereof I have hereunto affixed my signature, in the presence of two subscribing witnesses, this 14th day of February 1921.

GEORGE L. BENNETT.

Witnesses:
F. T. WENTWORTH,
FRIEDA KOEHLER.