Sept. 20, 1955 T. B. GILLIAM 2,718,124

ICE CUBE APPARATUS AND METHOD

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FIG. 1

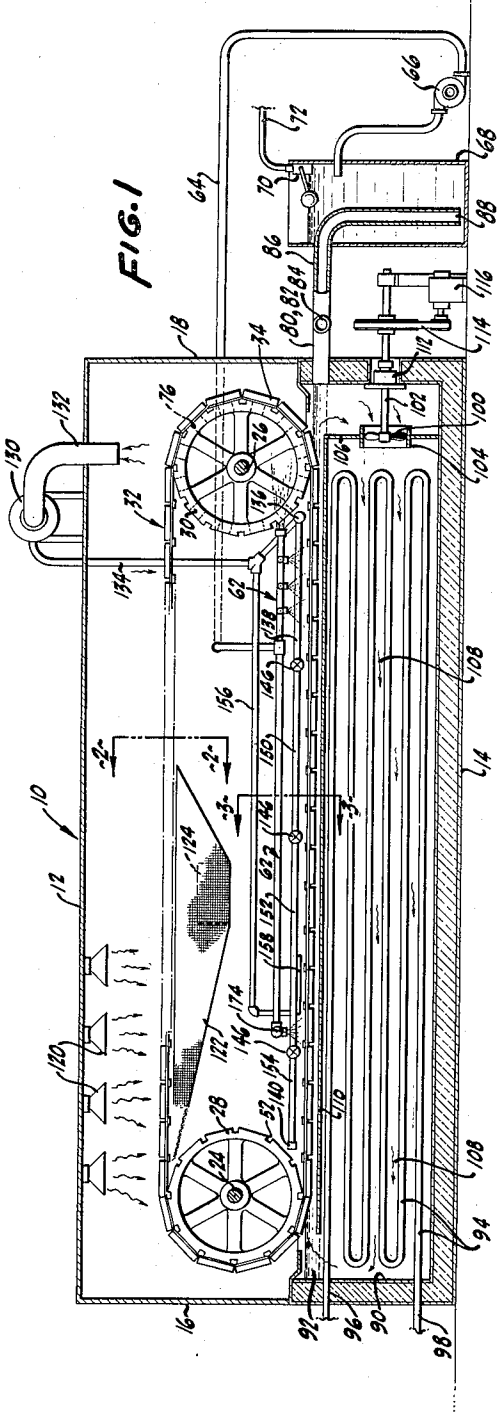
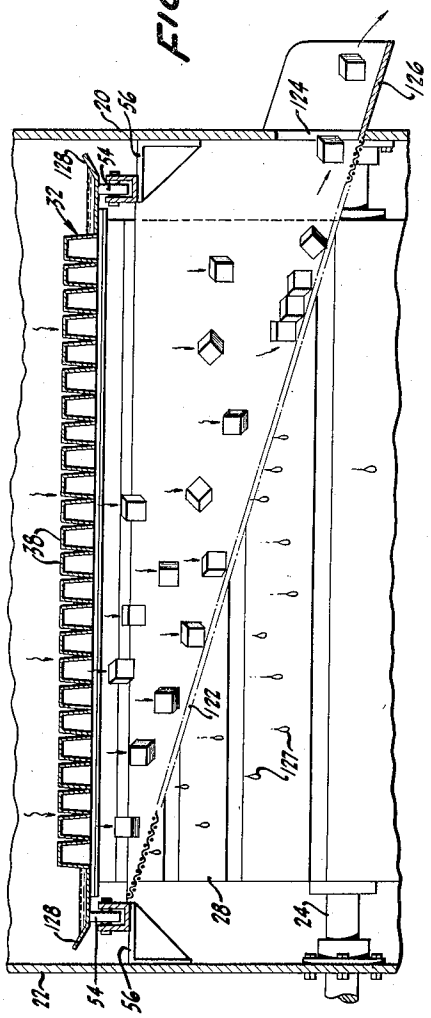


FIG. 2



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ICE CUBE APPARATUS AND METHOD

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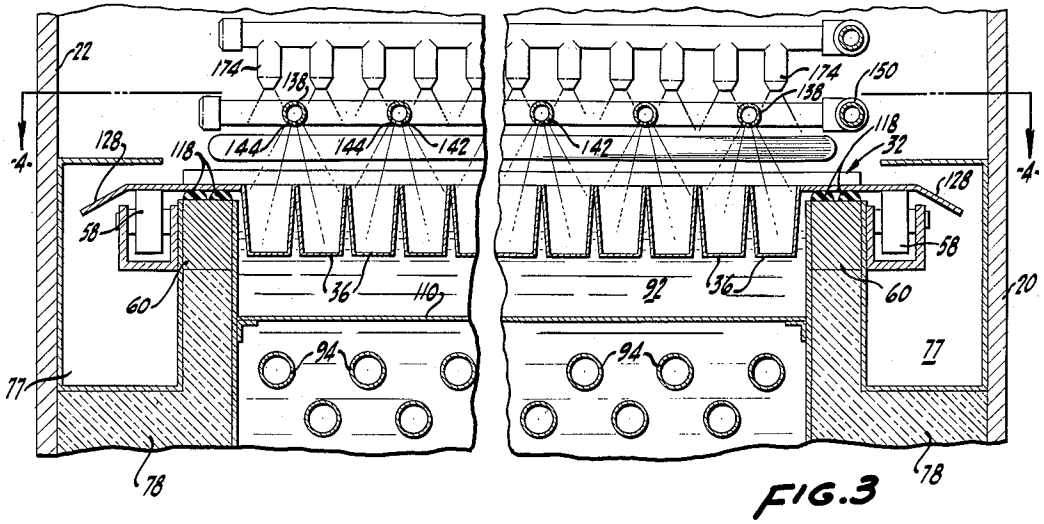


FIG. 3

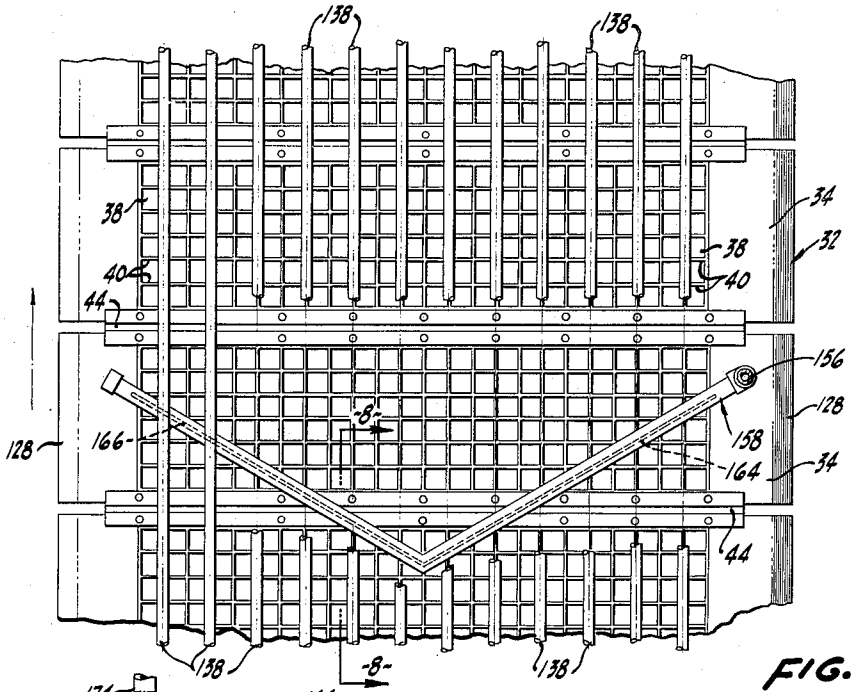


FIG. 4

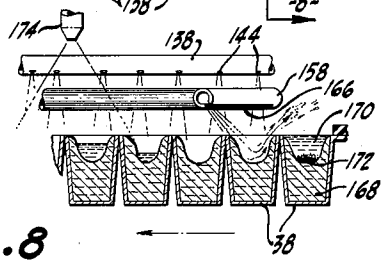


FIG. 8

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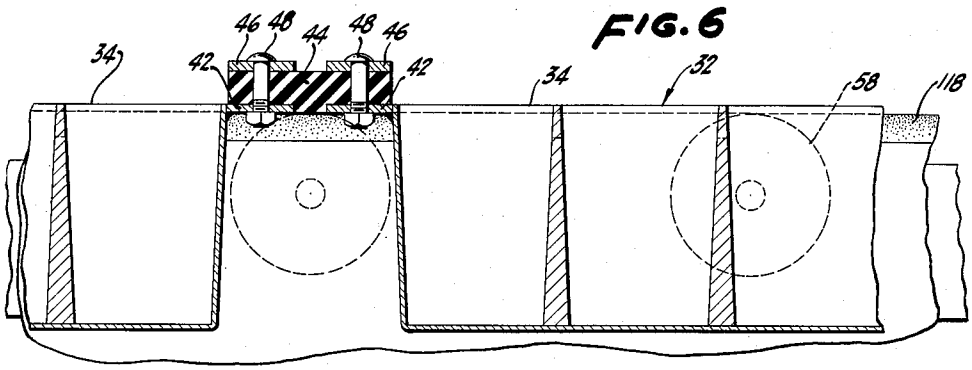
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ICE CUBE APPARATUS AND METHOD

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FIG. 6



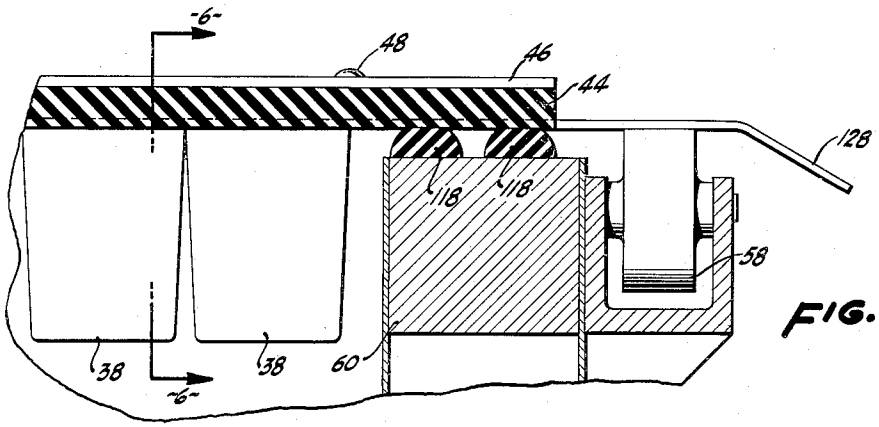


FIG. 5

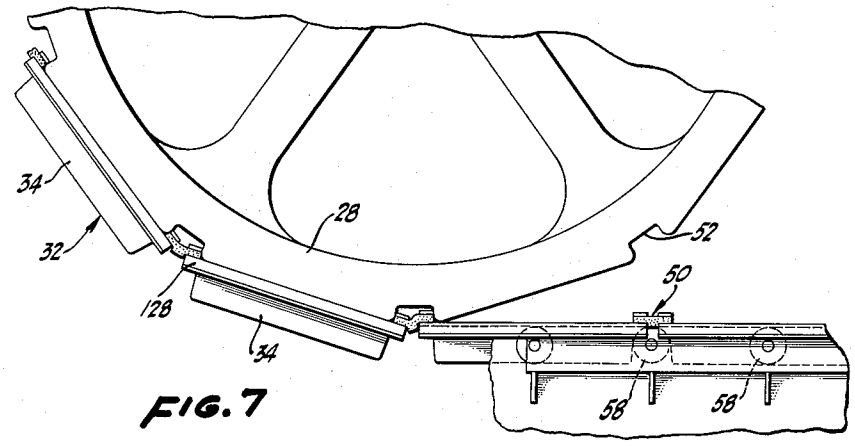


FIG. 7

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United States Patent Office

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ICE CUBE APPARATUS AND METHOD

Thomas B. Gilliam, San Francisco, Calif.

Application June 1, 1953, Serial No. 358,761

14 Claims. (Cl. 62—106)

This invention relates to improvements in refrigerating methods and apparatus, and more particularly to an improved method and apparatus for the continuous manufacture of ice cubes, or other frozen shapes and articles. This application is a continuation-in-part of my co-pending application Serial Number 297,021, filed July 3, 1952, now abandoned.

Among the primary objects of the invention are the following: The provision of a method and apparatus for the automatic and continuous manufacture of clear ice cubes uniformly shaped and sized; and the provision of a method and apparatus for manufacturing ice cubes, and the like, while maintaining a heat balance of optimum efficiency.

Other objects and advantages of the invention will be apparent from the following description taken in conjunction with drawings forming part of this specification, and in which:

Figure 1 is a view in elevation of the ice cube producing apparatus of the invention, with the side wall of the housing thereof being removed for purposes of illustration of the apparatus;

Figure 2 is an enlarged view in section taken along lines 2—2 of Figure 1;

Figure 3 is an enlarged view in section taken along lines 3—3 of Figure 1;

Figure 4 is a top plan view of a portion of the continuous ice cube mold belt embodied in the apparatus of the invention as taken along lines 4—4 of Figure 3;

Figure 5 is an enlarged detail view of a portion of the apparatus which is shown in reduced form in Figure 3;

Figure 6 is a detail view in section taken along lines 6—6 of Figure 5;

Figure 7 is an enlarged partial view showing the cooperative relationship between the ice cube mold belt and a support drum used for the driving of the same; and

Figure 8 is an enlarged detail view taken along lines 8—8 of Figure 4.

Referring to the drawings for more specific details of the apparatus and method of the invention, the apparatus includes a housing **10** having top and bottom walls **12** and **14**, end walls **16** and **18**, and side walls **20** and **22**. Journalled between the side walls are rotatable shafts **24** and **26** having mounted thereon for rotation therewith drums **28** and **30**. Shaft **24** is adapted to be driven by variable speed drive means, not shown.

A continuous ice cube mold belt **32** comprising a plurality of articulated sections **34** is carried on and is adapted to be moved by the driver drum **28** and idler drum **30**. The belt sections **34** are preferably formed from metal sheets which are deep-drawn to provide longitudinal rows **36** of mold pockets, with these pockets being in turn subdivided to form ice cube molds **38** by removable partition members **40**. The marginal edges, or flanges, **42** of adjacent belt section **34** are

secured together by strips of rubber belting **44** which are clamped between the flanges **42** and metal strips **46** by bolts **48** (Figure 6). The belting **44** is provided at its underside with a rib-like extension which fills the space between adjacently disposed edges of flanges **42**. The protuberances, which are indicated generally by the reference numeral **50**, and which are comprised of the rubber strips **44** and the metal clamping strips **46**, constitute cleat members which enable the belt **32** to be driven by the drums **28** and **30**, said drums being provided with equi-spaced parallel grooves **52** within which the cleat members **50** are received.

Means are embodied in the apparatus for the support of the upper and lower reaches of the belt **32** so as to maintain these reaches horizontally disposed during movement of the belt. The sections **34** of the upper reach of the belt are supported beyond the extremities of the cleat members **50** by spaced rollers **54** mounted on brackets **56** carried by the side walls **20** and **22** of the housing. Rollers **58** carried by internal wall members **60** (Figure 3) support the sections **34** of the lower reach of the belt.

The mold cavities **38** of the belt are filled by water delivered to a spray-head system indicated generally at **62**, the water being delivered through a suitable feed conduit **64** by a pump **66** which is in communication with a sump **68**. Means, such as a float control valve **70**, serves to admit water through a delivery line **72**, communicating with a suitable water supply source, not shown, to maintain a sufficient level of water within the sump **68** so that the pump **66** may continuously operate to feed the spray-head system **62**. The spray-head system **62** includes a rearwardly directed spray-head **74** adapted to spray water through apertures **76** in drum **30** so that the mold cavities may be washed and partially filled with water before they leave the drum **30** and enter the horizontally disposed lower reach of the belt.

The water which is directed onto the lower reach of the ice cube mold belt, over and above that required to fill the mold cavities **38** of the belt, passes over the side edges of the belt section **34** into drainage channels **77** formed between the inner or bulkhead walls **60** and the outer walls **20** and **22** of the housing. The inner or bulkhead walls **60** are vertical extensions of thick insulation walls **78** which form the lower ends of the drainage channels **77**. The water from the drainage channels **77** passes into conduits **80** and **82** which are joined together outside of the apparatus housing at **84** to form a common discharge conduit **86** having an outlet **88** disposed within the sump **68**.

The relatively thick insulation walls **78** extend around the sides, ends and bottom of the lower portion of the apparatus housing to define a tank **90** containing a brine solution **92**. Refrigerant coils **94** having an inlet **96** and an outlet **98** communicating with a suitable refrigerator unit, not shown, circulate a refrigerant in heat transfer relation to the brine solution. It is contemplated, of course, that the brine may be cooled outside of the tank **90** and then be pumped into the tank. Means are provided in the cooling system portion of the apparatus for moving the brine counter-currently to the lower reach of belt **32** and in heat transfer relation to the ice cube mold cavities **38**. A propeller **100** mounted on a rotatable shaft **102** and disposed within a suitable open-ended housing **104** located in an end partition **106** in the tank **90** causes the brine to circulate in the direction indicated by the flow arrows **108**. The brine is constrained to flow in counter-current contact with the mold cavities **38** of the belt by a horizontally disposed partition **110**, said partition **110** together with the wall members **60** defining an open ended relatively shallow brine

pan. The propeller shaft 102 passes through a fluidtight bearing 112 and is driven through a suitable speed reduction system 114 by motor 116.

Sealing means are provided in association with the belt 32 in order to prevent water, from the spray-head system 62, from entering the brine pan within which the mold cavities of the belt travel, and also to prevent brine from getting into the drainage channels 77 to become mixed with the water within the water sump 68. The sealing means comprise continuous rubber strips 118 disposed at the upper ends of the inner wall member 60 in wiping engagement with the underside of the belt sections 34 within the margins of the ends of the rubber strip elements 44, the latter serving as resilient and sealing connections between adjacent belt sections.

The ice cubes which are formed in the mold cavities 38 as the cavities travel the lower reach of the conveyor are freed from the mold cavities as they pass along the upper reach of the conveyor by heating means, such as radiant heat lamps 120. As the cubes fall from the mold cavities they are received on a wire mesh screen 122 which is inclined downwardly toward the middle of the apparatus and is also inclined toward one side thereof, the screen thus serving to funnel the ice cubes to a discharge opening 124 formed in the side wall 20 of the apparatus and communicating with a suitable delivery chute 126. Water droplets indicated at 127 in Figure 2, formed in the process of freeing the cubes from the mold cavities pass through the screen member 122 to be received by the tray sections which are passing through the freezing cycle section of the apparatus. The re-use of these water droplets, which are close to the freezing temperature, makes for an increased efficiency in the over-all heat balance relation of the system.

Means are also provided in the apparatus to materially reduce the possibility of brine droplets, which adhere to the undersides of the mold cavities of the belt, from gravitating from the upper reach of the conveyor onto the water or ice filled cavities in the lower reach of the conveyor. For this purpose, the outer edges of the belt section 34 are deflected out of the normal planes of these sections as indicated at 128. The outer edges of the belt sections are thus inclined upwardly when the belt sections are disposed along the upper reach of the conveyor, and these edges thus serve to entrap the relatively small amount of brine solution which drains downwardly from the side and end walls of the mold cavities. This entrapped brine solution is re-deposited within the brine tank as the belt sections pass around the idler drum 30. It will also be noted, with reference to Figure 3, that the deflected marginal edges of the belt sections serve to direct the drainage of excess water from the belt into the drainage channels 77 when the belt sections are disposed along the lower reach of the belt conveyor.

Novel means are provided in the apparatus for producing ice cubes which are clear, or uncloudy, in appearance, said means consisting of an air spray system comprising: a blower 130 mounted on the housing 10; an intake line 132 adapted to feed cold air from the interior of the housing to the blower; an output line 134 which re-enters the housing and is connected to a manifold line 136; and a plurality of parallel spaced lines 138, each of which is connected at one end to the manifold line and is provided with a closure cap 140 at the other end.

As indicated in Figures 3 and 4, an airline 138 is disposed over the interjacent walls of a pair of rows of cube molds 38. Each line is provided with a plurality of spaced and angularly inclined apertures 142 adapted to blow jets of air into the molds of one row and with a plurality of spaced and angularly inclined apertures 144 adapted to blow jets of air into the molds of the other row. The spacing between successive apertures 142 and successive apertures 144 is such that at all times each of the molds of the adjacent rows associated with an airline 138 is receiving a jet of air. Thus, the water within the molds is agitated and circulatory currents are induced therein. It is preferable, although not necessary, that the air jets strike the water at an angle. This air-induced agitation of the water within the molds, in conjunction with other elements of the apparatus hereinafter described enables the formation of ice cubes which are excellent from the standpoint of clearness.

The airlines 138 are provided at spaced intervals with throttling valves 146 adapted to sequentially reduce the force of the air jets in direct relation to the degree to which the water within the molds is frozen. Thus, in section 148 of the airlines 138, the air issues from the lines at a pressure of two pounds per square inch. The air pressure is progressively reduced through sections 150, 152 and 154 by the throttling valves, to the point where the air pressure within section 154 is approximately one ounce.

Means are provided to scavenge the individual molds of their final unfrozen portions of water, which portions contain the cloud-inducing minerals which initially were contained in the full charge of water within a mold. Such means comprise an airline 156 connected to line 134 and terminating in a V-shaped line 158, which I prefer to call an air plow, which is disposed over, for example, section 152 of the bank of airlines 138. The arms 160 and 162 of the air plow 158 are provided with air emitting slots 164 and 166 which are directed downwardly and rearwardly, with respect to the direction of movement of belt 32. As with the unthrottled section 148 of airlines 138, air issues from the airplow at a pressure of approximately two pounds per square inch.

Figure 8 illustrates the mode of operation of the airplow. As the cube molds 38 reach the airplow, the principal portion of the water therein has been frozen, as indicated at 168, with the unfrozen water 170 containing substantially all of the minerals, indicated at 172, which formerly constituted the entire solute content of the total mold charge. These minerals are one of the primary causes of cloudiness in ice. As indicated in Figure 8, the angularly disposed curtains of air from the airplow blow the mineral-containing residual water rearwardly and to the sides of the belt 32.

The airplow-evacuated molds are then refilled with relatively clean water, from the standpoint of mineral content, by spray-heads 174, forming the terminal portion of water spray-head system 62. The refill water is then gently agitated by the one ounce pressure air jets of section 154 of airlines 138 until the water is completely frozen. The air-induced movement or agitation of the water within the mold cavities is augmented by the spray action of the water and the gravity action of the droplets which fall onto the freezing cycle section of the belt from the thawing section thereof.

An advantage to be pointed out in connection with the provision of the spray-head 74, which serves to rinse the mold cavities and begin the filling thereof before the cavities reach the brine solution, is that the mold cavities are pre-cooled, thus removing therefrom any of the heat picked up during the thawing cycle. In this manner, the over-all efficiency of the refrigerating portion of the apparatus is maintained at a high level.

From the foregoing, it will be seen that I have provided a novel method and apparatus for the automatic production of ice cubes, and the like, whereby the objects initially set forth herein can be readily attained. While a preferred embodiment of the apparatus has been shown and described, it is to be understood that all substantial equivalents thereof are within the spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent is:

1. A method of producing ice cubes, or other frozen shapes, comprising directing a jet of air against the surface of water within a mold while subjecting said water

to a freezing temperature for a time sufficient to freeze the greater volume of said water, blowing the unfrozen water out of said mold with pressurized air, adding fresh water to said mold to replace the blown-out water, and directing a relatively gentle stream of air against the surface of said water while subjecting said mold to a freezing temperature until the contents thereof are completely frozen.

2. A method of producing ice cubes, or other frozen shapes, comprising directing a jet of air against the surface of water within a mold while subjecting said water to a freezing temperature for a time sufficient to freeze the greater volume of said water, ejecting the unfrozen water from said mold, adding fresh water to said mold to replace the water removed therefrom, and completely freezing the contents of said mold.

3. A method of producing ice cubes, or other frozen shapes, comprising directing a jet of air against the surface of water within a mold while subjecting said water to a freezing temperature for a time sufficient to substantially completely freeze said water, and progressively decreasing the force of impingement of the air on said water as the freezing of said water is carried on to substantial completeness.

4. A method of producing ice cubes, or other frozen shapes, comprising constraining liquid within successive open-top molds while subjecting said molds to a temperature sufficiently low to rapidly congeal the liquid, inverting the molds as the liquid therein becomes frozen above other molds being subjected to the congealing temperature while subjecting said inverted molds to a temperature sufficiently high to free the cubes therefrom, and preventing the freed cubes from being deposited on the molds being subjected to the low temperature while allowing the liquid droplets produced by said high temperature to gravitate onto the molds being subjected to the low temperature.

5. Ice cube producing apparatus comprising a closed path conveyor belt having parallel and horizontally disposed upper and lower reaches, said belt being formed of a plurality of articulated sections having formed therein a plurality of open-top mold cavities, means for immersing the mold cavities of the lower reach of said belt in a refrigerating medium while preventing said medium from entering said cavities, spray means located above the lower reach of said belt and disposed to spray water into the cavities thereof while said cavities are immersed in said medium, heating means disposed above the upper reach of said belt operable to free the ice cubes from the cavities thereof, and a foraminous trough in cube-catching relation to said upper reach adapted to transmit therethrough to said lower reach the liquid droplets formed by said heating means.

6. Ice cube producing apparatus comprising a conveyor belt formed of a plurality of metal sections, each of said sections having a plurality of open-topmold cavities, means forming a fluid-tight connection between the edges of adjacent sections and serving to flexibly secure said sections together for conjoint movement, and means for moving said belt in a closed path characterized by relatively long parallel and horizontally disposed upper and lower reaches.

7. Ice cube producing apparatus comprising a tank adapted to receive a refrigerating medium, a closed path conveyor belt having parallel and horizontally disposed upper and lower reaches, said belt being formed of a plurality of metal sections having a plurality of open-top dependent mold forms, said sections having a width dimension greater than that of said tank, fluid impervious means forming a connection between the transverse edges of adjacent sections operable to flexibly secure said sections together, means disposing said belt for movement lengthwise of said tank with said mold forms exposed to said medium, means disposed above the lower reach of said belt for filling said mold forms with liquid, and means forming a fluid seal between the top of said tank and the underside of the sections of the lower reach of said belt operable in conjunction with said fluid impervious means to prevent admixture of said liquid and refrigerating medium.

8. Ice cube producing apparatus as set forth in claim 7 comprising, further, means for forcing circulation of said medium in relation to said mold forms.

9. In ice cube producing appartus, the combination of a tank containing a refrigerating medium, a conveyor belt having a plurality of open-top mold forms, with the mold forms of the lower reach of said belt being partially immersed in said medium, means for moving said belt, liquid spraying means adjacently disposed above said mold forms of the lower reach of said belt for the filling of the same, and fluid sealing means associated with said conveyor belt for mutually preventing contamination of said liquid by said medium and said medium by said liquid.

10. Ice cube producing apparatus comprising a closed path conveyor belt having parallel and horizontally disposed upper and lower reaches, mounted on a driver and an idler drum, said belt carrying open-top mold forms throughout its length, a spray-head system for filling the mold forms in the lower reach of said belt, refrigerating means associated with the lower reach of said belt for congealing the liquid in the mold forms thereof, thawing means associated with the upper side of the upper reach of said belt for freeing the cubes from the mold forms thereof, means associated with the underside of the upper reach of said belt for receiving said cubes and discharging them from said apparatus, and pre-cooling means for the empty mold forms comprising apertures through the drum around which the belt moves toward its lower reach, and at least one spray-head in said system disposed to spray liquid through said apertured drum and onto the mold forms passing around said drum.

11. In ice cube producing apparatus, the combination of a tank containing a refrigerating medium, a closed path conveyor belt having a plurality of open-top mold forms, with the mold forms of the lower reach of said belt being partially immersed in said medium, water spray means disposed above and adjacent said lower reach of said belt for moving said belt, means for filling said mold forms with water, sealing means associated with said conveyor adapted to prevent the water from said spray means from contacting said refrigerating medium, and means including a blower and an apertured conduit system for impinging streams of air on the surface of the water within the mold forms.

12. In ice cube producing apparatus, the combination as set forth in claim 11 including, further, means associated with said conduit system for progressively decreasing the force of impingement of said streams of air on said water in the direction of movement of the lower reach of said belt.

13. In ice cube producing apparatus, the combination as set forth in claim 12 including, further, means for scavenging the unfrozen water from said lower reach mold forms after the greater portion of water within said forms has been frozen, and means for delivering water to said lower reach mold forms to replace the water scavenged therefrom.

14. In ice cube producing apparatus, the combination of means enclosing a refrigerating medium, a conveyor belt having a plurality of mold forms adapted to travel in heat transfer relation with said medium, means for moving said belt, means for filling said forms with liquid to be frozen, means for scavenging the unfrozen liquid from said forms after the greater portion of liquid therein has been frozen, and means for adding liquid to said forms to replace the scavenged liquid.

(References on following page)

References Cited in the file of this patent

UNITED STATES PATENTS

1,551,439	Stoms	Aug. 25, 1925
2,070,943	Harold	Feb. 16, 1937
2,098,753	Mulch	Nov. 9, 1937
2,181,584	Gross	Nov. 28, 1939
2,252,913	Baer	Aug. 19, 1941
2,340,721	Whitney	Feb. 1, 1944
2,385,539	Pownall	Sept. 25, 1945
2,403,275	Gilliam	July 2, 1946
2,510,400	Hurley	June 6, 1950
2,575,892	Roberts	Nov. 20, 1951

FOREIGN PATENTS

179,899	Great Britain	Apr. 11, 1923