June 7, 1966 R. A. BRAEKING 3,254,506

CARBON DIOXIDE FREEZING APPARATUS AND METHOD

Filed March 2, 1964 2 Sheets-Sheet 1

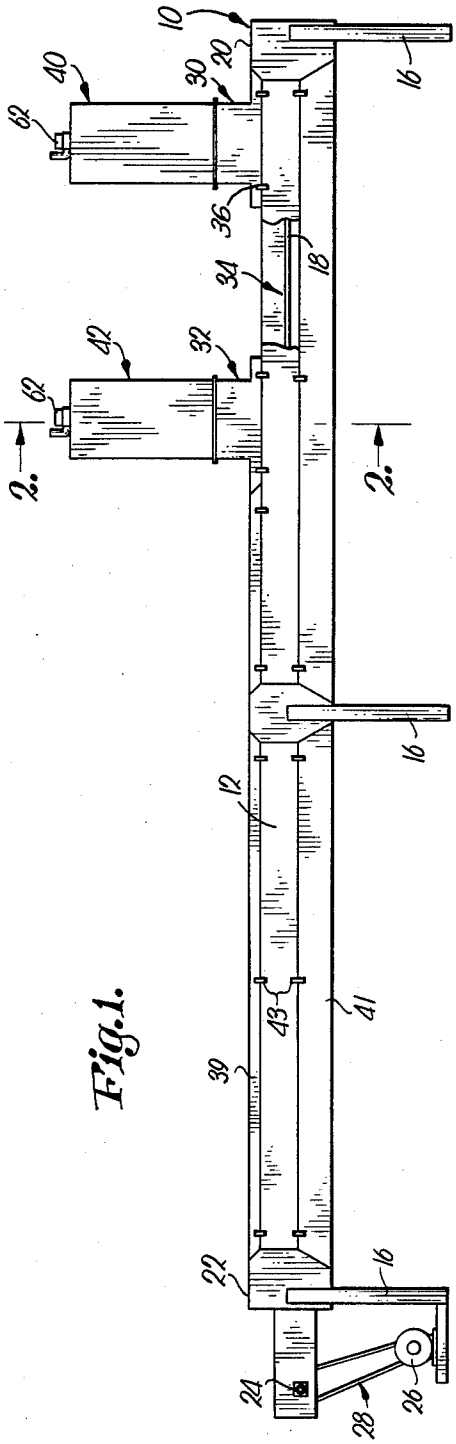

Fig. 1.

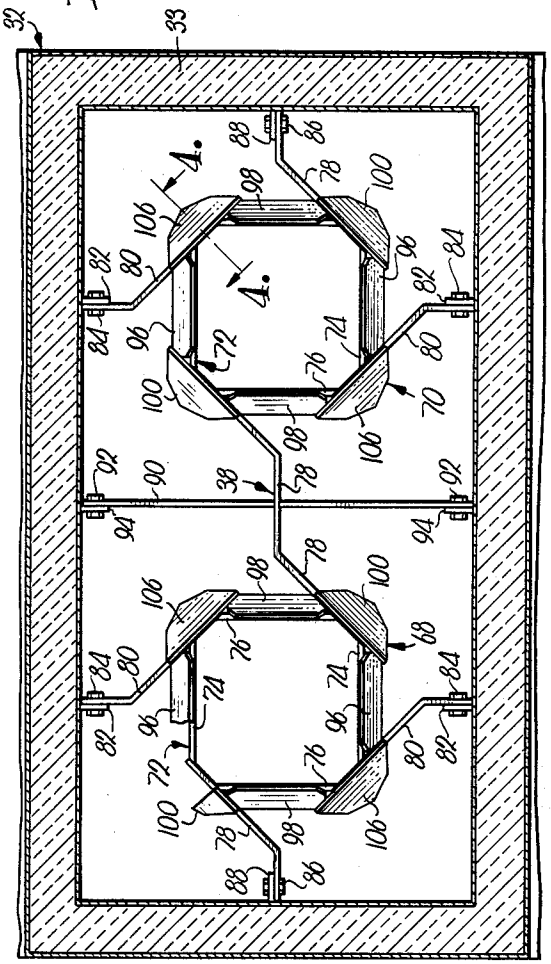

Fig. 3.

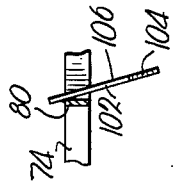

Fig. 4.

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CARBON DIOXIDE FREEZING APPARATUS AND METHOD

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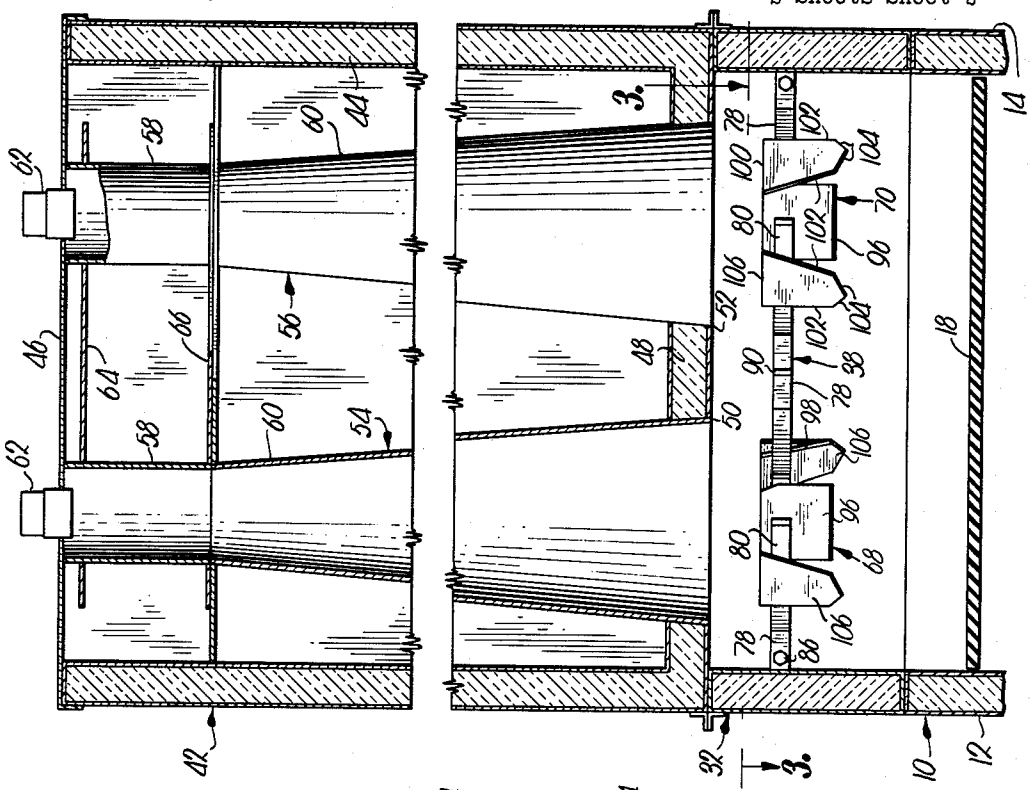

Fig.2.

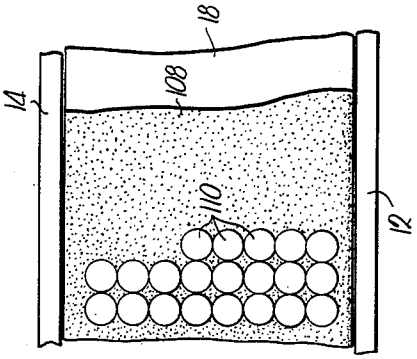

Fig.8.

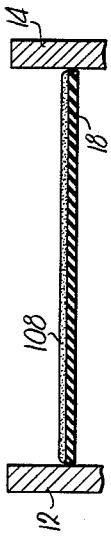

Fig.5.

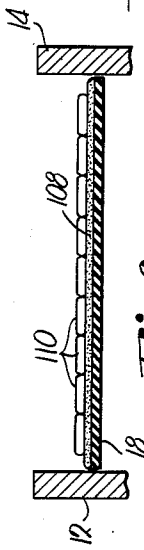

Fig.6.

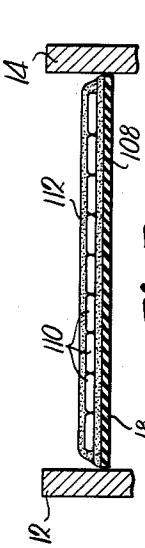

Fig.7.

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United States Patent Office 3,254,506 Patented June 7, 1966

3,254,506

CARBON DIOXIDE FREEZING APPARATUS AND METHOD

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Filed Mar. 2, 1964, Ser. No. 348,416
4 Claims. (Cl. 62—379)

This invention relates to the chilling of articles of merchandise, and more particularly, to improvements in the freezing of food products by the use of congealed coolants having a snow-like character.

Carbon dioxide snow has been widely used as a coolant for chilling food products since it is capable of rapidly lowering the temperatures of such products and does not leave a residue inasmuch as it vaporizes without melting. The use of this coolant, however, poses a problem involving the distribution of the snow over products to be chilled as the snow gravitates through a confining tube onto the products from a source thereabove. Heretofore, the snow used in this manner has not ben uniformly deposited over products to be chilled, but has been deposited in such a way that there is too great a concentration of the snow in some areas and too small a concentration of the snow in other areas.

This distribution problem depends to a large extent on the configuration of the delivery tube inasmuch as changes in cross section of the delivery tube will affect the way in which the mass of snow is deposited below the tube. However, the aforesaid distribution problem appears to exist regardless of the tube configuration.

The difficulty then, in using conventional apparatus and methods is that either too much snow or not enough snow is deposited on products to be chilled to the end that optimum chilling is unattainable. Since large numbers of products are sometimes to be chilled simultaneously, it is important, at least for food products, that the concentration of the snow on the products be uniformly distributed so that the products will be uniformly chilled.

No attempt has heretofore been made apparently to solve this problem by deflecting the gravitating snow in a manner such that it will be distributed over an area which is adapted to contain products to be chilled. Distributed in this way, the snow will be deposited in a layer of uniform thickness at its location of use and products in contact with the layer will all be chilled to the same degree.

The present invention overcomes the above-mentioned distribution problem in precisely this way and thus it represents a distinct advance in the art inasmuch as economies can be practiced when employing the teachings of this invention which could not and cannot be practiced by conventional product-chilling apparatus and methods. The instant invention obviates having to use too much snow in order to be sure that the concentration of the snow will be adequate to uniformly and simultaneously chill a number of products. The invention also assures that all products will be uniformly chilled for a given quantity of snow deposited thereon.

Moreover, the instant invention provides for more effective chilling of food products than has heretofore been capable since upper and lower layers of the snow are used to chill food products. Conventional chilling methods teach the depositing of only a single layer of snow at a location where products are to be chilled.

It is thus the primary object of this invention to uniformly chill a number of products by a coolant of the type described in a more efficient manner than has heretofore been capable while maintaining the chilling operation on an economical basis by precluding the use of unrequired amounts of the snow.

Another object of the invention is the provision of apparatus and a method for applying upper and lower layers of a coolant having a snow-like character to upper and lower surfaces of a number of food products so as to uniformly chill the same in less time than is required with conventional apparatus and methods which use only a single layer of such a coolant to chill products.

Still another object of this invention is the provision of structure for initially depositing a layer of carbon dioxide snow of uniform thickness on a supporting surface for contact with the lower side of a group of food products and thereafter depositing a layer of carbon dioxide snow of uniform thickness on the food products supported by the first layer, whereby the food products may be chilled from both sides to facilitate the chilling process. Such process may be carried out in a more economical manner than is capable with conventional methods inasmuch as unrequired amounts of the snow are not used.

Yet another object of this invention is the provision of a distributor in the form of a baffle which is disposed across a portion of a mass of gravitating carbon dioxide snow for deflecting the snow into a pattern having a uniform distribution of the snow therein, whereby the snow will be deposited in a layer of uniform thickness.

In the drawings:

FIGURE 1 is a side elevational view of the apparatus for chilling food products made pursuant to the teachings of the present invention, a portion of the apparatus being broken away to reveal a product conveyor and an opening for placing food products on the conveyor;

FIG. 2 is an enlarged, cross-sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a cross-sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is a cross-sectional view taken along line 4—4 of FIG. 3;

FIGS. 5, 6 and 7 are fragmentary, end views of the apparatus showing successive stages of depositing a uniform lower layer of coolant on the conveyor, placing a number of food products on the lower layer, and thereafter depositing a uniform layer of coolant on the food products; and

FIG. 8 is a fragmentary, top plan view of the apparatus showing food products to be chilled in position on the conveyor.

The present invention provides apparatus for chilling food products including an elongated support, an endless conveyor mounted on the support for horizontal movement longitudinally of the support, and a pair of coolant delivery structures on opposed sides of an opening in the support adjacent one end thereof for placing food products to be chilled on the conveyor. The delivery structures are adapted to be coupled, by virtue of a pair of valves, to a source of a coolant which congeals upon expansion and becomes a solid having a snow-like appearance. The invention further includes a distributor beneath each structure respectively for deflecting the coolant as the latter gravitates through the structure so that the mass of the coolant will be uniformly distributed over the conveyor and be deposited thereon in a layer having a uniform thickness throughout.

The present invention further contemplates the method of chilling food products by initially depositing a layer of uniform thickness of a solidified, snow-like coolant on the conveyor, thereafter placing the food products to be chilled on the layer as the latter is moved under the influence of the conveyor, and finally depositing a top layer on the food products supported by the bottom layer. The food products thus contacted by the top and bottom layers

of coolant are moved to a receiving area and removed from the conveyor.

Support 10 includes a pair of spaced, horizontal insulated side walls 12 and 14 positioned above ground level by legs 16. A conveyor 18 including an endless, flexible belt, is mounted on support 10 between side walls 12 and 14 for horizontal movement, the upper stretch of conveyor 18 being movable from end 20 of support 10 to end 22 thereof. A pair of rotatable drums (not shown) are disposed on horizontal shafts 24, only one of which is shown in FIG. 1, for shiftable mounting conveyor 18. A motor 26 adjacent end 22 is coupled with conveyor 18 through a belt and pulley assembly 28 to effect movement of conveyor 18 in the proper direction.

A pair of hollow frames 30 and 32, each comprised of a continuous, insulated wall 33 and provided with an open top and open bottom, are secured to the upper edges of side walls 12 and 14 adjacent end 20 and are spaced apart to define an opening 34 in support 10 and aligned with the upper stretch of conveyor 18 for placing food products to be chilled onto the latter. Frames 30 and 32 may be removably disposed on support 10 by virtue of clips 36 or the like, so that the frames may be separated from support 10 for cleaning purposes, for instance. Each of the frames 30 and 32 houses a distributing device 38 hereinafter described. A top 39 and a bottom 41 are removably secured by fasteners 43 to side walls 12 and 14 to enclose conveyor 18. Bottom 41 extends the entire length of support 10, and top 39 extends from frame 32 to end 22.

A pair of housings 40 and 42 are mounted uprightly on the upper extremities of frames 30 and 32 respectively. As shown in FIG. 2, each of the housings 40 and 42 includes a continuous, insulated side wall 44, a top 46, and an insulated bottom 48 provided with a pair of spaced openings 50 and 52 therein. A pair of horns or tubes 54 and 56 span the distance between top 46 and bottom 48 in alignment with openings 50 and 52 respectively. Each of the tubes 54 and 56 includes a cylindrical section 58 adjacent top 46, and a frusto-conical section 60 secured to and extending downwardly from section 58. The lowermost extremity of section 60 is complementally received within the corresponding opening 50 or 52.

An actuatable fluid valve 62 is provided for each of the tubes 54 and 56 and extends through top 46 to communicate with the interior of the corresponding section 58 as shown in FIG. 3. Valves 62 are adapted to be coupled with a source of a coolant under pressure which congeals upon expansion to form a snow-like substance capable of gravitating through tubes 54 and 56 and toward conveyor 18 therebelow. Valves 62 are preferably coupled with a source of carbon dioxide which forms carbon dioxide snow upon entering sections 58 from valves 62. To support tubes 54 and 56, plate-like braces 64 and 66 are provided on the interior of the corresponding housing 40 or 42.

Distributing devices 38 in frames 30 and 32 are substantially identical in all respects so that a description of one of such devices will suffice for the other. Each device 38 includes a pair of baffle structures 68 and 70, each of which is substantially identical with the other. Each of structures 68 and 70 includes a polygonal base 72 comprised of a first pair of parallel strips 74, a second pair of parallel strips 76, a third pair of parallel strips 78, and a fourth pair of parallel strips 80. Bases 72 of structures 68 and 70 are substantially coplanar so that the upper edges of the various strips comprising the bases are in a horizontal plane when device 38 is coupled to the corresponding frame. Strips 74, 76, 78 and 80 are formed of a material suitable to provide structural rigidity for the corresponding structure 68 or 70. As shown in FIG. 4, strips 80 are bent at the outer ends thereof and are secured at such outer ends to ears 82 by bolt means 84. Ears 82 are secured to opposed sides of the corresponding housing 40 or 42.

Strips 78 are configured similar to strips 80 and one of the strips 78 is secured by bolt means 86 to an inwardly projecting ear 88 on the corresponding end of the housing. The other strip 78 is connected to the corresponding strip 78 of the adjacent baffle structure. Such construction assures that base 72 is located in a fixed position within the corresponding frame at all times.

A cross brace 90 is secured by bolt means 92 to inwardly projecting ears 94 as shown in FIG. 3. Brace 90 and strips 78 are notched and interlocked to join the brace 90 with the inner strips 78 of structures 68 and 70. A pair of first baffle sections 96 are rigid to and depend from strips 74 as shown in FIGS. 2 and 3. Each baffle section 96 is formed from a relatively rigid, flat plate and is provided with a generally horizontally disposed, lowermost edge 97 approximately equal in length to the width of the major portion of the corresponding section 96. As shown in FIG. 2, the lowermost edge of each section 96 is below the horizontal plane in which bases 72 are disposed.

Another pair of sections 98, similar in all respects to sections 96, are rigid to and depend from strips 76. The lowermost edges of sections 98 are in the same plane as the lowermost edges of sections 96. Sections 96 and 98 extend outwardly and downwardly from the corresponding strips 74 and 76 so that the outer faces thereof are inclined slightly to the vertical.

A pair of baffle sections 100 are rigid to and depend from strips 78 and substantially span the distance between the adjacent sections 96 and 98. Each section 100 is formed from a flat plate and is configured to provide a pair of convergent side edges 102 and a pair of convergent end edges 104 which define the lowermost extremity of the corresponding section. As shown in FIG. 2, edges 104 are joined at a point below the plane in which the lowermost edges 97 of the adjacent sections 96 and 98 are disposed.

A pair of opposed baffle sections 106, similar in all respects to baffle sections 100, are rigid to and depend from strips 80. Sections 100 and 106 are inclined to the vertical in the same manner as sections 96 and 98 and, as shown in FIG. 4, a section 106 is tilted to provide an outer face which may be utilized for deflecting a solid gravitating from above the section.

The angularity and relative positions of sections 96, 98, 100 and 106 have been found to distribute a mass of a gravitating, solidified coolant uniformly over the area directly below and to the outer sides of each of the structures 68 and 70. In utilizing the specific configuration of tubes 54 and 56, which are disposed directly above structures 68 and 70 as shown in FIG. 2, the two masses of gravitating carbon dioxide snow are deposited uniformly over the entire width of a segment of conveyor 18 directly below device 38. For a conveyor width of two feet, it has been determined that the largest diameter of each of the tubes 54 and 56 should be approximately eight inches and that the tubes should be symmetrically mounted with respect to conveyor 18 as shown in FIG. 2. Without the use of device 38 and utilizing the eight-inch tubes, the snow would be concentrated on conveyor 38 in a ring having a diameter of approximately nine inches. The portion of the conveyor within such a ring would be covered so that the snow on the conveyor would form a crater effect. Device 38 causes the snow particles to be deflected outwardly, both laterally and fore and aft, so that the outer margins of a two-foot square space on conveyor 18 will be uniformly covered with the snow. Thus, device 38 prevents the aforesaid crater effect.

By using tubes of different configurations from that described herein, carbon dioxide snow will be distributed differently on the conveyor. For example, for tubes having a rectangular cross section, the snow is delivered

from each tube and deposited on the conveyor in four distinct piles aligned with the corners of the tube. It is conceivable that a distributing device may be provided for this type of tube so as to acheve uniformity in the deposit of carbon dioxide snow on conveyor **18**.

Some of the snow gravitating through tubes **54** and **56** will tend to fall outwardly as well as downwardly due to the frusto-conical inner surface of the tubes. The snow passing through the space enclosed by strips **74** and **76** of each of the structures **68** and **70**, will tend to continue along a frusto-conical path. Since sections **96**, **98**, **100** and **106** are across a portion of the path of the gravitating snow, the outer faces of these sections will deflect the snow outwardly as it continues to gravitate. The combined fall of the snow through the central space formed by strips **74** and **76**, and the fall of the snow after being deflected by the baffle sections, results in a deposit of the snow on conveyor **18** having a uniform thickness throughout its extent.

Device **38** is properly positioned above and spaced from conveyor **18** to assure this uniformity in the thickness of the snow layer, and such is accomplished by the use of a minimum amount of carbon dioxide snow. At the same time there is sufficient snow provided to cover substantially the entire width of the conveyor when snow is delivered through both tubes **54** and **56** simultaneously.

Control means coupled with valves **62** may be preset in a manner such that valves **62** remain open continuously or for a predetermined time. Thus, carbon dioxide snow is delivered to each tube **54** and **56** to obtain the optimum deposit of the snow on conveyor **18** to assure proper freezing of the food products depending upon the spacing of the later on conveyor **18**.

The quantity of snow delivered to conveyor **18** may be changed, of course, by varying the outlet orifices of valves **62** or the speed of conveyor **18**. For different food products, it may be required that more or less snow be delivered to the conveyor for freezing the products.

Operation

The apparatus of the instant invention is initially placed in operation by energizing motor **26** so that conveyor **18** moves in a direction to convey food products from end **20** of support **10** to end **22** thereof. Valves **62** are then coupled with a suitable source of a coolant under pressure which congeals into a snow-like character when the pressure is removed. For purposes of illustration, valves **62** are preferably coupled to a source of carbon dioxide under pressure so that carbon dioxide snow will be delivered to the tubes **54** and **56** of housings **40** and **42**.

With conveyor **18** moving in the proper direction, a first layer of snow is deposited on conveyor **18** by actuating valve **62** corresponding to housing **40**. As shown in FIG. 5, layer **108** of snow has a substantially uniform thickness across the entire width of conveyor **18**. Such uniformity in the thickness of layer **108** is due to the presence of device **38** below tubes **54** and **56** of housing **40**. A portion of the snow is deflected by the various baffle sections **96**, **98**, **100** and **106** in the manner described above so as to prevent the formation of concentrated piles or mounds of the snow on conveyor **18**.

Since conveyor **18** is moving when layer **108** is deposited thereon, a predetermined time must elapse before layer **108** is aligned with opening **34**. After this time has elapsed, food products are placed on layer **108** and, as shown in FIG. 8, food products such as patties **110**, are placed in relatively close proximity to each other so as to utilize all of the effective space on layer **108**. This is further illustrated in FIG. 6 wherein the patties **110** are shown on the upper surface of layer **108**.

Again, it is to be noted that food products are placed on layer **108** as conveyor **18** continues to move. Thus, after the lapse of another interval of time, the food products and layer **108** will be disposed below frame **32** and thereby, tubes **54** and **56** of housing **42**. At this moment, valve **62** corresponding to housing **42**, will be actuated to deliver carbon dioxide snow to the tubes for gravitation onto the food products supported by layer **108**.

Device **38** of frame **32** will deflect a portion of the gravitating snow from tubes **54** and **56** of housing **42** so that the snow will be uniformly distributed over conveyor **18** and will be deposited on the food products in the form of a layer of uniform thickness throughout its extent. This is illustrated in FIG. 7 wherein a layer **112** is uniformly distributed over the patties **110** which have been initially placed on layer **108**.

The food products are thereafter advanced toward end **22** of support **10** as conveyor **18** continues to move, and the products will thus be chilled to a predetermined degree by virute of the fact that layers **108** and **112** are in thermal interchange relationship therewith. The length of support **10** and the speed of conveyor **18** determines the decrease in the temperature of the food products for a given initial temperature of the snow in layers **108** and **112**.

After the food products reach end **22**, the same may be removed from conveyor **18** and placed in containers or the like for transfer to a storage region.

The freezing of food products by utilizing the instant invention contemplates chilling spaced groups of food products, but snow may be continuously applied by valves **62** where it is desired to chill large volumes of individual food products.

Products other than food products may be chilled with the apparatus of the present invention. For instance, utilitarian parts of metal, rubber or plastic may conveniently be lowered in temperature by this invention in preparation for special handling or for subsequent operations to be performed thereon.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. Apparatus for use in chilling food products with carbon dioxide snow comprising:

a movable conveyor having a predetermined width and adapted for supporting food products to be chilled;

tubular means above said conveyor for confining a mass of said snow to a frusto-conical path as the snow gravitates toward said conveyor with said path having a maximum transverse dimension less than the width of said conveyor; and

structure across a portion of said path for deflecting the snow in said portion outwardly of the path to cause the snow to be uniformly distributed across the width of said conveyor, said structure including a baffle disposed adjacent the lower extremity of said path and in substantially surrounding relationship thereto, the baffle including a plurality of baffle sections, each having an inclined upper face for deflecting the snow.

2. Apparatus as set forth in claim **1**, said baffle including a number of first baffle sections spaced apart from each other and disposed about said path, and a second baffle section for each pair of first baffle sections respectively, said second baffle sections being disposed in substantially spanning relationship to the corresponding first baffle sections.

3. Apparatus as set forth in claim **2**, each of said first baffle sections having a generally horizontally disposed, lowermost edge, each of said second baffle sections having a pair of edges converging toward each other as the lowermost extremity of the section is approached.

4. Apparatus for chilling food products with carbon dioxide snow comprising:

an elongated support;

a conveyor;

means mounting said conveyor on said support for horizontal movement, said support having an opening

adjacent one end thereof permitting food products to be placed on said conveyor;

a delivery tube for each side of said opening respectively, said tubes being secured to said support above said conveyor and disposed for directing respective gravitating masses of said snow onto the conveyor as the latter is moved; and

an actuatable valve for each tube respectively, said valves being coupled to the corresponding tubes adjacent the upper ends thereof and adapted to be coupled with a source of liquid carbon dioxide to permit respective masses of carbon dioxide snow to be successively delivered first to the tube adjacent said one end of the support and then to the other tube as the corresponding valves are successively

actuated to direct the liquid carbon dioxide into the tubes, whereby a first layer of snow may be deposited on the conveyor before food products are placed thereon and a second layer of snow may be deposited on the food products after the latter have been placed on said conveyor.

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