

[54] **NOZZLE CONSTRUCTION FOR ICE MAKER**

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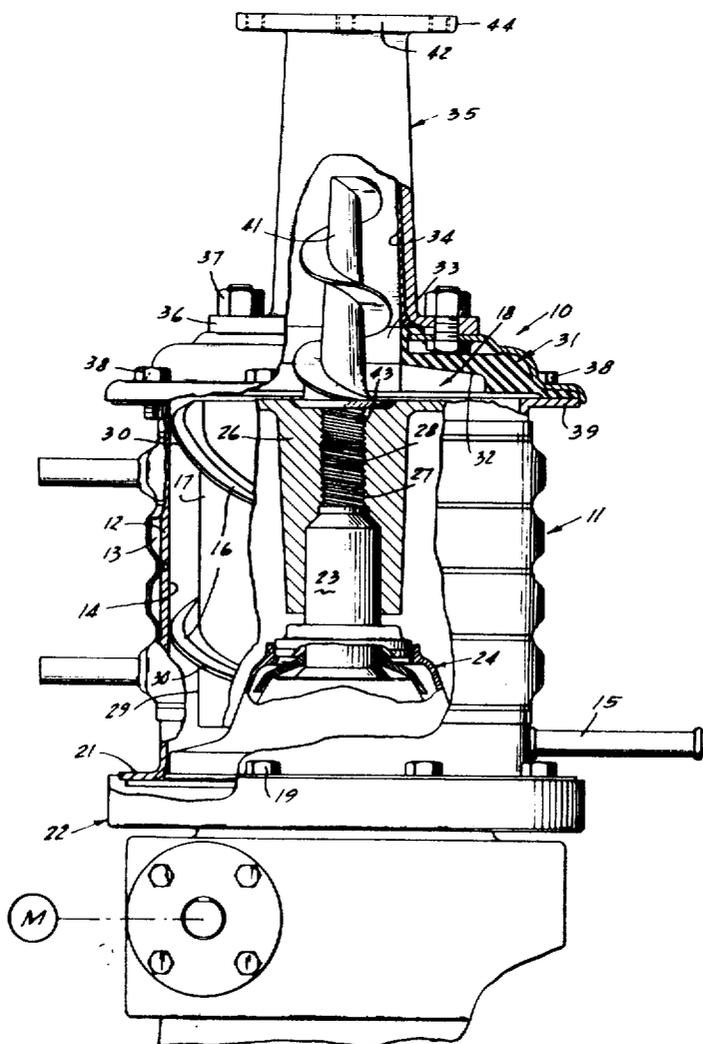
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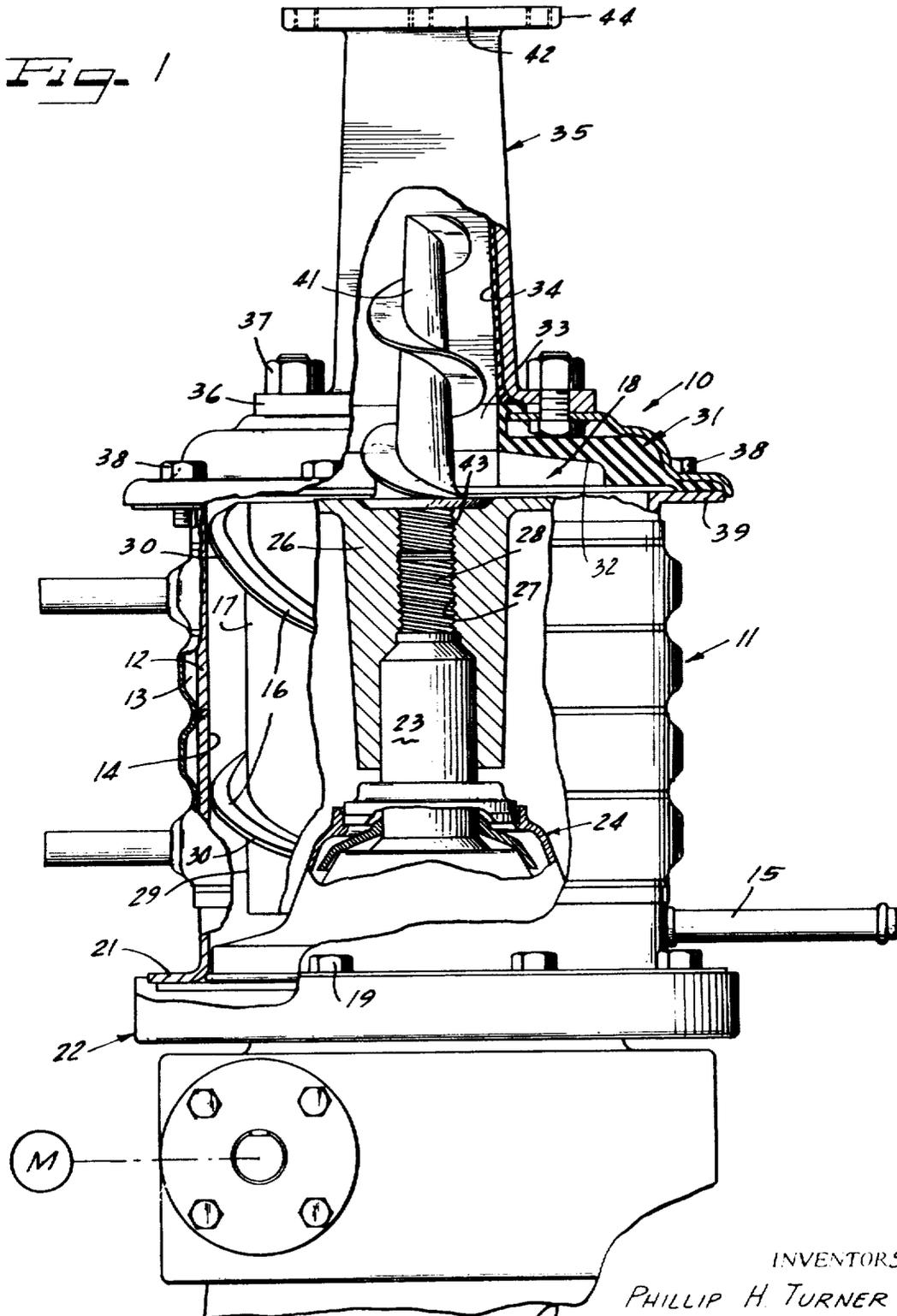
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[57] **ABSTRACT**

A nozzle construction for an ice maker provides a restricted passageway to compact particulated ice product into a solidified columnar-shaped extrudate and is particularly characterized by a liner made of material having a low thermal conductivity, thereby to provide a surface which improves the lubricity relative to the ice product moving therethrough.

7 Claims, 11 Drawing Figures





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NOZZLE CONSTRUCTION FOR ICE MAKER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to ice maker constructions and more particularly relates to a nozzle construction sometimes referred to as an interchangeable extrusion means for producing variously configured ice products.

2. Description of the Prior Art

The prior art to which the present invention may be compared is exemplified by the copending application assigned to the same assignee as the present invention Ser. No. 867,222, filed Oct. 17, 1969. In such ice makers, there are means for harvesting ice by breaking an ice product from a refrigerated freezing surface as well as means for collecting and extruding the ice product through a restricted passageway to compact the ice product into a solidified columnar-shaped extrudate.

SUMMARY OF THE INVENTION

The present invention is specifically directed to improvements in the so-called nozzle construction, or extrusion means. First of all, it is contemplated by the present invention that the restricted passageway provided by the nozzle means has the walls thereof lined with a material having a low thermal conductivity, thereby to form a surface which will improve the lubricity relative to the ice product moving therethrough. Thus, the nozzle may be made of a thermally conductive metal such as stainless steel, thereby to provide rigid walls prescribing the confines of a compression passageway. The walls are lined with a thermally non-conductive material such as plastic or rubber-like material.

It is contemplated by the present invention that the nozzle could comprise an outer shell made of two separable pieces, whereas the liner could comprise a separate part formed as an insert. By virtue of such provision, clamping means are used to lock the shell and the insert into firm assembly with one another. It is also contemplated that the insert could be made of one or more separate pieces so that the entire assembly could be locked together by appropriate clamping means. By virtue of such provision, variously configured inserts can be utilized so that several interchangeable extrusion members or dies arranged and formed to produce variously configured ice products such as "ice cubes," cracked ice, of either irregular or substantially uniform size, or ice flakes might be provided.

It is particularly contemplated by the present invention that the extrusion member of nozzle has a liner which is configured to provide two separate zones, including a gradually tapered compression section having one degree of convergence for removing excess water from the particulated ice product and a throat or outlet section forming a second zone and having a different degree of convergence, thereby operating to hold the compressed ice product together to prevent stress cracks from forming.

With such a structure, an emerging column or extrudate of solidified characteristics is provided constituting hard and crack-free ice.

It is further contemplated by the present invention that there be provided an elbow in association with the nozzle or extrusion means, which elbow is connected to the outlet end of the passageway through which the extrudate is directed and the elbow is proportioned to break the solidified extrudate into cubes. The elbow is particularly characterized by wall means which are angularly disposed to overlie a passageway in register with the compression passageway, thereby to assist in breaking the columnar extrudate into separate cubes.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view with parts broken away showing an ice maker provided in accordance with the principles of the present invention and incorporating a nozzle construction embodying the principles of the present invention;

FIG. 2 is an enlarged fragmentary cross-sectional view showing details of construction of the nozzle provided in accordance with the principles of the present invention;

FIG. 3 is a view of the nozzle taken on line III—III of FIG. 2; FIG. 4 is an enlarged cross-sectional view of the lower end of the nozzle of FIG. 2 and shows additional details of construction;

FIG. 5 is a somewhat reduced view similar in orientation to FIG. 2 but showing an alternative construction utilizing a multi-part nozzle;

FIG. 6 is a cross-sectional view taken on line VI—VI of FIG. 5;

FIG. 7 is a top plan elevational view of the structure of FIG. 5;

FIG. 8 is a cross-sectional view of an ice breaker elbow as used in conjunction with the nozzle of either FIG. 2 or FIG. 5;

FIG. 9 is a cross-sectional view taken on line IX—IX of FIG. 8;

FIG. 10 is a side elevational view of the ice breaker elbow of FIGS. 8 and 9; and

FIG. 11 is a fragmentary cross-sectional view taken on line XI—XI of FIG. 10.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Although the principles of the present invention may be of general applicability, a particularly useful application is made in an ice maker having means for harvesting ice by breaking an ice product from a refrigerated freezing surface and means for collecting and extruding the ice product through a restricted passageway to compact the ice product into a solidified columnar-shaped extrudate. Referring to the drawings, an ice maker of such characteristics is shown generally at 10 and includes an evaporator unit 11 having an internal bore forming a cylindrical wall 12. An integrally formed evaporator passageway 13 has a refrigerant or coolant expanded thereinto by a refrigeration system through an expansion valve or some other pressure-reducing means. Water is introduced into the evaporator internally of the wall 12 through an inlet conduit 15 disposed near a base of the unit 11. The water tends to freeze on the wall 12 in the form of a thin film of ice. One or more helical flights 16 formed or carried on a rotating harvesting auger 17 cooperate with the wall 12, which, in effect, forms a freezing surface 14, whereby thin films of ice formed on the freezing surface 14 will be continuously harvested. The auger 17 progressively advances a mixture of ice particles, including slush and chunks upwardly in the unit 11 towards a collection chamber 18 superjacent the evaporator unit 11.

Suitable fastening means, such as bolts 19, attach a radially outwardly extending flange 21 formed on the evaporator unit 11 to a drive housing 22. A shaft 23 is disposed centrally of the evaporator unit 11 and has a lower end portion supported within axially spaced bearing means in the drive housing 22. Gear reduction means are driven by a prime mover such as an electric motor M. The shaft 23 is disposed coaxially of the evaporator bore and has a driven connection with the gear reduction means. Water is prevented from entering the drive housing 22 by seal means including a shaft seal 24 engaging the shaft 23.

The harvesting auger 17 includes a central hub portion 26 having a through bore. A threaded portion 27 of the bore receives an upper threaded end portion 28 of the shaft 23 to support the harvesting auger 17 for corotation with the driven shaft 23. A cylindrical portion 29 formed on the harvesting auger 17 which may be somewhat conical and spaced concentrically inwardly of the refrigerated scraping surface 14 has an outer diameter relatively larger than a diameter of the shaft 23 and carries the helically extending flights or blades 16, which have edges 30 closely spaced adjacent surface 14 to harvest a thin film of ice as the harvesting auger 17 rotates relative to the surface 14.

The collection chamber 18 is formed by a generally circular or inverted cup-shaped cap means generally indicated at 31 and having one or more channels receiving the ice flake product from the harvesting auger 17 and which operates as a mechanical transfer means for transferring harvested ice

product from the harvesting auger to a compression zone. The channels 32 are formed in a separate insert member made of thermally non-conductive material, for example, a plastic material having low thermal conductivity, thereby to improve the lubricity relative to the ice product moving in the channels. Each of the channels 32 extends in a generally spiral path of increasing cross-section for conducting the flake ice product discharged from the evaporator unit 11 upwardly into a central passageway 33 leading into an internal bore 34 of a compression and forming nozzle 35. The nozzle 35 has a generally outwardly extending flange 36 secured to the cap means 31 by suitable fasteners, such as nut and bolt assemblies as at 37 and the cap means 31 are suitably secured by a plurality of circumferentially spaced bolts to a radially outwardly extending flange 39 on the evaporator unit. Thus, the drive housing 22, the evaporator 11, the cap means 31 and the compression nozzle 35 are detachably secured in a stacked relationship by the fastening means 19, 37 and 38.

In order to compress the flake ice product harvested from the refrigerated scraping surface 14 into a solid ice product, a compression auger 41 mounted for corotation with the harvesting auger 17 receives the flake ice product from the collection chamber 18 and squeezes the ice particles through the nozzle bore 34 to remove excess water and form an emergent solid column of ice as a solidified extrudate at an upper end 42 of the nozzle 35. The compression auger 41 has a depending threaded stud 43 engaged into the threaded bore 27 of the harvesting auger.

Appropriately configured extrusion means are attached to an outwardly extending flange 44 at the upper end 42 of the nozzle 35 for forming the emerging solid column of ice into a desired configuration. The extrusion means may be designed to transversely shear the emerging column of ice into ice cubes or otherwise shape the column into desired configurations, for example, chipped ice, shaved ice, cracked ice or small ice cubes.

The specific improvements of the present invention are directed to the nozzle construction shown generally at 35.

Referring more specifically to FIG. 2 and the other figures of the drawings, it will be noted that the nozzle 35 constitutes a means forming a restricted passageway which is the passageway previously referred to as 33. In accordance with the principles of the present invention, it is contemplated that the nozzle 35 may be made of a thermally conductive material such as stainless steel. Accordingly, the nozzle 35 is shown as having a main body portion 351 flanged as at 36 and 42 and suitably apertured to cooperate with the fastening means 37.

In FIG. 2, an ice breaker shown generally at 50 has an apertured flange 51 by means of which the ice breaker 50 may be connected to the outlet end of the nozzle 35 by suitable fasteners 52. If desired, the element identified as an ice breaker 50 may simply comprise a conduit leading to a storage bin or some other point of utilization, either adjacent the ice maker 10 or remote from the ice maker 10, depending on the needs of the particular user.

As is well known, the basic Fourier conduction law states that the steady rate of heat conduction is proportional to the cross-sectional area normal to the direction of flow and to the temperature gradient along the conduction path. In applying such conduction law, persons skilled in the art refer to the term "thermal conductivity." The "thermal conductivity" of a substance may be defined as the quantity of heat, usually expressed in terms of btu's, that flows in a unit of time through a unit area of plate of unit thickness having unit difference of temperature between its faces.

Thus, metal materials are generally regarded as having extremely high thermal conductivities. For example, a typical thermal conductivity of aluminum is 117 at 64° F. Steel has thermal conductivity in the range of 12 to 30 at a temperature range of 60° to 600° F., depending on the specific alloy constituents of the steel. Yellow brass has a thermal conductivity of approximately 50 at 32° F.

Insulating materials, on the other hand, have relatively low thermal conductivity. For example, hard rubber has a thermal conductivity of 0.092 at 100° F., whereas soft vulcanized rubber has a thermal conductivity of approximately 0.08 at 86° F.

In accordance with the principles of the present invention, it is contemplated that the passageway 33 of the bore 34 be lined with an insulating material having low conductivity. We have discovered that providing such a non-conductive liner in the passageway 33 improves the operation of the ice maker and would appear to provide improved lubricity between the ice product moving through the compression means. Further, the provision of the liner appears to make the operation of the ice maker independent of the ambient in which it is located.

In the form of the invention illustrated in FIG. 2, the nozzle 35 constitutes an integral structural member which may be an integral casting or a machined part made of a metal such as stainless steel. The liner may constitute a plastic which is either poured or injected into the nozzle and it will be noted that the liner is shown herein at 53. It will be noted that the bore wall 34 is recessed as at 54 at the top of the nozzle and at 55 at the bottom of the nozzle, thereby permitting the liner material to flare radially outwardly and, in effect, form flanges which enhance the stability of the liner within the passage 33.

The liner 53 has a radially extending wall 56 characterized by an annular axially projecting rib 57. The rib 57 projects beyond the end surface 58 of the flange 36, thereby to engage against an adjoining surface against which the nozzle 35 is clamped by the fasteners 37.

It will be noted that the nozzle body 351 and the liner 53 constitute an elongated structural part including two separate axial zones indicated at Z1 and Z2, respectively. The first zone extends from the inlet end of the nozzle which receives ice product discharged from a collection point shown generally at 59. The walls in the zone Z2 have a first degree of convergence, thereby to form a compression zone.

The zone 1 has inwardly tapered walls disposed at a second degree of convergence, thereby constituting a continuation of the compression zone Z2.

It will be understood that as the flights carried on the compression auger 41 force the wet ice particles through the nozzle 35, the cross-sectional areas of the column of advancing ice product are gradually reduced, thereby squeezing excess water from the ice product and forming a compacted column or mass of advancing ice.

We have found that a 3 1/2 degree convergence in zone 2 and a 3/4 degree convergence in zone 1 produces a compacted column or extrudate of hard ice which is discharged through outlet member 50.

Intersecting the walls of the body member 351 of the nozzle 35 and also intersecting the walls of the liner 53 in the zone Z2 near the bottom of the nozzle, is a drain opening 60. The drain opening 60 has a nipple 61 connected thereto and is used to carry away fluids forced out of the ice product and liquid circulated through the ice maker 10.

Referring now to FIGS. 5, 6 and 7, another alternative embodiment of nozzle construction is illustrated therein. In the form of the invention illustrated in FIGS. 5, 6 and 7, the nozzle may comprise an outer shell 35a, stamped or cast, and made in two pieces so that it can be clamped or bolted together in integral assembly. Thus, the nozzle 35a has an elongate axially extending body portion shown generally at 70 and comprising two wall portions 71 and 72 disposed at right angles to one another and which together with one another form two of the walls of an axially extending internal passage 73.

The body portion 70 is flanged on opposite sides, thereby to provide a flange web 74 and a second flange web 76.

The second piece is identically constructed and the same reference numerals have been applied to like parts. Thus, the two parts are placed in face-to-face relationship with the flange webs 74,74 and 76,76 facing one another in confronting relation so that suitable bolt and nut fasteners shown at 77 can be used to clamp or bolt the parts together.

In this form of the invention, the liner can be conveniently made as a separate part formed as an insert and adapted to be inserted between the outer shell parts of the nozzle 35a.

It is also contemplated by the present invention that the liner insert constitute a two-piece construction, for example, as shown in the drawings, there are two separate liner parts each shown generally at 53a and since each part is symmetrically identical, like reference numerals will be used to describe like parts.

It will be noted that the liner includes elongated wall portions including a first wall 80 and a second wall 81 disposed at right angles to one another. The respective parts confront one another along a parting line shown at 82 and when assembled are clamped within the shell parts 70,70, thereby to form a lined passage 33a.

The liner insert 53a has an upper flange 83 and a lower flange 84. The upper flange 83 overlies an upper flange 78 and a lower flange 79 provided on opposite ends of each respective shell part 70,70.

Referring specifically to FIG. 7, it will be noted that the flanges 83 and 84 may be recessed, for example, as shown at 90 in FIG. 7. Thus, the flanges 78 and 79 may be suitably apertured for receiving fasteners, and by such means, the flanges 83 and 84 can be clamped between opposing flange surfaces. The apertures in the flange 78 are shown at 91 in FIG. 7.

In terms of other structural and functional features, it will be understood that the nozzle 35a can also be constructed to provide the features previously described such as the zone Z1 and the zone Z2. Further, by having the multi-part nozzle construction, the parts are readily interchangeable and may be conveniently fabricated at a reduced cost, thereby to provide great selectivity in terms of the substitution of configurations to produce variously configured ice products such as ice cubes, ice chips, ice flakes or cracked ice, depending upon the particular requirements of the user.

In selecting a material for use in the liner 53 or the liner parts 53a, it is contemplated that any suitable thermally non-conductive material such as a synthetic plastic or rubber-like material can be used. In any event, it is specifically contemplated that the thermal conductivity of the material selected will be preferably less than 0.1 at 100° F.

In accordance with the present invention, an ice breaker elbow is provided at the discharge end of the nozzle either 35 or 35a for the purpose of breaking the emerging column of hard ice or extrudate, as it is sometimes referred to herein, into discrete lengths for producing "ice cubes." The ice cube breaker is shown in FIGS. 8-11 generally at 100 and constitutes a mounting flange 101 having a plurality of apertures formed therein 102 by means of which suitable fasteners such as indicated at 103 may be utilized to place the ice breaker elbow 100 in firm assembly with the end of the nozzle.

Internally of the elbow 100, there is provided an upstanding wall 104 which is disposed at right angles to the flange 101. Thus, the upright wall 104, in effect, prescribes the boundaries of a passage 106 which is of the same configuration in cross-section as the passage 33 or 35a formed in the nozzle and which overlies the discharge end of such passage in registry therewith and in such a position to receive the solidified ice extrudate which is in the form of a column of hard ice and which is depicted in FIG. 8 of the drawings at 1.

The elbow 100 is further characterized by an angularly inclined wall 107 which forms a continuation of the wall 104 and which has formed on the inside surface thereof an action surface 108 engageable with the columnar extrudate as at 110, thereby to assist in breaking the solid ice column by applying a bending moment to the rigidified ice column and producing a break-line, as shown at B.

As shown in the drawings, the wall of the elbow 100 are extended through a transition zone 109 into a cylindrical con-

figuration as at 111, thereby to form a passage 112 which can be connected by appropriate conduit means for transmission of the cubed ice product to a point of utilization or to a storage bin.

To assist in venting any fluids from the elbow, a special venting aperture is provided by forming in the elbow a boss 113 through which a venting passage 114 is directed.

Although various minor modifications might be suggested by those versed in the art, it should be understood that we wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of our contribution to the art.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In an ice maker of the type having a combined harvesting auger and press for producing hard ice, the improvement of mechanical transfer means for transferring harvested ice product from the harvesting auger to a compression zone, and a compression unit comprising a nozzle into which the compression auger extends and through which the transferred ice product is extruded to form a column of hard ice, said mechanical transfer means and said nozzle having means made of a material having low conductivity, i.e., less than 0.1 at 32° F., forming a surface lining the entire passage for the ice product and extending continuously from the harvesting auger to the outlet end of the nozzle, thereby to make the ice maker relatively independent of the ambient in which it is located and improving the lubricity of the passage through which the ice product is being compressed and extruded.
2. In an ice maker as defined in claim 1, said nozzle comprising an outer shell made of two separable pieces, said material of low conductivity comprising a separate liner part formed as an insert, and clamping means locking said shell and said insert into firm assembly with one another.
3. In an ice maker as defined in claim 2, said outer shell being made of thermally conductive metal comprising stainless steel, and said non-conductive material comprising a plastic material having a thermal conductivity of less than 0.1 at 32° F.
4. In an ice maker as defined in claim 2, said liner part comprising two separable pieces and together with one another forming a passageway of a desired cross-sectional shape through which an ice product may be advanced to form a solidified extrudate of a corresponding cross-sectional shape.
5. In an ice maker as defined in claim 1, said nozzle having a configuration to form an inner passage in two axial zones including a first zone of a given degree of convergence and a second zone of a lesser degree of convergence, thereby to compact the ice product into a solidified extrudate, said nozzle and the liner material having an opening formed therein in said first zone through which fluids removed from the ice product are vented.
6. In an ice maker as defined in claim 1, an elbow connected to the outlet end of said nozzle and through which a column of hard ice is directed, said elbow having wall means angularly disposed to overlie the nozzle in such a manner as to assist in breaking the column of ice into pieces of utilitarian size.
7. In an ice maker as defined in claim 6, and further characterized by said elbow having a venting opening formed therein through which fluids may be removed from the interior of the elbow.

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