Apr. 17, 1923. 1,451,902

C. FIELD

METHOD OF SEPARATING A BRITTLE PRODUCT FROM A BASE

Filed April 29, 1920 2 Sheets-Sheet 1

Fig:1.

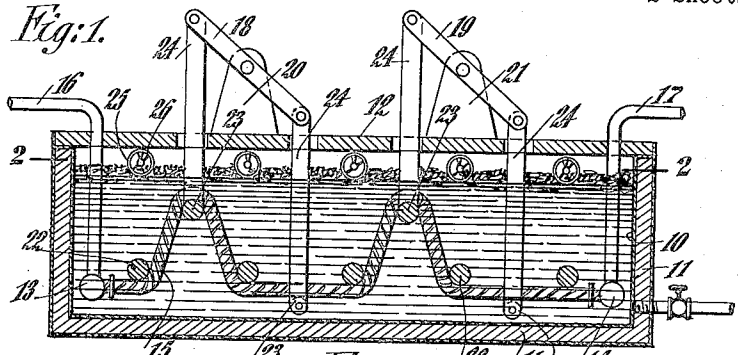


Fig:2.

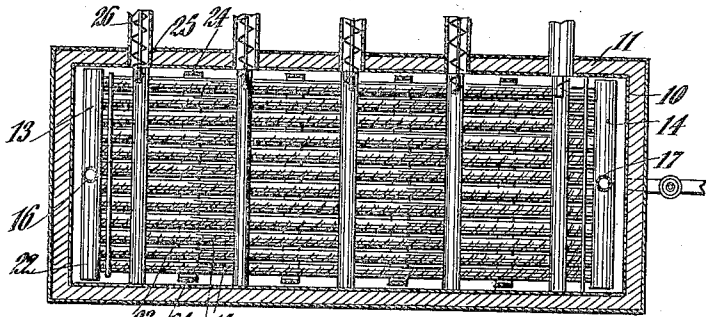


Fig:3.

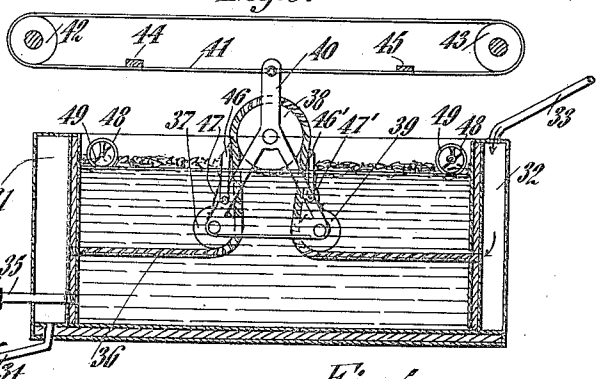


Fig:4.

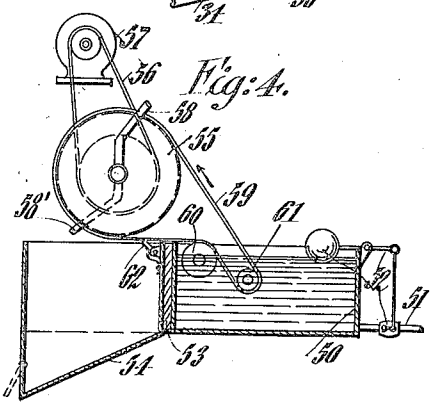
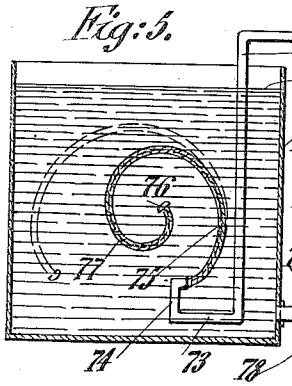


Fig:5.



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Fig:6.

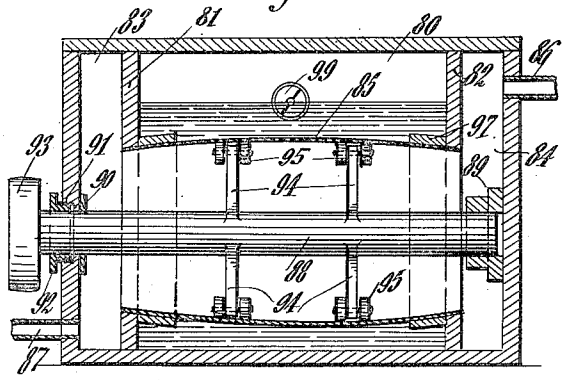


Fig:7.

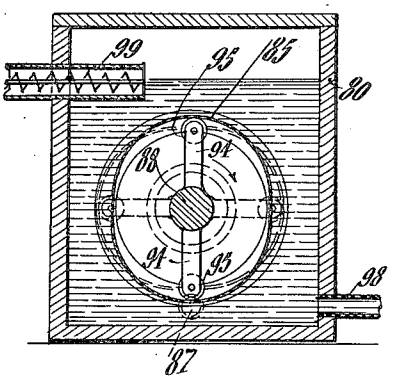


Fig:8.

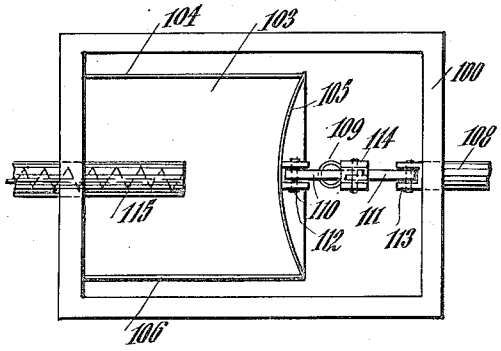
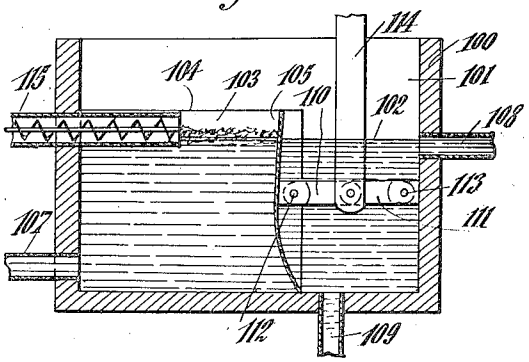


Fig:9.



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Patented Apr. 17, 1923. 1,451,902

UNITED STATES PATENT OFFICE.

CROSBY FIELD, OF NEW YORK, N. Y., ASSIGNOR TO CHEMICAL MACHINERY CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

METHOD OF SEPARATING A BRITTLE PRODUCT FROM A BASE.

Application filed April 29, 1920. Serial No. 377,464.

To all whom it may concern:

Be it known that I, CROSBY FIELD, a citizen of the United States, and a resident of the city of New York, county and State of New York, have invented certain new and useful Improvements in Methods of Separating a Brittle Product from a Base, of which the following is a description.

The present invention relates to an improved method for separating a brittle product from a base upon which said product is formed or deposited and irrespective of the particular process by which such product may be produced. To this extent the subject matter of this application constitutes a division of my parent application filed July 30th, 1918, Serial No. 297,365.

As disclosed in the application just referred to, the present invention is particularly devised with a view to its use in the manufacture of ice wherein an ice film is formed upon a flexible wall or base. It has been found in practise that such an ice film may be readily fractured and caused to separate from the base by flexing the latter or temporarily altering its normal conformation. However, as will hereinafter appear, this invention is not necessarily limited in its utility to ice manufacture but may be employed in the production on a commercial scale, of various other products of a more or less brittle nature.

With these and other objects in view, embodiments adapted to carry out my invention are shown in the accompanying drawings, and these embodiments will be hereinafter more fully described with reference thereto and the invention will be finally pointed out in the claims.

In the accompanying drawings:

Figure 1 is a vertical sectional view, partly in elevation, showing one method of carrying out my invention.

Figure 2 is a horizontal sectional view thereof, taken along the line 2—2 of Figure 1,

Figure 3 is a vertical sectional view, partly in elevation, of a modified form,

Figure 4 is a view partly in section and partly in elevation, showing a further modified apparatus for carrying out the invention,

Figure 5 is a view partly in section and partly in elevation, showing a still further modified apparatus,

Figure 6 is a vertical longitudinal sectional view of a still further modified apparatus for carrying out my invention.

Figure 7 is a vertical transverse sectional view thereof,

Figure 8 is a plan view of another modified apparatus, and,

Figure 9 is a vertical longitudinal sectional view thereof.

Similar reference characters indicate corresponding parts throughout the several figures of the drawings.

Referring to the drawings, and more particularly to Figure 1 thereof, the embodiment shown therein comprises a tank or vessel 10, insulated at its side and bottom with lagging 11, and provided with a cover 12. The tank is filled with pure water, when used for manufacturing ice, although it will be understood that other substances capable of being frozen or otherwise treated, may be contained therein. Secured within the tank at its ends and relatively near the bottom there are provided headers 13 and 14, which are connected by a plurality of flexible tubes 15, these being preferably of metal and of the well-known commercial type, and their ends are in communication with the brine or other refrigerants which flow into headers 13 and 14, the refrigerant being supplied to the header 13 by means of a supply pipe 16, and is exhausted from the header 14 through the exhaust pipe 17. The tubes may be of any suitable number and are spaced apart slightly, as shown, for instance, in Figure 2.

Instead of the tubes we may also employ solid wires or other suitable means which will conduct heat from to or from the liquid, or is suitable for heat transference. The principle of the invention as applied to the formation of ice, is that a layer of ice will form about the cylindrical surface of the submerged tubes, and when this reaches a suitable thickness, as for instance, one eighth of an inch, the tube is warped or otherwise changed in its position, so that the ice is cracked therefrom. It has been found in practice, that the ringlets of ice formed upon the tubes are readily cracked longitudinally of the axis of the tubes. This ice, upon being released from the tubes, rises to the upper surface of the water in the tank, and may thereupon be removed by any suitable means. Although primarily

intended for the manufacture of ice, the invention has already been successfully adapted to other processes involving heat transfer, in which a solid or semi-solid material precipitates out of the solution upon the media through which the heat transfer took place, this action sometimes resulting in the formation of a hard crust. This precipitate may readily be removed by warping or flexing the tubes, according to the present invention, and falls to the bottom of the tank, if heavier than the liquid from which it was precipitated, and rises to the top of the liquid in those cases where it is lighter, as for instance, in the formation of ice. As a particular example of the use of my invention in processes involving heat transfer, other than the formation of ice may be mentioned the evaporation to partial dryness of calcium salts of organic acids.

In Figures 1 and 2 I have shown one means of bringing about the warping of the flexible tubes, consisting of a pair of walking beams 18 and 19, pivotally mounted upon suitable standards 20 and 21, and adapted to be operated in unison by means of cranks or pulleys (not shown). At the side of the flexible tubes and in spaced relation to each other there are provided a plurality of fixed transverse supports 22, and arranged at the under side of the flexible tubes and in alternate relation to the fixed transverse supports 22 there are provided transverse rods 23, carried at the ends of the arms 24, extending downwardly through the cover 12 from the ends of the walking beams 18 and 19. Through the operation of the walking beams the flexible tubes are caused to change their configuration and, as above pointed out, this action readily causes the layer of ice or other precipitate formed upon the flexible tubes to be cracked off, whence it rises to the surface and is removed through the ports 25 by means of suitable screw conveyors 26 arranged in said ports.

In Figure 3 I have shown a modified form of apparatus in which the tank or vessel 30 is provided at its ends with compartments 31 and 32, and into each brine, freezing gas, or other suitable refrigerant is adapted to be circulated or expanded, such refrigerant being supplied to the compartment 31 by means of a supply pipe 33 and carried off from the compartment 32 by means of an exhaust pipe 34. Water may be supplied to the tank 30 by means of a supply pipe 35, provided with a control valve 35a. The ends of the tank are connected by a plurality of flexible tubes 36, which are in communication at their ends with the compartments 31 and 32, so that the refrigerant circulates through the compartments and the flexible tubes.

The means for warping the flexible tubes to remove the layer of ice or other precipitate formed thereon, consists of three rollers 37, 38 and 39, mounted upon frames 40 provided at the ends of the rollers, and which are connected to the cable 41, carried upon the pulleys 42 and 43, and adapted to be moved back and forth so that the rollers are conveyed from one end of the tank to the other, engaging all parts of the flexible tubes which are threaded over the rollers. I have indicated diagrammatically at 44 and 45 stops adapted to be engaged by the frame, and by connection with suitable electrical or mechanical means to reverse the direction of movement of the cable. Scrapers 46 and 46′ are supported upon the frames 40 and these are held in yielding engagement with the surface of flexible tubes by means of springs 47 and 47′, to insure complete removal of the ice formed thereon. As the ice is removed from the flexible tubes and rises to the surface, it is conveyed from the tank through a port 48 in which is provided a conveyor 49.

In Figure 4 I have shown a further modified apparatus for carrying out my invention, and which consists of a tank 50 containing water, supplied thereto by a supply pipe 51, controlled by a float valve 52, so that the water is always maintained at the proper level. At the end of the tank 50 and separated therefrom by lagging 53, there is provided a receiving tank or hopper 54, adapted to receive the formed ice or other precipitate produced. Upon the said hopper 54 there is mounted a cylindrical drum 55 adapted to be rotated by means of a belt 56 and motor 57. The ends of the drum are closed and brine or other suitable refrigerant is adapted to be circulated or expanded therein through suitable connections 58.

The surface of the drum is relatively large and a plurality of wires 59 are carried thereover and extend downwardly into the water over pulleys 60 and 61, these wires being preferably arranged close together so as to form a relatively large water conveying surface. Instead of wires I may also employ a wide flat belt preferably of metal, or I may employ a plurality of belts. A scraper 62 is arranged at the ends of the hopper adjacent the water tank, for the purpose of entirely removing the ice or other precipitate from the wires before the same again enter the liquid.

The operation is as follows:

As the drum is rotated the wires or belts are moved in the direction of the arrow the surface thereof being covered with water, and as this water comes into relation with the surface of the drum 55 the same is frozen upon the wires or belts, this freezing action being completed before the same leave the drum. Upon leaving the drum the wires assume a straight position so that the ice formed thereon is cracked and drops

into the hopper 54. Should any of this ice fail to be removed by this cracking operation, the scraper 62 will cause the same to be precipitated into the hopper.

In Figure 5 I have shown a still further modification which consists of a tank 70 containing water or other liquid up to the level 71, and within the tank there is provided a pipe 72 extending toward the bottom thereof, bent laterally at 73, and turned upwardly at its end, as at 74. To the end of this pipe there is secured a flexible tube 75 closed at its end 76, and provided with a coil spring 77 adapted to normally coil the flexible tube. This spring may either be contained within the tube, or it may be secured to the outside of the same, or instead, the tube itself may be inherently elastic. Brine, freezing gas, or other refrigerant is adapted to be introduced within the flexible tube causing a layer of ice to be formed thereon. By increasing the pressure of the fluid within the flexible tube, the same is caused to move toward a straight position, as indicated in dotted lines, thereby cracking the ice and causing the same to be removed therefrom, this ice floating to the top of the water, where it may be removed in any suitable manner, as for instance by means of a screw conveyor, as shown in the other forms of my invention. Water or other liquid is supplied to the tank by means of a supply pipe 78, provided with a valve 79.

In Figures 6 and 7 I have illustrated a still further apparatus adapted to carry out my invention, which comprises a covered tank 80, provided with a lagging and having at each end thereof barriers or partitions 81 and 82 forming a jacket 83 and 84 at each end. These jackets are connected by means of a tube 85 of thin flexible material, and through which brine or other suitable refrigeratant is adapted to flow from the jacket 82 to the jacket 83, a supply pipe 86 being provided for the jacket 84 and an exhaust pipe 87 being provided for the jacket 83. Liquid to be frozen, such, for instance, as water, is contained in the tank between the two end jackets up to the level 88 and it completely surrounds the flexible tube 85.

Normally the flexible tube is circular in cross section, but, in order to warp the same so as to remove the ice formed upon its outer surface, there is provided a shaft 88 extending axially therethough, being journaled at one end in the bearing 89, while at its other end it passes through a collar 90 and a packing ring 91, held in place by a nut 92 to make the bearing liquid type. A pulley 93 is provided upon the end of the shaft, and is adapted to rotate the same through any source of power in the direction of the arrow. In spaced relation upon the shaft there are provided radial arms 94 carrying at their ends rollers 95 which engage the inner surface of the tubular member, the distance between the peripheries of the diametrically opposite rollers being greater than the diameter of the tubular member so that as the shaft rotates, the tubular member assumes an elliptical cross section, the longitudinal axis of which constantly rotates, the tubular member taking in succession the positions shown by the dotted lines in Figure 7. It will be noted that these rollers are not disposed close to the ends of the flexible tubes. The purpose of this is to allow sufficient flexibility to permit the central part of the flexible tube to warp without putting too great a strain on the ends which are connected to the partitions 81 and 82. It is essential, therefore, that the end parts of the flexible tube be not permitted to accumulate ice and consequently they are covered by flexible rings 96 and 97 of insulating material.

Water or other liquid to be frozen is supplied to the tank by means of a pipe 98 controlled by a valve (not shown), and as the formed ice floats to the top of the water, it is conveyed from the tank by means of a screw conveyor 99.

In the still further modified form of construction shown in Figures 8 and 9, a tank 100 is provided, divided into two compartments, the outer compartment 101 containing brine or other refrigerant up to the level 102, while the inner compartment 103 contains water or other material to be frozen. These compartments are separated from each other by partitions 104, 105 and 106, of which at least one is very flexible, and preferably the remainder are of some flexibility. The liquid to be frozen is fed to the compartment 103 by means of a pipe 107, this being controlled by a suitable valve (not shown), while the refrigerant is fed to the compartment 101 by means of a pipe 108 and is exhausted therefrom by means of a pipe 109, the pipe 108, being controlled by a valve (not shown), so as to maintain the level of the refrigerant at 102.

The cold produced causes ice to form upon the inside of the thin flexible partition 105, the flexible partitions 104 and 106 being preferably made of insulating material, so that ice will form only upon the partition 105. This partition is caused to be warped by means of a pair of pivoted links 110 and 111 respectively, pivoted to the said partition at 112 and to the wall of the tank at 113, while the pivotal connection between the links is connected to a lever 114 to which reciprocating motion is imparted by any suitable means, causing the same to rise and fall by means of the links 110 and 111, and the partition 105 to be warped to and fro so that the ice formed upon its inner surface is cracked therefrom. As this ice is formed,

it floats to the top of the water, and is removed by means of a screw conveyor 115.

It will be understood that where I have referred in the description of my invention to water and the formation of ice, that I do not wish to limit myself to this particular process, but on the other hand it is within the principle of my invention to utilize the process and apparatus in connection with other liquids or solutions, and in the formation of other materials than ice. The essential feature of my present invention resides in the method which I employ to effect the removal of the product, however produced, from the base upon which it is formed or deposited so that production on a commercial scale may be expedited and without loss or waste of the product. While particularly applicable to the manufacture of artificial ice for refrigeration purposes, it is manifest that the sphere of utility of my present improvement is more comprehensive and is capable of successful and advantageous application in the commercial manufacture of various other products.

Likewise it will be apparent that though I have herein made reference to several practical forms of apparatus by means of which the method may be successfully practised, numerous other alternative structures might be designed for accomplishing the same purpose. Accordingly it is to be understood that any preferred form of apparatus may be adopted without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. The herein described method which consists in producing a continuous layer of a brittle product upon an imperforate, non-metallic normally stationary flexible base and then applying a positive pressure to said base to flex the same and separate the brittle product therefrom in the form of flakes.

2. The herein described method of manufacturing artificial ice in flake form which consists in producing a continuous layer of ice upon a normally stationary imperforate, non-metallic base, and then applying a positive pressure to said base to flex the same and cause the ice to separate therefrom in the form of flakes.

In testimony that I claim the foregoing as my invention, I have signed my name hereunder.

CROSBY FIELD.