

April 9, 1935.

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1,996,781

METHOD OF FREEZING LIQUID OR SEMILIQUID SUBSTANCES IN CONTAINERS

Filed Aug. 23, 1930

3 Sheets-Sheet 1

Fig. 1.

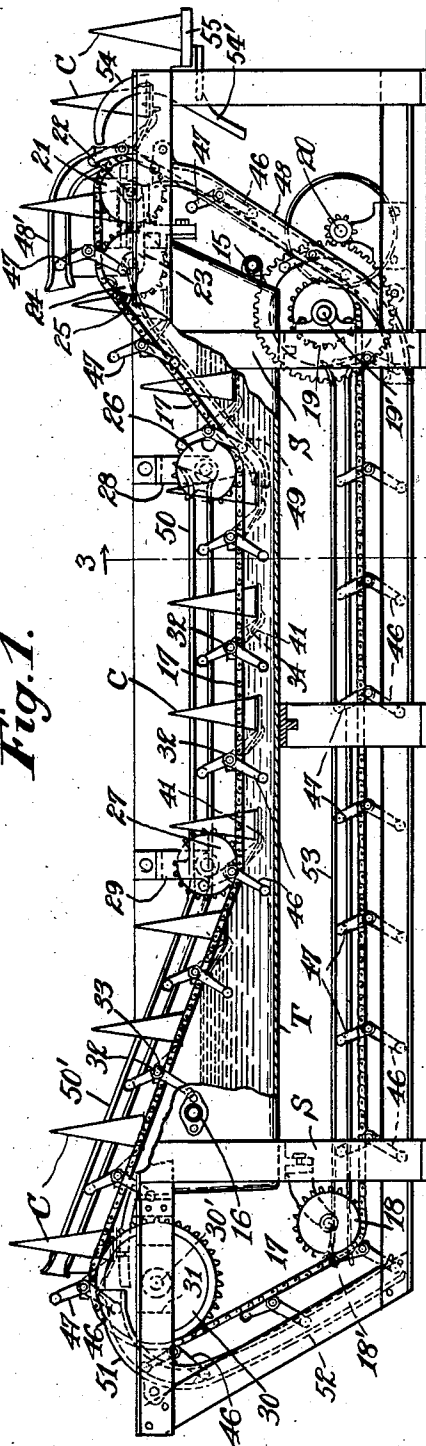
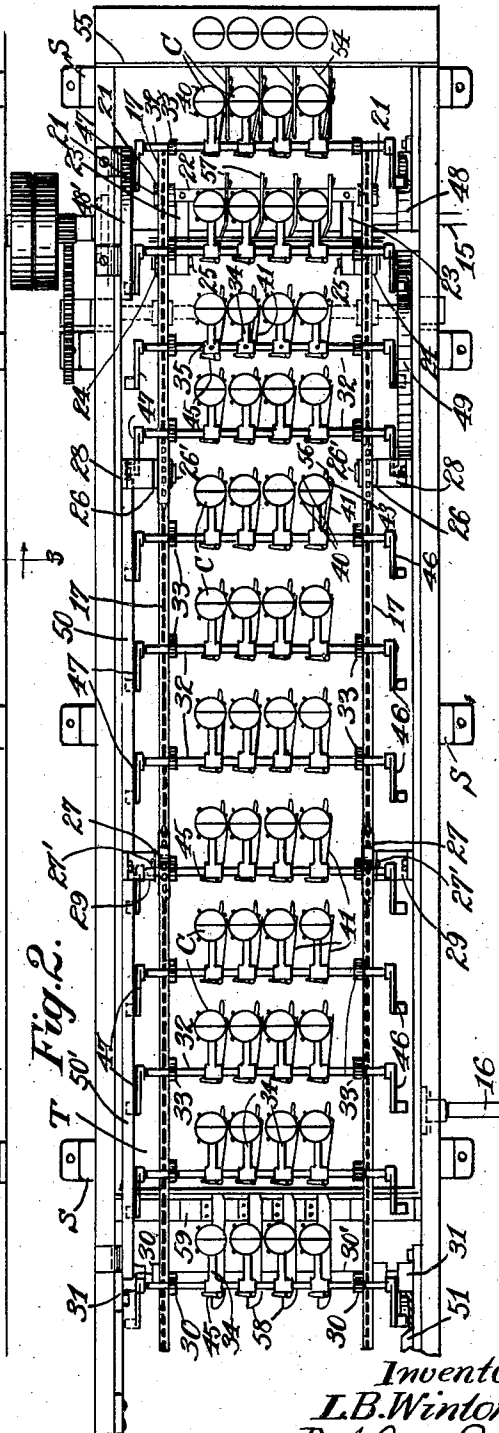


Fig. 2.



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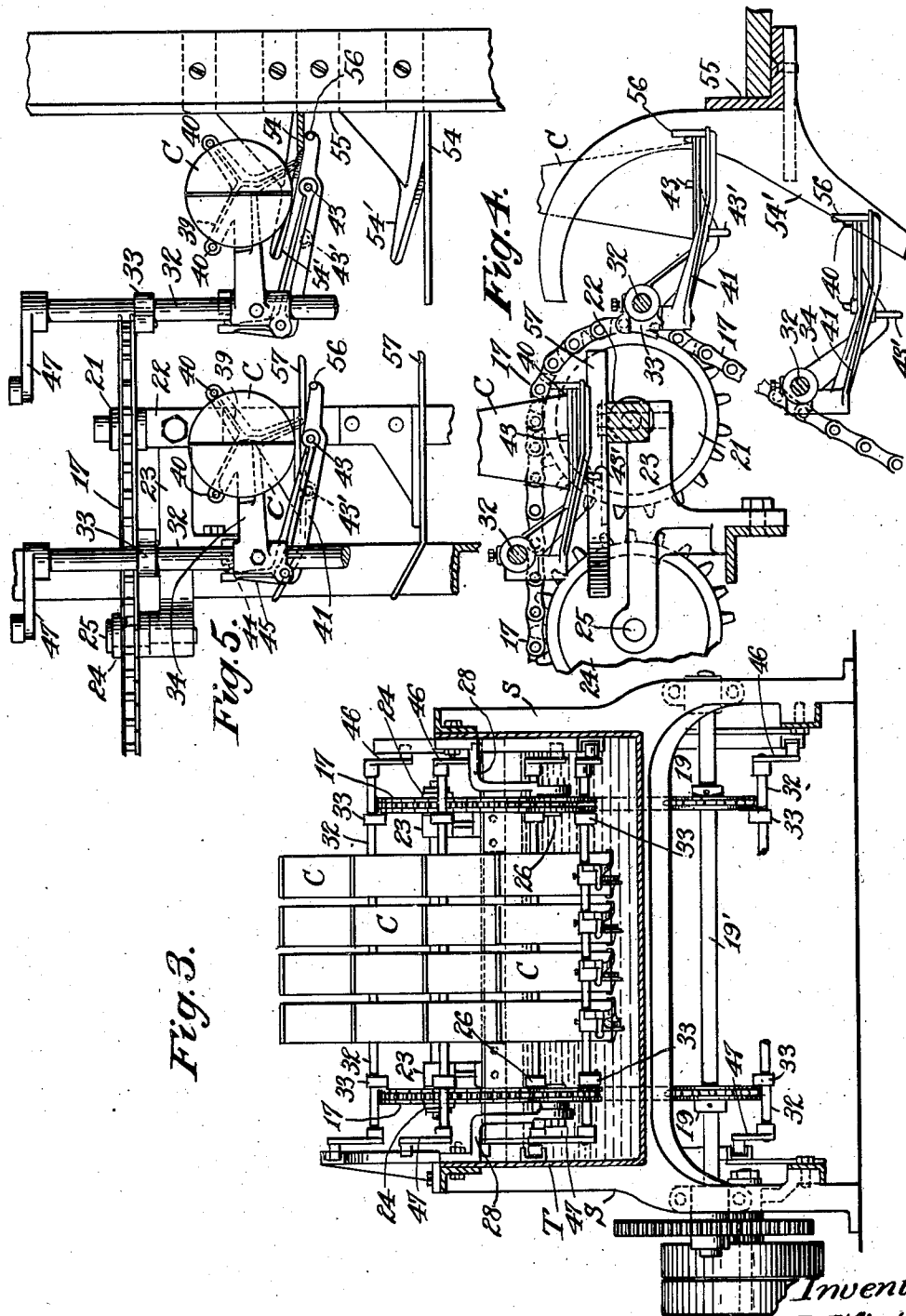
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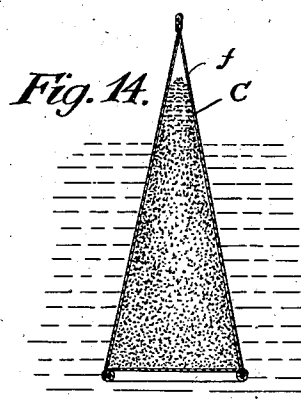
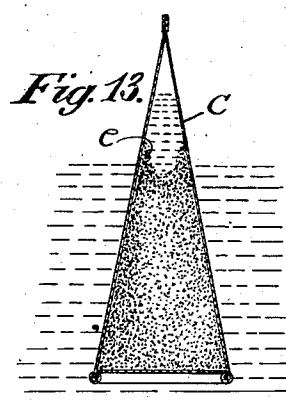
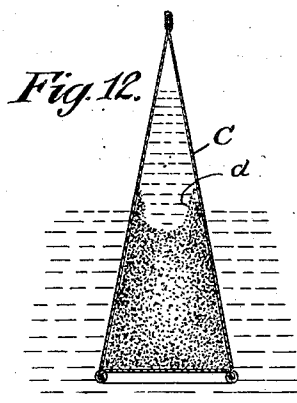
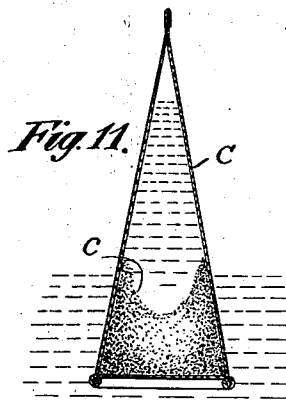
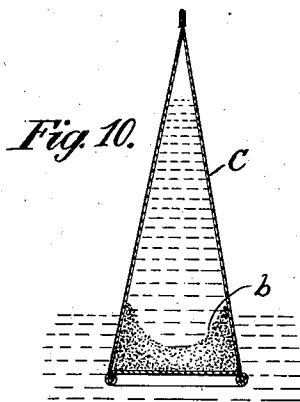
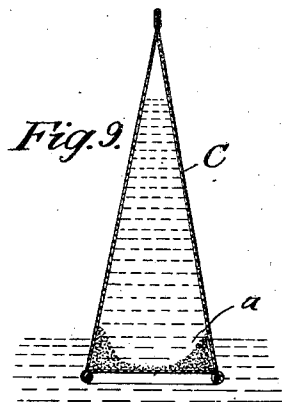
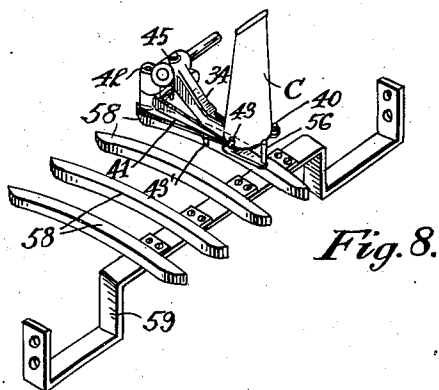
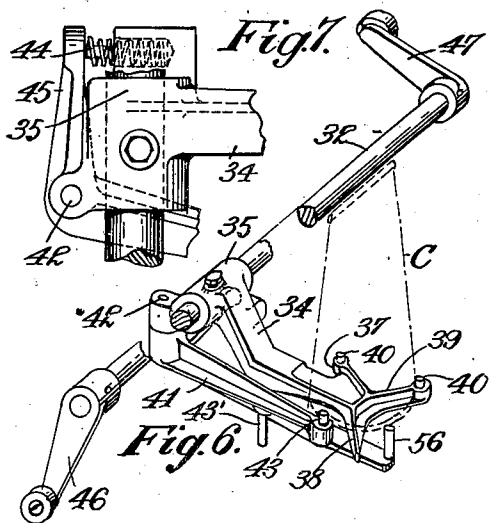
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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METHOD OF FREEZING LIQUID OR SEMI-LIQUID SUBSTANCES IN CONTAINERS

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13 Claims. (Cl. 62-173)

This invention relates to the dispensing of frozen mobile substances, such as liquid or semi-liquid food products, and it is the primary object of the invention to provide an improved method of and means for freezing liquid or semi-liquid food products, such as orange juice, milk, water or eggs, in containers, and dispensing the product with the container in which it is frozen.

While the invention is adapted for use with containers of different structure and material, it is particularly adapted for use in connection with weak containers, preferably of conical form, constructed of paper and paraffined, comprising a body shaped from a blank to tubular form and secured by a seam at the longitudinal marginal portions, as by a paper strip adhesively applied over the longitudinal marginal portions of the blank, and having a flanged disk, to constitute the bottom of the container, secured in the end of larger diameter of the body by rolling the contiguous portions of the disk flange and end of the container body together to form a seam, after which the container is subjected to a paraffine bath to apply a paraffine coating on the exterior and interior of the container with a paraffine fillet filling the interstices, and sealing the joint between the bottom and body as well as of the side seam. After the contents have been filled into the container it is closed by the collapsing or squeezing together opposite wall portions at the open end and sealed substantially liquid tight by a V-shaped closure member engaged over and clamped to the collapsed container end with extended end portions of the closure member folded about the sides of the collapsed container end.

In the application of known methods of freezing to freeze liquid or semi-liquid substances in a container; that is, by subjecting the container to a freezing medium to effect a transference of the latent heat from a substantial portion of the entire surface of the substance, the expansion forces set up during the freezing will distort the container to such an extent as to rupture the container, not only opening the contents to the atmosphere but also permitting leakage of the substance from the container when thawed preparatory for use. In the use of a weak container, such as a paraffine coated paper container, this distortion of the container breaks the paraffine seal thereby exposing the paper material of the container to the substance in the container not only contaminating the substance but the paper will absorb such substance when thawed with a consequent leakage and rupture of the container.

In carrying out the present method the substance to be frozen is filled into the container and the container is closed and secured in closed condition by applying a closure member in liquid tight connection thereto, the quantity of the substance filled into the container being less than

the capacity of the container to provide an air space therein. While preferably the container is closed preparatory to freezing the contents thereof, the substance may be first frozen in the container and the container then closed and the contents sealed from the atmosphere. The container with the contents filled therein is then subjected to a freezing medium to effect a freezing of the contents of the container without distortion thereof by expansion of the contents due to the freezing with the consequent deleterious result as hereinbefore stated. For this purpose the freezing is effected in a direction upward from the bottom and inward from the side of the container without freezing the upper portion and the formation of ice at the top of the contents of the container. This is accomplished by subjecting the container to a freezing medium so that at the commencement of the freezing there will be a greater transference of the latent heat of the contents of the container from the bottom and an initial freezing of the contents at the bottom and about the side adjacent the bottom of the container, thus providing a frozen shell at the bottom and about the juncture of the bottom with the body of the container, and then continuously and progressively freezing the contents upward from the frozen bottom portion and inward from the side of the container toward the air space at the top, the substance at the side of the container being frozen progressively in advance of the substance centrally of the container above the frozen bottom portion. The initially frozen shell at the bottom and about the side adjacent the bottom of the container serves as a reinforcement therefor and prevents rupture of the container by expansion in the subsequent freezing of the remainder of the contents of the container. By the freezing of the substance at the side of the container progressively in advance of the substance centrally of the container above the frozen bottom portion there is a continuous formation of the reinforcing shell of frozen substance, the tendency of the forces of expansion being in an upward direction with a displacement of the unfrozen contents of the container toward the air space therein.

A conical container as described is particularly adapted for the freezing of liquid or semi-liquid substances in containers inward from the side and in an upward direction in the container as described as the tapered wall of the container tends to hold the frozen shell to the bottom, and since it is of greater capacity at the bottom than at the top there is provided a considerable surface area for the transference of the latent heat of the substance being frozen to the freezing substance and a quicker freezing of the contents than if the container were of uniform cross sectional dimension from end to end.

The freezing is effected by engaging the container in an upright position into a freezing liquid or substance having a temperature and freezing point lower than the freezing point of the substance to be frozen, and the temperature of the freezing liquid varying in the freezing of different products. Preparatory to freezing of the contents of a container the substance to be frozen is filled into the container to a point within the top of the container to provide an air space in the container approximately equal to one-sixteenth of the cubical contents of the container and engaging the container in the freezing liquid to an extent greater than one-half the height but below the level of the substance in the container, the engaging of the container into the freezing liquid from two-thirds to five-sixths of the height of the substance in the container having been found satisfactory.

While the method may be carried out by engaging the container to the extent stated in the freezing substance, the container is preferably gradually or progressively engaged into the freezing substance, the container being retained in the freezing substance until the contents is entirely frozen or solidified, or until such time as the contents at the bottom and about the side of the container in advance of the frozen bottom portion is frozen to the top or adjacent the top, when the container may be removed from the freezing substance and the freezing completed in the atmosphere by freezing the unfrozen portion of the contents of the container at the top from the top downward and inward by a transference of the latent heat thereof to the frozen portion of the contents of the container, the temperature of the atmosphere being at least as low as the freezing point of the contents of the container which may be effected by placing the container in a refrigerator of sufficiently low temperature to produce freezing. After the substance has been frozen in the container it is stored at a temperature to prevent thawing of the contents and in such condition distributed to the ultimate consumer of the product.

While the method is adapted for freezing any liquid or semi-liquid substance it is particularly adapted for the freezing of liquids having component parts of different specific gravity, such as orange juice, which parts tend to stratify or form in layers, since by the rapid freezing and in the manner in which the contents of a container is frozen as described a stratification of the component parts of the substance being frozen is prevented. Furthermore the substance frozen being sealed from the air in a container it will retain all of its natural flavor and there will be no deterioration in the food value of the same.

In the drawings accompanying and forming a part of this application there is illustrated apparatus for carrying out the method wherein Figure 1 is a side elevation of apparatus for immersing containers carrying the substance to be frozen into a freezing liquid and transporting the same through and out of said liquid.

Figure 2 is a plan view.

Figure 3 is a cross sectional view taken substantially on the line 3—3 of Figure 1 looking in the direction of the arrows.

Figure 4 is a longitudinal section, on an enlarged scale, of the right hand end portion of the apparatus shown in Figure 1 to show actuating means to release means for releasably retaining containers on container supports of a traveling conveyor.

Figure 5 is a plan view of the parts shown in Figure 4.

Figure 6 is a perspective view of a container carrier of the conveyor means.

Figure 7 is a view of a portion of the means for releasably retaining containers on holders of the conveyor means.

Figure 8 is a perspective view to show the means for releasing the container retaining means of the holders; and

Figures 9 to 14 are views of a container and showing in a diagrammatic manner the progressive freezing of the substances in a container.

In performing the method there is provided a refrigerating or freezing apparatus comprising a tank or trough T, substantially of rectangular shape, supported upon standards S to contain a suitable freezing medium or liquid, such as brine, having a temperature and freezing point lower than the freezing point of the substance to be frozen, the freezing liquid being flowed through the tank by connecting the tank through a pipe 15 with a source of supply and entering the liquid adjacent the bottom and one end of the tank, to constitute the entering or forward end of the tank, the liquid being maintained at a predetermined level in the tank and returned to the source of supply by an outlet and overflow pipe 16 positioned at a desired point above the bottom of the tank and at the end opposite to the inlet pipe 15.

The containers containing the substance to be frozen are engaged in an upright position with the bottom lowermost into the liquid in the tank and transported through and out of the liquid by conveyor mechanism comprising a pair of chains 17, the lower stretch of the chains passing over and being guided by sprocket wheels 18, 19 below the tank, said wheels being fixed to shafts 18', 19' journaled in brackets mounted on the standards S and the shaft 19' being driven at a reduced speed through gearing from a drive shaft 20. The chains pass from sprocket wheels 19 over sprocket wheels 21 loose on stubs 22 journaled in brackets 23 at the forward end and above the tank, and from which sprocket wheels the chains are guided in a horizontal plane and over sprocket wheels 24 fixed to a stub 25 carried by the brackets 23, thence into and through the liquid in the tank below sprocket wheels 26, 27 fixed to shafts 26', 27' rotatably carried by brackets 28, 29 fixed to and within the tank in spaced relation to the sides thereof, as shown in Figure 3, the chains passing from sprocket wheels 28, 27 over sprocket wheels 30 fixed to a shaft 30' journaled in brackets 31 fixed to the rear end and extended above the tank, and pass from said latter sprocket wheels 30 to the sprocket wheels 18.

Carriers for container holders or supports are connected to the chains to participate in the travel thereof, said carriers comprising bars or shafts 32 rotatably mounted in supporting members 33 fixed to the chains to extend between the chains and spaced in predetermined relation longitudinally of the chains.

A holder, or a series of holders, in the present instance shown as four in number, for releasably supporting containers C are mounted in equidistant spaced relation upon the carrier bars 32. The container holders or supports comprise members or arms 34 having a sleeve portion 35 whereby they are fixed on the carrier bars to extend laterally therefrom, each arm having a series of three radially extending fingers 37, 38, 39 in the form of a spider with ribs projecting from

one face of the arms and fingers for contact engagement and support of a container at marginal portions about the bottom. The containers are positioned upon the arms and fingers by pins 40 fixed in and extending upward from the extremity of the fingers engaging marginal portions about the bottom of the containers, and the containers are releasably retained thereon by gripping means yieldingly engaged with a marginal portion at the bottom end of the container opposed to and intermediate the pins 40. Each of the gripping means comprises a lever pivotally supported, as at 42, upon the sleeve portion 35 of arms 34 with one arm 41 of the lever juxtaposed to an arm 34 to have movement in a direction transversely of and urged toward the arms 34 to engage a pin 43 fixed in and extending from the end of said arm with the containers positioned on fingers 37, 38 and 39 of arms 34 relative to the pins 40 carried by said fingers and thereby clamping the container between the pins 40, 43 by a spring 44 interposed between an arm 45 extended from the lever at substantially a right angle from its pivotal support to the arm 41 and the sleeve portion 35.

As stated, the containers in an upright position are engaged into the freezing liquid and transported through and out of the liquid in such position, and to maintain the containers in such position by the travel of the conveyor chains into, through and out of the tank means are provided to adjust the carriers for the container supports during the travel of the containers. For this purpose crank arms 46, 47 are fixed to the opposite ends of the carrier bars 32, said crank arms carrying rollers to engage and follow cam or guide members fixed to the tank and arranged relative to the travel of the conveyor chains. As the chains travel from sprocket wheels 19 to sprocket wheels 21 the rollers of crank arms 46 engage and travel relative to a cam member 48 and crank arm 47 relative to a horizontal cam member 48' as the chains travel in a horizontal plane from sprocket wheels 21 to sprocket wheels 24, thereby adjusting the carriers and the holders from a vertically extending position to a substantially horizontal position and retaining the holders in said latter position during the initial portion of the travel of the upper stretch of the chains and during which time the containers are placed and positioned upon the holders. During the travel of the chains from sprocket wheels 24 to sprocket wheels 26 the rollers of crank arms 46 engage and travel relative to a cam member 49 thereby rotatably adjusting the carriers for the supports or holders to maintain the containers in an upright position. During the travel of the chains from the sprocket wheels 26 to sprocket wheels 27 the rollers on cranks 47 engage and follow a cam member 50 at the side of the tank opposite to the cam member 49, rollers of cranks 47 during the travel of the chains from sprocket wheels 27 to sprocket wheels 30 traveling relative to a forwardly inclined portion 50' of the cam 50. As the chains travel to sprocket wheel 30 the rollers on cranks 46 engage and travel relative to a curved cam member 51 and as the chains travel from sprocket wheels 30 to sprocket wheels 18 the rollers on crank arms 46 engage and follow a straight portion 52 of cam member 51, and from sprocket wheels 18 to sprocket wheels 19 the rollers on crank arms 47 engage and travel relative to a horizontal cam member 53, when the rollers on crank arms 46 again engage and travel relative to the cam member 48.

The containers are placed upon the conveyor supports or holders during the travel of the conveyor from sprocket wheels 21 to sprocket wheels 24 and in order that the containers may be placed upon the supports the releasable container retaining arms 41 are spread laterally of the arms 34. To effect the automatic operation of said arms 41 during the travel of the conveyor and to retain them in such position to permit engaging containers on the supports 34 gauged relative to the pins 36, 37, cams, in the form of plates 54, are mounted on a transverse bar 55 fixed to the supporting structure forward of and in a plane below the sprocket wheel carrying shaft 22, these cams being in number equal to the number of the container supports on the carrier bars and spaced apart distances corresponding to the spacing of the supports on the carrier bars. The cams 54 have an angular portion 54' extending downward from the support 55 to intersect the path of travel of and for engagement by pins 56 extended upward from the support arms 41, and as such pins ride up said inclined cam portions the arms are moved laterally of the holder arms 34 against the tension of the springs 44. The upper portion of the cam plates 54 is of arcuate shape and extends in the direction of travel of the conveyor, and as the pins 56 ride up the inclined portions 54' and onto said arcuate portions of the cam plates the sides of such arms 41 engage said arcuate portions and are moved laterally from the arms 34. As the holder arms 41 ride off from the arcuate portion of cam plates 54 pins 56' extended downward from the arms 41 engage a portion of cam plates 57 extended in the plane of the arcuate portion of the cam plates 54, said cam plates 57 being mounted upon a transverse member of the supporting structure.

During the travel of the container supports with the conveyor from sprocket wheels 19 to sprocket wheels 21 relative to the cams 54 filled containers may be positioned upon the cam support 55, which may be arranged as a shelf, and during the travel of the container supports relative to the curved portions 54' of cams 54 and to the cams 57 the containers are placed upon the supports 34. As the pins 56 of arms 41 ride off from the cam plates 57 the arms 41 are moved by the springs 44 to engage the arm pins 43 with the containers and thereby clamp the containers between said pin and the pins 40.

As the carriers for the container supports in the travel of the conveyor chains approach the terminus of the upper stretch of the conveyor the arms 41 are moved in a direction away from the arms 34 to release the containers and permit of removal of the containers from the container supports, said movement of the arms 41 being effected by the pins 43 carried by said arms engaging and moved by the travel of the conveyor relative to cams 58 fixed upon a transverse member 59 mounted upon the supporting structure.

The freezing of the contents of the containers is effected progressively from the bottom upward substantially as indicated diagrammatically in Figures 9 to 14. The temperature of the freezing substance is such as to effect a quick freezing of the substance in the containers and as the containers are entered into said liquid there is an initial freezing of the substance in the containers at the bottom and about the side of the containers at the juncture of the bottom with the body and slightly above the bottom, as at *a* in Figure 9, thus forming a frozen shell at and about the side at the bottom which serves as a

reinforcement for the containers. The containers are entered into the freezing liquid to an extent so that level of the freezing liquid is below the level of the substance in the containers, and as the containers are progressively or gradually entered therein there is a progressive freezing of the contents of the containers upward from the bottom without freezing at the top of the containers, as shown diagrammatically at b, c, d, e and f. By this method the forces of expansion are in an upward direction toward the air space above the substance in the container and the expanded substance displacing said air, the pressure of the expanded substance in the container on the air forcing the air from the container through the interstices in the connection of the closure member. The closure members while having a liquid-tight seal with the containers permit of the ejection or passage of the air by the forces thereon created by the expansion of the freezing contents. The upper stretch of the conveyor between sprocket wheels 26, 27 is spaced from the bottom of the tank to permit of a free flow of the freezing liquid entering the tank about the bottom of the container, and may be of an extent to retain the containers in the freezing liquid for a length of time sufficient to freeze the contents of the containers until entirely solidified. However, to increase the capacity of the apparatus the containers may be left in the freezing liquid for a length of time sufficient to only freeze the liquid at the bottom and about the side progressively in advance of the frozen bottom portion to, or adjacent to, the top of the container when they may be removed and the freezing completed by placing the containers in a refrigerator having a sufficiently low temperature to produce freezing.

Having thus described my invention I claim:

1. The packaging of orange juice, consisting in providing a tank and connecting said tank with and flowing therethrough a freezing liquid having a temperature and freezing point below the freezing point of orange juice, filling the orange juice into a container, engaging a container containing the orange juice progressively from the bottom upward into the freezing liquid in the tank to a predetermined depth without entirely immersing the container in the freezing liquid and maintaining the container therein for a predetermined length of time to initially effect a freezing of the orange juice at the bottom of the container and then continuing the freezing progressively in a direction upward from the frozen bottom portion and inward from the side of the container progressively in advance of freezing the center portion of the juice in the container to adjacent the top of the orange juice in the container, then removing the container from the freezing liquid and completing the freezing of the orange juice at the top of the container by a transference of the latent heat of said unfrozen orange juice at the top to the frozen portion of the orange juice in the container, and maintaining the orange juice in its frozen condition until it is dispensed.

2. The freezing of liquid or semi-liquid substances, consisting in providing a container of progressively decreasing cross sectional area from one end to the opposite end having a quantity of the substance to be frozen filled and sealed therein to provide an air space above the substance in the container, and then subjecting the container to a freezing medium to effect a continuous progressive freezing of the substance in

the container inwardly from the end and side of the container of greater cross sectional area toward the air space above the substance in the container, the container wall holding the frozen portion of the substance to the end of the container of greater cross sectional area during the progressive freezing of the substance in the container.

3. The freezing of liquid or semi-liquid substances, consisting in providing a container having a bottom secured in one end and the filler opening at the opposite end and having a quantity of the substance to be frozen filled therein to provide an air space above the level of the substance in the container, and subjecting the container to a freezing medium to initially freeze the substance at the bottom of the container and then continuously progressively freeze the substance inward from said frozen bottom portion toward the air space, the wall of the container being shaped to hold the initially and successively frozen portions of the substance to the bottom of the container and prevent the rupturing of the container by the expansion forces of the freezing substance.

4. The packaging of liquid food commodities, consisting in providing a paper conical container and a freezing medium having a temperature and freezing point lower than the freezing point of the commodity, filling and sealing the substance in the container, then progressively engaging the container in upright position with the end of larger diameter lowermost into the freezing medium to effect a transference of the latent heat of the substance at the end of larger diameter and juncture of said end with the wall of the container and initially freeze the substance at said end of the container, and then effect a continuous progressive freezing of the substance upward from said frozen end portion and inward from the side in advance of the freezing of the center portion of the substance in the container to the top whereby the wall of the container will hold the frozen portion of the substance to said end of the container, and maintaining the substance in frozen condition in the container until it is dispensed with the container.

5. The freezing of mobile food commodities, consisting in providing a conical container having the substance to be frozen filled into and enclosed therein and a tank connected with a source of and flowing therethrough a freezing medium having a temperature and freezing point lower than the freezing point of the substance to be frozen, engaging the container with the substance therein in upright position with the end of larger diameter lowermost into the freezing medium in the tank to an extent below the level of the substance in the container to effect an initial freezing of the substance at the bottom of the container and maintaining the container in the freezing medium for a predetermined length of time to effect a continuous progressive freezing of the substance in the container in a direction upward from the frozen bottom portion and inward from the side of the container progressively in advance of freezing the substance at the center portion of the container to the top thereof.

6. The packaging of orange juice, consisting in providing a conical container and filling the orange juice into and liquid sealing the filler opening of the container, and then subjecting the container with the orange juice therein to a freezing medium having a temperature and freezing point lower than the freezing point of the

orange juice by progressively engaging the container with the orange juice therein in an upright position and the end of larger diameter lowermost into the freezing medium to an extent greater than one-half the height but to a point below the level of the orange juice in the container to effect an initial freezing of the orange juice at the end of larger diameter of the container and then upward from the frozen end portion and inward from the side of the container progressively in advance of the frozen bottom to adjacent the top of the container, the conical wall of the container holding the frozen portion of the orange juice to the end of larger diameter and thereby preventing rupture of the container by the expansion forces of the frozen orange juice, then removing the container from the freezing medium and placing the container in a refrigerator and completing the freezing of the orange juice at the top of the container by a transference of the latent heat thereof to the frozen portion of the orange juice and maintaining the orange juice in frozen condition in the container until it is dispensed with the container.

7. The freezing of substances in conical containers, consisting in providing a freezing medium and subjecting the end of larger diameter of the container with the substance therein in upright position to the freezing medium to first effect a freezing of the substance at the end of the container of larger diameter and then freezing the remaining portion of the substance continuously progressively upward from the frozen bottom portion, whereby the conical wall of the container holds the frozen substance to the end of larger diameter and prevents the same from rising upward in the container during the progressive freezing of the substance in the container.

8. The freezing of liquid substances in containers, consisting in providing a conical container with the substance to be frozen filled and enclosed therein, a tank carrying a freezing liquid having a temperature and freezing point lower than the freezing point of the substance to be frozen, a traveling conveyer arranged with adjustable supports for the containers, means operative during the travel of the conveyer relative of the tank to adjust the container supports to and maintain the containers in upright position with the end of larger diameter lowermost and guide the conveyer to engage the containers in said position to a predetermined extent into the freezing liquid, transport the containers for a predetermined length of travel of the conveyer through the freezing liquid and then move the containers out of the freezing liquid to effect a freezing of the substance in the containers continuously progressively upward from the end of larger diameter, and the wall of the container holding the frozen portion of the substance to the end of larger diameter of the containers against movement upward in the containers.

9. The method of freezing food commodities which comprises the steps of packing the commodity liquid tight in a conical container and engaging the container with the commodity therein in upright position with the end of larger diameter lowermost progressively into a refrigerating medium having a temperature and freezing point lower than the freezing point of the commodity in the container to effect a freezing of the commodity at the lower end of the container and then progressively upward from said frozen portion, the conical wall of the container

holding the frozen portion to the lower end of the container against movement upward in the container to prevent rupture of the container by the expansion forces induced by the freezing of the commodity.

10. The method of freezing liquid or semi-liquid food commodities which comprises the steps of packing the commodity liquid tight in a conical container and engaging the container with the commodity therein in upright position and with the end of larger diameter lowermost continuously into a refrigerating medium having a temperature and freezing point lower than the freezing point of the commodity in the container to effect a freezing of the commodity continuously and progressively upward from the lower end of the container, the conical wall of the container holding the frozen portion to the lower end of the container.

11. The method of freezing liquid or semi-liquid food commodities which comprises the steps of packing the commodity liquid tight in a conical container in quantity less than the capacity of the container to provide an air space in the container and engaging the container with the commodity therein in upright position and the end of the container of larger diameter lowermost continuously into a freezing zone to effect a transference of the latent heat and freezing of the commodity progressively from the lower end upward in the container, the conical wall of the container holding the frozen portion to the lower end against movement upward in the container.

12. The method of packaging food commodities, consisting in providing a container filled with the commodity to a predetermined point within the top to provide an air space above the commodity in the container, and subjecting the container in upright position with the bottom lowermost continuously progressively to a freezing medium having a temperature and a freezing point lower than the freezing point of the commodity in the container to first effect a transference of the latent heat and an inward freezing of the commodity in the container at the bottom and then continuously progressively upward from said frozen bottom portion, the container wall being shaped to hold the frozen portion of the commodity from moving upward in the container, and maintaining the commodity in a frozen condition in the container until it is dispensed with the container.

13. The method of packaging food commodities, consisting in providing a conical paper container, filling the commodity into the container in quantity substantially one-sixteenth less than the volumetric capacity of the container to provide an air space in the container and liquid sealing the filler opening of the container, and then engaging the container in upright position with the bottom lowermost progressively continuously to a point below the level of the commodity in the container into a freezing liquid having a temperature and freezing point lower than the freezing point of the commodity in the container to effect an inward freezing of the commodity at the bottom of the container and then continuously inward from the side and upward from said frozen bottom portion, the container wall holding the progressively frozen commodity to the bottom of the container and thereby preventing rupture of the container by the expansion forces of the freezing commodity.