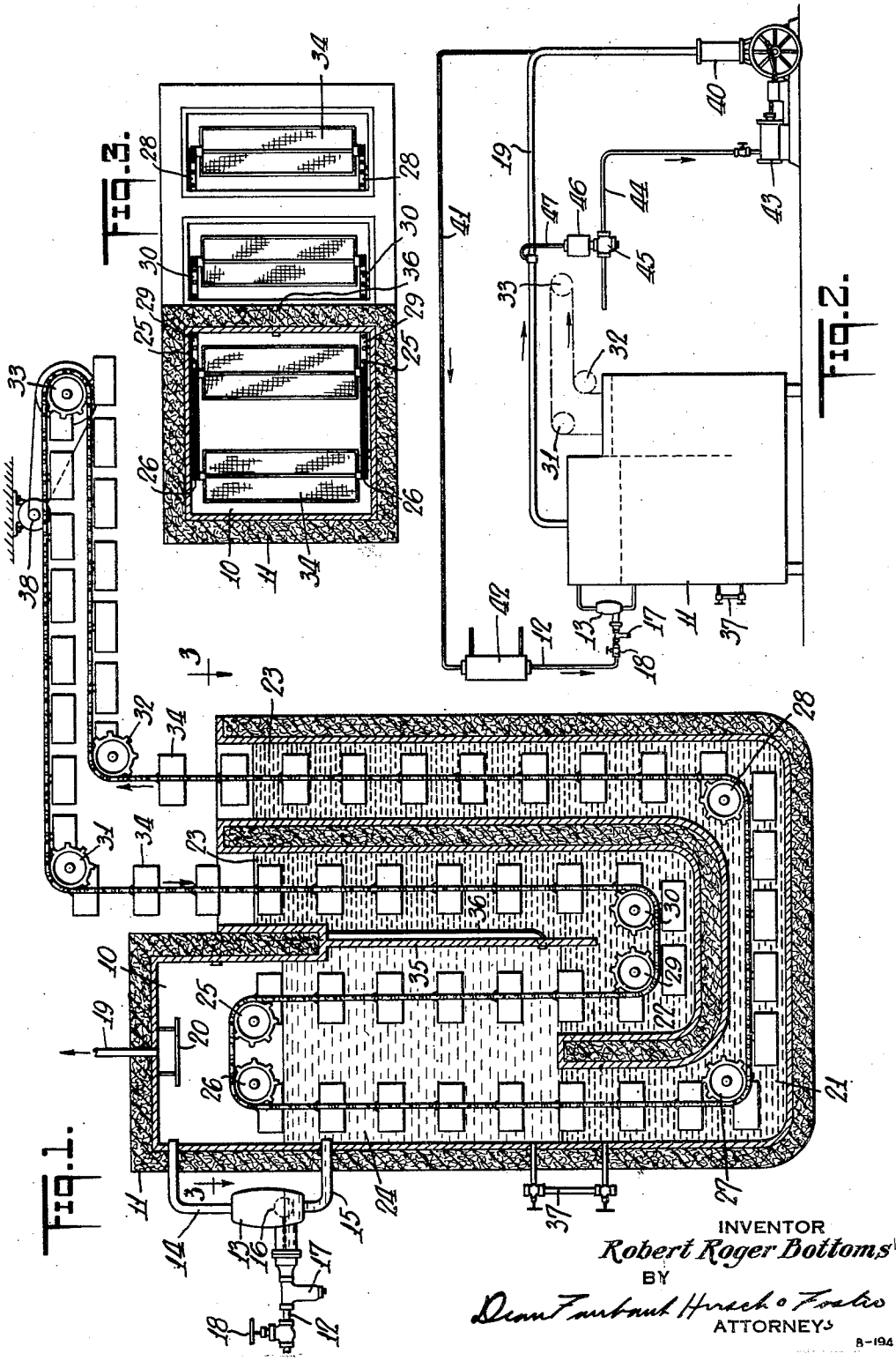
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REFRIGERATING APPARATUS FOR PACKAGED GOODS

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ROBERT ROGER BOTTOMS, OF LOUISVILLE, KENTUCKY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO VOGT INSTANT FREEZERS INCORPORATED, OF LOUISVILLE, KENTUCKY, A CORPORATION OF DELAWARE

REFRIGERATING APPARATUS FOR PACKAGED GOODS

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This invention relates to the refrigerating of materials, and more particularly to a process and apparatus in which the materials to be refrigerated are caused to pass through a body of liquid refrigerant.

As one important feature of my invention I employ a refrigerant of a character which is either in gaseous form at atmospheric pressure or has a very high vapor pressure at such temperature.

In order to permit of the use of a body of such refrigerant I provide as a further important feature means for maintaining the refrigerant in a sealed chamber and provide means whereby the articles to be frozen are passed through a seal into said chamber and then through a seal out of the chamber so that none of the refrigerant will escape to the atmosphere.

My improved process and apparatus may be employed for the freezing of various materials. If such materials be of such a character that they might be injured in any way by direct contact with the refrigerant from the seal, said materials are preferably enclosed in liquid tight containers or packages. The packaging of the material to be frozen is not essential if such materials be of such character that they do not absorb either sealing liquid or refrigerant and are not injured in any way by contact with the fluids employed in carrying out the process.

The refrigerant which I preferably employ is a liquefied petroleum of low vapor pressure which will produce the refrigerating action by its own evaporation. It is advantageous to use propane as the refrigerant, although obviously the propane need not be pure and may have other analogous compounds associated therewith, as for instance, ethane, butane, etc.

For effecting the seal it is advantageous to use a liquid which is not miscible with the refrigerant and which is not volatile to any objectionable extent at atmospheric pressure and the low temperature employed and which has no undesirable action on the materials to be refrigerated.

As an example of such sealing liquid I may employ ethyl alcohol if the temperature of the refrigerant is not substantially below −40° F., but if a lower temperature is to be employed, a suitable alcohol having a lower freezing point may be used or ingredients added to the ethyl alcohol which will lower its freezing point.

It is preferable to use a refrigerant which will boil at or near atmospheric pressure to produce the desired cooling effect.

As one important feature of my invention I provide means for automatically controlling the pressure in the refrigerant chamber so as to maintain a substantially constant temperature inasmuch as the temperature of the boiling refrigerant will vary with its pressure.

In the accompanying drawing I have illustrated somewhat diagrammatically an apparatus embodying my invention and adapted for carrying out my improved process.

In these drawings:

Fig. 1 is a central vertical section of the refrigerant chamber and associated parts,

Fig. 2 is a side elevation of the apparatus shown in Fig. 1 together with the additional parts going to make up a complete system, and

Fig. 3 is a transverse section on the line 3—3 of Fig. 1.

In the construction shown in Fig. 1 there is provided a refrigerant chamber 10 adapted to contain a volatile liquid refrigerant, such as propane. The chamber is provided with suitable insulation 11 to prevent heat losses and suitable means for maintaining the liquid refrigerant at a substantially constant level and preferably enough below the top of the chamber to provide a gas space. For maintaining the level there is shown a supply pipe 12 leading to a float chamber 13 which communicates with the refrigerant chamber through pipes 14 and 15 above and below the desired liquid level so that there will be the same level in the float chamber as in the refrigerating chamber. Within the float chamber is a float 16 for operating a valve 17 and admitting refrigerant at such rate as to maintain the desired level.

In addition to the automatic float controlled valve 17 there is preferably provided

a manually controlled shut-off valve 18. The details of the float controlled valve form no portion of my invention and have not been illustrated in detail, but it will be evident that various well known types and constructions of valve may be employed for this purpose.

In connection with the valve 17 there is preferably a strainer for preventing a solid material from passing to the valve or interfering with its proper operation.

Evaporated refrigerant may be drawn off from the gas space of the chamber 10 through a pipe 19 and opposite the inlet of this pipe there may be provided a baffle 20 for impeding the outflow of any unevaporated entrained liquid refrigerant.

The refrigerant chamber 10 adjacent to the lower portion is provided with means for maintaining a sealing liquid and for permitting the passage of the material to be refrigerated through the sealing liquid into the refrigerating liquid. As illustrated the chamber 10 has at the lower portion thereof conduits 21 and 22 of such size that the material to be refrigerated may be passed therethrough. These conduits both terminate at such an elevation that they may contain sufficient sealing liquid to prevent the escape of any of the refrigerant. As illustrated they terminate adjacent to the upper part of the refrigerant chamber and contain the sealing liquid 23. This liquid is of greater specific gravity than the refrigerant liquid 24 and is not miscible therewith so that the sealing liquid is maintained at one level at the lower portion of the refrigerant chamber or in the adjacent portions of the conduits and is maintained at a different level at the outer upper ends of the conduits. These levels will vary with the difference in the specific gravity of the liquids employed, the quantities of such liquids, and the back pressure in the gas space of the refrigerant chamber.

For moving the material to be refrigerated into and out of the refrigerating chamber a suitable conveyor is employed. As illustrated the refrigerant chamber adjacent to the upper end thereof has two pairs of sprocket wheels 25 and 26 disposed above the inlet ends of the two conduits 23 and 24. In the conduits are similar pairs of sprockets 27, 28, 29 and 30 and above the outer ends of the conduits are similar pairs of sprockets 31 and 32. On approximately the same level as the sprockets 31 and 32 is an additional pair 33. Two separate chains pass over these sprockets in succession and have connected therebetween suitable containers 34 for the material to be refrigerated. These containers 34 are preferably reticulated so that the refrigerant may pass therethrough in contact with the material to be refrigerated or the packages of the same and they are so suspended from the chains that they are held by gravity in the same right side up position at all points of the path of travel.

The chains and receptacles 34 form substantially horizontal runs to and from the sprockets 33 so that an operator may fill the containers or baskets as they travel from the sprockets 33 to the sprockets 31 and may remove the refrigerated products from the receptacles or baskets as they travel along from sprockets 32 to the sprockets 33. Adjacent to these horizontal runs may be provided suitable loading platforms or other apparatus to facilitate the filling and emptying of the receptacles.

It will be noted that as the receptacles are filled they pass the sprocket 31 and thence down through the sealing liquid in the conduit 22, thence around the sprockets 30 and 29 and up out of the sealing liquid and through the refrigerating liquid. This refrigerating liquid is kept at very low temperature by the proper control of the back pressure, and if propane be employed and the back pressure be in the neighborhood of atmospheric pressure, the body of refrigerant liquid will be at a temperature sufficient to very rapidly freeze any water containing materials passed therethrough.

The receptacles move across from the sprockets 25 to the sprockets 26, and thence down through the refrigerating liquid and into the sealing liquid in the conduit 21. They then move around the sprockets 27 and 28 and up out of the sealing liquid and around the sprockets 32 where they emerge thoroughly frozen and ready for removal from the receptacles or baskets.

The conduit 21 for the outward movement of the material is preferably insulated both from the outside atmosphere and from the conduit 22, but the conduit 22 need not be insulated from the wall of the refrigerant chamber as it is desirable that the sealing liquid be cooled in order to precool the incoming material as it passes down the conduit 22 from the sprockets 31 to the sprockets 30. As shown the wall 35 between the conduit 22 and the refrigerant chamber is not insulated so that there may be heat transfer through this wall and to facilitate the cooling of the sealing liquid in the conduit 22 there may be provided one or more pipes 36 along the outer side of the wall 35, and opening into the refrigerant chamber at their lower ends above the sealing liquid and at their upper ends above the sealing liquid. Thus there will be an upflow of refrigerant in the conduits 36 due to heat absorption from the sealing liquid and the gases resulting from the evaporation of this refrigerant liquid will escape into the gas space of the refrigerant chamber.

Although I have illustrated the refrigerant chamber as having two separate conduits 21 and 22 for the incoming and out-

going runs of the conveyors it will be obvious that in some constructions the partition between these conduits might be omitted and a single sealing chamber employed.

I have illustrated a gauge glass 37 on the wall of the refrigerant chamber and communicating at its upper and lower ends with the refrigerant space and the sealing liquid space respectively so that the level between the two liquids may be readily observed and the amount of refrigerant maintained substantially constant.

Because of the low temperature of the refrigerant it is preferable that this gauge glass be of double wall type to prevent accumulation of frost and the obscuring of vision. In order to permit ready observation of the level of the dividing line between the two liquids the sealing liquid may be colored or the gauge glass may be so constructed that light refraction of the liquids of different densities may be readily observed.

Obviously an increase in pressure in the chamber 10 will tend to lower the level of the sealing liquid, and it is desirable that this level be kept sufficiently low so that there will be an adequate volume of the refrigerant through which the material to be frozen will pass. It is also important that this level should not be too low as it would permit escape of refrigerant through the sealing liquid to the exterior.

By maintaining a proper volume of refrigerant in the sealed chamber and properly controlling the speed of travel of the conveyors, the material carried by the conveyors may be frozen to any desired extent, within the limits of the physical characteristics of the refrigerant.

Any suitable means may be provided for operating the conveyor at the desired speed in accordance with the desired extent of freezing. I have illustrated somewhat diagrammatically a motor 38 which may be operatively connected to the sprocket wheels 33 and may have its speed controlled at will.

In order to maintain the temperature of the refrigerant substantially constant I employ means for maintaining the back pressure in the refrigerant chamber substantially constant. As illustrated there is provided a refrigerating system including a compressor 40 adapted to deliver the compressed refrigerant gas through a conduit 41 and a condenser 42 to the inlet pipe 12. The outlet pipe 19 leads from the refrigerant space back to the compressor. The compressor is driven by a suitable prime mover, the speed of which is regulated by the amount of back pressure in the refrigerating chamber. Merely as an example I have shown a steam engine 43, in the steam supply 44 of which there is provided a control valve 45. The valve is operated by a suitable plunger piston or diaphragm in the chamber 46 and the opposite side of this operating member is connected by a pipe 47 to the return gas line 19. If the pressure in the chamber 10 and the return line 19 increases the operating member for the valve 45 will open the valve to the required extent to speed up the engine 43 and thus speed the compressor 40 and reduce the pressure. Likewise any decrease in pressure in the refrigerant chamber will be automatically restored to normal by a slowing down of the compressor.

Various other means might be employed for automatically controlling the compressor in accordance with the back pressure in the refrigerating chamber.

If the rate of delivery of the material or the temperature of the material delivered through the refrigerating chamber be such that there is an abnormally rapid evaporation of the refrigerant, the increased outflow of gas through the pipe 19 may be employed for the control of the speed or volumetric displacement of the compressor.

Merely as an example of materials which may be frozen or refrigerated in my improved apparatus and process I may mention fish, fruit and confections. Such materials may be packed in liquid tight containers which have comparatively thin walls which permit rapid heat transfer or they may be wrapped in thin sheets of material such as cellophane or the like. In using it for frozen confections, ice cream, sherbet or the like, the confection in its partially frozen condition as it comes from the freezer may be placed in liquid tight containers and the final hardening accomplished while passing through the chamber 10 instead of being placed in hardening rooms as is now the usual practice.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A process of refrigerating material, which includes maintaining a body of volatile liquid refrigerant under a pressure permitting rapid evaporation, sealing said liquid from the outside atmosphere, and passing the material to be refrigerated into and out of the refrigerant without permitting escape of the latter to the atmosphere.

2. A process of refrigerating materials, which includes maintaining a body of volatile liquid under a pressure permitting rapid evaporation, preventing escape of volatilized refrigerant to the atmosphere, and passing the material to be refrigerated into and through the refrigerating liquid.

3. A process of refrigerating materials, which includes maintaining a body of volatile liquid under a pressure permitting rapid evaporation, maintaining a body of sealing liquid for preventing escape of said refrigerant to the atmosphere, passing the material to be refrigerated through the sealing liquid and into the refrigerating liquid, and there-

after passing said material out through the sealing liquid.

4. A process of refrigerating material, which includes continuously advancing the material through a sealing liquid, thence through a body of volatile liquid refrigerant, and then out through the sealing liquid.

5. A process of refrigerating material, which includes maintaining a body of liquid propane under approximately atmospheric pressure whereby the liquid may rapidly evaporate at low temperature, passing the material to be refrigerated through said liquid, and preventing the escape of refrigerant during the in movement and out movement of said material.

6. An apparatus for refrigerating material, which includes a refrigerant chamber, means for delivering a volatile liquid refrigerant thereto, means for withdrawing vaporized refrigerant therefrom, a conveyor for moving the material to be refrigerated into and through said chamber in contact with said liquid, and means for controlling the pressure in said chamber to control the temperature to which the material is subjected.

7. An apparatus for refrigerating material, which includes a refrigerant chamber, means for maintaining a volatile liquid refrigerant therein, a conveyor for moving the material to be refrigerated into and through said liquid, and means for preventing the escape of refrigerant from said chamber during the inward and outward movement of the material.

8. An apparatus for refrigerating material, including a refrigerating chamber having inlet and outlet openings, means for maintaining a volatile liquid refrigerant therein at a substantially uniform level, seals at said openings and means for passing the material to be refrigerated through the seals and through the liquid refrigerant.

9. An apparatus for refrigerating material, including a refrigerating chamber, means for maintaining a volatile liquid refrigerant therein at a substantially uniform level, a conveyor for moving the material to be refrigerated into and out of the liquid refrigerant and means for sealing the chamber at the points of entrance and exit of said conveyor.

10. An apparatus for refrigerating material, including a refrigerating chamber adapted to contain a volatile liquid refrigerant, a liquid seal communicating with the lower portion of said chamber, and an endless conveyor extending through said liquid refrigerant and in and out through said liquid seal, and including containers for the material to be refrigerated.

11. An apparatus for refrigerating material, including a refrigerant chamber having an inlet at the lower portion thereof, a sealing liquid closing said inlet, a refrigerating liquid non-miscible with said sealing liquid and disposed within said chamber, a conveyor extending through said sealing liquid and said refrigerating liquid, and means for maintaining the level of the liquid refrigerant within said chamber substantially constant.

12. An apparatus for refrigerating material, including a refrigerating chamber having an inlet at the lower portion thereof, a sealing liquid closing said inlet, means for delivering to said chamber a refrigerating liquid non-miscible with said sealing liquid, a conveyor extending through said sealing liquid and adapted to carry material into the sphere of action of said refrigerating liquid, and means for maintaining the pressure within said chamber substantially constant.

13. A refrigerating apparatus including a refrigerating chamber having a conduit communicating therewith at the lower portion thereof and having an upwardly extending outer end portion, a sealing liquid within said conduit, a volatile liquid refrigerant within said chamber and sealed from the atmosphere by said liquid, means for maintaining the sealing liquid in said conduit at a low temperature, and means for delivering the material through said conduit and sealing liquid into said refrigerating liquid.

14. An apparatus for refrigerating material, including a refrigerating chamber, means for delivering a volatile liquid refrigerant thereto, means for maintaining the level substantially constant in said chamber, means for maintaining the pressure in said chamber substantially constant, a liquid seal to said chamber, means for maintaining the liquid in said seal at a low temperature, and means for passing the material to be refrigerated through said liquid seal into said liquid refrigerant and back out through said liquid seal.

15. A refrigerating apparatus including a refrigerating chamber, means for maintaining a volatile liquid refrigerant therein, means for withdrawing refrigerant gas therefrom, means for automatically varying the rate of withdrawal of gas to maintain the pressure substantially constant, a conveyor having a series of receptacles, means for moving said conveyor into and out of said chamber, and means for preventing the escape of liquid refrigerant during the movement of said conveyor.

16. A refrigerating apparatus including a refrigerating chamber, means for maintaining a volatile liquid refrigerant therein, means for withdrawing refrigerant gas therefrom, means for automatically varying the rate of withdrawal of gas to maintain the pressure substantially constant, a conveyor having a series of receptacles, means

for moving said conveyor into and out of said chamber, and a liquid seal communicating with said receptacles and through which said conveyor extends.

17. The process of refrigerating material, including advancing the material into, through and out of a chamber, continuously delivering volatile refrigerant in liquid form to said chamber for direct contact with the material or the wrapping or container thereof, and withdrawing said refrigerant in gaseous form from said chamber.

18. The process of refrigerating material, including advancing the material into, through and out of a chamber, maintaining a substantially constant amount of refrigerant in liquid form in said chamber for direct contact with the material or the wrapping or container thereof, withdrawing said refrigerant in gaseous form from said chamber, and substantially preventing the escape of refrigerant from said chamber or the entrance of air to said chamber at the points of entrance and exit of the material.

19. The process of refrigerating material, which includes circulating a volatile refrigerant through a closed cycle including compressing the refrigerant vapor, cooling and liquefying the same, and vaporizing the liquid under reduced pressure, maintaining a substantially constant amount of said liquid at the point in the cycle where said vaporizing is effected, and passing the material to be refrigerated into, through and out of the vaporizing liquid.

20. The process of refrigerating material, which includes circulating a volatile refrigerant through a closed cycle including compressing the refrigerant vapor, cooling and liquefying the same, and vaporizing the liquid under reduced pressure, passing the material to be refrigerated into, through and out of the vaporizing liquid, and preventing intermixing of the refrigerant and the atmosphere at the point of entrance of the material to the chamber and the point of exit of the material therefrom.

Signed at New York in the county of New York and State of New York this 9th day of September A. D. 1930.

ROBERT ROGER BOTTOMS.