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METHOD OF FREEZING FOODSTUFFS AND THE LIKE

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Fig. 1

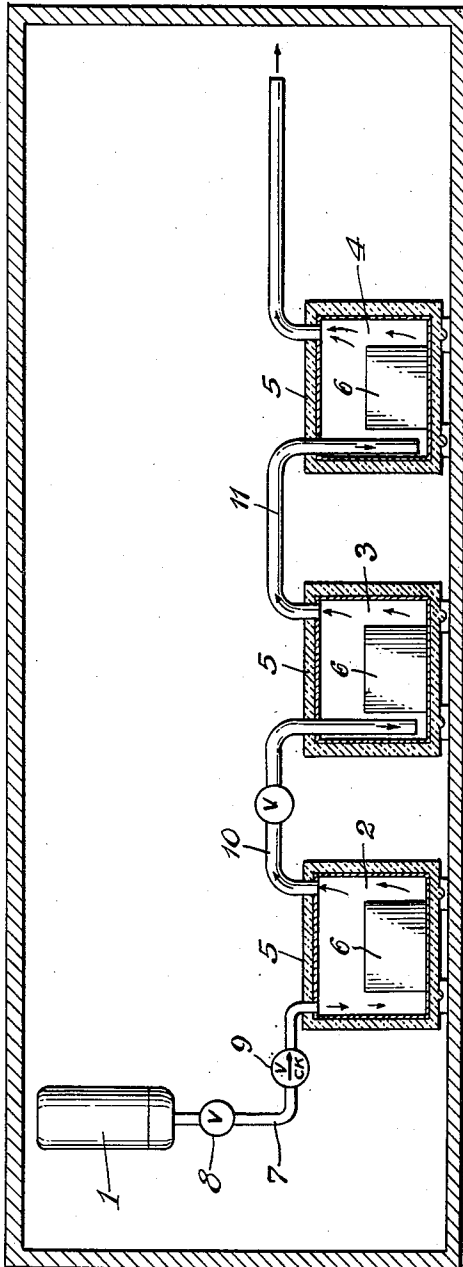
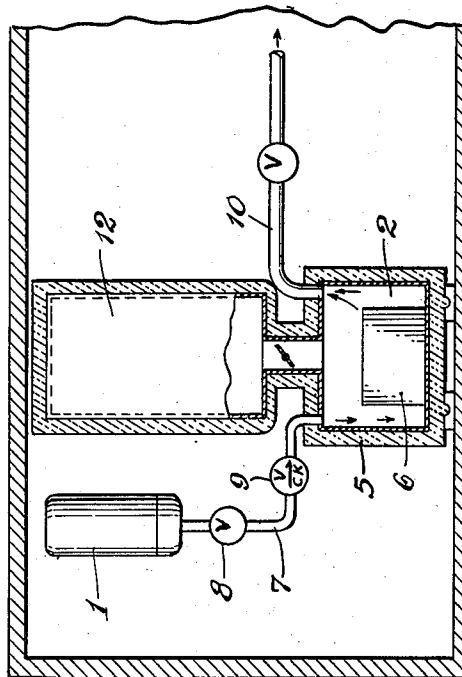


Fig. 2



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METHOD OF FREEZING FOODSTUFFS AND THE LIKE

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4 Claims. (Cl. 62—173)

My invention relates to a method of freezing foodstuffs and the like for storage and shipment at temperatures far below freezing by the use of cold boiling liquids. Liquid nitrogen, liquid air, and other liquids inert in the sense that they neither form combustible nor explosive mixtures with air, may be used provided those liquids at or about atmospheric pressure are far below zero degrees F. When foodstuffs or similar materials are to be stored or held in frozen condition during shipment for long periods of time the temperature must be not zero but far below it.

While I prefer to maintain the liquid and resultant gases or vapors at approximately atmospheric pressure, the pressures may under some circumstances be above that point.

I propose to pack the material to be frozen loosely enough in a plurality of gas and liquid tight, preferably insulated storage and shipping containers to permit liquid and gas penetration into the interstices or spaces between the packages or bodies of the material.

The containers will be arranged in series and at the start of an operation, each container will contain the material in the presence of air.

I propose to introduce the cold boiling liquid, perhaps nitrogen, at -320° F. into the first container. The heat of the material and the container will cause such liquid to boil without loss of temperature but with resultant expansion of the gas at the boiling temperature. This will either expel the air from the container or some of the air will be mixed with the gas and brought down to the temperature thereof.

When the first container is filled with the cold gas further evaporation of the liquid will build up a sufficient pressure in the chamber or container to cause the gas to flow from the first chamber to the next chamber in series. The cold gas will preferably be discharged into the next chamber at the bottom thereof and as the gas gradually fills the chamber, it will be warmed, will expand and will mix with the air in the chamber. The gas discharged from the second chamber will be at a temperature above that of the gas discharged from the first chamber and will be discharged into the third chamber in the series in the same manner. This sequence of gas passage through a plurality of chambers in series will continue until the temperature of the gas discharged from the last chamber in the series has risen to a point at which its temperature is perhaps near the temperature of the material originally packed in the container.

By this time the first container and its contents will have been brought down to the desired low temperature so the first chamber is taken out of the series, additional cold boiling liquid is supplied to the second chamber in the series and another chamber is added to the high temperature end of the series and the process continues. By this arrangement, the temperature is brought down step by step by heat exchange with first the cold boiling liquid and then the cold gas evaporated therefrom.

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This makes it possible to load the chambers with foodstuffs and the like in a relatively warm atmosphere. If desired, the room in which the loading of the chambers takes place may be cooled by the cold gas discharged from the last chamber in the series or may be used for any other desired purposes.

The containers will preferably be insulated and the freezing of the foodstuffs can take place in the same insulated container in which the material is to be stored or shipped.

The pressure relief valves, under some circumstances, may be used in the conduits joining the chambers or containers or at the end of the line so as to cause a sufficient pressure to be built up to insure of penetration of the cold gas into the interstices between the packages if the food is packaged or the objects themselves if they are not packaged.

The same principle may equally well be applied to the cooling of foodstuffs in a single step in a single cooling chamber. Under these circumstances there would be associated with a cooling chamber an expansion chamber so that when the cold boiling liquid was condensed in the cooling or storage and shipment chamber and began to evaporate or boil off, the expansion chamber would receive the gas expelled from the food container chamber so that the cold gas will not be spilled out and wasted. As the temperature of the gas in the chamber rises, gas from the expansion chamber will return to the cooling chamber.

A predetermined amount of cold boiling liquid may be added to the first container in the series and then after it evaporated, the container may be taken out of the series and liquid added to the next chamber series and so on. On the other hand, a continuous supply of the liquid might be desirable.

My invention is illustrated in the accompanying drawings, wherein

Figure 1 is a diagram illustrating one exemplification of my invention; and

Figure 2 is a diagram illustrating a somewhat simpler exemplification of my invention.

Like parts are indicated by like characters throughout the specification and drawings.

1 indicates a source of a cold boiling liquid such as liquid nitrogen which for example is at -320° F. at atmospheric pressure. The source as far as my invention is concerned may be a plant wherein liquid nitrogen is produced or it may be an insulated tank in which liquid nitrogen is being stored.

2 is a superchill shipper container. 3 and 4 are pre-cooling shipper containers. Each of the shipper containers is insulated at 5 and contains foodstuffs or other material to be frozen, loosely packed therein at 6. 7 is a duct through which liquid nitrogen is supplied from the source to the shipper container 2. Flow of liquid nitrogen is controlled by flow control valve 8 and a check valve 9 in the duct 7 between the flow control valve 8 and the shipper container 2 prevents reverse flow in the duct 7.

When liquid nitrogen preferably though not necessarily in predetermined quantity is caused to enter the superchill shipper container, it will be in heat exchange relationship with the material to be frozen and with the walls of the container. The heat of this material and the walls will cause the liquid nitrogen to boil and as a result the liquid evaporates and resumes its gaseous phase while the walls of the container and the stuff being frozen are both reduced in temperature. The gas boiled from the liquid will be at substantially the same pressure as the liquid nitrogen itself and will, where it comes in contact with the foodstuffs and the container

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walls assist by heat exchange in cooling them, thus raising its temperature to some extent.

10 is a gas duct leading from the top of the superchill container 2 and discharging into the bottom of the precooler shipper container 3. Such gas when it enters the precooler container may be at approximately 250° F. and will by heat exchange with the walls of the shipper container 3 and its contents be warmed as it cools the chamber and contents, rising from the bottom of the container to the top for discharge through the gas duct 11 to the bottom of the next precooler shipper container 4 where the same type of heat exchange takes place at of course a higher temperature, the temperature of the gas entering the second precooler shipper container may for example be at approximately 250° F. and the temperature of the gas discharged from the final precooler shipper container may be at -50° F.

This cold gas may be used for any suitable purpose. For example, it could be discharged into the room in which the shipper containers are filled with food or it may by heat exchange assist in precooling or prefreezing the foodstuffs before they are placed in the precooled shipper container.

When the nitrogen in the superchill shipper container is all evaporated and no further nitrogen in gaseous form is evolved, there will still be as temperature rises in the container some expansion of the gas supporting flow at a much lower rate from the superchill through the first precooler container. When the temperature in the superchill container has reached the desired low point, liquid nitrogen will be added to the first precooler container which now becomes the superchill container and a new precooler container will be put into circuit at the hot end of the series to receive the cold gas from the last precooler. Meanwhile, the container that was the superchill container is closed for storage or shipment.

Thus the individual containers will gradually step by step be lowered in temperature as they approach the head of the line where they are finally chilled with liquid nitrogen. I have shown only three of those containers but it will be understood that a multiplicity of containers in series may be used or that the containers might be arranged in parallel, a plurality of them receiving cold gas direct from the superchill container.

When the liquid nitrogen or other coolant is evaporated in the superchill container, it expands some six hundred times in volume without substantial loss in temperature and that cold gas will much more than fill the container. Hence in the preferred form of the arrangement I conduct it to another container where the material is cooled by gas alone without contact with the liquid nitrogen. However, if desired a single container can be used. In such case, there will be associated with the superchill container above it, an expansion chamber 12 joined by a duct of large cross section so that as the cold gas boils off from the liquid after filling the superchill container, it will pass up into the expansion chamber and then as the gas at the lower part of the column is warmed by heat exchange with the foodstuffs on the walls of the shipper container it will rise to be replaced by cold gas descending by convection to the expansion chamber.

One application of my method is as follows: The various methods of freezing foodstuffs and the like down to the temperature at which such foodstuffs are stored and shipped under refrigeration, temperature in the order of something below zero degrees F. are well established and mechanisms and apparatuses and systems are presently in successful operation but in order to prevent the foodstuffs rising above a dangerous temperature, it has been customary in the past to provide after freezing while in storage and transit, refrigerating apparatus to maintain the low temperatures.

My method may follow the initial freezing of the food-

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stuffs and the like and is adapted to reduce the temperature substantially below the conventional temperatures down perhaps to several hundred degrees below zero F. or somewhere, depending on circumstances, between that temperature and the usual temperatures in the order of slightly below zero depending on the length of time it is desired to be able to store the goods, what length of time required to ship the goods without additional refrigeration.

Therefore the frozen foodstuffs may be packed in insulated shipper containers and these shipper containers may then be placed in the series above disclosed and each shipper container will step by step be reduced in temperature and as successive shipper containers move forward in the series, the temperature attained, progressively decreases. If it is desired to get the minimum temperature, the shipper container will go through the entire cycle. If an intermediate temperature is adequate, the shipper container will be removed from the cycle as soon as the necessary minimum has been reached.

It is important to note in this connection that since the individual shipper containers and their contents are cooled and since the containers are insulated, the cold foodstuffs or if desired the foodstuffs before freezing, may be placed in the shipper container, the men working in a warm room and therefore avoiding the necessity of special clothing and the like. After each individual shipper container is closed, cooling of the container and its contents will proceed without substantial cooling of the area in which the men work and in which the individual shipper containers are cooled.

I claim:

1. The method of freezing foodstuffs and the like which consists in assembling the material to be frozen in a plurality of gas and liquid tight portable shipper container chambers connected in series, depositing a predetermined quantity of cold boiling liquid in heat exchange relationship with the first chamber in the series and the contents thereof at substantially atmospheric pressure and using the liquid and the gas vaporized therefrom by the heat in such chamber to lower the temperature of the contents of the chamber and discharging the cold gas as the liquid vaporizes from the first to the next chamber in the series at substantially atmospheric pressure in heat relationship with such chamber and the contents thereof and using such cold gas to lower the temperature of the contents of the second chamber.

2. The method of chilling foodstuffs and the like which consists in assembling the material to be frozen in a plurality of gas and liquid tight portable shipper container chambers connected in series, depositing a predetermined quantity of cold boiling liquid in heat exchange relationship with the first chamber in the series and the contents thereof at substantially atmospheric pressure and using the liquid and the gas vaporized therefrom by the heat in such chamber to lower the temperature of the contents of the chamber and discharging the cold gas as the liquid vaporizes from the first to the next chamber in the series at substantially atmospheric pressure in heat relationship with such chamber and the contents thereof and using such cold gas to lower the temperature of the contents of the second chamber, discharging the gas from the second chamber at substantially atmospheric pressure into heat relationship with the third chamber and the contents thereof and using such gas to lower the temperature thereof.

3. The method of freezing foodstuffs and the like which consists in assembling the material to be frozen in a plurality of gas and liquid tight portable shipper container chambers connected in series, depositing a predetermined quantity of cold boiling liquid in heat exchange relationship with the first chamber in the series and the contents thereof at substantially atmospheric

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pressure and using the liquid and the gas vaporized therefrom by the heat in such chamber to lower the temperature of the contents of the chamber and discharging the cold gas as the liquid vaporizes from the first to the next chamber in the series at substantially atmospheric pressure in heat relationship with such chamber and the contents thereof and using such cold gas to lower the temperature of the contents of the second chamber, then when the contents of the first chamber in the series has reached the desired low point removing that chamber from the series and supplying cold boiling liquid at substantially atmospheric pressure to the chamber immediately following the chamber just removed from the series and continuing the operation.

4. The method of freezing foodstuffs and the like which consists in assembling the material to be frozen in a plurality of gas and liquid tight portable shipper container chambers connected in series, depositing a predetermined quantity of cold boiling liquid in heat exchange relationship with the first chamber in the series and the contents thereof at substantially atmospheric pressure and using the liquid and the gas vaporized therefrom by the heat in such chamber to lower the tempera-

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ture of the contents of the chamber and discharging the cold gas as the liquid vaporizes from the first to the next chamber in the series at substantially atmospheric pressure in heat relationship with such chamber and the contents thereof and using such cold gas to lower the temperature of the contents of the second chamber, discharging the gas from the second chamber into heat relationship with the third chamber at substantially atmospheric pressure and the contents thereof and using such gas to lower the temperature thereof, then when the contents of the first chamber in the series has reached the desired low point removing that chamber from the series and supplying cold boiling liquid at substantially atmospheric pressure to the chamber immediately following the chamber just removed from the series and continuing the operation.

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