

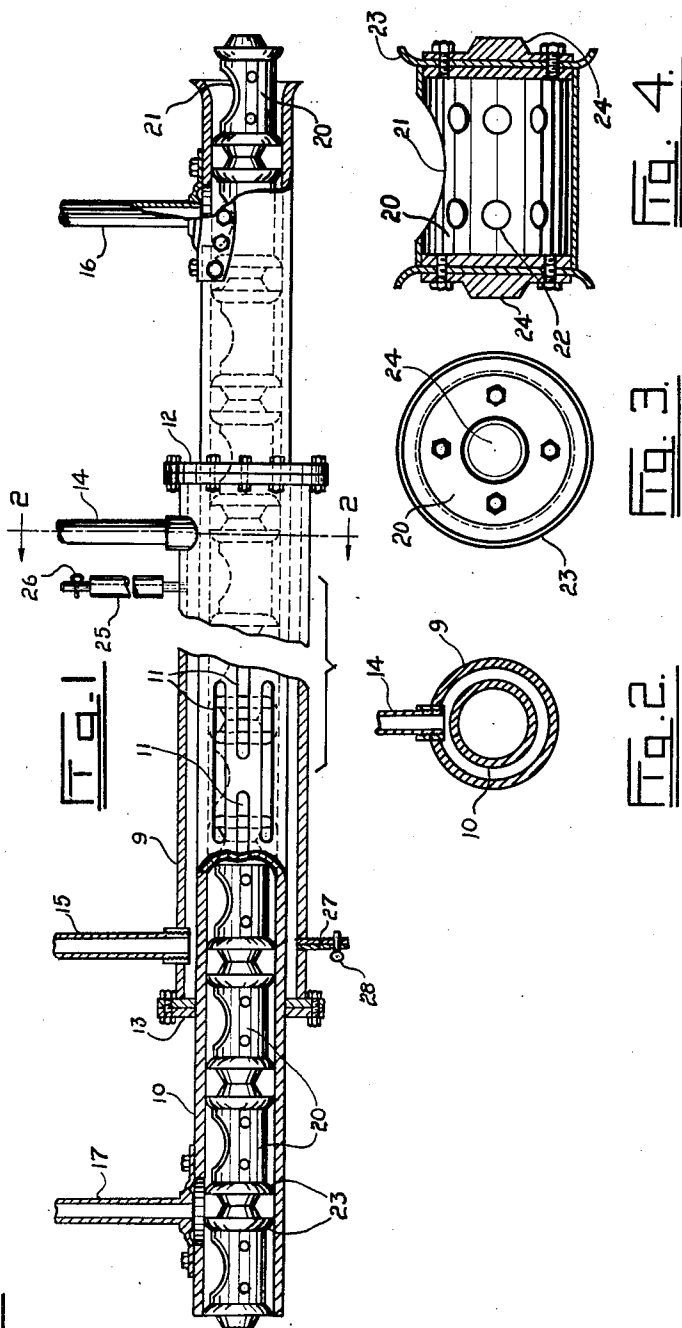
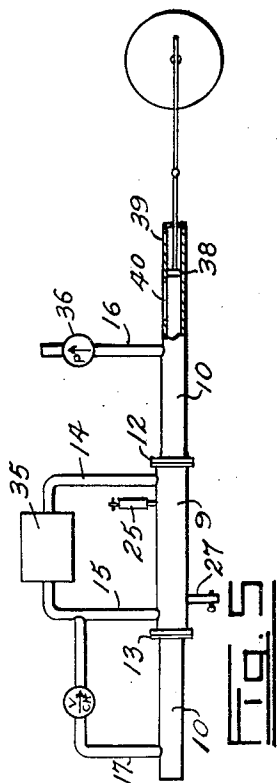
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QUICK-FREEZING METHOD AND APPARATUS

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QUICK-FREEZING METHOD AND APPARATUS

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1

This invention relates to a method of and apparatus for quick freezing products, such as fruit, vegetables, meat, fish, and the like.

Methods and apparatus have been used heretofore for quick freezing products but these have either necessitated the handling of the products in batches, or there has been a loss of the gaseous refrigerant, or the gas has been diluted with air during the operation. This dilution slows down the freezing process to some extent, and it is necessary to separate the air before the gas may be re-used.

The present invention overcomes these objectionable features by providing a method of and apparatus for quick freezing products continuously. The air is removed from the products before they are exposed to the gaseous refrigerant so that the latter instantly surrounds the products, thus freezing them much faster than it has hitherto been possible. At the same time the gas is not diluted so that it may be re-used without any treatment for the removal of air. This gas may be re-used constantly without any loss or dilution.

The method of accomplishing these desirable results consists in placing the products to be frozen in a container, removing the air from the container, inserting the container in an expansion chamber, and directing a vaporizable refrigerant, such as carbon dioxide in liquid or solid form, under pressure into the chamber. In order to make this method continuous, a plurality of containers are used and these are continuously moved through the expansion chamber. The gas is removed from the chamber for re-use therein after it has been treated in the same manner as refrigerants are treated in ordinary freezing equipment. The air is removed from each container before it enters the chamber so that the products may be exposed to the gas in the chamber without diluting said gas, whereby the products are frozen with extreme rapidity as they are not enclosed in an envelope of air. This gas is removed from the chamber and the containers for re-use.

In actual practice, it has been found advantageous to insert the products in open containers, seal the containers from each other, remove the air from each container, move the evacuated containers through the expansion chamber, direct a vaporizable refrigerant under pressure into the chamber where it comes into direct contact with the products, and then remove the gaseous refrigerant from the chamber and the containers.

An example of apparatus which may be used

2

to carry out this method is described in the following specification and illustrated in the accompanying drawings, in which

Figure 1 is a side elevation of the apparatus, partly in section,

Figure 2 is a vertical section taken on the line 2-2 of Figure 1, without a container therein,

Figure 3 is an enlarged end elevation of a container to be used in the apparatus,

Figure 4 is a longitudinal section through the container, and

Figure 5 diagrammatically illustrates one complete form of the apparatus.

Referring more particularly to the drawings, 9 is a cylindrical expansion chamber and 10 is a tube extending through and beyond both ends of said chamber. The tube is substantially concentric with the chamber and communicates with the interior of the latter by means of one or more elongated ports 11, while end plates 12 and 13 fitting around the tube close the ends of the chamber. An inlet pipe 14 is provided adjacent the front end of the expansion chamber through which a vaporizable refrigerant under pressure from the pressure side of a pump and refrigerant apparatus 35, see Figure 5, may be directed into the chamber, and an outlet pipe 15 is located adjacent the back end of the chamber for removing the refrigerant therefrom, said pipe extending back to the refrigerant apparatus so that it may be re-used.

A pipe 16 communicates with the interior of the tube 10 near its front end, that is, in the part of the tube projecting outwardly from the front end of the expansion chamber. This pipe is connected to a suction pump 36, see Figure 5. Another pipe 17 communicates with the interior of the tube near its opposite or back end and this pipe is connected to the refrigerant apparatus similarly to the pipe 15.

A plurality of containers 20 are provided and these are preferably cylindrical in shape and fit into the tube 10. Each container has an opening 21 at the top thereof, and it is preferably formed with a plurality of holes 22 in its side walls. The containers are slightly smaller in diameter than the tube 10 but they are provided at their opposite ends with circular sealing rings 23 formed of suitable resilient material which is capable of withstanding rapid changes from normal to low temperatures. These rings fit snugly and slidably inside the tube to seal the interior of each container from the rest of the tube and from the interior of any other containers. These containers may be formed with buffers 24 at their

3

opposite ends, in which case the containers are not connected to each other, or they may be connected together in any suitable manner. Suitable means is provided for moving the containers through the tube 10 and the expansion chamber 9. In the example shown, the containers may be moved by means of a ram 38 slidably mounted in an extension 39 of the tube adjacent the entrance 40 of the latter, or the containers may be connected in an endless chain and moved by any desirable source of power.

An air bleed 25 having a control cock 26 may be located at the top of the expansion chamber, and a drain pipe 27 with a cock 28 therein may be provided at the bottom of said chamber near its back end.

In operation, the products to be frozen are placed in the containers 20 and they are moved in succession through the tube 10 and the expansion chamber 9. This may be done by inserting the containers one by one through the entrance 40 of the tube ahead of the ram 38. Movement of the ram moves each container away from the entrance, and each container moves any containers ahead of it along the tube. The sealing rings 23 seal the interior of each container from the others, and when a container passes beneath the pipe 16, the air is sucked out of the container through said pipe. A vaporizable refrigerant, such as carbon dioxide, is directed under pressure into the expansion chamber and since the latter is in communication with the interior of the tube through the ports 11, the gaseous refrigerant is brought into immediate contact with the containers and the products therein. The fact that the containers are open and have holes 22 formed therein and yet do not contain any appreciable amount of air, ensures an extremely rapid freezing of the products and, as is well known, this is highly desirable. At the same time, there is no dilution of the gas owing to the lack of air in the containers. The gas is drawn out of the expansion chamber as well as the tube and containers through the pipe 15. Any gas remaining in and around the containers after they leave the chamber, is withdrawn through the pipe 17 as the containers pass therebeneath.

It is highly desirable to have the pipe 17 spaced from the discharge end of the tube far enough so that there are always at least two sealing rings 23 between them. This prevents air from being drawn in through the discharge end by the suction in pipe 17. Similarly, it is desirable to arrange the pipe 16 so that there are at least two sealing rings between it and the entrance to the tube in order to ensure a better evacuation of the containers as they pass beneath this pipe.

If any air does get into the expansion chamber, it will accumulate in the top thereof because it is lighter than the carbon dioxide, and it may be bled off periodically by opening the cock 26. As the sealing rings are treated with a low temperature resisting lubricant the pipe 27 and cock 28 are provided for drawing off any of this lubricant which may accumulate in the bottom of the chamber.

What I claim as my invention is:

1. Apparatus for continuously quick freezing products, comprising an expansion chamber, a tube extending through the chamber and having at least one port in the portion thereof within the chamber to bring the interior of the tube into communication with said chamber, said tube extending beyond the opposite ends of the cham-

4

ber, a plurality of containers for receiving the products movably positioned in the tube and adapted to be moved therethrough, means for sealing the containers in the tube from the opposite ends of the latter, means for removing air from the container in the tube before reaching the port in the latter, and means for directing a vaporizable refrigerant under pressure into the chamber.

2. Apparatus for continuously quick freezing products, comprising an expansion chamber, a tube extending through the chamber and having at least one port in the portion thereof within the chamber to bring the interior of the tube into communication with said chamber, said tube extending beyond the opposite ends of the chamber, a plurality of open containers for receiving the products movably positioned in the tube and adapted to be moved therethrough, means for sealing each container from the others in the parts of the tube extending beyond the ends of the chamber, each of said tube parts being long enough to accommodate at least one whole container, means for removing air from the containers in the tube before reaching the port in the latter, and means for directing a vaporizable refrigerant under pressure into the chamber.

3. Apparatus for continuously quick freezing products, comprising an expansion chamber, a tube extending through the chamber and having at least one port in the portion thereof within the chamber to bring the interior of the tube into communication with said chamber, said tube extending beyond the opposite ends of the chamber, a plurality of open containers for receiving the products movably positioned in the tube and adapted to be moved therethrough, means at each end of each container for sealing the interior thereof from the rest of the tube while in the parts of said tube extending beyond the ends of the chamber, each of said tube parts being long enough to accommodate at least one whole container, means for removing air from the containers in the tube before reaching the port in the latter, and means for directing a vaporizable refrigerant under pressure into the chamber.

4. Apparatus for continuously quick freezing products, comprising an elongated expansion chamber, a tube extending lengthwise through the chamber and having at least one port in the portion thereof within the chamber to bring the interior of the tube into communication with said chamber, said tube extending beyond the opposite ends of the chamber, a plurality of open containers for receiving the products movably positioned in the tube and adapted to be moved therethrough, means at each end of each container for sealing the interior thereof from the rest of the tube while in the parts of said tube extending beyond the ends of the chamber, means for removing air from the containers in the tube before reaching the port in the latter, means for directing a vaporizable refrigerant under pressure into the chamber adjacent the front end thereof relative to the movement of the containers, and means for removing refrigerant from the chamber adjacent its back end.

5. Apparatus for continuously quick freezing products, comprising an expansion chamber, a tube extending through the chamber, said tube having at least one port in the portion thereof within the chamber to bring the interior of the tube into communication with said chamber, a plurality of open containers for receiving the

5

products movably positioned in the tube, means for moving the containers through the tube, a sealing ring at each end of said container fitting snugly and slidably in the tube, the interior of each container being in communication with the chamber while it is passing the port, means for removing air from each container in the tube before it reaches the port, and means for directing a vaporizable refrigerant into the chamber.

6. Apparatus for continuously quick freezing products, comprising an expansion chamber, a tube extending through the chamber, said tube having at least one port in the portion thereof within the chamber to bring the interior of the tube in communication with said chamber, a plurality of open containers for receiving the products movably positioned in the tube, means for moving the containers through the tube, means for sealing each container from the others while in the tube before it reaches the port and after leaving the latter, the interior of each container being in communication with the chamber while

6

it is passing the port, means for removing air from each sealed container before it reaches the port, means for directing a vaporizable refrigerant into the chamber, means for removing refrigerant from the chamber and from the containers before they leave the portion of the tube within the chamber, and means for removing any refrigerant remaining in the containers in the tube after leaving the portion of the tube within the chamber.

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