Oct. 31, 1933. J. C. GOOSMANN 1,933,258

REFRIGERATING APPARATUS AND METHOD

Filed April 14, 1932 4 Sheets-Sheet 1

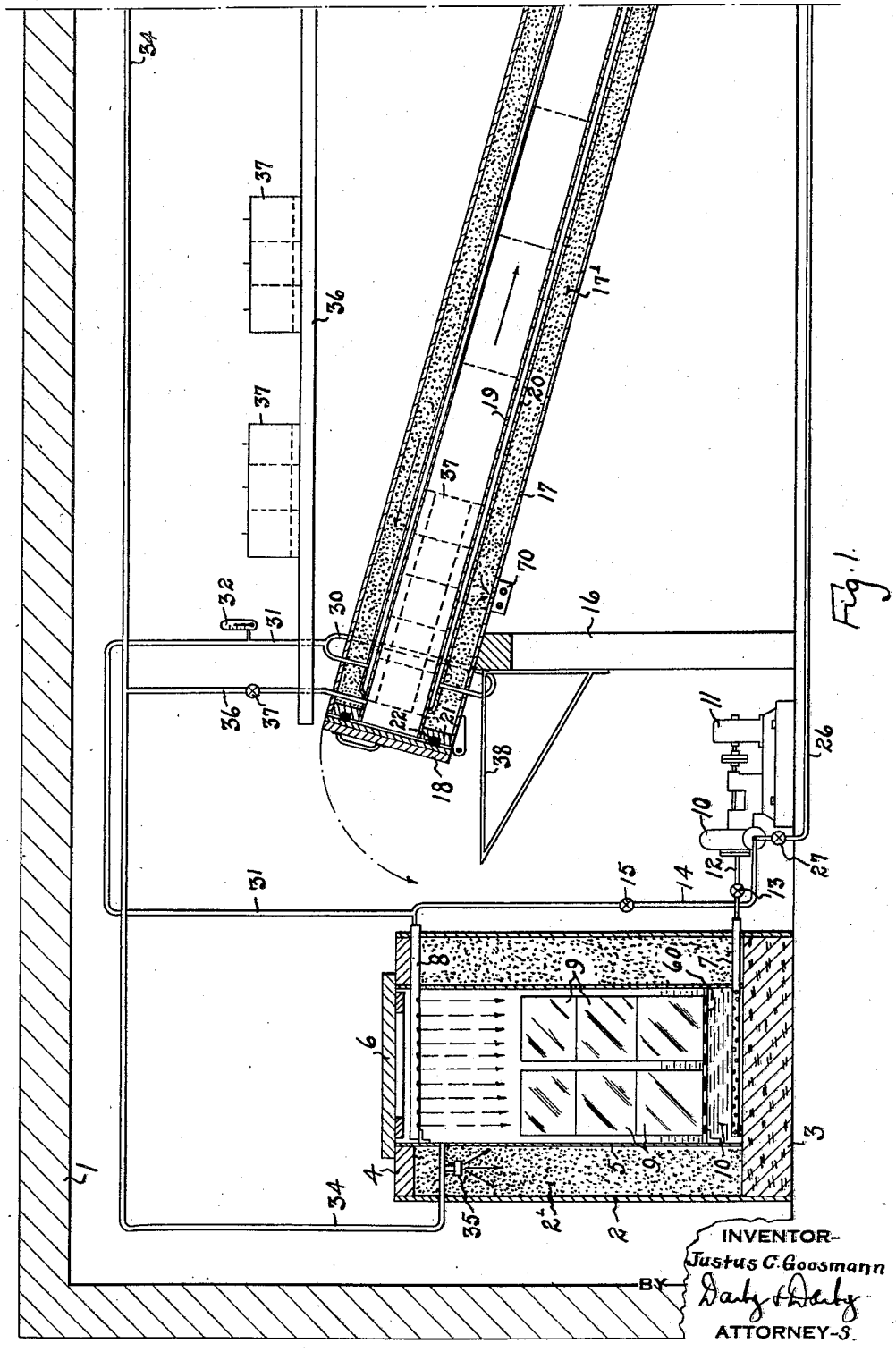


Fig. 1.

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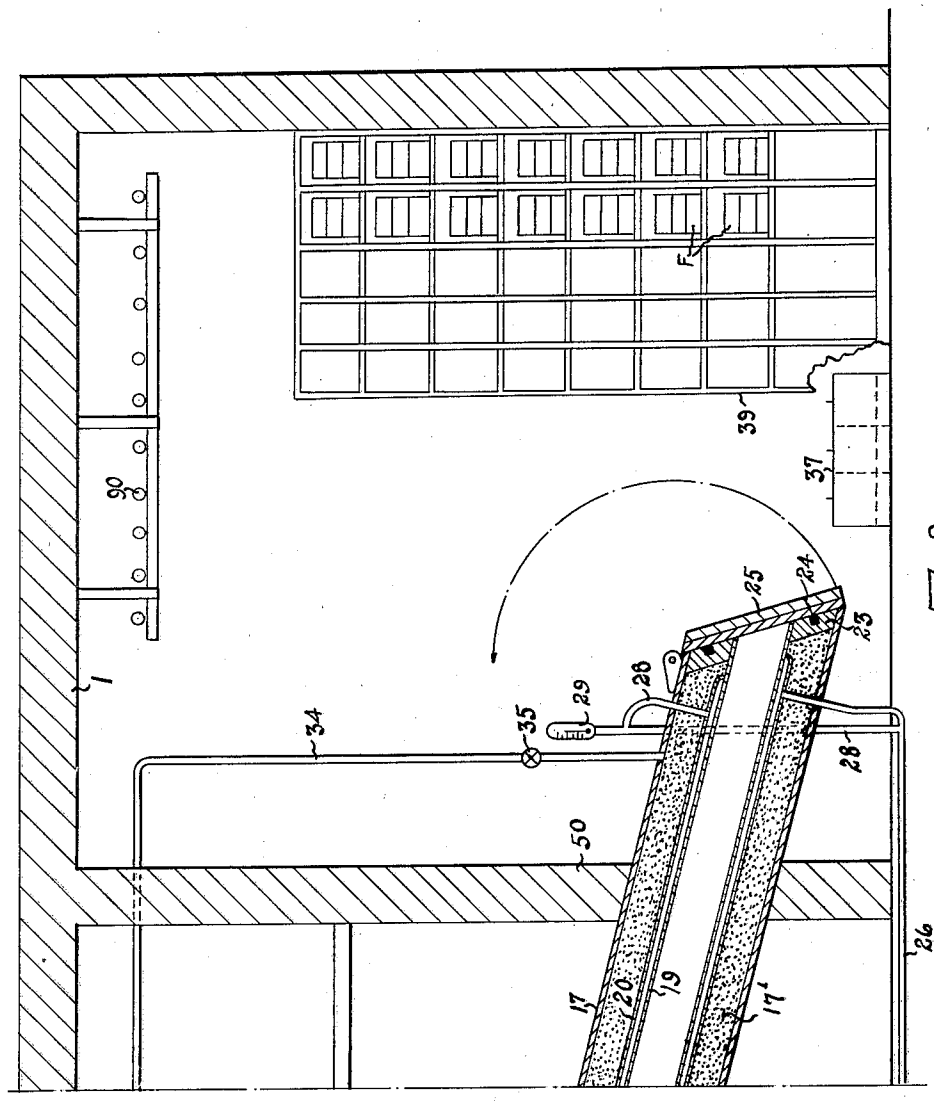


Fig. 2.

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REFRIGERATING APPARATUS AND METHOD

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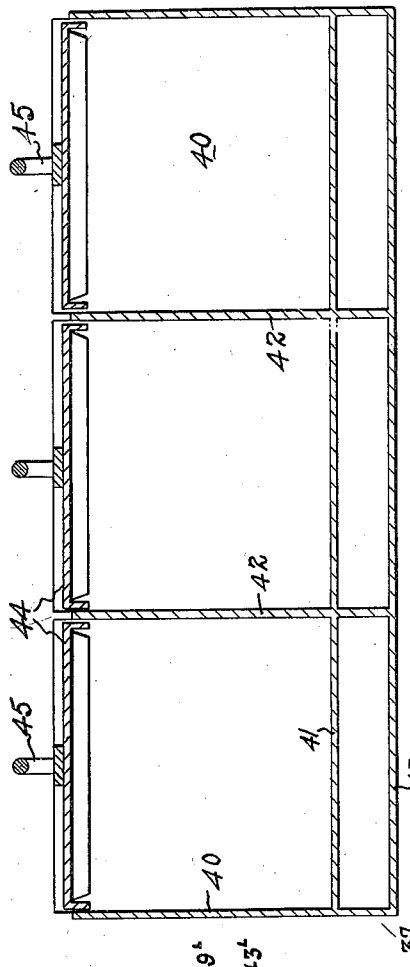


Fig. 4.

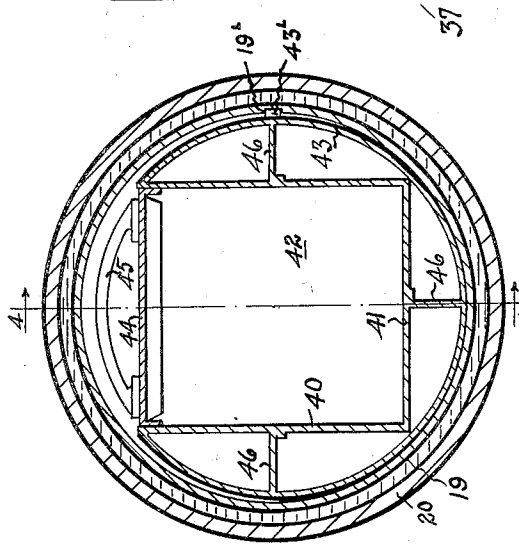


Fig. 3.

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REFRIGERATING APPARATUS AND METHOD

Filed April 14, 1932 4 Sheets-Sheet 4

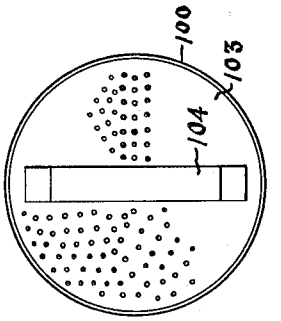


Fig. 9.

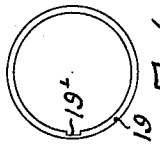


Fig. 6.

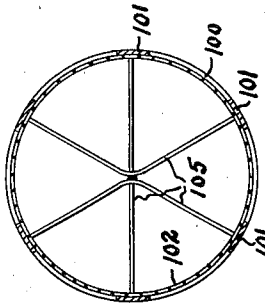


Fig. 8.

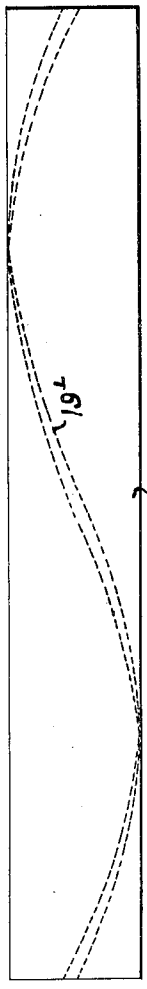


Fig. 5.

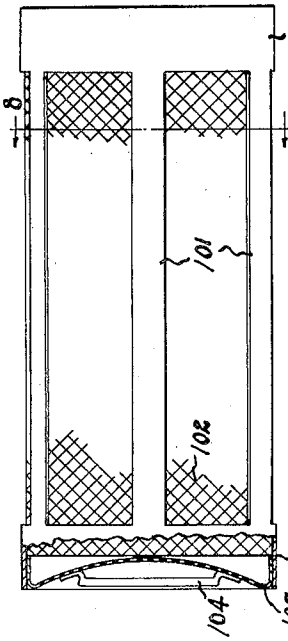


Fig. 7.

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UNITED STATES PATENT OFFICE

1,933,258

REFRIGERATING APPARATUS AND METHOD

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Application April 14, 1932. Serial No. 605,162

17 Claims. (Cl. 62—91.5)

This invention relates to improvements in refrigerating apparatus and methods.

One of the objects of this invention is to provide refrigerating apparatus employing brine cooled by solid carbon dioxide by heat exchange therewith, preferably through direct contact between them.

Another object of this invention is to provide an exceedingly simplified form of refrigerating apparatus employing such a cooled brine solution for cooling and/or freezing perishable products in a relative rapid treatment.

A further object of this invention is to provide a simplified apparatus of the above nature of a form to render it substantially portable.

A further object of this invention is to provide apparatus forming a cooling and refrigerating chamber in which specially shaped metal baskets for holding the products to be cooled or refrigerated are placed and through which they may move under the aid of gravity.

A still further object of this invention involves a novel method of refrigeration.

These and many other objects as will appear from the following disclosure are secured by means of this invention.

This invention resides substantially in the combination, construction, arrangement, relative location of parts, steps and series of steps as will be described in detail in the following specification in connection with the attached drawings.

Referring to the drawings—

Figures 1 and 2 taken together show in vertical cross-sectional view one form of apparatus embodying the present invention;

Fig. 3 is a vertical cross-sectional view through the refrigerating chamber and one of the baskets in place therein;

Fig. 4 is a longitudinal vertical cross-sectional view through one of the baskets along the line 4—4 of Fig. 3;

Fig. 5 is a diagrammatic view of the inner tube showing a spiral groove on the interior wall thereof;

Fig. 6 is an end elevational view of the tube;

Fig. 7 is a side elevational view of another form of basket with a portion thereof broken away;

Fig. 8 is a cross-sectional view taken on the line 8—8 of Fig. 7; and

Fig. 9 is an end elevational view of the modified form of basket.

It has long been realized that low temperature is the best preservative for perishable products. This fact is so well established that practically all perishable food material which is abundant only periodically in nature is carried over between seasons by means of cold storage. Much of the perishable food material is carried over in cold storage in an unfrozen rather than a frozen condition because experience has disclosed the fact that a slow freezing process often damages such products considerably.

Recently, however, a radical change has taken place in this respect. Careful observation has revealed that while slow freezing is often undesirable, speed or rapid freezing, on the other hand, has shown remarkable and rather unexpected advantages. It is now quite definitely established that speed or rapid freezing retains within food products the very desirable elements which, when they are slowly frozen, are most invariably lost.

This condition pertains to nearly all perishables with the only difference that in animal foodstuffs, such as meat, fish and fowl, the cell walls remain unbroken, whereas in many of the vegetable products these walls are quite frequently disrupted owing to the inelasticity of the cell walls. The nutritious and valuable juices of the animal as well as the vegetable products are, nevertheless, retained during the speed freezing process and are delivered unimpaired to the consumer as long as these products remain in their frozen state at the time of delivery to their user. It has been discovered lately, however, that not all food products are benefited by speed freezing. It is necessary, therefore, to differentiate between classes of food products in freezing them for storage in order that they may be subjected to the proper freezing process. Investigation has indicated definite types and kinds of material which improve by speed freezing. This selectivity quite often pertains to the same species, that is, between peas as well as between berries and many other products.

Sometimes it is preferable to merely chill fresh fruit and retain it in the chilled condition for a limited period.

All of these conditions can successfully be met by means of speed freezing processes employing carbon dioxide either in the solid liquid or gaseous form.

When large quantities of food material are to be frozen the large continuous speed freezing apparatus and method employing liquid carbon dioxide may be used. Such an apparatus is disclosed in my copending applications Serial No. 451,243 filed March 10, 1930, and Serial No. 551,169 filed July 16, 1931. Similar quantities may be economically chilled or frozen by means

of the solid carbon dioxide brine freezer of this invention. The particular form of apparatus employed is mainly determined by the requirements of economy. For processing large quantities of materials a complete equipment with mechanical refrigeration so arranged that low temperatures for speed freezing can be economically produced is the most desirable apparatus. For smaller quantities the solid carbon dioxide brine freezer of this invention is preferable because of the low investment required and low operating cost. The apparatus of this invention is designed so as to be a practically portable equipment which can be set up at any required place at low cost. It is so arranged that very nearly a complete exchange of heat between the cold brine and the products being treated is obtained. This advantage taken in connection with the relatively low cost of solid carbon dioxide reduces the cost of chilling or freezing to a very small value.

For example, this will be appreciated by considering that meat has a latent heat of freezing slightly more than 100 B. t. u. per pound. Its sensible heat above the freezing point is less than 0.8 B. t. u. per pound per degree F. When it is frozen its specific heat drops down to 0.4 B. t. u. per pound per degree F. Therefore, the total heat to be extracted during the freezing process between 40° F. and −10° F. at which point most products are frozen solid is approximately 125 B. t. u. Solid carbon dioxide has a latent heat per pound of 247 B. t. u. In addition a small additional heat quantity can be obtained from the vapor as it issues from the solid ice, so that the total heat available for freezing purposes is approximately 250 B. t. u. per pound.

In the case of vegetable products, such as peas for instance, the latent heat differs only slightly from that of meat since the water contents are almost identical in both cases. The specific heats above and below freezing likewise are practically the same so that in the case of peas, like in that of meat, the total of 125 B. t. u. per pound must be extracted to obtain complete freezing of the texture as well as the enclosed juices. Therefore, two pounds of product will be frozen by the available freezing heat of one pound of solid carbon dioxide. Assuming a cost of solid carbon dioxide of 2½¢ per pound when consumed in quantity, it will be seen that the actual freezing expense is very close to 1.25¢ per pound of frozen product.

This figure can be still further reduced by precooling the product before freezing and stopping the freezing process when the temperature of the frozen product has reached approximately the zero point of the Fahrenheit thermometer. Some materials require a lower freezing temperature but brine cooled by solid carbon dioxide can be easily produced at temperatures lower than −100° F.

An important advantage of the solid carbon dioxide brine apparatus and process of this invention lies in the fact that low brine temperatures are obtained practically at once which, as is well known, is not the case when mechanical refrigerating equipment is used where a considerable period of time is required to reduce the brine temperature to the low temperature required. Furthermore, the refrigerating characteristics of the carbon dioxide vapor produced as the solid carbon dioxide sublimes during the freezing operation are available for use in enveloping the materials being processed as well as for use in insulating the refrigerating apparatus against heat loss.

Other objects of the invention will be apparent from the following description. A suitable housing is shown diagrammatically at 1 within which the equipment may be placed. At 2 is a metal casing which may be heat insulated, if desired, which is provided with a lower wall 3 of some suitable heat insulating material such as cork, for example. Within the casing 2 is an inner container 5 which rests on the bottom wall 3 and is held in position at the top by means of a heat insulating wall 4. This double wall construction provides a closed annular space around the inner container. The container may be closed by a removable closure member 6. Within the container and supported at a suitable point above the bottom thereof is a perforated metal wall 60 on which the blocks 9 of solid carbon dioxide rest. Extending across the top of the container is an apertured pipe which may be of suitable form and size as indicated at 8 from which the brine may be sprayed down over the solid carbon dioxide. This brine collects at the bottom of container 5 and may be withdrawn therefrom through the perforated pipe 7. The brine which collects in the bottom of the container in the operation of the apparatus will maintain a desired level and is in contact with a part of the solid carbon dioxide and with the perforated metal wall 60 so that heat exchange can occur. Instead of flowing the bring over the solid carbon ice as shown, the latter may be entirely submerged. For very low temperature brine a certain percentage of alcohol can be added.

The refrigerating device itself is shown comprising an outer tube 17 supported on the framework 16 and the portion 50 of the building. This tube is supported in inclined position, as shown, with such an inclination that the movement therethrough of the articles to be refrigerated is facilitated by the action of gravity. Within the tube 17 is an inner tube 19 which is enclosed for the greater portion of its length by an outer tube 20 forming by this double wall construction a closed chamber through which the refrigerated brine may be flowed. The upper end of the tube structure is closed by means of a pivotally mounted door 18 and the lower end is similarly closed by a pivotally mounted door 25. The door 18 seats on a sealing ring 22 mounted in the end wall 21 and similarly the door 25 seats on the sealing ring 24 and the lower end wall 23. This construction provides a closed chamber formed by the double wall tube 17 and spaced therefrom to provide an annular closed space to be filled with cold carbon dioxide gas as will be described later. If desired the outer tube 17 may be enclosed within a suitable heat insulating material. The inclination of this tubular structure, its length and diameter may be varied to meet particular conditions. A convenient diameter of the inner tube 19 is 8 inches while the outer tube 20 may have a diameter of 9 inches giving a relatively shallow chamber therebetween through which the brine is circulated thereby insuring that a maximum amount of heat will be absorbed by the brine as it passes therethrough.

At 10 is a pump driven by the motor 11. The intake port of the pump is connected by pipe 12 through valve 13 through the perforated pipe 7. The discharge port of the pump is connected by port 14 through pipe 15 to the spray header 8. Port 14 is also connected by pipe 31 to a pipe 30 which connects with the space between the tubes 19 and 20 at its upper end. Pipe 31 is provided with a suitable diameter indicating de-

vice 32. The discharge port of the pump is also connected by pipe 26 through the valve 27 to the lower end of the annular space as shown in Fig. 2. Pipe 26 is provided with the branches 28 which likewise connect with this space. A second temperature indicating device 29 is connected to the pipe 28. The space within the container 5 is connected by a pipe 34 through valve 35 to the annular space around the double wall tube and within the outer tube 17. This pipe is also provided with a branch 36 having the valve 37 in it connecting with the space within the inner tube 19. At 38 is a platform adjacent the upper end of the refrigerating chamber from which it may be charged with the articles to be refrigerated. At 36 is a suitable platform above the apparatus along which the articles to be refrigerated may be delivered to the operator on the platform 38.

As shown in Figs. 1 and 2 the space between the casings 2 and 5 and the tubes 17 and 20 may be filled with a suitable porous material, such as granulated cork, as indicated at 2' and 17' respectively. Any suitable material of a heat insulating nature through which the cold carbon dioxide gas may slowly seep may be employed for this purpose.

In order to efficiently abstract the heat from the articles to be cooled it is desirable to place them in metal baskets of a particular construction in order to insure that they are thoroughly chilled throughout. Such a suitable basket is illustrated in Figs. 3 and 4 at 37. It comprises a square container having the side and end walls 40 and the bottom wall 41. This rectangular container is part of a substantially cylindrical outer container shown at 43 and connected to the rectangular container by heat conducting walls as shown at 46. The rectangular container is broken up into smaller chambers by means of the transverse metal walls 42 which act as heat conducting walls for abstracting the heat from the interior of the articles to be cooled and, in effect, breaking up a particular volume of material into smaller volumes by reason of the separating metal walls. The smaller compartments are provided with removable covers 44 and handles 45 for facilitating their removal. The circular outer wall 43 is proportioned so as to fit in to the inner tube 19 with a maximum area of contact therebetween without interfering with free movement of the structure through the tube.

The metal baskets thus constructed permit intimate contact between the products to be frozen and the interior wall of the freezing tube so that sufficient heat conducting capacity will be available. These baskets have sliding contact with the inner wall of the tube 19 so as to facilitate rapid heat transfer to the cold brine flowing on the other side of the metal wall. These baskets are preferably made of aluminum or any other metal of good heat conductivity.

In many cases the product to be frozen is packed in smaller paper boxes which are tightly packed into the metal baskets in intimate contact with all of the metal walls thereof. The divisional walls 42 aid in the conduction of heat from the surfaces of the packages or articles in contact therewith.

The individual baskets may be designed to accommodate refrigerating or freezing packaged products or products in bulk, such as peas, berries and the like. When the basket is constructed like that shown in Figs. 3 and 4 the compartments thereof may be so proportioned with respect to the packaged goods that each compartment will receive a single package of a size to be in close contact with all the walls of the compartment. This aids in the abstraction of heat from all parts of the package. When refrigerating or freezing peas, beans, berries and the like in bulk, the basket may be made in a different form if desired, although they may be equally well treated in a basket such as shown in Figs. 3 and 4 where a larger number of heat conducting walls 40 is preferably employed so that each compartment holds a smaller quantity of the bulk material. This aids in the abstraction of heat from the interior of the mass.

In the case of bulk material a modified form of basket may be employed such as that shown in Figs. 7, 8 and 9. In this case a cylindrical metal framework comprising the cylindrical end members 100 joined by the integral longitudinal strip members 101 is employed. This frame is lined with a suitable wire screen or metal cloth lining 102. Each end of the container is closed by means of the telescoping closure members 103 which are preferably perforated as shown and provided with handles 104. The container may be readily braced at the necessary longitudinal points by means of a spider or strut members 105. The external diameter of such a basket will obviously be such as to permit the basket to be readily inserted within the inner tube 19. In this case the basket will contact throughout its circumference with the tube.

In the case of baskets of the forms shown in Figs. 3 and 4 where the basket only contacts for a portion of its circumference with the interior of the tube 19 it may be desirable to employ some mechanism for causing the baskets to slowly revolve about their longitudinal axes as they proceed through the tube. This feature has been illustrated in Figs. 3, 5 and 6. The interior wall of the tube 19 is provided with a long spiral groove 19' in which slides the lug 43' (Fig. 3) secured to the side of the basket. Thus as the basket is moved through the tube it is given at least one complete revolution so that all portions of the circumference thereof will at one time or another be in contact with the tube 19. This feature need not be employed with the cylindrical basket of Fig. 7 because all portions of the circumference thereof are in contact with the interior wall of the tube 19.

In the operation of the apparatus solid carbon dioxide having been charged into the container 5 and sufficient brine solution placed therein pump 10 is set in operation. This withdraws the cold brine from container 5 through pipe 7 and pipe 12, valve 13 being open, into the pump. This brine is discharged through pipe 26, valve 27 being open, into the space between the double wall tube 19—20. The branch 28 likewise delivers brine into this space. The articles to be refrigerated, preferably packed in the baskets previously described, are within the space in the inner tube 19. The cold brine quickly fills the space between the double walls and flows out through branches 30 into pipe 31 and thence to the spray header 8. Thus it will be seen that the colder brine is delivered to the lower end of the double wall tube and is withdrawn at the upper end at which time it is at its highest temperature. Thus the articles to be refrigerated are gradually advanced towards the coldest end of the double wall tube. The warm brine, relatively speaking, is sprayed from the header 8 over the solid carbon dioxide 9

where it is again chilled and finally collects in the bottom of container 5 to be withdrawn therefrom. Thus the brine is being continuously circulated, first through the double wall tube where it abstracts heat from the articles to be refrigerated and thence over the solid carbon dioxide where it gives up that heat. By means of the temperature indicating devices 29 and 32, by adjusting the speed of the pump 10 and setting of valve 27 it is possible to obtain any desired temperature conditions for the brine at various points in its cycle of travel. This action may be further aided by adjusting the valve 13 in the by-pass line 14 so as to deliver some of the colder brine back into the spray header 8 for mixture with the warmer brine coming through pipe 31. Cold carbon dioxide gas may be withdrawn from container 5 through pipe 34 and delivered to the space around the double wall tube and within the outer tube 17. This forms a cold insulating layer which prevents loss of efficiency by the absorption of heat from the circumambient atmosphere. The cold gas is also delivered through the branch 36 into the inner tube 19 so that the articles being refrigerated, if desired, will be immersed in a cold carbon dioxide atmosphere. The gas may be allowed to leak out of the space between the tubes 17 and 20 through the discharge port device 70. Pipe 34 is also provided with a gas discharge nozzle or orifice 35 within the space between the casing 2 and the container 5 to assist in the insulation of the inner chamber against heat loss.

Under average operating conditions a device of this nature will refrigerate food products to the proper degree within about thirty minutes. Thus thirty minutes will elapse between the introduction of a basket at the upper end of the tube and its removal at the lower end of the tube.

It is a well known principle of thermodynamics that heat always travels from a higher to a lower temperature level. The greater the temperature difference between the articles being refrigerated and the brine the more rapidly heat will be transferred from the articles to the brine. For instance, with a brine temperature of −40° F. an initial temperature of the product of +40° F., a temperature difference of 112° F. obtains between the two at the beginning. Assuming that at the end of the freezing process the product has been reduced to a temperature of −10° F. it will be apparent that there is a final temperature difference of 30° F. By reason of these relatively large temperature differences it is possible to effect rapid or speedy freezing which is a highly desirable economic condition. The flexibility of this apparatus will be apparent when it is realized how simple it is to effect these high temperature differentials.

By way of completeness there is shown in Fig. 2 a storage chamber into which the lower end of the refrigerating tube discharges. The baskets 37 may be unpacked and the packages indicated at F may be stored in storage racks 39. The space which contains the storage racks may be refrigerated by means of the refrigerating coils 90 in accordance with well known practice.

From the above description it will be apparent that this invention resides in certain principles of operation and certain forms of physical apparatus which may be carried out and constructed in other ways without departure from the scope of this invention. I, therefore, do not desire to be strictly limited to this disclosure as given in an illustrated sense but rather to the scope of the appended claims.

What I seek to secure by United States Letters Patent is:

1. A method of refrigerating articles comprising the steps of gradually advancing the articles through a closed space in contact with a heat conducting wall, circulating a refrigerating medium in contact with said wall to abstract the heat through the wall from the articles spraying the warm medium over the solid carbon dioxide to cool it for further use and introducing the carbon dioxide gas produced by sublimation of the solid into the closed space.

2. A refrigerating method as described comprising the steps of moving articles to be refrigerated under the action of gravity in contact with a heat conducting wall, circulating a refrigerating liquid in heat exchange relation with said wall, and spraying the warmed liquid onto solid carbon dioxide for reuse.

3. A refrigerating method as described comprising the steps of moving articles to be refrigerated under the action of gravity in contact with a heat conducting wall, circulating a refrigerating liquid in heat exchange relation with said wall, spraying the warm liquid onto solid carbon dioxide and enveloping the articles to be refrigerated with the cold carbon dioxide gas produced by sublimation of the solid carbon dioxide.

4. A refrigerating method as described comprising the steps of moving articles to be refrigerated along a heat conducting wall, circulating a liquid refrigerating medium in heat exchange relation with the wall, circulating the warmed liquid in heat exchange relation with solid carbon dioxide, recirculating the cooled liquid in heat exchange relation with the wall, and enveloping the articles with the cold carbon dioxide gas produced by the sublimation of the solid carbon dioxide while in contact with the wall.

5. A refrigerating method employing a metal double wall tube comprising the steps of gradually advancing articles to be refrigerated through the tube and in contact therewith, circulating cold brine between the double walls, circulating the warm brine in heat exchange relation with solid carbon dioxide, and enveloping the double wall tube with cold carbon dioxide gas produced by the sublimation of the solid carbon dioxide.

6. A refrigerating method employing a metal double wall tube comprising the steps of gradually advancing articles to be refrigerated through the tube and in contact therewith, circulating cold brine between the double walls, circulating the warm brine in heat exchange relation with solid carbon dioxide, enveloping the double wall tube with cold carbon dioxide gas produced by the sublimation of the solid carbon dioxide, and enveloping the articles in cold carbon dioxide gas produced by sublimation of the solid carbon dioxide while in said tubing.

7. A refrigerating method as described comprising the steps of intermittently moving articles to be refrigerated along a definite path in contact with a heat conducting wall, circulating a cold liquid in heat exchange relation with the wall to abstract heat from the articles through the wall, spraying the warm liquid onto solid carbon dioxide to cool it, circulating the cooled liquid in heat exchange relation with the wall and mixing a portion of the cooled liquid with the warm liquid to control the temperature of the cooled liquid being circulated in heat exchange relation with the wall.

8. A metal basket as described comprising a

metal container subdivided into smaller compartments by transverse walls in heat conducting relation with the container, a cover for each of the compartments, and an outer substantially circular wall heat conductively connected to the container.

9. In an apparatus as described the combination comprising a double wall tube, movable closure members for each end of the tube, a liquid container, a pipe connected between the container and the double wall tube including means for circulating a liquid therethrough, said container being provided to receive solid carbon dioxide, and a spray header in communication with the pipe connections and disposed within the container.

10. A refrigerating apparatus as described comprising a double wall tube, means for mounting said tube at an angle to the horizontal, an outer casing enclosing the double wall tube, means for supporting the double wall tube within said means for enclosing it to provide a closed chamber therearound, a container for solid carbon dioxide and a liquid, a delivery pipe connection extending from the container to the double wall tube and including means for circulating a liquid therethrough, a spray header in said container near the top, and a discharge connection from the double wall tube to the spray header.

11. A refrigerating apparatus as described comprising a double wall tube, means for mounting said tube at an angle to the horizontal, an outer casing enclosing the double wall tube, means for supporting the double wall tube within said means for enclosing it to provide a closed chamber therearound, a container for solid carbon dioxide and a liquid, a delivery pipe connection extending from the container to the double wall tube and including means for circulating a liquid therethrough, a spray header in said container near the top, a discharge connection from the double wall tube to the spray header, and a pipe connection from the container to the space around the double wall tube.

12. A refrigerating apparatus as described comprising a double wall tube, means for mounting said tube at an angle to the horizontal, an outer casing enclosing the double wall tube, means for supporting the double wall tube within said means for enclosing it to provide a closed chamber therearound, a container for solid carbon dioxide and a liquid, a delivery pipe connection extending from the container to the double wall tube and including means for circulating a liquid therethrough, a spray header in said container near the top, a discharge connection from the double wall tube to the spray header, and a by-pass pipe connection between the delivery pipe and the discharge connection having a control valve therein.

13. A refrigerating apparatus as described comprising a pair of concentric tubes united at the ends to form a closed space, the inner tube being open at each end, movable closure means for the open ends of the inner tube, a wall surrounding the inner tube and spaced therefrom to provide a closed space, means connected to the closed space between the inner tube and the enclosing wall for circulating a cooling medium therethrough, a container for solid carbon dioxide and a refrigerating liquid, means for withdrawing the liquid from the container and delivering it to the space between the inner tube and the enclosure wall, a connection from the space between the inner tube and the enclosing wall for delivering the liquid back to said container and a connection from the container to said inner tube for conducting carbon dioxide gas.

14. A refrigerating apparatus as described comprising a pair of concentric tubes united at the ends to form a closed space, the inner tube being open at each end, movable closure means for the open ends of the inner tube, a wall surrounding the inner tube and spaced therefrom and united therewith to provide a closed space, means connected to the closed space between the inner tube and the enclosing wall for circulating a cooling medium therethrough, a container for solid carbon dioxide and a refrigerating liquid, means for withdrawing the liquid from the container and delivering it to the space between the inner tube and the enclosing wall for delivering the liquid back to said container, and a pipe connection from the container to the space formed by the inner tube.

15. A refrigerating apparatus as described comprising a pair of concentric tubes united at the ends to form a closed space, the inner tube being open at each end, closure means for the open ends of the inner tube, a wall surrounding the inner tube and spaced therefrom to provide a closed space, means connected to the closed space between the inner tube and the enclosing wall for circulating a cooling medium therethrough, a container for solid carbon dioxide and a refrigerating liquid, means for withdrawing the liquid from the container and delivering it to the space between the inner tube and the enclosure wall, a connection from the space between the inner tube and the enclosing wall for delivering the liquid back to said container, and a pipe connection from the container to the space between the inner and outer tubes.

16. A refrigerating apparatus as described comprising a pair of concentric tubes united at the ends to form a closed space, the inner tube being open at each end, closure means for the open ends of the inner tube, a wall surrounding the inner tube and spaced therefrom to provide a closed space, means connected to the closed space between the inner tube and the enclosing wall for circulating a cooling medium therethrough, a container for solid carbon dioxide and a refrigerating liquid, means for withdrawing the liquid from the container and delivering it to the space between the inner tube and the enclosure wall, a connection from the space between the inner tube and the enclosing wall for delivering the liquid back to said container, and a pipe connection from the container to the closed space formed by the inner tube and to the space between the inner and outer tubes.

17. A refrigerating apparatus as described comprising a metal tube, means for supporting said tube at an angle with the horizontal, movable closure members for the ends of said tube, an outer wall connected to and surrounding said tube to form a closed space, means for circulating a cooling medium through the closed space, said tube having a spiral groove formed in the inner wall thereof, a metal basket shaped to fit within said tube and lugs on said basket positioned to engage said groove so that as the basket advances longitudinally through the tube it will revolve about the longitudinal axis of the tube.

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