Nov. 12, 1929. J. W. MARTIN, JR 1,735,082

REFRIGERATED PACKAGE AND METHOD

Original Filed April 2, 1927

Fig. 2.

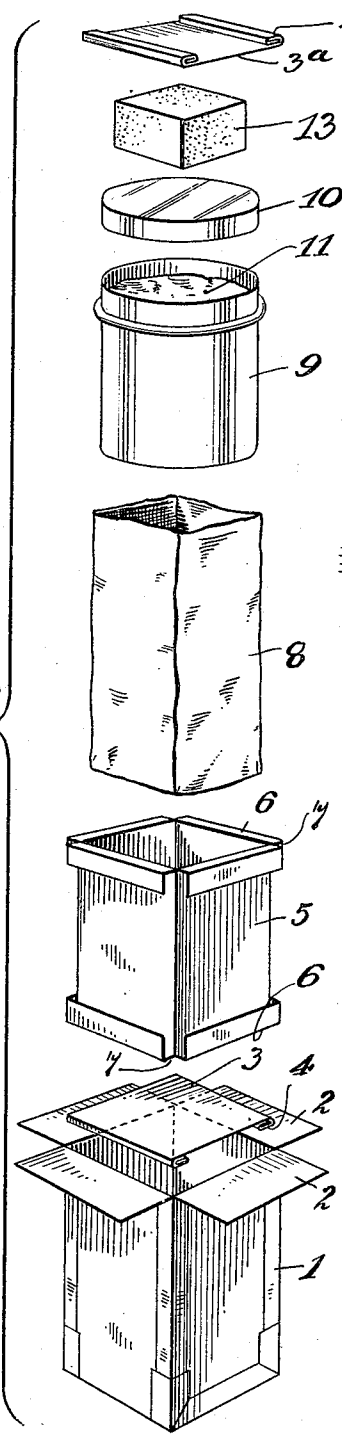


Fig. 1.

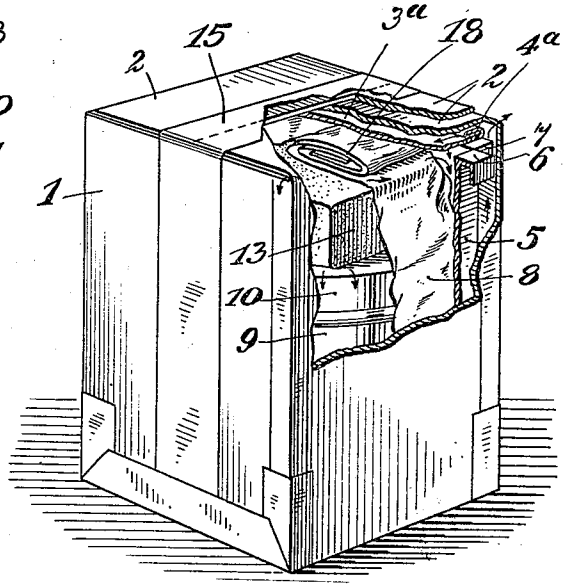


Fig. 3.

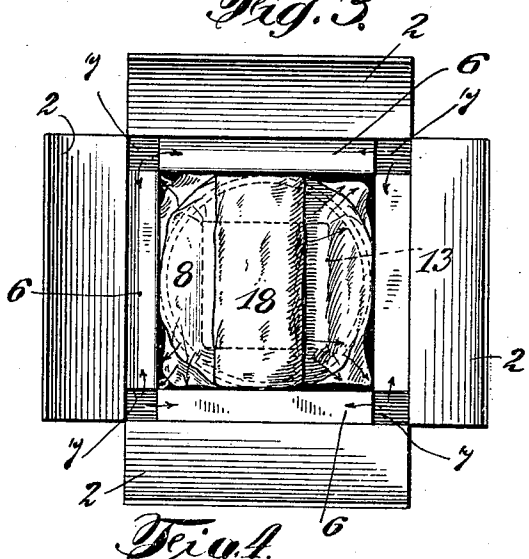


Fig. 4.

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UNITED STATES PATENT OFFICE

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REFRIGERATED PACKAGE AND METHOD

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My present invention relates to use of frozen carbon dioxide enclosed in a package with perishable products of types not injured by over-freezing. The package may be used for ordinary storage or for transportation of the goods as, for instance, in Slate Patent No. 1,595,426, granted August 10th, 1926, and in another closely related patent, Cusack, No. 1,595,385, granted the same day, but my present invention concerns more particularly the embodiment in a package for such purposes, of principles of insulation and control of melting of the ice by control of flow of the gaseous product and sublimation of the ice, in accordance with the principles set forth in applications, Ser. Nos. 116,103, 142,550 and 169,170.

A specific feature of the present invention relates to the simplicity of the means employed for insuring the desired functioning in accordance with the above principles. There may be and preferably are included features modifying and improving the functioning, that are particularly adapted for package use.

The frozen carbon dioxide is usually in the form of dense, highly compressed blocks which, as is well known, do not melt to a liquid under atmospheric conditions, but sublimate directly to carbon dioxide gas. The freezing temperature of the carbon dioxide is approximately 114° F. below zero, but the effective temperature of the gas sublimating from the solid, under atmospheric conditions, is approximately 85° below zero. Because the carbon dioxide molecule (CO_2) is intrinsically much heavier than either the oxygen or nitrogen constituent of the air and because of its very low temperature, the gas thus evolved is almost twice as heavy as air at ordinary refrigerator temperatures. Consequently, the gas readily displaces air, tends to remain in the bottom of a receptacle and will diffuse but slowly. My present method utilizes these characteristics.

In the present case the arrangements are such that the outflow of the gas evolved from the frozen carbon dioxide is in a downflow leg of the circulation, and this downflow leg includes the perishable product to be refrigerated, the product being preferably enclosed in a water-tight container. There are certain special advantages in having this container of metal, with the frozen carbon dioxide in direct contact with the metal. There is further advantages in having this container, and the dryice in contact therewith, enclosed together in a bag, preferably a paper bag, the upper end or mouth of which is unsealed and so affords easy vent for escape of gas from the bag.

When this bag is used, the freshly evolved gas will flow downward in the bag around the container, displacing air and warmer gas upward, and the arrangement is such that the gas escaping from the bag flows downward around the outside of the bag.

Whether or not the bag is used, I prefer to arrange a false wall or lining fitting around the product container, but affording ample space for downflow of said gas, said lining being spaced apart from the outer walls of the package so as to afford an interspace for upflow of warm gas adjacent the said outer wall. The outer or enclosing box affords vent at the upper end for the warm gas upflowing in the interspace between the lining and the package walls.

Preferably, the outer package is an ordinary rectangular carton of corrugated fiber-board such as commonly made of corrugated pasteboard between two plain sheets of pasteboard with flap ends adapted to be folded over and secured by paster strips in the usual way. The lining or false wall may be of similar material suitably folded and cut so as to afford the interspace.

The above and other features of my invention will be more evident from the following description in connection with the accompanying drawings, in which

Fig. 1 is a perspective view of the complete package with parts broken away to show the relation of parts therein;

Fig. 2 is a perspective view showing all of the parts in perspective and in the relation in which they are assembled; and

Fig. 3 is a top plan view of the complete package shown in Fig. 1, but with the closing flaps open.

Fig. 4 is a detail section indicating the con-

struction of the ordinary corrugated board which is only diagrammatically indicated in the foregoing figures of the drawings.

In Figs. 1, 2 and 3, the outer container parts of the package are indicated as made of solid material, but this is only for simplicity and it will be understood that the material is preferably the ordinary corrugated board shown in Fig. 4. In Figs. 1, 2 and 3, 1 is a well known type of corrugated board carton, with the usual flaps, 2, 2, that may be folded in as indicated in Fig. 1 to close the top. Similar flaps at the bottom of the package not shown, are already folded in and secured.

3 is a supplemental false bottom or lining, preferably of corrugated board, the edges of which are curled to form spacing battens or flanges, 4, thereby affording an interspace between the integral flap bottom of the carton 1 and the false bottom 3.

5 is a false wall lining, preferably of the same material, with the edges folded reversely as at 6, so that when 5 is telescoped into 1 a double wall box will be formed. The flanges are cut away as at 7, 7, to afford lower and upper ducts for entrance and escape of the carbon dioxide gas in the up leg of its circulation.

8 is a paper bag, preferably square, preferably of calendered manila paper with the seams pasted so that the bottom of the bag will be approximately gas tight.

9 is a container and 10 the container cover adapted to enclose the perishable products indicated at 11, which may be ice cream. On top of the cover is a cake of frozen carbon dioxide ice, 13. Above the ice is a false top, 3^a, which is just like 3, except that the folded battens, 4^a, are upwardly presented.

As will be evident from Fig. 2, the false bottom 3, liner 5 and bag 8 are successively telescoped down into the carton 1, the container 9 with the cover thereon being in bag 8 and with the block of ice 13 resting on the cover. The mouth of the bag is then loosely secured without sealing, by the fold roll shown at 18, Figs. 1 and 3. The false cover, 3^a, is then placed inside the box, resting on the ledges 6 of the liner 6. The top flaps, 2, are then folded over in successive opposite pairs and secured in any desired way as by paster 15.

Thus, the completed package comprises the inner paper bag enclosing the frozen carbon dioxide 13 and container 9; within false bottom 3, liner 5 and false top 3^a, completing what amounts to an inner rectangular box, the six sides of which are spaced apart from the carton by the battens 3, 3^a and the flanges 6. Laterally, the liner 5 is practically gas tight, but the top and bottom are more or less loose and lightly associated therewith. Consequently, the cutaway corner portions of the liner at 7, 7, are adapted to form inlets and outlets for the interspaces which are in effect flues having relatively warm exterior walls, the heat from which causes said flues to determine an up leg of the circulation of the gas.

As indicated by small arrows, in Fig. 1, the carbon dioxide escaping from the ice 13, naturally flows downward in the bag, first displacing all the air upward and thereafter displacing the warmer carbon dioxide gas which, it will be understood, is warmer only by comparison with the fresh gas, both being in fact intensely cold. Thus the refrigerative values of the refrigerant are first applied to the container 9 and its contents to further over-freeze the latter, thus conserving and so to speak, storing up refrigerative values in the mass of the ice cream, against a possible time of need. The gas also affords extremely effective gaseous insulation for both the carbon dioxide ice and the container. All air being displaced, the ice is protected from melting because the partial pressure of the carbon dioxide gas atmosphere in contact with it, is so much greater than that of air. The melting point is correspondingly lowered.

As the volume of gas evolved in the bag is more than 500 times the volume of solid carbon dioxide that is sublimated, the resistance of the vent outlet, even though slight, will result in maintaining a slight excess of gas pressure within the bag, the amount of such excess pressure being of course dependent on the rate of gas evolution, and the resistance, or degree of tightness with which the mouth of the bag is folded. Moreover, the flexibility of the paper walls of the bag permit in and out flexing of said walls in conformity to excess of external or internal pressure, while the natural tendency of such walls is to remain in any shape in which they are flexed, thus minimizing possibility of inbreathing of air or gas, within the bag under conditions of practical use. Normally, the gas within the bag will tend to keep it expanded, so as to fill up exterior voids between the ice cream container and the outer wall by which it is supported and protected. Any such minimizing of the exterior voids, reduces the flow section available for outflow of gas after its escape from the bag and correspondingly accelerates the speed of such flow and the rate of convection to the exterior atmosphere, of moisture and heat from within the container.

As also indicated by the arrows, the gas leaking from the folded mouth of the bag flows downward around the outer surface of the bag, embracing it and its contents in the down leg of its circulation in the interspace between the bag and the liner 5. The air and gas in the interspace between the liner 5 and the outer carton 1 being most exposed to outer heat coming through walls of the carton, naturally rises, thus establishing a thermo-

circulation of heavy gas entering the interspace between the lower notches 7, rising through the interspace, and ballooning out through the upper exit notches 7. From this point, as indicated by the arrows, the gas can flow into the interspace between false top 3ª and the folded flaps 2, 2, and eventually leaks out at the top through the joints of the folded over flap. A certain amount of the carbon dioxide gas finds its way into the lower interspace between false bottom 3 and the bottom of the carton, and some of it may leak out in this direction, but in practice, the rate of gas evolution is such as to maintain a fair outward flow of gas at all times, and the above described thermo or thermostatic principle of circulation will cause most of the escape to be through the top of the package as above described. If the bag, 8, is omitted, the down leg and up leg of the circulation will be the same as before, except the down leg is supplied directly from the ice, instead of first circulating in the bag and escaping from the mouth thereof. In practice, however, the bag will be found to phenomenally effective means of decreasing the ice consumption, so much so that in certain cases it may be found possible to substitute for the liner 5, an insulating packing that will serve to space the bag away from the direct contact of the walls of the carton; also where the liner is arranged to afford an extremely low resistance upflow path for the gas adjacent the outer wall of the carton, the bag may be dispensed with. It is important, however, to have the container 9 sufficiently loose fit within the liner to afford ample space for circulation of the carbon dioxide gas from the ice. Obviously, the container does not have to be cylindrical, provided only it fits loosely enough to afford such circulation and a rectangular inner container of pasteboard is often used. Similarly, it is not essential that the bag have a rectangular bottom or that the tight-bottom, bag-form be given it before the inner container is inserted. The bag does not have to be of gas-tight material, nor does its mouth have to be unsealed in the special case where the paper is porous enough to permit outward ooze of gas and to prevent reverse flow.

While the container 9 and cover 10 need not be of metal, nor the ice 13 in direct contact therewith, both of these features will be found of advantage in that direct contact of ice with the metal will serve to facilitate refrigeration of the product within the container and the all metal path afforded by the container will distribute the refrigeration over a large area of the product. This is particularly desirable where the product within the container has already been over-frozen to a very low temperature. In such case, the distribution of the refrigerating effect through the conducting metal will tend to protect the bottom and remote parts of the container from conducting heat from the outside to the over-frozen product.

Obviously, the frozen carbon dioxide and the gas therefrom being perfectly anhydrous, its effect will be to dry rather than to impart moisture to the paper of the bag, the liner, or the carton. This quality also makes it possible to pack the ice anywhere in or around the container, either inside or outside of the paper bag; also a cake of ice may be placed under as well as over the container; also the package can be turned upside down without damage. Although in the latter case the down leg of the circulation will be shortened, the up leg, sweeping out the heat from the interspace between the liner 5 and the carton wall, will function as before.

It will thus be seeen that I have combined in a most practically effective form, several important scientific principles, one merit of the invention being the cheapness and simplicity of the means employed.

For instance, five gallons of ice cream may be enclosed in the thinnest, cheapest kind of "throw-away" metal container, enclosed in a cheap paper bag, and the whole enclosed in the carton above described at very small expense. Such a package, costing very little, can be shipped to a distant point, the ice cream used and all parts of the package thrown away, at far less expense than is now involved in handling shipments of ice cream, in the usual way, with the expensive containers and refrigerating devices which must be returned to the shipper.

As in the prior patent to Slate referred to above, the expressions "solid carbon dioxide", "frozen carbon dioxide", etc., are used as shorthand description of a solidified mass of an inert substance which at ordinary temperatures is a gas heavier than air and which on absorption of heat passes directly from the solid to the gaseous state. Hence it will be understood that such expressions as used in the appended claims are intended to include equivalent solid substances as, for instance, frozen carbon dioxide with small admixtures of other material that may be present either as impurities or which have been incorporated for special purposes as, for instance, to facilitate the formation of cakes from snow; or to increase the strength or improve the appearance of the cakes or to change the melting point, etc.

I claim:

1. A refrigerated package including a perishable product adapted to be over-frozen, a metal container enclosing said product, frozen carbon dioxide in contact with the metal of the container, a paper bag in which said container and frozen carbon dioxide are enclosed, with the latter nearest the mouth of the bag, a corrugated pastboard carton enclosing said paper bag, and false walls between said bag

and said carton affording interspaces for up-circulation of gas escaping from the paper bag, said metal container being circular in cross-section and said carton being rectangular.

2. A refrigerated package including a perishable product adapted to be over-frozen, a metal container enclosing said product, frozen carbon dioxide, a paper bag in which said container and frozen carbon dioxide are enclosed, with the latter nearest the mouth of the bag, a corrugated pasteboard carton enclosing said paper bag, and false walls between said bag and said carton affording interspaces for up-circulation of gas escaping from the paper bag.

3. A refrigerated package including a perishable product adapted to be over-frozen, a metal container enclosing said product, frozen carbon dioxide, a paper bag in which said container and frozen carbon dioxide are enclosed, with the latter nearest the mouth of the bag, a corrugated pasteboard carton enclosing said paper bag, and means between said bag and said carton for preventing contact of the bag with the walls of the carton.

4. A refrigerated non-return shipping package, including a perishable product adapted to be over-frozen, a throw-away metal container enclosing said product, frozen carbon dioxide in close heat exchange relation with a wall of the metal container, for causing or maintaining over-frozen condition of its contents, and a paper bag in which said container and frozen carbon dioxide are enclosed by folding over the mouth portion of the bag.

5. A refrigerated non-return shipping package, including a perishable product adapted to be over-frozen, a throw-away metal container enclosing said product, frozen carbon dioxide in close heat exchange relation with a wall of the metal container, for causing or maintaining over-frozen condition of its contents, a paper bag of substantially larger size than said container and said solidified carbon dioxide in which said container and frozen carbon dioxide are enclosed, and a paper-board box enclosing said paper bag, the mouth of said bag being folded to permit slow leak of gas therefrom.

6. A refrigerated non-return shipping package including a perishable product adapted to be over-frozen, a throw-away metal container enclosing said product, frozen carbon dioxide, a paper bag in which said container and frozen carbon dioxide are enclosed, and a paper-board box enclosing said paper bag having false walls between said box and said bag affording interspaces with open low resistance openings adjacent the top and bottom thereof for up-circulation of gas escaping from the paper bag.

7. A refrigerated non-return shipping package, including a perishable product adapted to be over-frozen, a throw-away metal container enclosing said product, frozen carbon dioxide, a paper bag in which said container and frozen carbon dioxide are enclosed, and a paper-board box enclosing said paper bag having false walls affording interspaces for up-circulation of gas escaping from the paper bag, said metal container being circular in cross-section and said carton being rectangular.

8. A refrigerated package, including frozen carbon dioxide, a perishable product adapted to be over-frozen, a closed paper bag in which said container and frozen carbon dioxide are enclosed and a paper-board box enclosing said paper bag, said closed bag being formed and arranged to permit escape of gas generated therein, but maintaining a slight excess pressure thereof within the bag, and said bag having flexible walls adapted to expand or contract the volume of the bag under varying conditions of external and internal pressures, for the purpose described.

9. A refrigerated package, including frozen carbon dioxide, a perishable product adapted to be over-frozen, a paper bag in which said container and frozen carbon dioxide are enclosed by collapsing and repeated folding of the mouth of the bag, a paper-board box enclosing said paper bag, and spacing means preventing contact of the bag with the walls of the box and providing channels for up-circulation of gas escaping from the paper bag.

10. A refrigerated package, including frozen carbon dioxide, a perishable product adapted to be over-frozen, a paper bag in which said container and frozen carbon dioxide are enclosed, a paper-board box enclosing said paper bag, and spacing means for preventing contact of the bag with the walls of the box, said products container being circular in cross-section and said carton being rectangular and said bag being of a size and shape to loosely fit the interior of said rectangular carton.

11. A refrigerated package, including a perishable product adapted for over-freezing and frozen carbon dioxide enclosed within a bag of paper or the like with the mouth folded loosely so as to afford low resistance vent for gas evaporating from said frozen carbon dioxide, said paper bag being enclosed in an insulating outer container, said paper bag having flexible walls adapted to expand or contract the volume of the bag under varying conditions of external and internal pressures, as determined by the rate of gas evaporation and the resistance of said vent.

12. A refrigerated package, including a perishable product adapted for over-freezing and frozen carbon dioxide enclosed within a bag of paper or the like with the mouth closed loosely so as to afford low resistance vent for gas evaporating from said frozen

carbon dioxide, said bag being enclosed in an insulating outer container and spaced apart from the walls of the outer container by inner walls affording interspaces for circulation of the gas.

13. A refrigerated package, including a perishable product adapted for over-freezing, an inner metal container in which said product is enclosed, frozen carbon dioxide above and in proximity to said container, all enclosed in an insulating outer container of corrugated paper-board, said inner container having curved sides and said outer container having flat sides to afford spaces for gas evaporating from the frozen carbon dioxide.

14. A shipping package, including frozen carbon dioxide enclosed within a bag of paper or the like, adapted for low resistance outward escape of gas evaporating from said frozen carbon dioxide, said bag being loosely enclosed in an insulating outer container having inner walls spaced apart from the outer walls thereof and affording ample interspaces for low resistance circulation of the gas.

15. A refrigerated package, including a perishable product adapted for over-freezing, an inner container in which said product is enclosed, frozen carbon dioxide above and in proximity to said container, all enclosed in an insulating outer container made of corrugated paper-board and having liner walls spaced apart from the outer walls, said inner container loosely fitting said outer container to afford ample spaces for low resistance upflow of gas evaporating from the frozen carbon dioxide.

16. A refrigerated container of insulating material enclosing frozen carbon dioxide and a perishable product, said frozen carbon dioxide and perishable product being enclosed in a bag of paper formed and arranged to permit escape of gas while maintaining a slight excess pressure thereof within the bag and said bag having flexible walls adapted to expand or contract the volume of the bag under varying conditions of external and internal pressures, for the purpose described.

17. In a method of refrigerating a perishable product adapted to be overfrozen, the steps of enclosing the product with frozen carbon dioxide in a permeable container, generating carbon dioxide gas to create a pressure in said container and heat insulating said container by continuously maintaining a flow of said generated gas adjacent the said container in a plurality of substantially concentric paths.

Signed at New York city, in the county of New York and State of New York, this 31st day of March, A. D. 1927.

JAMES W. MARTIN, JR.