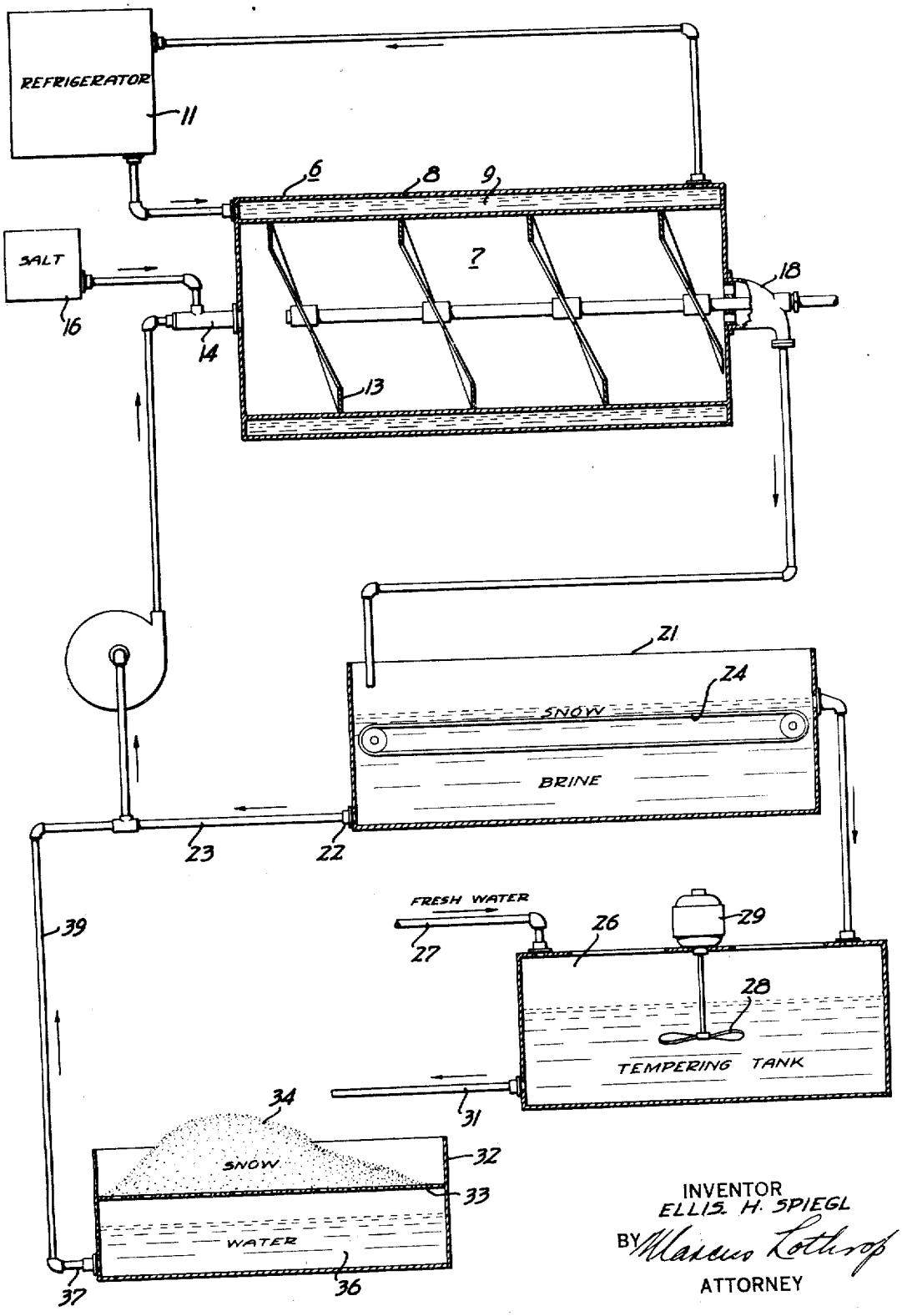
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REFRIGERANT AND METHOD OF PROVIDING THE SAME

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REFRIGERANT AND METHOD OF PROVIDING THE SAME

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9 Claims. (Cl. 62—172)

My invention relates to a refrigerant which is suitable for use in a produce package and to a way of providing such refrigerant.

While the scope of my invention is to be limited only by the claims, one example of it can be considered as it has been developed in connection with the packaging of lettuce. Lettuce heads fresh from the growing field customarily are packed in crates containing a predetermined number of lettuce heads and an amount of crushed water-ice to reduce the temperature of the lettuce heads and to keep their temperature reduced during transit and storage. The dimensions of the crate and of the lettuce heads are such that the lettuce heads are compressed within the package when the enclosure is completed. Lettuce has the characteristic of being rather easily bruised mechanically and, when bruised, of exuding a milky liquid which, upon contact with air, turns brown. Not only is the lettuce actually so damaged, but its appearance is adversely affected; so that a serious commercial problem exists in refrigerating lettuce and yet minimizing adverse effects upon its condition and appearance. Many solutions of this problem have been attempted, some of them of some value and others of no value, but in the main the problem still exists. Some of the solutions have involved wrapping each individual head of lettuce in some sort of an envelope or container, but this not only is expensive but reduces the effect of the refrigerant. I myself have, as shown in my copending application Serial No. 246,661, filed December 19, 1938, entitled "Lettuce pack and method of packing lettuce," endeavored to prevent the appearance of damage by largely eliminating contact between the letfuce and the atmosphere so that oxidation does not occur. Nevertheless, the general practice still is to place the lettuce heads in crates, to crush large blocks of water-ice into relatively small size, sometimes screening the ice and sometimes using it just as it comes from the crusher, then to pack the ice in with the lettuce heads and close the crate under pressure.

It is an object of my invention to improve considerably upon the stated standard practice.

In the drawing the figure is a diagrammatic representation of my invention.

After a very extensive experience in packaging hundreds of thousands of crates of lettuce and in trying virtually all of the commercially available manners of packaging represented in the patent literature and otherwise, it occurred to me that the source of a major part of the trouble was the character of the crushed ice.

This crushed water-ice, as it results from the ordinary crushing mechanisms, is a mass of particles which, when closely examined, are seen to have very sharp edges and piercing points. These are not lost as the ice is kept in mass prior to use and are most efficient in piercing the lettuce, cutting it and otherwise initially bruising it so that exudation and resultant oxidation ensue. For the ordinary crushing machines I therefore at first attempted to substitute a ball mill and screening devices, believing that if the ice were hammered or differently crushed and were separated into exceedingly small particles the difficulty would be overcome. Such was not the case, however, since the sharp edges of the small particles, although not effective to penetrate as deeply as large pieces of sharp ice, nevertheless bruise the leaves and in many cases perforate them in a greater number of places. No feasible change in the crushing or screening arrangement appeared to make any improvement.

I then endeavored to utilize an intermediate product produced by a Vilter "Pak-Ice" machine, manufactured by the Vilter Company, of Milwaukee, Wisconsin. This machine includes a jacketed chamber or cylinder within which are rotating helical knives. A refrigerant is recirculated through the jacket to maintain a low temperature within the cylinder, and water is introduced into the jacketed cylinder and immediately turns into a snow-like mass. This mass is scraped from the chamber walls and is expelled from the cylinder into a briquetting device which compresses the mass into briquettes or blocks of snow-ice. These briquettes or blocks or snow-ice normally are commercially utilized as a substitute for artificial water-ice.

I attempted to utilize the snow-like product which is expelled immediately from the cylinder, taking it before it went into the briquetting device, but I found that such product is useless for packing purposes since the particles are tenaciously cohesive and, while excellent for briquetting form otherwise such a tenacious, rubbery mass as to be commercially unusable.

Then, after a great deal of further experimenting, I found that by adding salt to the water entering the Vilter machine and therefore making a light brine, the machine would furnish discreet water crystals of approximately $\frac{3}{1600}$ of an inch diameter, which were smooth and relatively round and hence very satisfactory, and, further, which were substantially non-

cohesive and hence distinctly usable in the packaging operations.

As an interesting indication that these discreet particles are distinctly different from those furnished by the machine when operated upon ordinary water, it is found that when the discreet particles removed from the brine are put in the briquetting attachment they do not form briquettes. Upon analysis, the water crystals separated from the brine are substantially pure water, there being only an infinitesimal amount of brine adhering thereto. The remaining or separated brine is, of course, somewhat more concentrated after the crystals of water have been removed therefrom.

But a practical trial of such water crystals removed from the brine as a packing refrigerant was unsatisfactory, since lettuce is readily frozen, and the temperature of the separated water crystals ranges from substantially 29° to about 31° Fahrenheit, depending somewhat upon the concentration of the brine and other factors in the freezing operation.

I then mixed the water crystals, after they had been separated from the brine, with fresh water of a higher temperature and permitted the intermixture to continue until such time as the water crystals were of a temperature of substantially 31.8° Fahrenheit. This temperature is not injurious to lettuce, and the warmed or tempered crystals are not otherwise affected. The package is made by introducing lettuce into a crate and surrounding it immediately with the tempered and separated water crystals, and the crate is then closed under pressure.

It has been found, as a practical matter, that the refrigeration qualities of the package are considerably enhanced over standard practice and that there is no mechanical injury whatsoever to the lettuce, since the water crystals are devoid of points or sharp edges and hence do not in any wise mechanically injure the produce. As a convincing test of this, a mass of the separated water crystals, when held in the hand and squeezed, feels perfectly soft to the touch, whereas a comparable mass of crushed ice particles, when held in the hand and squeezed, is sharp and unpleasant. The difference in sensation so far as the touch is concerned is very much like the difference between grasping and squeezing a mass of cotton and grasping and squeezing a mass of crushed pebbles. The cotton analogy is further of interest in that a large pile of separated ice crystals looks very much like a pile of loose cotton or is somewhat suggestive of a mass of fine soapy lather. In effect, therefore, I have provided a refrigerant which has at least all of the cooling properties of crushed water-ice but which is devoid of injurious points or edges and in effect provides a cotton-like surrounding or packing for the produce.

In a typical commercial installation, there is provided a machine 6 having the characteristics of a Vilter "Pak-Ice" machine, there being an interior chamber 7 the jacket 8 of which is provided with recirculating refrigerant 9 from a refrigerating machine 11. Within the chamber 7 are rotating helical blades 13. Into the inlet 14 of the machine is introduced a stream of water to which is added an appropriate amount of a salt, usually sodium chloride, although other salts such as alum are effective. A representative amount of sodium chloride is 750 lbs. for each 1000 gals. of water in the circuit. This makes what may be termed a light brine, which, when introduced into the chamber 7, causes the deposition on the walls thereof of pure, non-saline water crystals which leave behind a somewhat more concentrated brine. The water crystals are discreet, non-cohesive particles about $\frac{3}{1000}$ of an inch in diameter and are devoid of sharp edges or points.

The crystals are scraped from the walls of the chamber 7 by the blades 13 and are discharged, together with the brine, through an outlet pipe 18. In the outlet about 20% to 25% of the material is water crystals, while the remaining amount is a somewhat concentrated brine, so that the entire mass is fluid and can readily be pumped from the Vilter machine 6 to a separating tank 21 into which the fluid mixture is discharged. The tank 21 is open at the top and is of sufficient dimensions, preferably, that the material therein is relatively quiescent. Since this is the case, the water crystals, having a lesser specific gravity than the accompanying brine, rise to the surface of the liquid within the tank 21, thereby effectuating a stratification or segregation of the two components. The brine, somewhat concentrated, is removed from the tank 21 through an outlet 22 and is returned through a pipe 23 which joins the inlet 14, so that the brine is recirculated.

The supernatant water crystals are removed from the tank 21 by a conveyor 24 or other suitable device and are deposited in an open tank 26 for tempering. The crystals moving on the conveyor 24 are substantially pure water crystals, but a small amount of salt is carried over with them in the adhering brine. The amount is entirely negligible in commercial operation and is an exceedingly small fraction of one per cent of all of the salt utilized in the process.

But the temperature of the crystals on the conveyor 24 ranges between 29 and 31 degrees Fahrenheit. Since there is practically no brine adhering to the crystals, their temperature begins to approach 32 degrees, and if fresh water at 32 degrees is added, a very close approximation of this temperature is obtained, all of which is quite satisfactory. But the tap water ordinarily available is warmer, ranging through 40 to 60 degrees Fahrenheit, and hence there is introduced into the tank 26, along with the crystals from the conveyor 24, an amount of relatively warm fresh water through a conduit 27, the water and crystals being intimately admixed by an agitator 28 driven by an electric motor 29. Some washing of the adhering brine from the crystals occurs. This intermixture is carried on in such a way as to provide a resulting slush of water and discreet artificial ice or snow particles and in such a way that the temperature of the water crystals is changed, either a small amount or a relatively large amount but, for use with lettuce, being raised until it is substantially 31.8 degrees Fahrenheit.

From the tank 26 the tempered slush is pumped through a conduit 31 to any convenient point, preferably very closely adjacent the point of use since the temperature of a mass of the water crystals cannot be expected to be maintained when part of the mass is exposed to the atmosphere for more than fifteen or twenty minutes. The conduit 31 discharges the tempered slush into a separator 32 which conveniently includes a tank having a perforated partition 33 extending thereacross, of such a nature that the tem-

pered water crystals are retained and supported thereon in a pile **34** available for use in packaging. This pile has the appearance of a pile of very fine soapsuds or of cottony material.

The water component of the slush as it has been pumped through the conduit **31** has acquired a very small salt content and drains through the partition **33** into a sump **36** from whence it is withdrawn through a conduit **37** and is discharged through a pipe **39** into the pipe **23**, therein admixing with the returning brine from the pipe **22** on the way to the inlet **14**. Since this returning liquid is made up of the somewhat concentrated brine and virtually fresh water, it may be necessary to add a little make-up salt to maintain the preferred brine concentration, and hence the salt addition mechanism **16** is operated to maintain the proportions described.

The tempered water crystals in the pile **34** can be utilized in the immediate packaging of lettuce or comparable produce. I have found it advisable in commercial practice not to have a very large pile **34** of water crystals available at any one time, but I prefer to have two structures such as the separator **32** from one of which the water crystals are utilized while the other one is being filled with slush and the carrying water is being drained therefrom. If about a ten- or fifteen-minute supply is provided in each of the two structures, and the supplies are alternately used and replenished, an entirely satisfactory result is obtained.

A package of lettuce containing water crystals, as described, is maintained at substantially 31.8 degrees temperature throughout the entire melting time of the crystals. The particles, being so small, are of virtually uniform temperature entirely therethrough, and this temperature can be established at virtually any selected level. During the entire shipping period, a number of days, the lettuce is uniformly held at a constant temperature and hence arrives at market in optimum condition. This is in great distinction to the result with crushed block ice. The blocks are usually in 300-lb. sizes and are held for protracted periods in cold storage at temperatures around 25 or 26 degrees Fahrenheit. Then, when the blocks are removed from storage and crushed, the surface of the crushed particles may fairly rapidly attain a temperature of 32 degrees, but the interior thereof remains much lower. Since 31.7 or 31.8 degrees is a safe shipping temperature for lettuce but 31.4 or 31.5 degrees will freeze the lettuce, it often results that after packing with crushed water ice the temperature of the lettuce drops far below a safe shipping temperature and freezing of the lettuce occurs. But with the water crystals the temperatures of manufacture and use are susceptible of such close control, and the temperature variation within a single crystal is so small, that satisfactory packing and shipping temperatures are readily obtained and maintained.

I claim:

1. A method of providing a refrigerant, comprising subjecting a light brine to a freezing temperature to deposit crystals having a temperature in the neighborhood of 30 degrees Fahrenheit, separating said crystals from said brine, mixing said crystals with fresh water of a higher temperature in the neighborhood of 40 to 60 degrees Fahrenheit, and separating said water from said crystals to leave said crystals as a refrigerant.

2. A method of providing a refrigerant, comprising freezing water crystals from brine in contact with chamber walls at a freezing temperature, discharging said crystals and said brine from said chamber, separating said water crystals from said brine, and increasing the temperature of said separated water crystals to a temperature just below the melting temperature of water.

3. A method of providing a refrigerant, comprising freezing water crystals from a light brine having a selected concentration, separating said water crystals from said brine, mixing said crystals and fresh water, separating said crystals from said fresh water, mixing said separated fresh water and said separated brine, adding salt to said mixture to reestablish said selected concentration, and repeating the process using said mixture.

4. A method of providing a refrigerant, comprising freezing water crystals from a light brine, separating said crystals from said brine, and changing the temperature of said separated crystals while keeping said temperature below 32 degrees Fahrenheit.

5. A refrigerant comprising water crystals which have been frozen from and carry a trace of a light brine, which are about three-thousandths of an inch in diameter, which are discreet, non-cohering particles, and which in mass feel soft and not sharp to the touch.

6. A refrigerant comprising artificially manufactured water crystals which carry a trace of salt, which are about three-thousandths of an inch in diameter and which in mass are non-cohesive and feel soft to the touch.

7. A refrigerant comprising artificially manufactured water crystals which carry a trace of salt and which are substantially non-cohesive and devoid of sharp edges or points.

8. A refrigerant comprising artificially manufactured ice particles which carry a trace of salt and which at atmospheric pressure are discreet, smooth particles approximately three-thousandths of an inch in diameter.

9. A method of providing a refrigerant comprising providing a light brine, freezing water crystals from said brine, separating said crystals from said brine, then augmenting said brine by adding fresh water to said brine, then freezing additional water crystals from said augmented brine, separating said additional crystals from said augmented brine, and adding said additional separated crystals to said separated crystals thereby forming a refrigerant.

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