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NEUTRALIZING AND INSULATING REFRIGERANT

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The present invention appertains to the art of refrigerants, of which ordinary ice is a type, and, practically speaking, provides a novel formula for making what may be termed a chemical ice for commercial purposes. A primary object of the invention is to obtain more effective distribution of heat absorbing properties than has heretofore been achieved with respect to refrigerants of the type of the invention.

A further object in view is the prolongation of the heat absorbing processes by a refrigerant through a retardation in the heat receiving action, without proportionally retarding the exhaustion of heat, so that the mixture of the invention is extremely effective in responding itself to refrigeration while even more effective in holding its low temperature and sufficiently slowly absorbing heat from the surrounding atmosphere or material as to prolong the refrigerating action of the mixture after it has itself been refrigerated.

The inadequacies of ordinary ice, and brine refrigerating mixtures, are too well known to need particular reference. One of the difficulties in the commercial use of brine refrigerants lies in the fact that brine solutions when placed in metal receptacles or circulating means attack the metal and cause deterioration and ultimate destruction thereof. An especial object of importance attached to the practice of my invention, therefore, resides not only in the properties that afford longer refrigerating power to the chemical ice, but in the elimination of those properties which largely neutralize chemical reaction of an element or elements of a refrigerant which might otherwise tend to destroy the metal of a container or the like so as to prevent deterioration or injurious action of the refrigerant upon the metal receptacle, container, or enclosure. Also ice and particularly brine of low temperature, when placed in proximity to or heat transfer relation to the substance or space to be cooled, absorbs heat at such a rate or low temperature that the cooling is carried out at a faster rate or to a lower temperature than is desired. This results in spoilage of delicate substances, as for example, foodstuffs sensitive to low temperatures or rapid changes in temperature. An object, therefore, of this invention is to make available under easily controllable conditions the large heat absorbing capacity of low temperature brines, and the like, while eliminating the danger due to too rapid or too low cooling.

In the carrying out of the invention, I avail of a refrigerant which includes salt, or a brine solution, and the composition of my refrigerant, as above premised, is such as to neutralize materially the effect of the salt or brine in solution, so that the advantageous result of preventing harmful effects upon metal containers in which the refrigerant may be received, are obtained.

With these and other objects in view as will in part be hereinafter apparent and in part be stated, the invention includes the art of heat absorption by a refrigerant retarded in its otherwise normal rate of heat reception.

The invention also includes a refrigerant comprising material well adapted to respond to treatment for exhaustion of contained heat, and means cooperating with said material for retardation of the otherwise normal rate of heat absorption by said material after the exhaustion of heat therefrom.

A further object will thus be seen to be the provision of a highly efficient refrigerant adapted to take the place of ice, and, to that end, the invention comprises materials highly responsive to heat exhaustion and relatively slowly respontive to heat absorption.

The invention still further comprises a refrigerant of materials including carbon as contained in charcoal, and still further comprises a refrigerant including salt and carbon.

While the precise effects and/or reactions of the substances used by me as generally stated are not fully known, it is found that the combining of charcoal in a salt solution for refrigerant purposes, especially when disposed in a metal container, creates certain novel results. The chemical constituents of charcoal apparently have a strong affinity for the salt in solution so that the salt is absorbed by the charcoal and its (the salt's) known effects of attacking and destroying metal are practically completely neutralized. In this aspect of the invention, where metal enclosing or containing means for my refrigerant are employed, a primary protection of the said means is secured. However, it additionally appears that when my refrigerant is disposed in a metallic container or enclosure the action of electrolysis comes into play and electrolytic deposits of carbon are received upon the metal affording mechanical insulation obviously advantageous for prolonging the period of heat exhaustion of the mixture employed. This latter constitutes a secondary protection for the purpose stated, as will be readily seen.

In greater detail, the practicing of the invention contemplates the provision of a refrigerant having unusual capacities and adapted to practice

the art of refrigeration in a more economical and effective manner than heretofore.

To the above ends, a mixture is made of the following materials in about the proportions indicated, found suitable for commercial purposes:

Water.....Eight and one-third (8⅓) lbs.
Salt.....Seven-eighths (⅞) lb.
Charcoal.....Five (5) ounces.

The foregoing are the principal substances utilized. Under some conditions I have found it desirable to use, in addition:—

Mineral or vegetable wool-like material, such as a suitable kind of asbestos or slag-wool or glass-wool or the vegetable, wool-like, mostly Indian stuffing material, known by the trade-name Kapok..... One (1) lb.
(Or similar woolly fibrous material)
Glycerine..... One (1) lb.

The resultant mixture possesses certain peculiarities not present in refrigerants heretofore commonly employed. It should be understood that reasonable variations from these proportions are available and that the salt referred to is the common sodium chloride (NaCl), but other haloid salts may be utilized as found appropriate for producing the required brine.

The charcoal is preferably fifty (50) per cent impalpable powder and fifty (50) per cent grains ranging from the size that will pass a screen of twenty mesh to the size that will pass a screen of forty mesh.

It will be noted that in the preferred manner of carrying out this invention, as above referred to, the amount of water in the compound is in excess of the saturation point which, for NaCl is 26% of salt, and that the total amount of charcoal amounts to more or less than about one-third of the weight of such salt, so that the charcoal in this compound does not merely act as a hydroionic buffer, as previously suggested, but the comparatively large bulk and volume of the highly porous absorbent charcoal in my invention acts as a powerful gas (or air) condensing and liberating agent in a manner similar to the condensation and liberation of ammonia and sulphur-dioxide ordinarily employed for refrigerating purposes and in view of this highly refrigerant activity of the carbon in my invention, I am enabled to use a very much less concentrated salt solution than ordinarily, and by this means, the otherwise known metal corroding action of the salt is practically eliminated. I am aware that the various kinds of active, absorbing carbons are composed of portions of different degrees of coarseness, but it is one of the important objects and results of my invention that by the judicious mixture of about equal portions of pulverulent, impalpable carbon and granular carbon the great advantage of the narrow slit-like pores is preserved and the danger of clogging of the pores is obviated, so as to insure a maximum degree of absorption and liberation of refrigerating and heat interchanging agents.

Preferably this mixture is solidified under heat exhaustion by reducing to a temperature of from ten to twenty degrees below zero, F., and when thus solidified, is well adapted for use as a refrigerant in substitution for ice, and brine refrigerants, as, for instance, in the ordinary domestic and commercial refrigerator or wherever ice or brine is commonly used as a refrigerant. It is also well adapted for substitution in use for dry ice (CO_2) where refrigeration to a point not as low as the temperature of dry ice minus 78° centigrade is sufficient.

While the work of the charcoal in the mixture is not completely and minutely understood, it has been proved by demonstration that the charcoal largely retards absorption of heat without proportionally retarding exhaustion of heat from the body to be cooled owing to the condensing and liberating action of the charcoal in my invention as above referred to, so that the mixture is effective in responding itself to refrigeration while even more effective in holding its low temperature and sufficiently slowly absorbing heat from surrounding atmosphere or material to prolong the refrigerating action of the mixture after it has itself been refrigerated.

It appears, therefore, that the charcoal, in addition to having its important characteristic of neutralizing the metal attacking effects of brine or salt solutions, has the supplemental effect of insulating so as to retard the dissipation of the frozen chemical solution of the invention, thereby affording much longer refrigerating life to the chemical ice produced by the use of my formula.

The fiber serves largely for distribution of the charcoal in suspension throughout the whole mass of the mixture.

It should be understood that while charcoal is specifically named, other forms of carbon or carbonaceous material, such as comminuted graphite or soot, may be substituted under appropriate circumstances.

The functions and uses stated for the respective ingredients of the mixture are not to be accepted in a limiting or restricting sense, since other capacities and functions not yet fully observed may inhere in such ingredients. The fact is, as proved by tests, that the mixture when made up of the materials stated is highly efficient, and that efficiency may or may not be dependent upon the functions stated above for the respective ingredients. The utility of the invention being made available, it is not desired that the invention be restricted to the present known functions of the respective ingredients. Obviously, the saline solution possesses a known capacity for heat exhaustion and proportional value as a refrigerant.

By comparative tests between the refrigerant of my formula and an ordinary 10% brine solution, it has been found that the refrigerating efficiency obtained with the frozen mass of the formula is 6% lower than that of said brine solution, which is a common solution commercially used at the present time. The duration efficiency of the frozen mass of my formula, however, has been found to be 80% above that of pure ice and 150% above that of brine solution.

It should be understood that for facility of commercial use the mixture is preferably placed in a container of appropriate material, whether of metal, glass, or other substance, dependent on convenience, expense and intended use, and when so contained the mixture is subjected to the requisite refrigeration to reduce it to a solid state. This may be accomplished either by mechanical refrigeration or by placing dry ice against or adjacent the container, or in such relation thereto as to enable the dry ice to absorb heat from the mixture in the container. When the mixture of the invention has been frozen as stated, the container may be transported and used exactly in the manner of the use of a block of ice of the same size except that the mixture and consequently the container will be at a

substantially lower temperature than ice made from water, and will hold its low temperature for a very substantially greater length of time. The absorption of heat by the mixture during the time it is used as a refrigerant, for example, in an ordinary domestic or other refrigerator, or elsewhere where ice is commonly employed as a refrigerant, is much slower than that of ice, and is prolonged accordingly, so that the time period for using the mixture as a refrigerant materially exceeds the time period required for refrigerating the mixture. The presence of the charcoal in the mixture appears to allow a more ready exhaustion of heat from the mixture than it allows absorption of heat by the mixture, and, at all events, the mixture affords a longer range of distribution of refrigerating property than would ordinarily be expected as proportional to the time and energy required for the requisite refrigeration of the mixture itself.

It will be understood, of course, that the mixture is designated and well adapted for continuous repeating of its cycles of operation, consisting first of itself being refrigerated, and, second, serving as a refrigerant until the heat absorbed by it destroys its capacity to act as a refrigerant, when it is taken back for re-refrigeration or repetition of the first cycle. Owing to the freedom from injury of the metal walls of the container for the mixture, the container may be repeatedly and continuously used. It is, of course, preferable to have the container provided with a small detachably closed outlet for initially filling and for addition of quantities of the mixture as required incident to evaporation or other loss, and the closed outlet may be provided with a check valve to allow the escape of gas when found desirable.

The rock wool referred to is in a state where the fibers are released, but may be the synthetic product produced from slag.

It is notable that in the practice of the use of the refrigerant hereof, the charcoal, in addition to being distributed through the mixture, has a tendency to become deposited in a film or layer upon the walls of a metal container by the action of electrolysis, or otherwise, and for this reason it is believed a certain amount of insulating effect is derived from this particular action of the charcoal alone, in addition to the other benefits of its use as previously pointed out. Also it is noted that some of the charcoal, both powdered and grainlike, has a tendency to rise in the vessel or container in which the refrigerant may be frozen, collecting in a layer a slight thickness at the top of the liquid solution. Similarly, an amount of the powdered and granular charcoal precipitates to the bottom of the container and forms at this point a slight layer of definite thickness, doubtless contributing to the insulating action of the charcoal in the practical use of the refrigerant. In no way does the foregoing action, however, interfere with the inherent neutralizing action of the charcoal relatively to the salts contained in the refrigerant incident to absorption of the salts in the manner herein set forth.

I find highly useful a container devised by me for my refrigerant, comprising a receptacle to hold the mixture and having a recess member depending from the top thereof at its central portion. In the recess may be disposed dry ice, or some similar refrigerant for facilitating original refrigeration of the contained admixture, and for quickly re-freezing same after melting. This container forms an invention separate from that herein set forth.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is—

1. A refrigerant mixture comprising a mixture of a soluble refrigerant salt with finely divided absorbent carbon in an amount approximating one third the quantity of salt to retard substantially the rate of absorption of heat and fibrous material for maintaining the carbon in a distributed state throughout the body of the mixture.

2. A refrigerant comprising a frozen mixture of a refrigerant salt with an amount of solvent in excess of the saturation point of said salt and mixed with an amount of sub-divided absorbent carbon approximating one third the quantity of salt to retard substantially the rate of absorption of heat, and fibrous wool-like material for maintaining carbon distributed throughout said compound.

3. A refrigerant compound comprising an unsaturated salt-brine, an amount of sub-divided charcoal approximating one third the quantity of salt to retard substantially the rate of absorption of heat, loose fibrous water insoluble material keeping the charcoal in suspension and glycerine incorporated with the brine.

4. A refrigerating compound suitable for freezing into solid bodies comprising a refrigerant salt solution, an amount of carbon approximating one third the quantity of salt to retard substantially the absorption of heat, consisting of a mixture of about equal portions of pulverulent, substantially impalpable absorbent carbon and of granular absorbent carbon sub-divided in said solution, and fibrous wool-like suspending material for maintaining the carbon in a distributed state incorporated with said solution.

5. A refrigerating and heat exchanging composition comprising a solution of refrigerant salts, and an amount of sub-divided, absorbently active carbon approximating one third the quantity of salt to retard substantially the rate of absorption of heat, a portion of which is adapted to become partially accumulated as a deposit of heat insulating carbon on the walls of the container for the composition during the thermic action of said composition.

6. A refrigerant mixture suitable for freezing into solid bodies comprising a saline solution, means mixed with the solution and insoluble therein for retarding the rate of cooling of a space or object in heat transfer relation with said mixture proportionally to the thermic properties of said solution, said means comprising finely divided absorbently active carbon and being in a substantial amount in proportion to the quantity of the salt to effect the function stated.

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