April 18, 1939. P. SCHLUMBOHM 2,154,473

COOLING BY SALTS HAVING A NEGATIVE HEAT OF SOLUTION

Filed Sept. 21, 1937

Fig. 1.

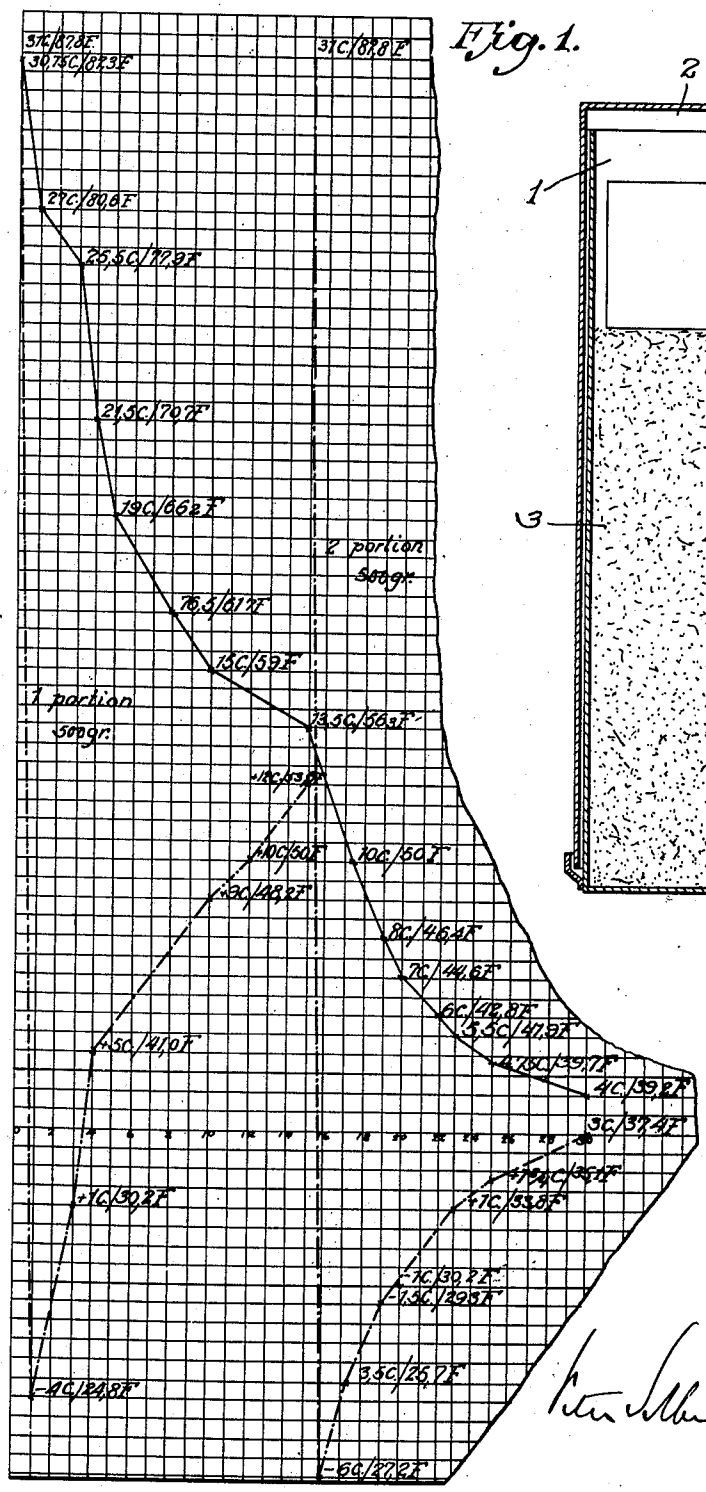
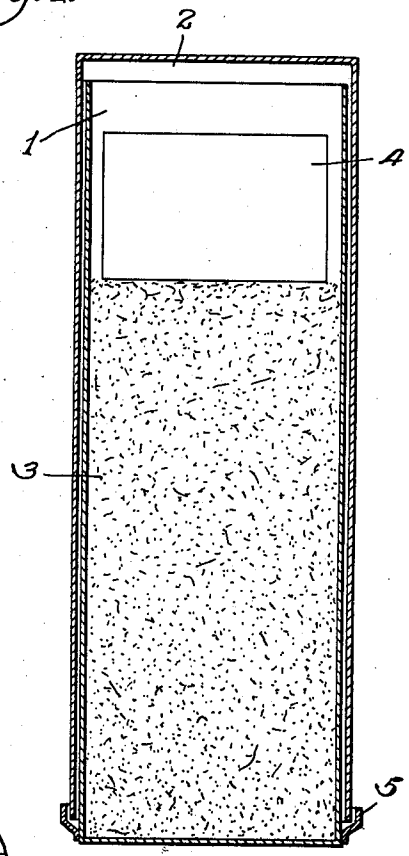


Fig. 2.



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Patented Apr. 18, 1939 2,154,473

UNITED STATES PATENT OFFICE

2,154,473

COOLING BY SALTS HAVING A NEGATIVE HEAT OF SOLUTION

Peter Schlumbohm, New York, N. Y.

Application September 21, 1937, Serial No. 164,855
In Germany September 23, 1936

1 Claim. (Cl. 62—94)

The invention relates to a new method of cooling by means of so-called "cooling salts", which are chemical salts with a negative heat of solution. Many such salts are known, the most popular salt being a nitrate of ammonia, and the use of such salts has been described in many patents, e. g. in my Patents No. 1,700,813 and No. 2,053,844. The invention further relates to a new equipment for applying the new method as disclosed in this invention.

The invention is illustrated in the accompanying drawing. Fig. 1 is an example of a temperature curve obtainable by the new method. Fig. 2 illustrates an example of the new equipment used in the practice of my invention.

In the technique of refrigeration cooling salts have kept their place due to the fact that they constitute one of the few forms of "storeable cold", in contrast to the melting away of ice or the evaporation of dry ice. These salts are generally employed when the cooling jobs are of a brief character, e. g. the cooling of a bottle within fifteen minutes or the freezing of a small quantity of ice cream within a short time. Such a cooling job is calculated as a definite job of withdrawing a definite amount of kilogram calories from a definite mass. This number of kilogram calories is absorbed by the specific heat content of the brine when warming the brine from its eutectic temperature to the end temperature of the brine, which is about 4 degrees centigrade in the case of cooling drinks and zero degrees centigrade in the case of freezing ice.

The ultimate goal of this process is seldom reached, as the water available for dissolving the salt is mostly too warm to permit the eutectic temperature of the brine to be reached and this explains why freezing of ice by this method has so far been practically a failure. The heat exchange between the object to be cooled and the cold brine is best demonstrated in cooling a bottle of champagne, described in my Patent No. 1,700,813, as a bottle of champagne is very nearly an equivalent of 1 kg. of water, thus allowing a good determination of the caloric effect. Cooling down a bottle of champagne 20 degrees centigrade would approximately indicate that the brine withdrew 20 kilogram calories from the bottle. For obtaining this cooling effect a definite amount of salt has to be dissolved in a definite amount of water and to withdraw the 20 kilogram calories from the bottle of champagne a cooling bath of a brine formed from 700 g. of nitrate of ammonia and 700 c. c. of water was applied.

Following my invention the caloric cooling effect of a definite amount of salt can be increased greatly. 700 g. of nitrate of ammonia, for instance, which have only 20 kilogram calories effect if applied by the method known so far, may have an effect of about 30 kilogram calories if used in the new manner as disclosed by this patent.

Following my invention the mass of salt is not applied in one single cooling bath but in two or more subsequent baths. For instance, instead of mixing 700 g. of nitrate of ammonia with 700 c. c. of water and applying the brine for fifteen minutes as a single cooling bath for a bottle of champagne, I apply one first bath of a brine made from 350 g. of the salt and 350 c. c. of water for 7 to 8 minutes and then I apply a second bath of a brine freshly made from the remaining 350 g. of the salt and of 350 c. c. of water for another period of 7 to 8 minutes. The trouble with the old method, I found, was that the valuable low temperature level of the brine was used, in part, in absorbing the kilogram calories at the warmer temperatures of the bottle, so that the equilibrium resulting from the two temperatures of the warm bottle and the cold fresh brine at the end of the heat exchange process was in a rather high zone. When the water as used for dissolving the salt was above 20 degrees centigrade, said zone of equilibrium would be easily above the temperatures desired for a cold drink. In my new method the first bath is a pre-cooling bath and the equilibrium resulting from the first bath-heat-exchange may be in a very high zone, e. g. 15 degrees centigrade. After the bottle has reached this temperature by the pre-cooling bath, the lowest temperature of the fresh second bath is available for a new equilibrium which will be at a much lower temperature than the equilibrium formerly obtained by the old method of applying the 700 g. of the salt in one cooling bath. This is especially efficient if the water available for dissolving the salt is rather warm. As a matter of fact, the new method opens new possibilities for the use of cooling salts in tropical countries where the available water generally has a temperature of about 30 degrees centigrade. This temperature is too high to obtain satisfactory results under the old method.

The temperature curve in Fig. 1 illustrates the temperature inside of a bottle of champagne as cooled according to my invention. The temperature of the brine is indicated by the dotted lines and the time is indicated in minutes on the horizontal coordinate line of the graphical sheet. In

order to obtain a complete picture, the first bath has been applied fifteen minutes to reach an equilibrium between 13.5 degrees centigrade temperature for the bottle and 12 degrees centigrade for the brine. The second bath was applied another 15 minutes until the equilibrium was approximately reached at 4 degrees centigrade for the bottle and 3 degrees centigrade for the brine. The starting conditions were 31 degrees centigrade for the bottle, 31 degrees centigrade for the water for preparing the first bath, 31 degrees centigrade for the water for preparing the second bath and about 30 degrees centigrade for the room temperature.

The pre-cooling bath cooled the bottle from 31 degrees centigrade down to 13.5 degrees centigrade and the second bath cooled the bottle further down to 4 degrees centigrade. For each bath 500 g. of nitrate of ammonia and 500 c. c. of water were used. If the 1 kg. of salt had been used together with 1 liter of water in one single bath, equilibrium would have resulted at around 10 degrees centigrade, cooling the bottle down an interval of about 20 degrees centigrade whereas by my new method the bottle is cooled down an interval of 27.5 degrees centigrade.

Such an increased temperature effect is the more important, as it takes place in a zone where the human tongue is very sensitive in judging temperatures. As a matter of fact, the manufacturer of a very popular bottled corbonated drink in this country so far has turned down various proposals to utilize "cooling salts" in connection with his product, especially for picnic packages, for the reason, that "cooling salts" would not cool low enough and would not create a bottle temperature of 35° F. Such a temperature can now easily be obtained by my new method.

In order to perform my new method, I have invented the new equipment as illustrated in section in Fig. 2. In illustrating the equipment I choose as an example a device for cooling a bottle. A bottle cooler 1 and a bottle cooler 2, both specifically dimensioned for the cooling process, as set forth in my Patent No. 1,700,813, vary only enough in their diameters that it is possible to telescope one into the other, preferably by using the one cooler 2 as lid for the other cooler, thus forming a container for the cooling salt 3 and for a measuring cup 4. The coolers may be of paraffined paper, and the whole package may be designed to be used once and to be tnrown away thereafter. The package may contain e. g. 1,000 g. of nitrate of ammonia and the measuring cup may be used to measure the salt for the two cooling baths. For operating the device the lid 2 is taken off, both coolers are placed on a table, 500 g. of the salt are put into the cooler 2 and 500 g. remain in the cooler 1. By means of the measuring cup 500 c. c. of water are poured into cooler 1 on the salt therein and the bottle is placed into this first bath, the pre-cooling bath, formed by the brine of 500 g. salt plus 500 c. c. water. When the cooling period of say 7–8 minutes is nearing its end, 500 c. c. water are poured on the second 500 g. salt in cooler 2 and the pre-cooled bottle is transferred from cooler 1 into the fresh brine in cooler 2 for the final cooling bath for another period of say 7–8 minutes.

Having created in this new equipment two nearly identical coolers without using more space than practically required for one cooler, I believe that it will be easy for the layman to follow the directions for use, as the second bath may be prepared in the second cooler available while the bottle is pre-cooled in the first cooler. If only one cooler would be available the equipment would not be as foolproof.

A rubber banderole 5 may serve to keep the telescoped two coolers together and to form an airtight and watertight seal to protect the cooling salt stored in the container formed by the two coolers. The two coolers 1 and 2 may also be made from other material than paper, for instance from aluminum, which is not attacked by nitrate of ammonia. Such a set of aluminum containers would be practical in connection with refill amounts of the salt and could serve the purpose of taking to a picnic just the salt stored within the container 1, 2. Such a set would even be useful without cooling salts if ice were available, as the ice could be transported safely within the watertight container 1, 2. Completely filled with ice, the mass of ice would fill one half of each cooler when the set is taken apart, thus leaving space within each cooler for inserting a bottle into each cooler. If such new equipment is of broader usefulness than just for the specific purpose for which it was designed, people are more inclined to buy such new equipment.

Although the dimensions of the coolers may vary in accordance to the various cooling jobs for which they may be designed specifically, I have found the following dimensions especially suitable for an "allround job": a diameter (inside) of 97 mm. and a depth of 275 mm. for the inner cooler 1, which leads to an inside diameter of about 103 mm. for the outer cooler 2.

Having now described my invention and, by way of example, the manner in which it may be performed,

What I claim is:

The method of cooling an object with a predetermined mass of a substance, which normally reacts with a given solvent to form a solution having a temperature below that of either said substance or solvent, said method comprising the steps of bringing said object into intimate heat exchange relation with a concentrated solution freshly prepared from a quantity of said solvent and a portion of said mass of substance, transferring heat from said object to said solution until they reach substantially the same heat level and then further reducing the temperature of the object from said heat level by subjecting it to the refrigerating effect of a second concentrated solution freshly prepared from a second quantity of said solvent and the remainder of said substance.

PETER SCHLUMBOHM.