A portable self-cooling device for beverages having a beverage chamber and a cooling chamber. A refrigerant under pressure is contained in the cooling chamber. When the pressure is released, cooling of the beverage occurs as the refrigerant evaporates and/or expands.

BACKGROUND OF THE INVENTION

The present invention relates generally to a portable self-cooling beverage cooling device for pop, beer and the like and, more particularly, the invention relates to a portable self-cooling beverage device containing a refrigerant substance under pressure and the beverage is cooled when the pressure is released.

There is a need today for a portable self-cooling beverage device which does not require refrigeration or ice for cooling a beverage or drink. Such a device would be particularly suitable for use by people in warm environments and underdeveloped areas of the world where electricity and modern conveniences are not readily at all, available, and by campers, fishermen, hunters, persons at the beach or on picnics, etc., who also do not have immediate access to conventional refrigerating means.

The subject invention utilizes the physical principle that a gas originally under pressure cools when the pressure is released and the gas is permitted to expand; and further utilizes a related physical principle that cooling occurs when a substance evaporates from one state into a gaseous state.

Previous to the subject invention, portable self-cooling beverage devices were devised which applied the foregoing physical principles. For example, prior devices comprised an outer chamber containing a beverage and an inner chamber containing a refrigerant substance either liquid or gas under pressure. In other devices, the outer chamber contained the refrigerant substance and the inner chamber contained the beverage. Although the operation of these prior portable self-cooling devices afforded some cooling when the pressure was released and the refrigerant was able to expand, the temperature drop was generally insufficient to adequately cool the beverage. If greater quantities of the refrigerant were used, there is no doubt that the desired cooling could have been achieved. However, the corresponding increase in cost made such an approach to overcome the problem commercially impractical.

One of the reasons attributed to the defect in these previous devices was that upon initiating the cooling operation, a substantial amount of the compressed gases expanded after flowing from inside the cooling chamber to the outside. The subject invention, on the other hand, provides means for controlling the gas flow and thereby insures that the primary expansion of the refrigerant gases occurs only inside the cooling chamber. In this manner, the drop in temperature derived from expansion of gases is fully utilized before the gases reach the exit opening at the top of the container.

Furthermore, a substantial amount of cooling was dissipated and lost inside the cooling chamber prior to being transferred to the beverage chamber. The subject invention increases efficiency and substantially improves cooling by providing an elongated portion of the cooling chamber for the expansion of refrigerant gases, so that any drop in temperature is immediately transmitted to the beverage as the gas flows from the lower end of the elongated portion to an exit opening at its upper end.

SUMMARY OF THE INVENTION

The present invention provides a portable self-cooling device for cooling beverages which includes a cooling chamber completely separated from a beverage chamber. The cooling chamber comprises a lower portion and an elongated upper portion that extends from the lower portion to the top of the container. A liquid, liquid gas or gas refrigerant substance may be contained in the lower portion of the cooling chamber under pressure. If the refrigerant is primarily a liquid or liquid-gas and the pressure is released, the refrigerant evaporates and gas which forms expands. The evaporation of the refrigerant and the expansion of the gases inside the cooling chamber cause the beverage to cool.

The subject invention provides an aperture for communicating the lower portion and upper portion of the cooling chamber. The upper end of the upper portion includes an exit opening which is sealed until the cooling operation is commenced.

Means are provided to cause evaporation of a liquid refrigerant at the aperture. A temperature drop immediately occurs when the evaporating refrigerant expands from the aperture into the substantially larger area of space inside the elongated upper portion of the cooling chamber. Since the liquid refrigerant evaporating into a vapor or gas at the aperture has a substantial distance to flow before being discharged from the exit opening, the full temperature drop from the gas expansion takes place inside the cooling chamber. Moreover, by restricting the size of the aperture, the amount of gas expanding per unit time is controlled to prevent an undesirable build-up of gas pressure from impeding maximum gas expansion and maximum temperature drop.

Radiator means are associated with the outer wall surface of the cooling chamber and extend into the beverage. The radiator means instantly transfer a drop in temperature to the beverage.

Accordingly, a primary object of the subject invention is to provide a portable beverage self-cooling device which efficiently cools a beverage to a desired temperature.

Another object is to provide a beverage cooling device which includes means for restricting the flow of the refrigerant gases during the cooling operation.

Still another object is to provide a cooling chamber having a lower portion containing a liquid refrigerant and an elongated upper portion through which the refrigerant gas flows and expands after evaporating from the liquid state.

Yet another object is to provide only an aperture linking the bottom portion with the elongated upper portion of the cooling chamber. A related object is to provide means for causing evaporation at said aperture of the liquid refrigerant contained in the bottom portion.

Still another object is to provide conducting or radiating means for instantly transmitting a drop in temperature from the cooling chamber to the beverage.

These and other objects and advantages of the invention will become apparent from the illustrations in the accompanying drawings and the following specification and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring to the drawings in which the same characters of reference are employed to indicate correspond-
ing or similar parts throughout the several figures of the drawings.

FIG. 1 is a perspective view of the portable self-cooling device embodying the principles of the invention;

FIG. 2 is a cross-sectional view taken on the plane of line 2—2 in FIG. 1, viewed in the direction indicated, and showing the inner cooling chamber and the outer beverage chamber;

FIG. 3 is a perspective view of the cooling chamber removed from association with the beverage chamber;

and

FIG. 4 is a fragmentary sectional view showing the aperture linking the bottom portion with the upper portion offset from the longitudinal center of the cooling chamber.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIGS. 1 and 2 of the drawings, the reference numeral 10 indicates generally a portable self-cooling beverage device having a substantially cylindrical outer configuration. The device 10 includes an outer cylindrical frame wall 11 with a top wall 12 and a bottom wall 12' integrally formed to its opposite ends.

The cooling device 10 comprises an outer beverage chamber 13 containing a beverage to be cooled and an inner cooling chamber 14 containing a refrigerant substance 15 (FIGS. 2 and 3). Cooling chamber 14 is spaced inward from the outer frame wall 11. In the illustrated embodiment, the cooling chamber 13 is actually an inner container rigidly secured within an outer container.

The beverage chamber 13 is defined between wall 11 and portions of the top and bottom walls 12, 12' and the outer wall surface of cooling chamber 14.

The inside of cooling chamber 14 is completely separated from the beverage chamber 13. Any attachment between the cooling chamber and the outer frame of the device 10 is a rigid air tight connection.

The cooling chamber 14 (FIGS. 2 and 3) includes a substantially cylindrical lower portion 16 and an elongated cylindrical upper portion 18 centrally spaced inward from the outer wall of lower portion 16.

The lower portion 16 comprises a cylindrical housing 20. A cap 22 is rigidly attached to the upper end of housing 20. The uppermost end of cap 22 terminates into a neck portion 24 (FIG. 2).

A lip member 26 is rigidly connected to the neck portion 24 and to the lower end 28 of the upper chamber portion 18. As shown, lip member 26 overlaps the outside surface of neck portion 24. The upper end 29 of upper portion 18 is rigidly attached to top wall 12.

In the described embodiment, the refrigerant 15 is in a liquid or liquid-gas state and contained in the lower portion 16 of the cooling chamber. The upper portion 18 functions as an expansion area for the refrigerant gases. The cooling chamber 14 is constructed from a metal having superior heat conducting properties such as aluminum.

A partition wall 30 is rigidly connected to the inside surface at the lower end 28 of the upper chamber portion 18. An aperture 32 extends through partition wall 30.

A conduit means 34 provides a pathway for the liquid refrigerant 15 to aperture 32 where evaporation takes place. Conduit means 34 comprises a hollow rod portion 36 extending downward into the liquid refrigerant 15 from aperture 32 and held in place by a cup portion 38. The outer or lowermost end 40 of rod portion 36 is adjacent the inside bottom surface 42 of housing 20. The upper end of conduit means 34 is securedly attached to a ring segment 44 by a press-fit connection or other suitable connecting means. Segment 44 is integrally formed to lip 26 and partition wall 30.

Radiator means indicated generally by reference numeral 45 (FIGS. 2 and 3), are formed to and protrude outward from the outer surface of the elongated portion 18. As shown, the radiator means 45 extend into the beverage chamber 13.

Radiator means 45 comprise a plurality of substantially circular fins 46 which form a continuous substantially helical or spiral configuration from the upper end 29 to the lower end 30 of the elongated portion 18. The fins 46 are thinly constructed of a metallic material having superior heat conduction properties such as aluminum. Alternatively, the individual fins 46 may lie on a plane angularly displaced from a perpendicular to the longitudinal center of the cooling chamber 14 (not shown). With the helical or angular arrangements for the fins 46, convection currents freely flow after the heat is absorbed from the beverage.

Circular grooves 47 are formed in the inside surface of the elongated portion 18. Grooves 47 catch the frozen refrigerant or moisture and thereby retain the coolness for a period of time after the refrigerator has been disassembled. Although grooves 47 are shown angled with respect to the longitudinal center of beverage chamber 13 and substantially parallel with each other, various other configurations are suitable.

An air exit opening 48 is formed in top wall 12 for providing a gas outlet during the cooling operation. A removable tab 49 is securely positioned over opening 48 in an air tight sealing attachment with top wall 12. Removal of the tab commences the cooling process.

A beverage opening 50 is also formed in top wall 12 which communicates the outside with the beverage chamber 13. A closure 52 is also removably secured over opening 50.

For optimum operation for the illustrated invention, the refrigerant substance 15 at atmospheric pressure and ambient temperature is a gas and a liquid or liquid-gas mixture for pressures exceeding atmospheric pressure. A suitable refrigerant substance having these properties is Freon.

The refrigerant substance 15 is contained in the lower portion 16 of the cooling chamber 14 under a pressure greater than atmospheric pressure to maintain the refrigerant 15 in a substantially liquid state. When the tab 49 is removed, the cooling process is commenced and the gas in the upper chamber portion 18 begins to flow out of exit opening 48. The release of pressure inside the upper portion 18 permits evaporation to take place at the aperture 32. The gas now created by the evaporation expands into the upper portion 18. This causes an immediate and sharp drop in temperature due to an absorption of heat equal to the heat of vaporization of the refrigerant substance. The heat transfer is transmitted by the walls of the upper portion 18 and the radiator means 45. During the gas flow from aperture 32 to exit opening 48, the gaseous refrigerant freely expands to provide an additional cooling effect to that derived from the evaporation.

When the gas is evaporating at aperture 32, secondary evaporation of the refrigerant is also occurring inside that part of lower portion 16 defined by the upper end of the housing 20 and cap 22. The secondary evaporation provides some cooling but primarily functions to create a bearing pressure acting on the liquid refrigerant to force it into rod 36 and up to the aperture 32.

Turning now particularly in FIG. 4, it will be seen that aperture 32 is offset from the longitudinal center of cooling chamber 14. The offset aperture causes the refrigerant vapors and gases to be ejected adjacent a side-wall surface of the upper chamber portion 18. The rod portion 36 is angled with respect to the longitudinal center and thereby provides an upward force pushing the refrigerant toward the side-wall surface. The offset opening and angle rod assure immediate heat transfer from the evaporating refrigerant to the cooling chamber walls and radiator means 45. Also, with such an arrangement, ice tends to form around the surface adjacent the
aperture which provides continued cooling after the refrigerant supply has been dissipated.

The aperture 32 is set smaller than the area size of exit opening 48 to permit only a gas flow through the upper chamber portion 18 which is able to expand freely. In this manner, undesirable pressure build-ups are avoided. Therefore, the cooling from gas expansion is fully utilized inside cooling chamber 14.

During the entire cooling process, primary evaporation occurs continually at aperture 32 and hence the gas flow is limited between aperture 32 and exit opening 48. Thus, the losses due to inefficient heat transfer are minimized by causing the primary gas expansion to occur only in the narrow pathway defined by the elongated upper portion 18.

Although the description and drawings refer to a liquid or liquid-gas refrigerant under pressure which becomes a gas when the pressure is released, the subject invention is also suitable for a refrigerant being a gas under pressure. For a gas refrigerant, the expansion rate would also be controlled by aperture 32 after the exit opening 48 is opened to the outside.

The description of the preferred embodiment of this invention is intended merely as illustrative of this invention, the scope and limits of which are set forth in the following claims.

I claim:

1. In a beverage cooling device including a beverage chamber for containing a beverage and a cooling chamber, said cooling chamber comprising:
   an upper portion;
   a lower portion for containing a refrigerant;
   a partition wall separating the lower portion from the upper portion;
   an aperture formed in the partition wall for communicating the upper portion with the lower portion; and
   a hollow rod extending down from the aperture toward the bottom of said lower portion, the pathway for the refrigerant being through the rod and aperture when flowing from the lower portion of the upper portion.

2. The cooling device of claim 1 wherein said aperture is located at a point displaced from the longitudinal center of the upper portion of the cooling chamber to cause the refrigerant to flow toward a wall surface of the upper portion.

3. In a beverage cooling device including a beverage chamber for containing a beverage and a cooling chamber, said cooling chamber comprising:
   an upper portion;
   a lower portion for containing a refrigerant;
   a partition wall separating the lower portion from the upper portion;
   an aperture formed in said partition wall; and
   a hollow rod extending downward from the aperture toward the bottom of said lower portion, the pathway for the refrigerant being through the rod and aperture when flowing from the lower portion of the upper portion; and
   a plurality of spaced apart substantially circular members protrude outward from the outer surface of the upper portion into the beverage chamber, each of said circular members being inclined with respect to a plane substantially perpendicular to the longitudinal center of the upper portion.

4. In a self-cooling device including a food chamber for containing contents for cooling and a cooling chamber, said cooling chamber comprising:
   a lower portion for containing a refrigerant;
   an upper portion having a top wall with an exit opening formed therein, said opening communicating the upper portion with the outside;
   a closure means for closing said opening;
   a partition wall separating the lower portion from the upper portion;
   an aperture formed in said partition wall, said lower portion containing said refrigerant, said refrigerant expanding in said upper portion during the cooling of said beverage after said closure means is removed from said opening, the size of said aperture being less than the size of said exit opening; and
   a hollow rod extending downward from said aperture and into said refrigerant, the pathway for the refrigerant being through the rod and aperture when the refrigerant flows from the lower portion to the upper portion, said pathway being angled with respect to the longitudinal center of the upper portion.

5. The beverage cooling device of claim 4 wherein grooves are formed in the inside of the upper portion to retain frozen refrigerant and moisture.

6. In a self-cooling device including a food chamber for containing contents for cooling and a cooling chamber, said cooling chamber comprising:
   an upper portion;
   a lower portion for storing a refrigerant under pressure;
   a partition wall separating the lower portion from the upper portion;
   an aperture formed in said partition wall for communicating the upper and lower portions; and
   a flow control means for conveying said refrigerant to said aperture at substantially said stored pressure during the cooling of said contents, so that the primary expansion of the refrigerant occurs in the upper portion of the cooling chamber.

7. The cooling chamber of claim 6 wherein said refrigerant is a liquid refrigerant and said flow control means enables said refrigerant during the cooling of said contents to evaporate from a substantially liquid state into a gaseous state adjacent said aperture.

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