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(54) Insertable thermotic module for self-heating can

(57) A self-heating container (1) having a container body (2) with an internal beverage section and thermic cavity (10). A liquid reactant is positioned in a first section of the thermic cavity (10) and a solid reactant is positioned in a second section of the thermic cavity (10). The solid reactant may be an amount of CaO ranging from about 80 to 99 percent by weight combined with a wax based inhibitor ranging from about 1 to 20 percent by weight. The wax based inhibitor has a melting point ranging from above 100°C to about 120°C.

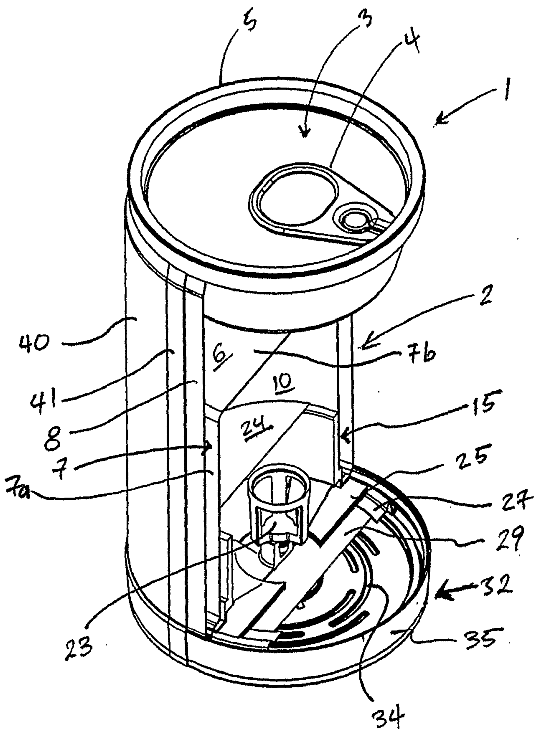

FIGURE 1

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Description

[0001] The application claims the benefit of U.S. Provisional Application Serial No. 60/704,471 filed on August 1, 2005, which is incorporated by reference herein in its entirety.

Field of Invention

[0002] The present invention relates to self-heating (or self-cooling) cans or other containers holding beverages, food, medicine, epoxy resins and other materials that it is desired to heat (or cool) before consuming or using. In particular, the present invention relates to an improved thermic module for such self-heating (cooling) containers.

Background of Invention

[0003] Containers may have integral or separate insertable modules for warming materials in the container, such as Japanese sake, coffee, or soup. Examples of such self-heating containers with integral thermic modules are disclosed in U.S. Pat. Nos. 5,461,867 and 5,626,022, issued to Scudder et al and an example of a separately insertable module is disclosed in U.S. Patent No. 6,134,894 to Searle, et al. Such containers typically include an outer can or body, in which the food or beverage is sealed and an elongated cavity or chamber which extends into the container body from the bottom end. The cavity is sized to accommodate the thermic module. The thermic module normally contains two chemical reactants which are stable when separated from one another, but when mixed in response to actuation of the thermic module by a user, produce an exothermic reaction (or, alternatively, an endothermic reaction) and thereby heat (or cool) the contents of the container. This elongated cavity functions as both a chamber in which to contain the reaction and a heat-exchanger for transferring heat between it and the surrounding contents of the container body.

[0004] The thermic module usually has two chambers, each of which contains one of the chemical reactants, separated by a breakable barrier such as metal foil. Typically, one of the reactants is a liquid, and the other is in a powdered or granular solid form. Calcium oxide (quicklime or CaO) and water are examples of two reactants known to produce an exothermic reaction to heat the container contents. Other combinations of reactants (e.g. ammonium nitrate and water) produce endothermic reactions to cool the container contents. The bottom of the thermic module cavity is normally closed off by an end-cap. The outside of the end-cap will serve as an actuator button that a user may depress to initiate the heating or cooling. The end-cap typically has a pushrod or similar prong-like member that extends from the actuator button nearly to the breakable barrier. Depressing the actuator button forces the prong into the barrier, puncturing it and thereby allowing the reactants to mix.

[0005] The heat produced by the resulting exothermic reaction (or, alternatively, used by a resulting endothermic reaction) is transferred from the reaction chamber of the thermic module to the contents of the container body by conduction. The end of the container body opposite the cavity has a seal or closure, such as conventional beverage container pull-tab or pop-top, which may be opened and through which the user may consume the heated or cooled contents.

Brief Description of Drawings

[0006]

Figure 1 is a cut-away view of one embodiment of the self-heating container of the present invention.

Figure 2 is an exploded view of the container seen in Figure 1.

Figure 3 is a cross-sectional view of the lower portion of the container seen in Figure 1.

Figure 4 is a perspective view of the liquid reactant cup of one embodiment of the present invention.

Figure 5 is a perspective view of the end ring of one embodiment of the present invention.

Figures 6A and 6B are cross-section views illustrating a nipple attachment of one embodiment of the present invention.

Figure 7 illustrates a lip protector device employed in one embodiment of the present invention.

Figure 8 illustrates sections of thermographic ink which could be utilized in an embodiment of the present invention.

Figure 9 illustrates one embodiment of a thermographic ink indicator.

Figure 10A and 10B are charts illustrating temperature change in the contents of the beverage space in the self-heating container.

Detailed Description of Invention.

[0007] Figure 1 illustrates one embodiment of a self-heating container 1 of the present invention. Container 1 will generally comprise a container body 2 being formed by body sidewalls 8, lid 3, and inner walls 7. Lid 3 will normally include a conventional pop top opening or pull tab 4 such as found on typical soda cans. It can also be seen how inner wall 7 has upwardly extending inner walls 7a and inner top wall 7b. As better seen in Figure 6A, the space between body side walls 8, inner sidewalls 7, and lid 3 will form an enclosed volume 6 for receiving a food or beverage substance. An internal cavity 10 will be formed by sidewalls 7 extending up into enclosed volume 6. While not explicitly shown, the inner walls 7a could be fluted to provide more surface area to facilitate heat transfer from internal cavity 10 to the contents enclosed within volume 6.

[0008] In the embodiment shown, the area of internal cavity 10 above cup 15 will house a solid reactant and a cup 15 will serve as a liquid reactant cup. A breakable barrier 24 will separate the interior space of liquid reactant cup 15 from the area of internal cavity 10 above cup 15. In the embodiment shown, breakable barrier 24 will be formed of a metal (such as aluminum) foil material approximately 10μm to 60μm thick and more preferably 20μm to 40μm thick. It will be understood that a punch member 23 may be moved upward by a user (as explained in more detail below) in order to puncture breakable barrier 24 and allow the solid and liquid reactants to mix.

[0009] Figure 1 also shows a cover or label of shrink wrap material formed on body 2. In the embodiment shown, the cover will be formed of two layers of material. The inner layer will comprise a polyethylene foam sheet 41 approximately 0.5 mm in thickness such as is available from TOSIN PACKAGING of Selangor, Malaysia. The outer layer will be a polyvinyl-chloride (PVC) shrink film 40 which is approximately 50μ in thickness and has a shrinkage of approximately 58%. Such film is available from manufacturers such as KOMAK General Labels of Balakong, Malaysia. In a preferred embodiment, foam sheet 41 will laminated to the PVC film prior to the film being applied to a container. Generally, the PVC film 40 is reverse side printed with a solvent based ink. This allows for high quality 5-8 color printing with full color separation that cannot be achieved on heat shrink foam material used on PET or glass bottles. The non shrinking foam sheeting is then laminated to the PVC film using a water soluble adhesive which will not adversely affect the ink on the PVC film. If multiple labels are formed on a single sheet of the foam insulation / PVC film label, then the individual labels are cut from the sheet and rolled into a tube shape. A thin (e.g. 0.5 cm) strip of clear PVC shrink film having a solvent based adhesive applied thereto may be used to glue together the overlapping edges of the tube.

[0010] The bottom portion of container 1 will accommodate the means for puncturing breakable barrier 24 and allowing the solid and liquid reactants to mix. These elements located in the bottom portion of this embodiment of container 1 generally form the "thermic module" when charged with reactants and are seen individually in the exploded view of Figure 2. These elements include liquid reactant cup 15, absorbent material ring 25, end ring 27 and end cap 32. Absorbent material ring 25 may be formed of a paper towel type material and in the embodiment shown, will be about 1mm to about 4 mm thick and will have a center opening 26. As better seen in Figure 5, end ring 27 will have a crimping edge 28 for attachment to container body 2 and the center opening of end ring 27 will be covered with a breakable barrier 29. Typically end ring 27 will be of the same material as container body 2 (e.g. aluminum) to allow crimping edge 28 to crimp onto the bottom of body 2. Similar to the breakable barrier 24, breakable barrier 29 may be formed of a metal foil and will be approximately 10μm to 100μm but in a preferred embodiment is 40μm to 60μm thick to better withstand the retort process. Breakable barrier 29 will be attached to the inner rim 31 by an adhesive, spot welding, ultra sonic welding, seaming, or any other suitable means which allows for a hermetic seal that can withstand the pressures and temperatures of a conventional retort process, which will vary depending on the product to be retorted but are generally between 10 and 20psi, 120 and 145°C for 20 to 45 minutes, yet which may be easy broken by the cutting projections 36 which are explained in greater detail below.

[0011] Viewing Figures 1 and 2, end cap 32 will be formed of a polymer material which in one embodiment is polypropylene. End cap 32 will have a raised side rim 35 and a grated center portion 33. Center portion 33 is grated in the sense that the material has been removed from certain sections 34 of center portion 33 in order to allow center portion 33 to more easily flex inward when force is applied to it. In the embodiments shown, the sections 34 of removed material are in the form of incomplete concentric rings. In other words, small segments of material are left in place along the otherwise complete ring of removed material.

[0012] The external features of liquid reactant cup 15 are best seen in Figure 4. Liquid reactant cup 15 will include side wall 22, outer shoulder 16, perimeter flange 18, and flexible bottom 21. In the embodiment shown, flexible bottom 21 will have a series of indentions 30 extending radially from the center of flexible bottom 21 toward perimeter flange 18. Indentions 30 will allow bottom 21 to more easily flex inward without mechanical failure of the material. Liquid reactant cup 15 will also include a series of vent passages 17 which pass through outer shoulder 16 (as best seen in Figure 3). Additionally, a series of vent slots 19 will be formed in perimeter flange 18. Figure 4 also illustrates how punch member 23 is formed of a base section 50, a series of vertical posts 51, and a ring cutter 52 attached to vertical posts 51.

[0013] The assembly of the various components in the lower portion of body 2 is best seen in Figure 3. Liquid reactant cup 15 will be inserted into cavity 10 with perimeter flange 18 resting against the curved bottom portion of inner wall 7. Absorbent material ring 25 will be positioned below liquid reactant cup 15. Thereafter, end ring 27 is placed against absorbent material ring 25 and the crimping edge 28 will be crimped around the existing crimp 9 which joins walls 7 and 8 at the bottom of container body 2. Thereafter, end cap 32 is positioned on the end of container body 2. In the embodiment shown, end cap 32 will have a snap ring 37 and a stop rim 38 such that when snap ring 37 slides over crimp 9, crimp 9 will be held firmly in place between snap ring 37 and stop rim 38. As suggested in Figure 3, the cover or label 40/41 will be a slightly longer than the can to which the label is applied. Thus, when the label is heat shrunk onto the can, this extra length of shrink wrap PVC material will form around sidewalls 35 of end cap 32 and assist in keeping end cap 32 firmly in place.

[0014] When the components of container 1 are assembled as illustrated in Figure 3, it can be seen how vent passage 17 in outer shoulder 16 forms a path that prevents any substantial pressure differential from building between the area 12 above liquid reactant cup 15 and the area 13 below liquid reactant cup 15. Any gas pressure building in area 12 may quickly pass to area 13. It will also be understood that breakable barrier 29 on end ring 27 forms a substantially air tight seal (hermetical seal) across the bottom of cavity 10. This air tight seal will prevent external moisture from entering cavity 10 prior to activation of the thermic module and reducing the reactivity of the solid reactant. This seal is especially important if the container is ultimately subject to a retort process.

[0015] In a preferred embodiment, the side of breakable barrier 29 which faces end cap 32 will be have a distinct coloration (for example red) which will allows breakable barrier 29 to be easily visible through the sections 34 of removed material in center portion 33. This will allow easy visual inspection of breakable barrier 29 through sections 34 to ensure breakable barrier 29 is still intact prior the initiation of the heating reaction. If breakable barrier 29 is not intact, the user is alerted to the possibility that the self-heating container has been damaged or may not be in working order.

[0016] Viewing Figure 3, the initiation of the heating reaction can be readily understood. A user will press the center portion 33 of end cap 32 inward (i.e., toward cavity 10). Because of the material removed from the incomplete concentric rings, center portion 33 easily flexes inward. Cutting projections 36 on end cap 32 will press against and penetrate breakable barrier 29 on end ring 27. Further pressing of end cap 32 will bring it into contact with flexible bottom 21 of liquid reactant cup 15. Flexible bottom 21 will then flex forward driving punch 23 through breakable barrier 24. It will be understood that ring cutter 52 will push aside the broken area of barrier 24 and liquid reactant in cup 15 will be able to flow into the solid reactant in cavity 10. The vertical posts 51 connecting to ring cutter 52 will keep the broken edges of barrier 24 separated and allow liquid reactant to flow freely through the "window" spaces 53 formed between vertical posts 51.

[0017] It will be understood that when the heating module is in its assembled state, cutting projections 36 are positioned very close to (almost contacting or barely contacting) breakable barrier 29. In addition to breaking through barrier 29 upon activation by a user, this allows cutting projections 36 to act as a safety mechanism should breakable barrier 24 fail and allow the liquid and solid reactants to mix. If a user has not activated the thermic module, barrier 29 will be intact and will contain the pressure buildup within the module due to the mixing reactants. If barrier 29 is not broken while the initial pressure in the module is low, the pressure may increase sufficiently to cause a dangerous explosion of the container. However, because barrier 29 is positioned quite close to cutting projections 36, even low pressure from the initial stages of the reaction will press barrier 29 against cutting projections 36 and cause them to tear barrier 29. Thus, pressure is never allowed to reach dangerous levels within the thermic module.

[0018] In one embodiment of the present invention, the liquid reactant will be water and the solid reactant will be a "quick lime" or CaO based mixture. The solid reactant may be a mixture of CaO and a granular or powdered wax which will act as a reaction inhibitor to slow the reaction rate. In a more preferred embodiment, the wax will be a palm oil based wax with melting point above 100 °C. One illustrative example is a wax designated SW-10 and supplied by Suka Chemicals, Sdn Bhd of Selangor, Malaysia. More preferably, the wax will have a melting point of ranging from above 100 °C to about 120 °C, and still more preferably, ranging from about 105 °C to about 115 °C. Also in a preferred embodiment, the wax will be in the form of granules having a size of approximately 0.5mm. In one preferred embodiment, the solid reactant will comprise CaO content ranging from about 80 to 99 percent by weight and a wax content ranging from about 1 to 20 percent by weight, and more preferably a CaO content ranging from about 95 to 98 percent by weight and a wax content ranging from about 2 to 5 percent by weight. Alternatively, the solid reactant could comprise a CaO content ranging from about 90 to 96 percent by weight and a wax content ranging from about 4 to 10 percent by weight. In certain embodiments, for example where the liquid reactant is water, the ratio of water volume to solid reactant weight could be about 0.25 to about 0.5 with one preferred embodiment being about 0.35.

[0019] As one example, in a container where 210 ml of beverage is being heated, the solid reactant could consist of 80 grams of CaO and 3 grams of the above described wax. Naturally, the above percentages of CaO are only approximate and factors such as impurities in the CaO or different types of waxes may result in mixtures outside of the above stated ranges or wherein the combined weight percentages of CaO and wax are less than 100%. In one preferred embodiment, a very low moisture content CaO will be employed with the CaO having been vacuum packed soon after exiting the kiln.

[0020] One experiment found that the above reactant combination of 80 grams of CaO and 3 grams of wax when combined with 27 ml of water in the above described thermic module will cause an increase in the temperature (delta T) of 210 ml of a water based beverage (located in beverage space 6) to at least above 50 °C and more commonly to about 55 °C. Figures 10A and 10B illustrate graphs of other similar experiments. Figure 10A shows results when 80 gm of CaO and 5 gm wax as described above (designated "stabilizer" in Figure 10A) were combined with various amounts of water. As suggested, approximately 32 ml or more of water reactant caused the water in the beverage space to increase over 50 °C in temperature. Figure 10B illustrates that when 82.5 gm of CaO, 7.5 gm wax, and 32.5 ml of water reactant are used, a change in temperature of the water in the beverage space of over 50 °C is typically achieved. Advantageously, it can be seen that the higher the starting temperature of the beverage, the lesser the temperature increase of the beverage. The above experiments have also demonstrated that the CaO/wax solid reactant produces virtually no steam. No visibly detectable steam was observed in the described experiments. A dry paper towel that was placed under the bottom end of the container while the reaction occurred remained perfectly dry to sight and touch after the reaction was complete.

[0021] In a preferred embodiment, some printing may be written on the inner surface of shrink wrap film 40 with thermographic ink or may be applied to certain areas of the can such as the can lid. Thermographic ink changes colors upon reaching a predetermined temperature. In this manner, certain areas of the can could change color when the contents of the can have reached a temperature which is considered to be sufficiently hot. As an example, Figure 8 shows two sections of thermographic ink 160A and 160B. The thermographic ink could be formulated such that both sections 160A and 160B are the same color (e.g. black with some marking or color printed below sections 160A and 160B in a different color thermographic ink which reacts at a different temperature than the covering ink) when the can is below a suitable temperature for drinking. As the can approaches the correct temperature range for drinking, in section 160B the black ink will become transparent thus disappearing allowing the second color below to appear (e.g. green) indicating the can contents are at the proper temperature for consumption. If the contents of the can became too hot, section 160B the green ink will become transparent thus disappearing (i.e., no colors in 160a) and at the same time in section 160A the black ink will become transparent thus disappearing and allowing the second color below to appear (e.g. red), thereby cautioning the consumer about the overly hot beverage. The thermographic ink will be "reversible" in the sense that as the temperature exceeds a threshold, the ink will change from a first color to a second color, but if the temperature again drops below the threshold, the ink will return to the first color. Using the above example, if the indicator became red suggesting the beverage was overly hot, the ink would later return to a green indicator when the beverage returned to correct temperature range for safely drinking.

[0022] Naturally, the thermographic ink could take on any design and could be formulated to change color over any given range of temperatures. For example, with infant baby formula the ink might change color at approximately 40° C to indicate the beverage is ready to drink as opposed to the approximately 65° C for an adult beverage. More preferably, when dealing with drinks for infants, the first color indication could take place at approximately 37° C to indicate a suitable drinking temperature and a second color indication could take place at approximately 43° C to indicate the drink was too hot for infants to drink. For adults, the first color indication could take place at approximately 60° C to indicate a suitable drinking temperature and a second color indication could take place at approximately 80° C to indicate the drink was too hot to drink. Naturally, variations of these temperature ranges are within the scope of the present invention. Additionally, the present invention encompasses the first and second indicators not only being true "colors" such as red and green, but also the indicators being different shades of a single color including different shades of gray and even the ink changing from opaque to transparent or some particular color. The term "color" as used herein is intended to encompass all these alternatives. For example, in the embodiment suggested in Figure 9, the first thermographic ink indicator 180a will be opaque below a certain temperature (e.g. 80 °C). Upon reaching that temperature, the thermographic ink will become transparent and reveal or unmask a "too hot to drink" warning symbol 180b positioned under the ink. Likewise, the second indicator 181a would have a "ready to drink" symbol 181b positioned under thermographic ink which became transparent at a suitably hot drinking temperature (e.g. 60 °C). If the temperature of the beverage reached 80 °C, the ink in 181b would become transparent as the indicator 180b appears. Furthermore, this concept of employing thermographic ink could be applied to food or drink containers which are not necessarily self-heating. For example, the above described thermographic ink printing could be used on disposable coffee cups or microwavable food products. Likewise, the thermographic ink could not only be used directly on the container, but also be applied to an adhesive label or "sticker" which would then be applied to the container lid. Thermographic inks for carrying out this embodiment are well known and available under the tradename "Chromazone" and manufactured by Thermographic Measurements Co. Ltd, in the United Kingdom and supplied by Eckart America located in Painesville, Ohio.

[0023] Figures 6A and 6B illustrate one embodiment of the present invention having a flexible nipple attachment 45 as described in US Patent No. 6,708,833 which is incorporated by reference herein in its entirety. Flexible nipple attachment 45 will further include nipple head 46, nipple neck 47, and nipple shoulder 48. Nipple attachment 45 may be formed of any suitable rubber-like material, such as latex, rubberized plastic, or silicone. Nipple head 45 will have a nursing aperture 49 formed therein. However, it is generally more hygienic and more aesthetically pleasing to close off nursing aperture 49 prior to use in order to prevent the contents of container 1 from escaping through nursing aperture 49.

[0024] To this end, a removable plug is formed over nursing aperture 45. In the embodiment seen in the figures, the removable plug consists of a pull tab 55 integrally formed with attachable nipple 45. Where the lower section of the pull tab 55 attaches to nursing aperture 49, a v-shaped cut is produced through nipple head 46 such that only a thin section of material holds tab 55 to nipple head 46. This produces a fault or fatigue point along which tab 55 will break off. When tab 55 is pulled, it readily tears away or twists off and leaves aperture 49 open to fluid flow induced by an infant's suckling. All the features of nipple attachment 45, including v-shaped cuts and pull tabs 55, may be integrally formed by any conventional technique such as pour molding or injection molding of silicon.

[0025] A second aperture, air aperture 53, is also formed in the shoulder portion 48 of nipple attachment 45. Air aperture 53 is closed with a removable plug 54 in the same manner as nursing aperture 49. The purpose of air aperture 53 is to allow air into container 1 to displace fluid removed through the infant's nursing and prevent a vacuum from forming in container 1. Naturally an air aperture could be positioned anywhere on the container which would allow air to replace the fluid removed.

[0026] Connecting nipple attachment 45 to container 1 may be accomplished as follows. Nipple attachment 45 will have an attachment perimeter which is sufficiently large in diameter in order to stretch across the container rim. The lid rim will then be placed over the attachment perimeter and the container rim and the lid rim will be crimped into place. It will be understood that when the rubber-like material is tightly crimped between the container rim and the lid rim, it will form an airtight seal for retaining and sealing in the contents of container 1.

[0027] When nipple attachment 45 is used in combination with container 1, a plastic rim cap or protective ring 5 (see Figure 2) may be positioned on top of the metal lid rim to ensure that overly warm metal does not come into contact with the infant suckling from contain 1.

[0028] In a preferred embodiment, container 1 will include some type of easy-opening lid 3, such as a conventional lid having a rim, a peel-back top, and a finger ring as suggested in Figure 1. As is well known in the art, the lid will be opened by first lifting the finger ring to cause a punch portion to break the seal between the peel-back top and the lid rim. Then the finger ring will be pulled backwards, pulling the peel-back top away from the rest of the lid rim.

[0029] Figure 6B shows nipple attachment 45 in an extended position, ready for use after the plug 55 is removed. However, prior to being placed in use, nipple attachment 45 will be placed in a folded or semi-inverted position within container 1 as seen in Figure 6A. The material between nipple neck 47 and nipple shoulder 48 will be semi-inverted such that nipple head 46 will be just below the container lid. In order to allow nipple attachment 45 to fold more readily, the side walls along the portion of nipple attachment 42 which semi-inverts will be somewhat thinner than the remaining sections of nipple attachment 45. For example, the inverting portion of the sidewall may be approximately 0.6 mm thick while the remaining sections of the nipple attachment 45 are approximately 2 to 3 mm thick.

[0030] It will be seen that placing nipple attachment 45 in the folded position within container 1 allows it to be sealed therein by the lid as suggested by Figure 1. This will ensure that nipple attachment 45 remains in a clean and sterile condition up until the moment it is placed in use. To place container 1 into use, it is only necessary to remove the peel-back the top of the lid, pull nipple attachment 45 into the extended position, and twist off removable plugs 55.

[0031] The present invention will further include a novel lip protector 60 as seen in Figure 7. Lip protector 60 will generally comprise a ring portion 62 substantially conforming to the rim of the container lid 3. Positioned in front of the collapsible tab 58 will be front portion 63 of lip protector 60. Positioned to the rear of collapsible tab 58 will be a middle section 61 which connects at each end to ring portion 62. It will be understood that a user can lift the rear of opening tab 64 which will pivot downward beneath middle section 61 and depress collapsible tab 58 and create an opening in lid 3. In the embodiment shown, lip protector 60 will be formed in a manner which leaves at least half of the lid 3 uncovered by lip protector 60. In an alternate embodiment, ring portion 62 will be fixed against rotation on the rim (e.g., by crimping or by an adhesive) such that lip protector 60 cannot rotate out of position at any time or at any temperature normal temperature range of container 1, either prior to activation of the themic module or at the highest temperature the container reaches after activation.

[0032] The present invention also includes a method of retorting a self-heating container. "Retorting" is a conventional process of sterilizing the contents of a canned goods and the like. Retorting typically comprises subjecting the contents of a sealed can to elevated temperatures (about 120 °C) and pressures (about 10 psi). The method begins with the step of providing a metal container 1 (see Figures 2 and 6a) having an open top end 11, a beverage space 6, and a cavity 10 for heat changing reactants formed in a bottom end of the container 1. A beverage is placed in the beverage space 6 and a lid 3 is hermetically secured onto open top end 11. Cavity 10 of container 1 is then charged with at least two reactants separated by a breakable barrier which in one embodiment is the process and structure described in the above Figures. Thereafter, the metal end ring 27 is crimped onto the bottom end of container 1 to form a substantially moisture tight seal between the interior of cavity 10 and an environment outside container 1. The crimp of end ring 27 is "substantially moisture tight" in the sense that it will prevent moisture (e.g. steam or water) from entering cavity 10 when container 1 is subject a retorting process at temperatures of at least 100 °C and pressures of at least 5 psi. More preferably, the end ring crimp prevents the entry of moisture at temperatures of at least about 120 °C and pressures of at least about 15 psi.

[0033] While the present invention has been described in terms of specific embodiments, many variations and modifications will be apparent to those skilled in the art. For example, the reactants in the above embodiments were CaO and water, but other reactants are within the scope of the present invention. Likewise, while wax is disclosed as the temperature moderating substance in the above embodiments, any substance maintaining the reaction temperature at between about 105 °C and about 120 °C is within the scope of the present invention. All such modifications and variations are intended to come within the scope of the following claims.

[0034] Preferred embodiments of the present invention may include any one or more of the following features:-

1. A self-heating container comprising: a. a metal container body having an enclosed volume for receiving a beverage and a bottom end with a cavity formed of metal internal walls extending upward into said enclosed volume; b. a solid reactant positioned within said cavity; c. a liquid reactant cup having a top and bottom end and a breakable barrier covering said top end to retain a liquid reactant therein; d. said liquid reactant cup having a an outer shoulder with a vent passage formed therethrough such that no pressure differential is created in a space above and a space below said cup.

2. The self-heating container, wherein said liquid reactant cup comprises a lower perimeter flange with vent slots formed therein.

3. The self-heating container, further comprising a metal end ring with a second breakable barrier attached thereto, said end ring being crimped onto a bottom of said metal container body to form a substantially moisture tight seal between an interior of said cavity and an environment outside said container.

4. The self-heating container, wherein a layer of absorbent material is positioned between said fluid cup and said end ring.

5. The self-heating container, further comprising an end cap having a grated center area positioned over said end ring.

6. The self-heating container, wherein said end cap has upper and lower surfaces and a cutting projection on said upper surface for penetrating said second breakable barrier.

7. The self-heating container, wherein said liquid reactant cup comprises a flexible bottom section having a series of indentations extending radially from a center of said bottom section.

8. The self-heating container, wherein said liquid reactant cup has a punch, said punch comprising a base, a plurality of vertical posts extending upward from said post to support a ring cutter.

9. The self-heating container, wherein said second breakable barrier has a surface facing said grated center area on said end cap, said surface facing said grated center area having a color coating allowing easier inspection through said grated center area.

10. The self-heating container, further including a lip protector comprising: a. a ring portion generally conforming to a rim of said container; b. a front portion located adjacent to a front of a collapsible tab on a lid of said container; c. a middle section located to a rear of said collapsible tab and connected to said ring portion; and d. wherein at least half of said lid is left uncovered by said lip protector.

11. The self-heating containe, wherein said ring lip protector is fixed against rotation on said rim at the highest temperature said container reaches after activation.

12. The self-heating container, further comprising a shrink wrap material covering an outside of said container body and a side portion of said end cap.

13. A self-heating container comprising: a. a container body having an internal beverage section and a thermic cavity; b. a liquid reactant positioned in a first section of said thermic cavity and a solid reactant positioned in a second section of said thermic cavity; c. said solid reactant comprising an amount of CaO ranging from about 80 to 99 percent by weight and a wax based inhibitor ranging from about 1 to 20 percent by weight; d. wherein said wax based inhibitor has a melting point ranging from above 100 <0>C to about 120 <0>C.

14. The self-heating container, wherein said wax based inhibitor has a melting point ranging from about 105 <0>C to about 115 <0>C.

15. A method of retorting a self-heating container comprising the steps of: a. providing a metal container having an open top end, beverage space, and a cavity for heat changing reactants formed in a bottom end of said container; b. placing a beverage in said beverage space and securing a lid on said open top end; c. charging said cavity with at least two reactants separated by a breakable barrier; d. crimping onto said bottom end of said container a metal end ring having a breakable barrier in order to form a substantially moisture tight seal between an interior of said cavity and an environment outside said container; and e. retorting said self heating container at a temperature of at least 100 <0>C and a pressure of at least 5 psi.

16. The method, wherein said end ring comprises a crimping edge and an inner rim to which a metal foil is secured with a substantially moisture tight seal.

17. The method, wherein said substantially moisture tight seal is formed by securing with an adhesive, welding, or seaming said metal foil to said inner rim.

18. The self-heating container, wherein said solid reactant, upon mixing with said liquid reactant, maintains a temperature of between about 105 <0>C and about 120 <0>C.

19. The self-heating container, wherein said solid reactant comprises about 80g to about 83g of CaO and about 5g to about 8g inhibitor and said liquid reactant is present in a volume of about 30 ml to about 35 ml.

Claims

1. A self-heating container comprising:

   a. a metal container body having an enclosed volume for receiving a beverage and a bottom end with a cavity formed of metal internal walls extending upward into said enclosed volume;
   b. a solid reactant positioned within said cavity;
   c. a liquid reactant cup having a top and bottom end and a breakable barrier covering said top end to retain a liquid reactant therein; and
   d. a metal end ring with a second breakable barrier attached thereto, said end ring being crimped onto a bottom of said metal container body to form a substantially moisture tight seal between an interior of said cavity and an environment outside said container.

2. The self-heating container according to claim 1, said liquid reactant cup further having a an outer shoulder with a vent passage formed therethrough such that no pressure differential is created in a space above and a space below said cup.

3. The self-heating container according to claim 2, wherein said liquid reactant cup comprises a lower perimeter flange with vent slots formed therein.

4. The self-heating container according to claim 1, wherein a layer of absorbent material is positioned between said fluid cup and said end ring.

5. The self-heating container according to claim 4, further comprising an end cap having a grated center area positioned over said end ring.

6. The self-heating container according to claim 1, wherein, said liquid reactant cup comprises a flexible bottom section having a cutting projection for penetrating said second breakable barrier.

7. The self-heating container according to claim 6, wherein said second breakable barrier has a surface facing said grated center area on said end cap, said surface facing said grated center area having a color coating allowing easier inspection through said grated center area.

8. The self-heating container according to claim 5, further comprising a shrink wrap material covering an outside of said container body and a side portion of said end cap.

9. The self-heating container according to claim 1, wherein said solid reactant comprises an amount of CaO ranging from about 80 to 99 percent by weight and a wax based inhibitor ranging from about 1 to 20 percent by weight, said wax based inhibitor having a melting point ranging from above 100 ºC to about 120 ºC.

10. The self-heating container of claim 9, wherein said wax based inhibitor has a melting point ranging from about 105 ºC to about 115 ºC.

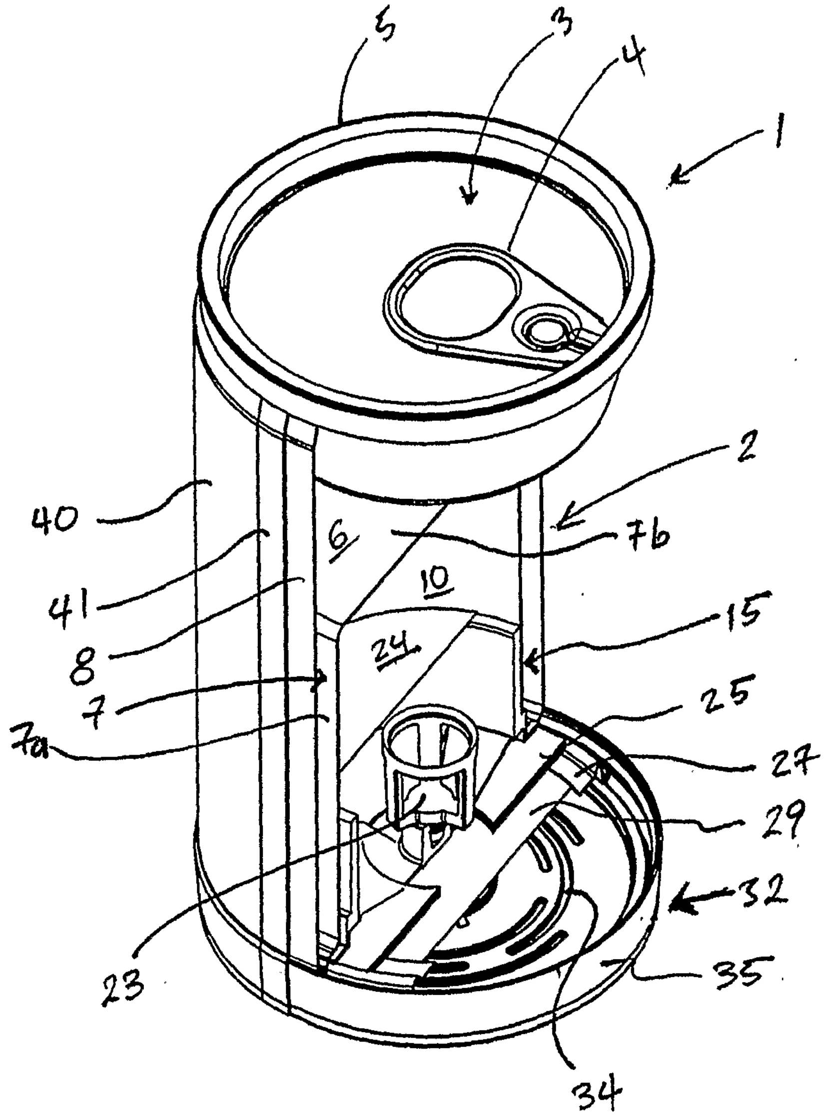

FIGURE 1

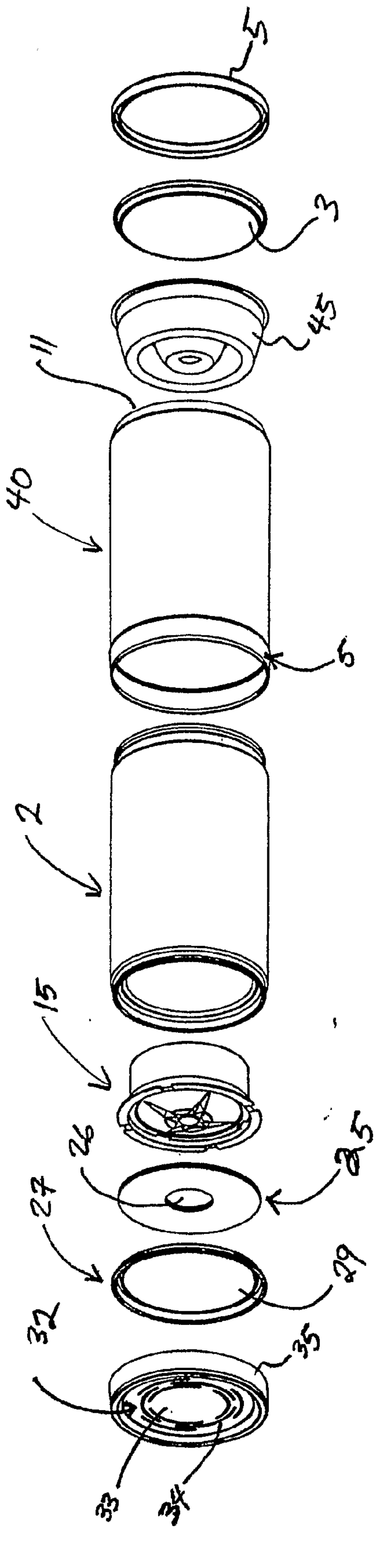

FIGURE 2

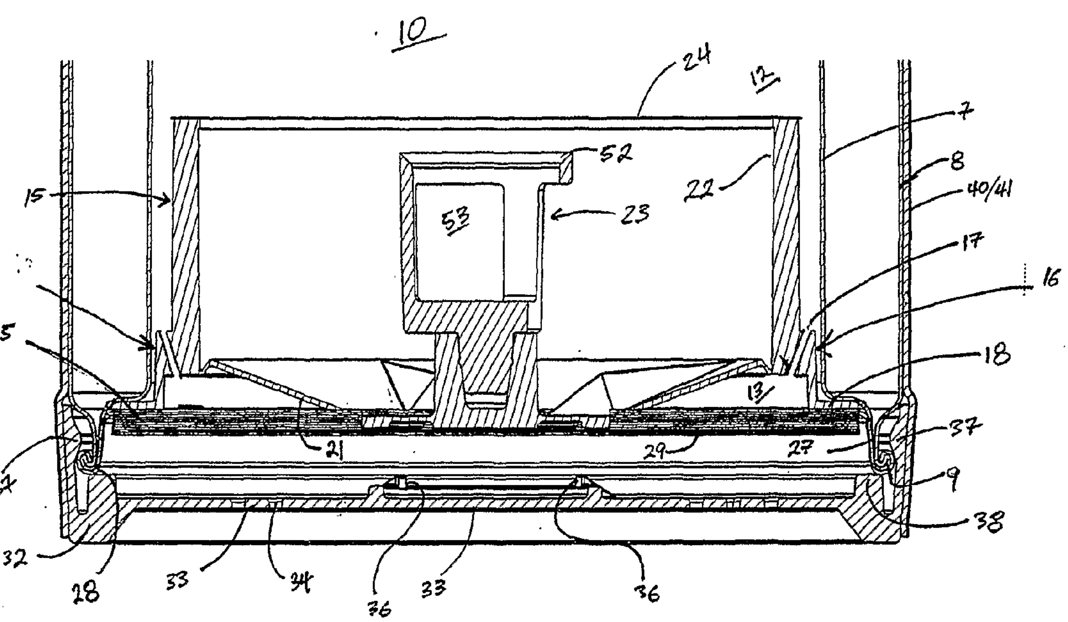
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FIGURE 3

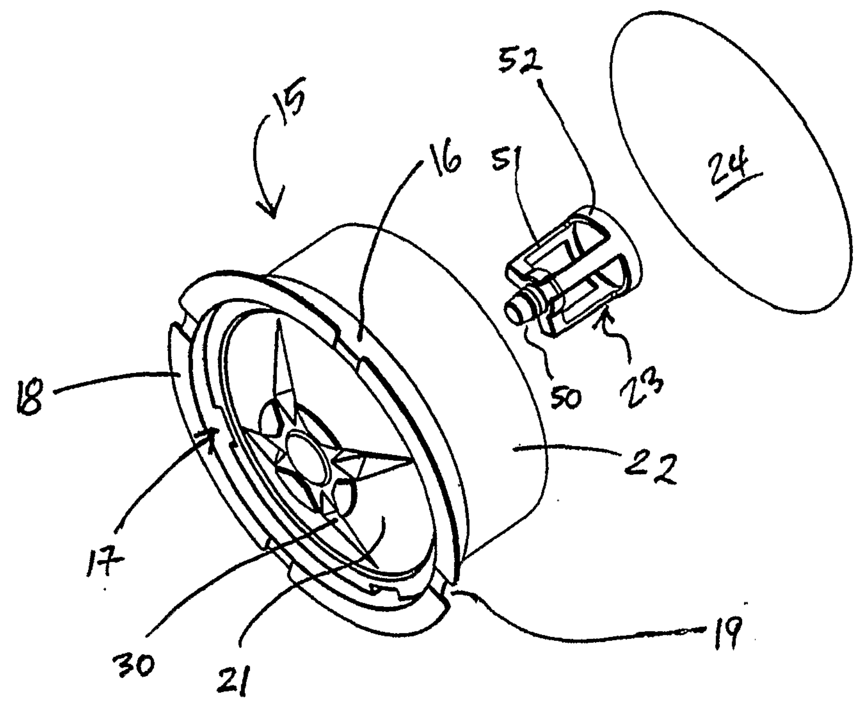

FIGURE 4

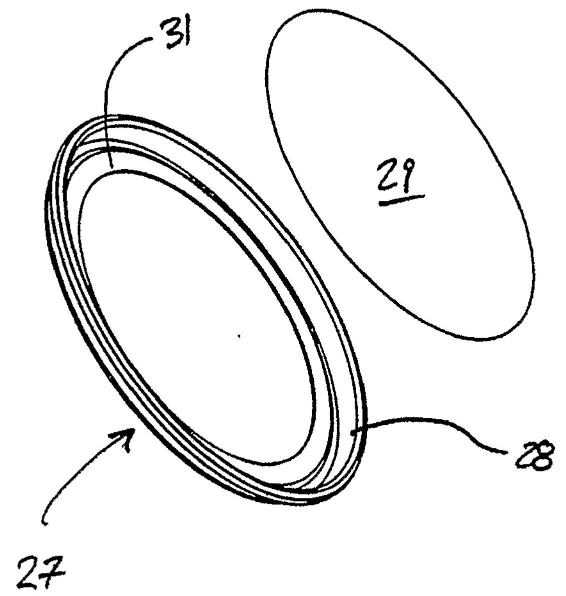

FIGURE 5

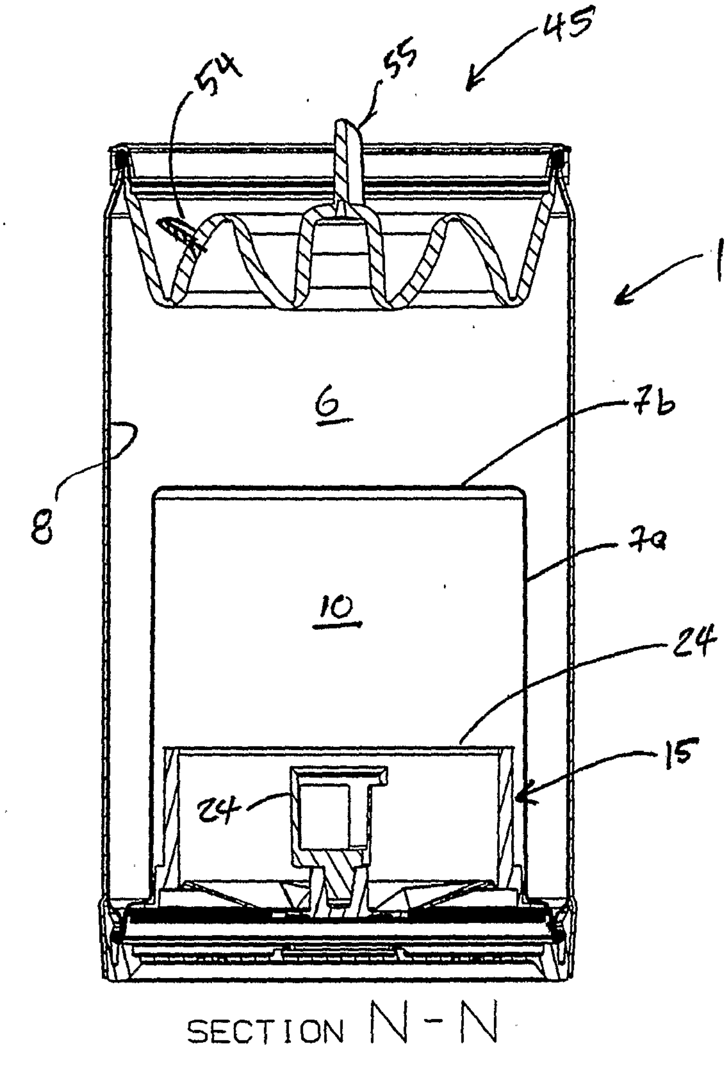

FIGURE 6A

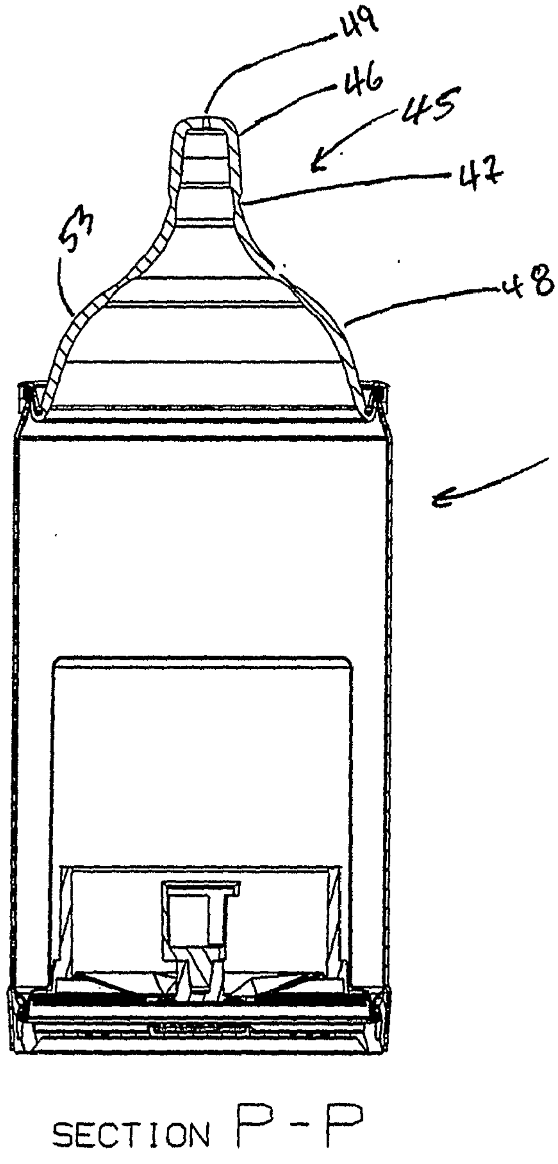

FIGURE 6B

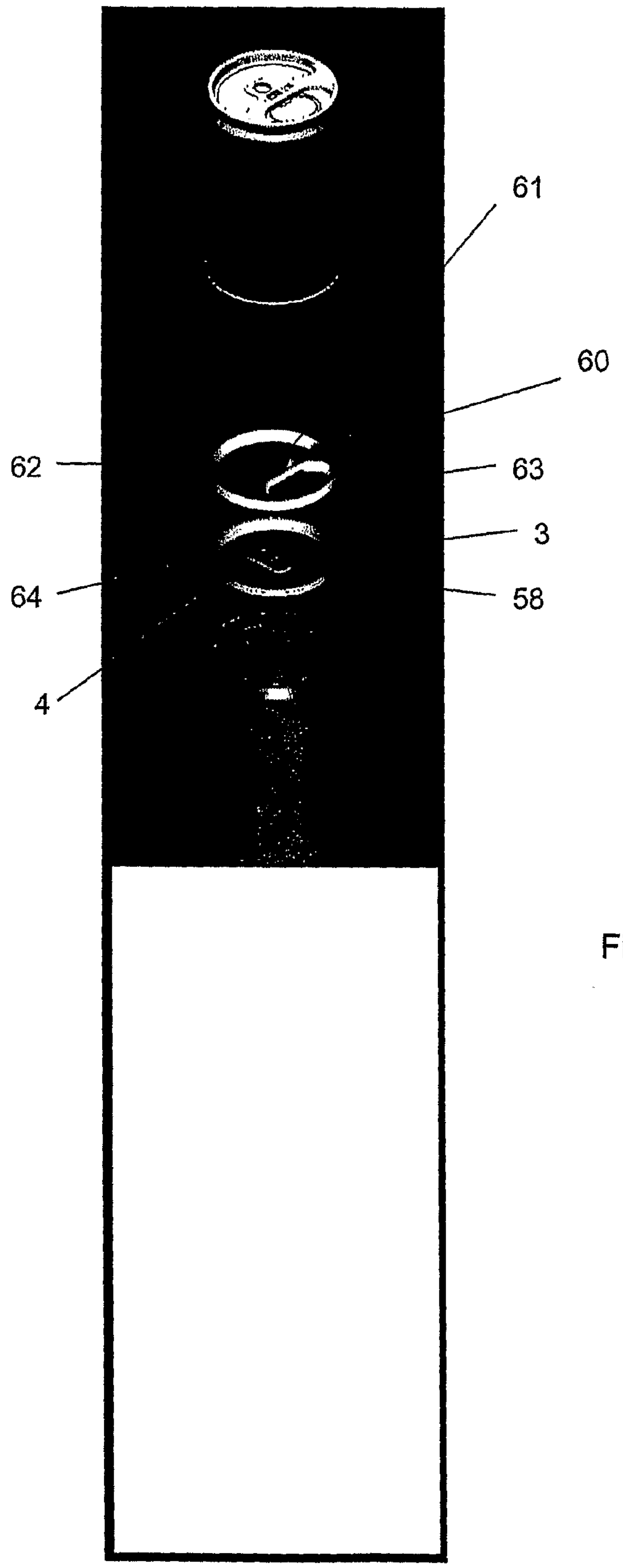

Figure 7

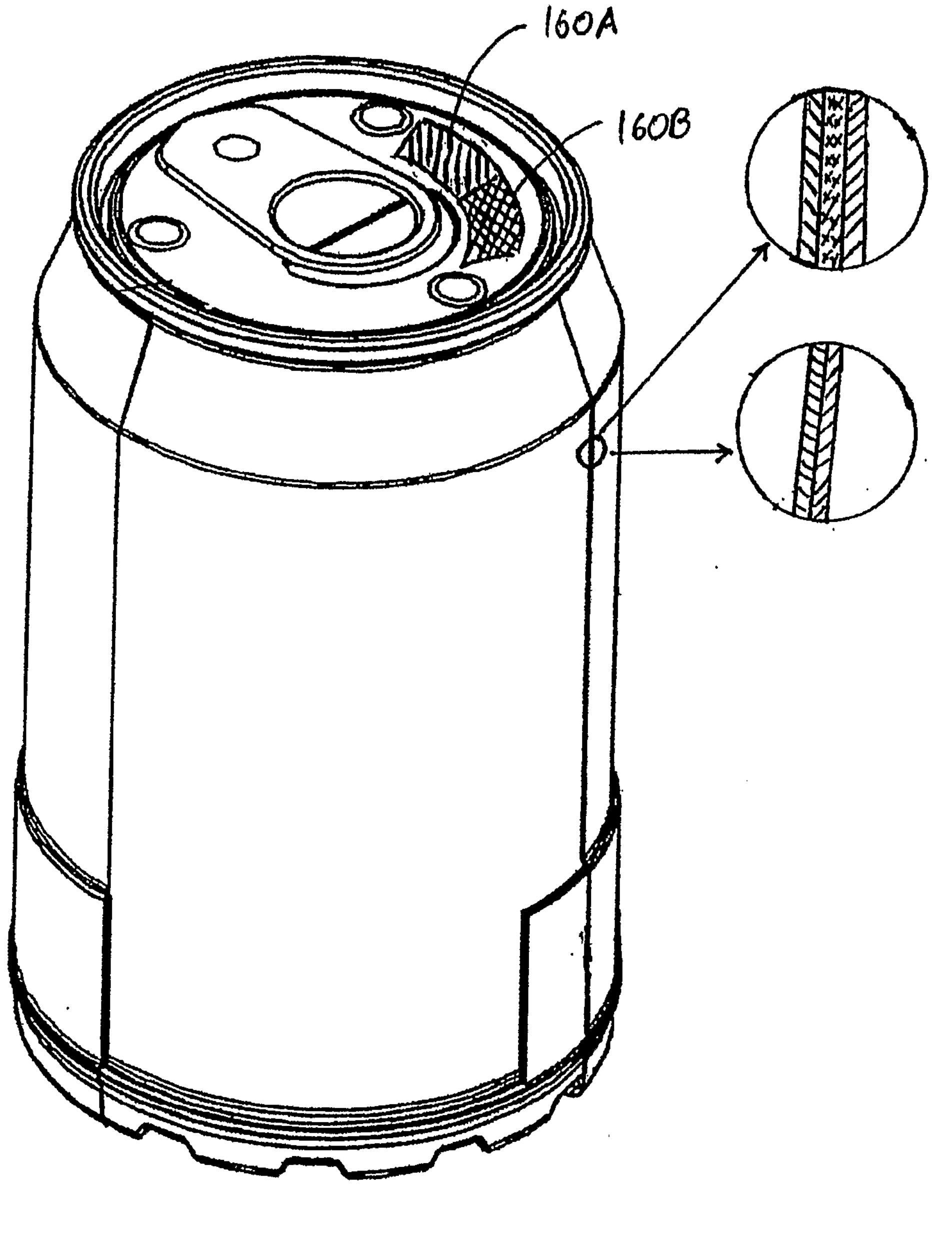

FIGURE 8

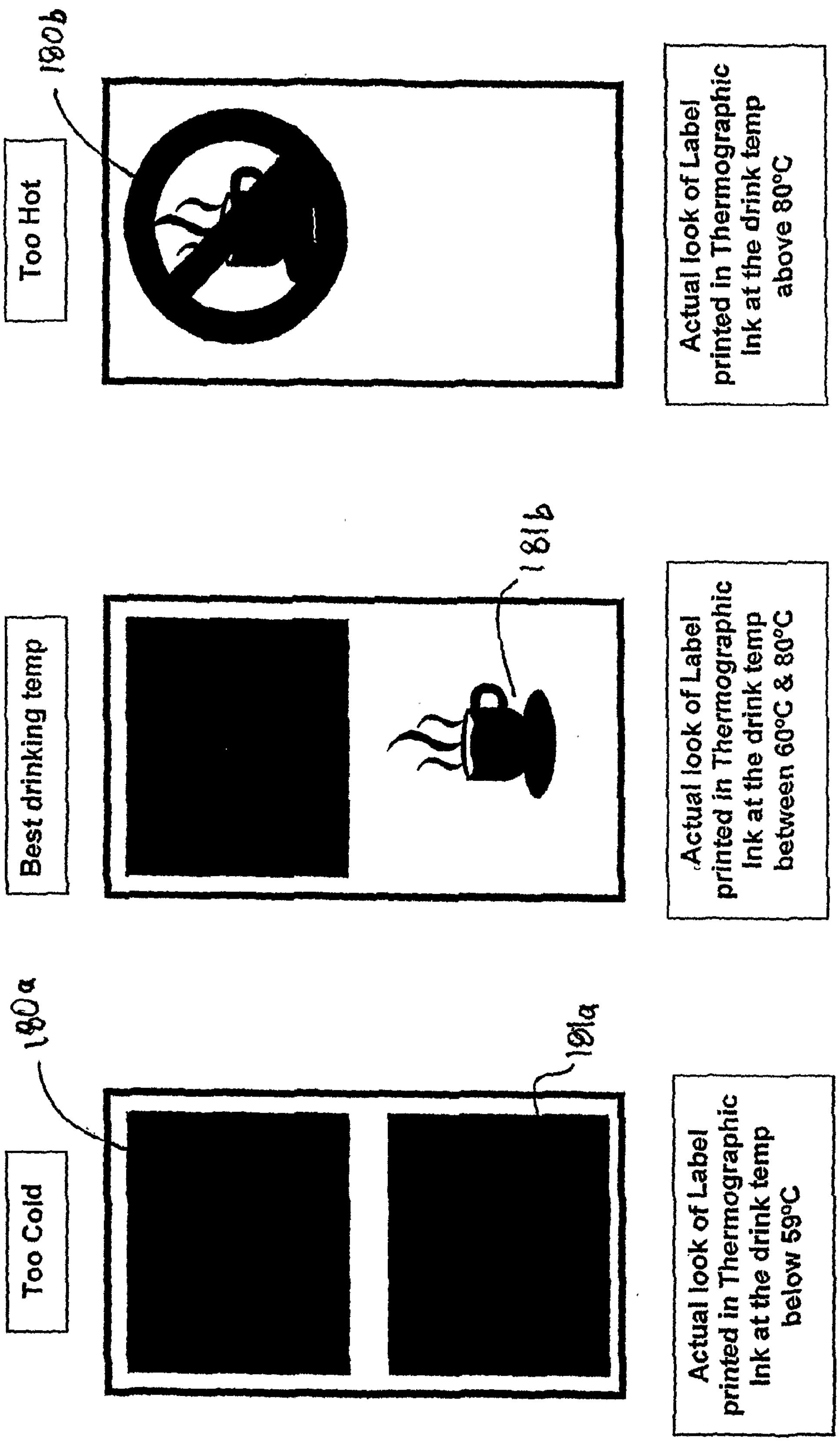
Too Cold
180a
181a
Actual look of Label printed in Thermographic Ink at the drink temp below 59°C
Best drinking temp
181b
Actual look of Label printed in Thermographic Ink at the drink temp between 60°C & 80°C
Too Hot
180b
Actual look of Label printed in Thermographic Ink at the drink temp above 80°C

FIGURE 9

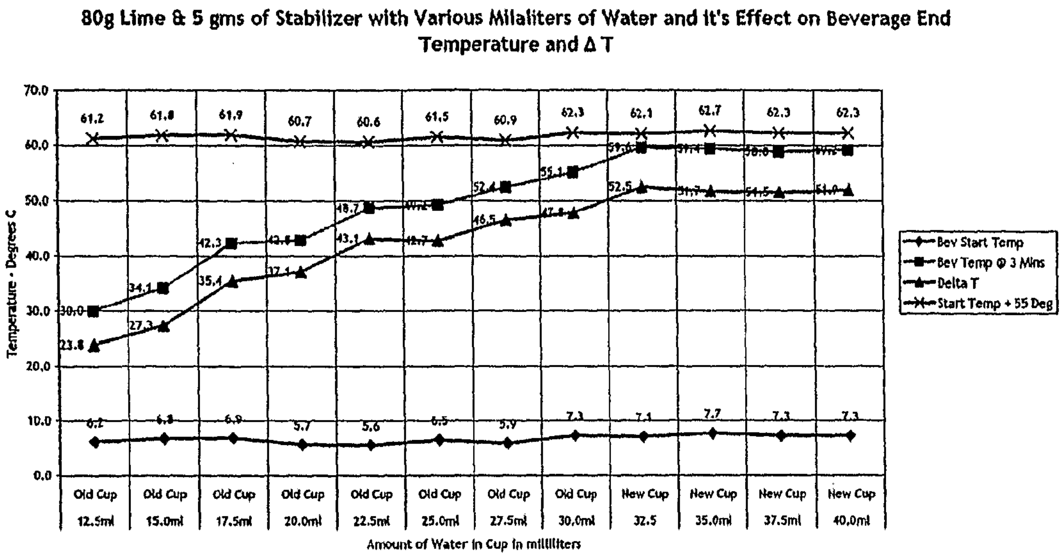

FIGURE 10A

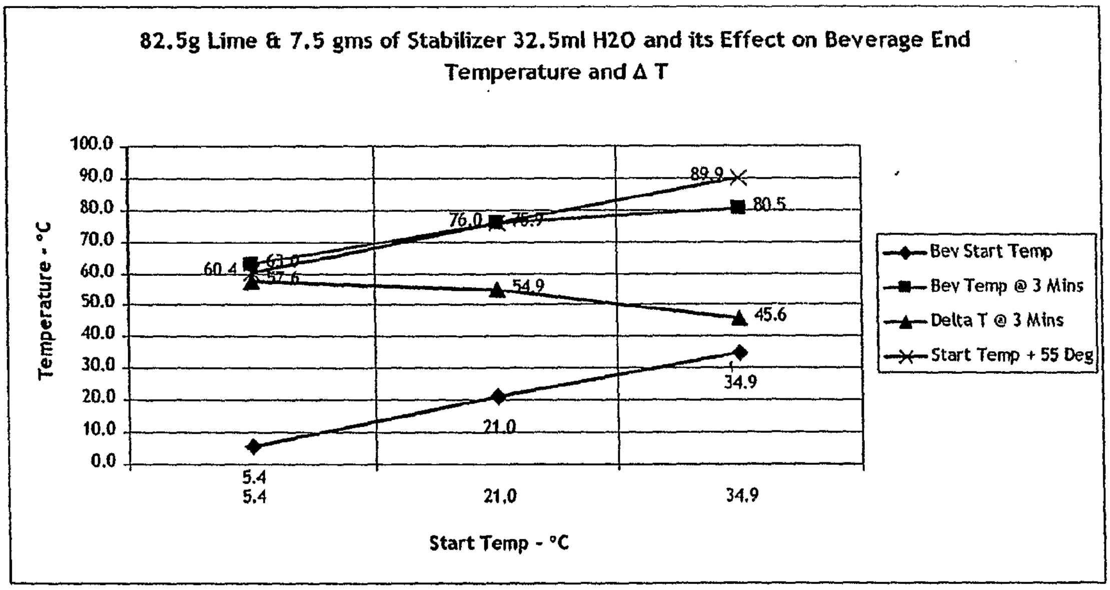

FIGURE 10B

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EUROPEAN SEARCH REPORT

Application Number
EP 11 19 4844

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
Munich	2 February 2012	Segerer, Heiko

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons

& : member of the same patent family, corresponding document

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