



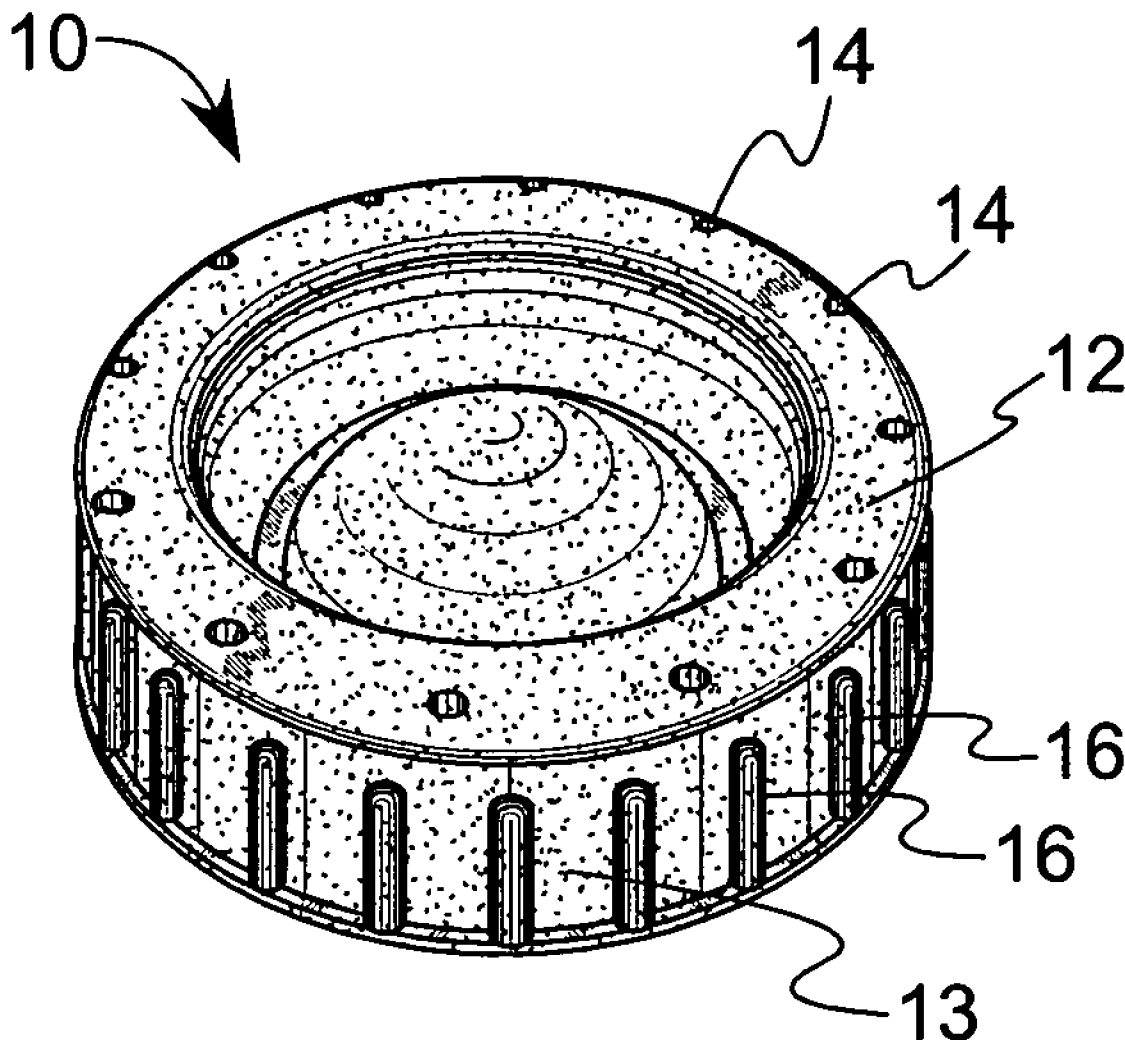
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(19) **United States**(12) **Patent Application Publication****Saliaris et al.**(10) **Pub. No.: US 2005/0147773 A1**(43) **Pub. Date:****Jul. 7, 2005**(54) **THERMALLY CONDUCTIVE CAP**(52) **U.S. Cl. 428/34.1**(76) **Inventors: George P. Saliaris, Dublin, OH (US);
Daniel P. Saliaris, Delaware, OH (US)**(57) **ABSTRACT**

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A cap for a liquid-containing bottle. The cap has a sidewall with inwardly facing threads and a ceiling with a plurality of openings. The ceiling extends between the sidewalls to form a chamber into which a liquid containing bottle is inserted. The composition of the cap includes a plurality of thermally conductive particles having a particle size ranging from about 25 microns to about 70 microns. The cap's composition ranges from about 5% to about 20% by weight of the particles and preferably includes an oxygen-scavenging additive incorporated into the cap to remove oxygen from an airspace above a contained liquid.



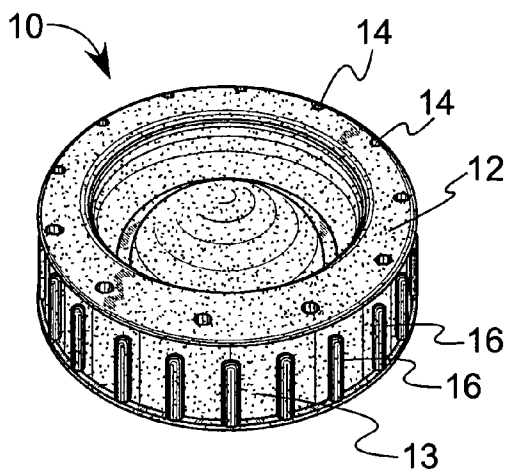


FIG. 1

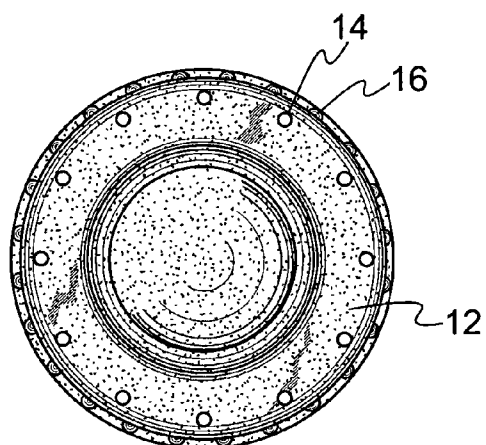


FIG. 2

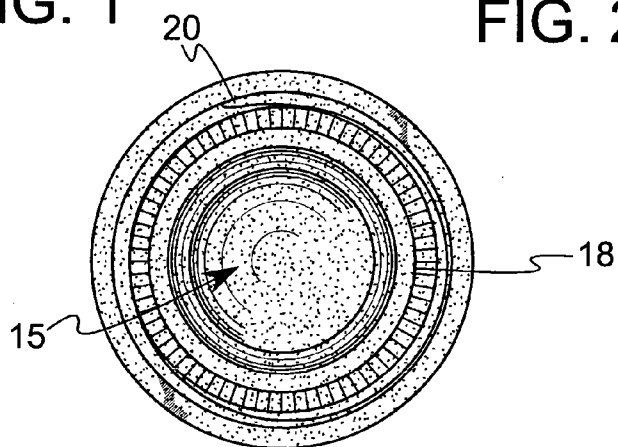


FIG. 3

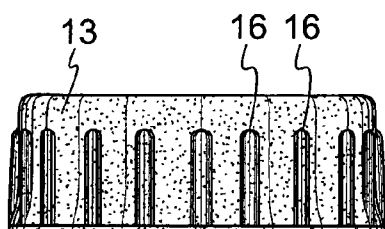


FIG. 4

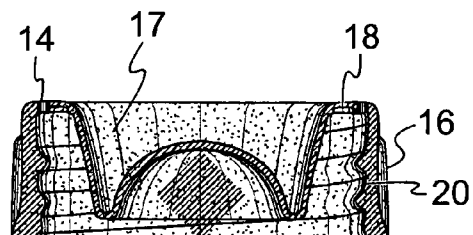


FIG. 5

THERMALLY CONDUCTIVE CAP

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates generally to bottles and their closures and more specifically to the cap used in closing a bottle used to hold a liquid, such as infant formula.

[0003] 2. Description of the Related Art

[0004] It has been known to use plastic for making bottles and other food storage containers. The lid or closure for the container or bottle is also typically made of plastic. Examples of thermoplastics used for bottles include polyethylene, polypropylene and polyvinyl chloride. Some plastics contain particles that enhance manufacturing or sealing of the container. Two examples of plastic bottles utilizing metallic particles are shown in U.S. Pat. No. 5,419,936 to Tindale and U.S. Pat. No. 5,409,983 to Jones et al.

[0005] Further examples of using metal particles in bottles and bottle caps are disclosed in U.S. Pat. No. 3,963,845 to Dukess and U.S. Pat. No. 5,586,589 to Voelker. Dukess discloses a plastic cap with a disk seal made, in part, of plastic with metal particles, while Voelker discloses a cap for a container where the cap has a valve with a component that is made of a plastic with metal particles in it. There is a need for a cap with superior thermal conductivity properties.

BRIEF SUMMARY OF THE INVENTION

[0006] The invention is a cap for a liquid-containing bottle having a sidewall with inwardly facing threads and a ceiling with a plurality of openings for venting the cap. The ceiling extends between the sidewalls to form a chamber into which the liquid containing bottle can be inserted. The cap is plastic that preferably includes a plurality of thermally conductive particles having a particle size ranging from about 25 microns to about 70 microns in a composition ranging from about 5% to about 20% by weight conductive particles. An oxygen-scavenging additive is preferably incorporated into the cap to remove oxygen from an airspace above a contained liquid when the bottle is in an operable orientation.

[0007] It is an object and feature of the invention to incorporate thermally conductive, and preferably metal, particles into plastic for enhancing its thermal conduction. It is a further object and feature of the invention to provide a cap that is sanitary and safe when used with bottles that contain consumable liquids.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0008] FIG. 1 is a view in perspective illustrating the preferred embodiment of the present invention.

[0009] FIG. 2 is a top view illustrating the embodiment of FIG. 1.

[0010] FIG. 3 is a bottom view illustrating the embodiment of FIG. 1.

[0011] FIG. 4 is a side view illustrating the embodiment of FIG. 1.

[0012] FIG. 5 is a cross-sectional view illustrating the embodiment of FIG. 1.

[0013] In describing the preferred embodiment of the invention, which is illustrated in the drawings, specific terminology will be resorted to for the sake of clarity. However, it is not intended that the invention be limited to the specific term so selected and it is to be understood that each specific term includes all technical equivalents, which operate in a similar manner to accomplish a similar purpose. For example, the word connected or term similar thereto is often used. They are not limited to direct connection, but include connection through other elements where such connection is recognized as being equivalent by those skilled in the art.

DETAILED DESCRIPTION OF THE INVENTION

[0014] The preferred embodiment of the present invention is illustrated in FIGS. 1-5. The invention is a plastic cap 10 for a liquid containing bottle. The cap 10 has a sidewall 13 with inwardly facing threads 20 that fix the cap to a bottle having a threaded neck with a rim. The ceiling 12 extends across the sidewall 13 to form a chamber 15 into which the liquid-containing bottle is inserted when the cap is in an operable position on the bottle.

[0015] A gasket 18 mounts on an inner, upper face of the ceiling 12 and seats against the rim of the bottle (not shown) when the cap 10 is in an operable position on the bottle. The gasket 18 forms an air and liquid impermeable seal between the rim of the bottle and the cap 10, when the cap 10 is screwed onto the bottle, to prevent the contents of the bottle from leaking out and to prevent air or other fluids from seeping in.

[0016] The cap 10 includes thermally conductive particles distributed evenly throughout the cap 10 to enhance the conduction of thermal energy through the cap's sidewall 13 and ceiling 12. The thermally conductive particles aid in the heating and cooling processes that are used to clean and sterilize the bottles and their contents. A liquid-containing bottle is filled with liquid, and the cap 10 closes the bottle. This is repeated until a plurality of bottles with caps are filled.

[0017] The filled bottles are then bathed in a liquid to heat the bottles, caps and the contained liquid to a desired temperature for a period of time. The thermally conductive particles in the cap allow the heat in the bath liquid to heat the contents of the bottle more rapidly, because the particles increase the thermal conductivity of the cap. The contents remain at the prescribed temperature for the required length of time and then the bottles are placed in a cooling bath, which rapidly cools the bottles and their contents. The more thermally conductive cap 10 allows the cooling bath to cool the bottles' contents more rapidly. This heating and cooling process, which is analogous to pasteurization, is necessary for the safety of the consumer. By having increased thermal conductivity, the cap 10 increases the heat transfer into and out of the bottle where there is often an airspace between the upper surface of the liquid and the cap.

[0018] A plurality of openings 14 are formed radially outwardly of the gasket 18 for venting the cap 10 as described below. The openings 14 in the preferred embodiment are circular, but the openings 14 can have a variety of shapes including oval, rectangular, triangular, etc. In addi-

tion, the size of the openings **14** can vary from a fraction of a millimeter to much larger openings.

[0019] The openings **14** permit water, air or any other cleaning fluid to wash through the cap **10** for cleaning the interior surfaces of the sidewall **13** and the exterior surfaces of the bottle (not shown). During cleaning, water is forced between the threads of the cap and bottle to dissolve and remove any of the liquid that is contained in the bottle, such as infant formula. The liquid can spill on the outside of the bottle and cap during filling of the bottle and will, consequently, spoil due to the fact that it is not within the sealed bottle.

[0020] After the cleaning fluid washes between the threads of the bottle and cap, it is blown out, preferably by pressurized air blown between the threads and through the openings **14**. Due to the pressurized air, the cleaning fluid exits through the openings **14** of the cap **10**, thereby leaving the threaded portions of the bottles essentially dry after the washing process. The washing process is necessary to protect the consumer from consuming spoiled or otherwise harmful liquid or any foreign matter that may have accumulated during the filling process. The cleaning process can be combined with the heating and/or cooling bath processes.

[0021] The sidewall **13** of the cap is a circular cylindrical shape in the preferred embodiment. However, a variety of cylindrical shapes are available as will be recognized by a person of ordinary skill. The sidewall **13** has a plurality of gripping ridges **16**, which aid the user in rotating and removing the cap **10**. The ridges **16** are raised from the sidewall **13** and spaced substantially equally around the sidewall **13** to provide maximum grip of the cap **10** by a person's hand. It will be clear to a person of ordinary skill that the ridges **16** may be in a variety of forms and shapes and that the ridges **16** described here are only one example of the type of grip that can be used.

[0022] In the preferred embodiment, the thermally conductive particles **17** are metal flakes, and most preferably copper flakes. The thermal conductivity of a material is equal to the quantity of heat that passes per unit time through a body, when its opposite faces are subject to a temperature gradient (e.g. one degree temperature across a thickness of one unit). Thermally conductive particles **17** used in this type of cap have a higher thermal conductivity than the plastic that the cap **10** is made of. Therefore, the particles can be any material of higher thermal conductivity than the plastic of the cap, and can include copper, aluminum, carbon, tin, steel, iron or any other suitable material.

[0023] Preferably, the particles **17** (see FIG. 5) range in size from about 10 microns to about 150 microns. More preferably the thermally conductive particles **17** range in size from about 25 microns to about 70 microns. Most preferably the thermally conductive particles **17** range in size from about 25 microns to about 45 microns. The fraction of the composition of the cap that is made up of the thermally conductive particles ranges from about 5% to about 20% by weight. More preferably, the composition of the cap's thermally conductive particles ranges from about 5% to about 10% by weight. It is most preferred that the composition of the cap's thermally conductive particles is 8% by weight.

[0024] An oxygen-scavenging additive is also incorporated into the cap for removing oxygen from the airspace

above the liquid within the bottle. At least about 1% by weight of the cap is oxygen-scavenging additive. However, more or less than 1% of the additive may be incorporated into the cap **10** as will be recognized by a person of ordinary skill. The oxygen-scavenging additive captures or traps the oxygen in the airspace and reduces the oxygen level in the air space to less than 1%, which reduces the probability that the contents of the container will spoil.

[0025] The thermally conductive particles and the oxygen-scavenging additive are incorporated into the plastic before molding of the cap occurs. The preferred plastic for the cap is polypropylene, although other plastics are contemplated as being suitable.

[0026] While certain preferred embodiments of the present invention have been disclosed in detail, it is to be understood that various modifications may be adopted without departing from the spirit of the invention or scope of the following claims.

1. A cap for a liquid-containing bottle, the cap comprising a sidewall with inwardly facing threads and a ceiling having a plurality of openings for venting the cap, the ceiling extending between the sidewalls to form a chamber into which the liquid containing bottle can be inserted, wherein the cap includes a plurality of thermally conductive particles having a particle size ranging from about 25 microns to about 70 microns and making up about 5% to about 20% by weight of the cap, and an oxygen-scavenging additive incorporated into the cap to remove oxygen from an airspace above a contained liquid when the cap is in an operable orientation.

2. The cap in accordance with claim 1, wherein the cap has at least one gasket that mounts on an inner upper portion of the ceiling.

3. The cap in accordance with claim 2, wherein the openings are positioned radially outwardly of the gasket.

4. The cap in accordance with claim 3, wherein the cap has a circular cylindrical sidewall.

5. A cap for a liquid-containing bottle, the cap comprising a sidewall with inwardly facing threads and a ceiling having a plurality of openings for venting the cap, the ceiling extending between the sidewalls to form a chamber into which the liquid containing bottle can be inserted, wherein the cap includes a plurality of thermally conductive particles ranging in size from about 10 microns to about 150 microns.

6. The cap in accordance with claim 5, wherein the thermally conductive particles range in size from about 25 microns to about 70 microns.

7. The cap in accordance with claim 6, wherein the thermally conductive particles range in size from about 25 microns to about 45 microns.

8. The cap in accordance with claim 5, wherein the composition of the cap ranges from about 5% to about 20% thermally conductive particles by weight.

9. The cap in accordance with claim 6, wherein the composition of the cap ranges from about 5% to about 10% thermally conductive particles by weight.

10. The cap in accordance with claim 7, wherein the composition of the cap is about 8% thermally conductive particles by weight.

11. The cap in accordance with claim 10, further comprising an oxygen scavenging additive incorporated into the cap.

12. The cap in accordance with claim 11, wherein the cap is at least about 1% oxygen-scavenging additive.

13. A cap for a liquid-containing bottle, the cap comprising a sidewall with inwardly facing threads and a ceiling having a plurality of openings for venting the cap, the ceiling extending between the sidewalls to form a chamber into which the liquid containing bottle can be inserted, wherein the cap includes a plurality of thermally conductive particles ranging from about 5% to about 20% of the cap by weight.

14. The cap in accordance with claim 13, wherein the composition of the cap ranges from about 5% to about 10% thermally conductive particles by weight.

15. The cap in accordance with claim 14, wherein the composition of the cap is about 8% thermally conductive particles by weight.

16. A cap for a liquid-containing bottle, the cap comprising a sidewall with inwardly facing threads and a ceiling having a plurality of openings for venting the cap, the ceiling

extending between the sidewalls to form a chamber into which the liquid containing bottle can be inserted, wherein the cap includes an oxygen-scavenging additive.

17. The cap in accordance with claim 16, wherein at least about 1% of the cap is the oxygen-scavenging additive.

18. The cap in accordance with claim 17, wherein the cap further comprises a plurality of thermally conductive particles ranging in size from about 10 microns to about 150 microns.

19. The cap in accordance with claim 18, wherein the thermally conductive particles range in size from about 25 microns to about 70 microns.

20. The cap in accordance with claim 19, wherein the thermally conductive particles range in size from about 25 microns to about 45 microns.

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