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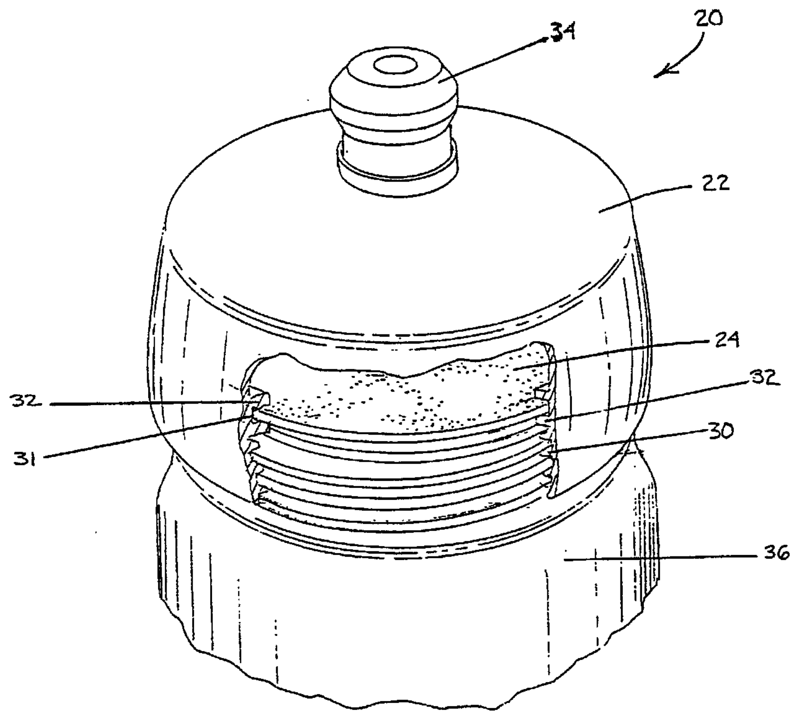
(54) Title: FILTERING CAP FOR BOTTLED FLUIDS



(57) Abstract: The present invention provides a filtering cap for bottled fluids. The filtering cap includes a filter within a chamber that is reasealably connectable to conventional bottles such as those used for the retail distribution of various fluids.

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TITLE OF THE INVENTION

FILTERING CAP FOR BOTTLED FLUIDS

PRIORITY CLAIM

The present application hereby claims priority based on Provisional Application Serial No. 60/172,604, filed December 20, 1999.

FIELD OF THE INVENTION

The present invention relates to a filtering cap for bottled fluids. More specifically, the present invention is directed to a filtering cap that includes a chamber in fluid communication with a spout and containing a filter media. The chamber is connectable to conventional bottles and others such as those used for the retail distribution of various fluids.

BACKGROUND OF THE INVENTION

A contaminant-free and readily available supply of drinking water is essential to human life. For people living in metropolitan areas, drinking water frequently comes from surface water sources such as lakes, rivers, and reservoirs. These surface water sources may be located nearby or at a distance requiring elaborate and frequently expensive systems for transport.

Surface water accumulates partly as a result of rainwater that flows over the earth's surface and into creeks, rivers, lakes, and other reservoirs. The land over which the water flows along its path is referred to as a watershed. Unfortunately, along this path, the water may collect and transport various contaminants. The larger a watershed, the greater the possibilities for contamination from activities occurring in the area of the watershed. Furthermore, a source of contamination can affect the water supply for a community miles away if the contaminants become mixed in with water as it travels over the watershed.

To provide water for use in homes and businesses, municipalities utilize industrial scale processes in an effort to eliminate or reduce harmful constituents present in water drawn from large, naturally occurring surface water sources. The consistency and efficiency of treatment by municipalities may vary due to numerous factors such as heavy rainfall, equipment failures, and usage levels. Depending upon the seriousness of a variation in treatment, a municipality may be forced to notify its users that further treatment of the water being supplied, e.g., boiling, is required at the point-of-use before consumption or use is safe. Even when the water supplied by a municipality is safe for use, the water may have high levels of chlorine or other additives that provide for an undesirable smell or taste to consumers.

While surface water is important, approximately two thirds of the world's fresh water is found underground. Thus, the likelihood that people are using water pumped from a well or other groundwater source increases as the distance from a community or other municipal water source increases. Generally, wells are drilled into the earth's aquifers, which are naturally occurring reservoirs under the surface. Groundwater in these aquifers resides in the tiny spaces between soil particles or in cracks and fissures in bedrock. The water at the top of these aquifers forms what is referred to as the "water table." The level at which the water table occurs may directly affect the level of surface water found in lakes, rivers, and other reservoirs.

Water accumulates in the aquifers by flowing in from the earth's surface. Various environmental factors such as soil type, plant cover, slope, and rainfall intensity affect the rate at which water accumulates in these aquifers. Accordingly, as with surface water, groundwater can be contaminated by activities occurring on the surface that contaminate the soil or surface water sources. Because groundwater migrates very slowly through an aquifer, several years may pass before a contaminant released on the surface finds its way into an aquifer. As a result, contamination is frequently widespread and unanticipated by the time it is actually detected. Even more time may be required for the aquifer to purify itself naturally. This purification process is essential because water obtained directly from underground sources, e.g., wells, springs, and the like, is typically consumed without any prior treatment.

As a result in part of the above discussed contamination problems, there exists a demand and market for bottled water and other bottled fluid products. Supermarkets, convenience stores, and other retail establishments frequently provide a large selection of bottled water products. Typically, the suppliers of these products claim to obtain the water from “naturally pure” sources such as mountain lakes, springs, or rivers. Some suppliers simply advertise that the water is pure and obtain the water through a license with a municipal supplier. Regardless, water for these bottled products ultimately must be obtained from surface or groundwater sources. Therefore, the possibility exists for the presence of undesired constituents as previously discussed. These undesired constituents may include health risks, such as bacteria or carcinogens, or may simply consist of additives such as chlorine that provide an undesirable taste and smell.

Additionally, the purchaser of these bottled fluid products may wish to reuse the container. For example, after consuming the contents of a bottled water container, the purchaser may wish to refill the container from a fountain, faucet, or the like. The water used in refilling the container, as with the original contents, may contain constituents the purchaser would like to remove.

Accordingly, a need exists for a filtering device that can be readily connected to the conventional containers used for the retail distribution of fluids such as bottled water, and other non-conventional containers used for various fluids. Such a device that can also utilize a variety of filter media is also desirable. Furthermore, the usefulness of such a device may be increased by including a feature through which the flow of filtered fluid may be controlled. A device that is resealably connectable would also allow the user to switch between containers and even refill used containers with unfiltered fluid.

SUMMARY OF THE INVENTION

The present invention is directed to a filtering cap for bottled fluids. More specifically, the present invention provides a cap having a filter media wherein the cap may be connected to fluid containers, such as the conventional containers found in retail stores, for the filtration of various fluid products. The present invention includes a spout, which in certain embodiments is positionable such that the user may control the flow of filtered fluid. An indicator may also be provided to notify the user of the filter's remaining useful life. The present invention is resealably connectable and may be switched between various containers.

A filtering cap for bottled fluids includes a chamber that is resealably connectable to a fluid container. A filter media is located within the chamber such that after exiting the container, fluid may then flow into the filter media. A spout is also provided that is in fluid communication with the chamber. Fluid flowing into the chamber passes through the filter media and exits the chamber through the spout. The filter media may be selected depending upon the fluid being filtered and the constituents to be removed.

These and other features, aspects and advantages of the present invention will become better understood with reference to the following description and appended claims. The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate an embodiment of the invention and, together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1A is a perspective view and partial cross-sectional view of an embodiment of the present invention connected to a fluid container;

Figure 1B is a perspective view of an embodiment of the present invention;

Figure 2A is a perspective view of another embodiment of the present invention connected to a fluid container;

Figure 2B is a perspective and partial cross-sectional view of an embodiment of the present invention; and

Figure 3 is a perspective and partial cross-sectional view of an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference now will be made in detail to the embodiments of the invention, one or more examples of which are set forth below. Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention. For instance, features illustrated or described as part of one embodiment, can be used on another embodiment to yield a still further embodiment. Thus, it is intended that the present invention cover such modifications and variations as come within the scope of the appended claims and their equivalents. Other objects, features and aspects of the present invention are disclosed in or are obvious from the following detailed description. It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not intended as limiting the broader aspects of the present invention.

As used herein, the term “charge-modified material” means any material that has an electric charge upon at least some of its surfaces. The charge may be cationic or anionic, and of any magnitude.

As used herein, the term "nonwoven web" means a web or fabric having a structure of individual fibers or threads which are interlaid, but not in an identifiable manner as in a knitted or woven fabric. Nonwoven webs generally may be prepared by methods which are well known to those having ordinary skill in the art. Examples of such processes include, by way of illustration only, meltblowing, coforming, spunbonding, carding and bonding, air laying, and wet laying. Meltblowing, coforming, and spunbonding processes are exemplified by the following references, each of which is incorporated herein by reference:

(a) meltblowing references include, by way of example, U.S. Patent Nos. 3,016,599 to R. W. Perry, Jr., 3,704,198 to J. S. Prentice, 3,755,527 to J. P. Keller et al., 3,849,241 to R. R. Butin et al., 3,978,185 to R. R. Butin et al., and 4,663,220 to T. J. Wisneski et al. See, also, V. A. Wente, "Superfine Thermoplastic Fibers", Industrial and Engineering Chemistry, Vol. 48, No. 8, pp. 1342-1346 (1956); V. A. Wente et al., "Manufacture of Superfine Organic Fibers", Navy Research Laboratory, Washington, D.C., NRL Report 4364 (111437), dated May 25, 1954, United States Department of Commerce, Office of Technical Services; and Robert R. Butin and Dwight T. Lohkamp, "Melt Blowing - A One-Step Web Process for New Nonwoven Products", Journal of the Technical Association of the Pulp and Paper Industry, Vol. 56, No.4, pp. 74-77 (1973);

(b) coforming references include U.S. Patent Nos. 4,100,324 to R. A. Anderson et al. and 4,118,531 to E. R. Hauser; and

(c) spunbonding references include, among others, U.S. Patent Nos. 3,341,394 to Kinney, 3,655,862 to Dorschner et al., 3,692,618 to Dorschner et al., 3,705,068 to Dobo et al., 3,802,817 to Matsuki et al., 3,853,651 to Porte, 4,064,605 to Akiyama et al., 4,091,140 to Harmon, 4,100,319 to Schwartz, 4,340,563 to Appel and Morman, 4,405,297 to Appel and Morman, 4,434,204 to Hartman et al., 4,627,811 to Greiser and Wagner, and 4,644,045 to Fowells.

A "nonwoven charge-modified microfiber glass web" may be prepared from a fibrous web which incorporates glass fibers having a cationically charged coating thereon. Generally, such microfibers would be glass fibers having an average diameter of about 10 microns or less. The coating includes a functionalized cationic polymer which has been crosslinked by heat; in other words, the functionalized cationic polymer has been crosslinked by heat after being coated onto the glass fibers. Such a fibrous filter is prepared by a method which involves providing a fibrous filter which includes glass fibers, passing a solution of a functionalized and crosslinkable cationic polymer through the fibrous filter under conditions sufficient to substantially coat the fibers with the functionalized cationic polymer, and treating the resulting coated fibrous filter with heat at a temperature and for a time sufficient to crosslink the functionalized cationic polymer present on the glass fibers. The functionalized and crosslinkable cationic polymer may be an epichlorohydrin-functionalized polyamine or an epichlorohydrin-functionalized polyamido-amine. The crosslinking may be accomplished by using heat or any other crosslinking means.

In general, when used as a filter media, a "charge-modified microfiber glass web" will contain at least about 50 percent by weight of glass fibers, based on the weight of all fibers present in the filter media. In some embodiments, essentially 100 percent of the fibers will be glass fibers. When other fibers are present, however, they generally will be cellulosic fibers, fibers prepared from synthetic thermoplastic polymers, or mixtures thereof.

As used herein, the terms "cationically charged" in reference to a coating on a glass fiber and "cationic" in reference to the functionalized polymer mean the presence in the respective coating and polymer of a plurality of positively charged groups. Thus, the terms "cationically charged" and "positively charged" are synonymous. Such positively charged groups typically will include a plurality of quaternary ammonium groups, but they are not necessarily limited thereto.

The term "functionalized" is used herein to mean the presence in the cationic polymer of a plurality of functional groups, other than the cationic groups, which are capable of crosslinking when subjected to heat. Thus, the functional groups are thermally crosslinkable groups. Examples of such functional groups include epoxy, ethylenimino, and episulfido. These functional groups readily react with other groups typically present in the cationic polymer. The other groups typically have at least one reactive hydrogen atom and are exemplified by amino, hydroxy, and thiol groups. It may be noted that the reaction of a functional group with another group often generates still other groups which are capable of reacting with functional groups. For example, the reaction of an epoxy group with an amino group results in the formation of a β-hydroxyamino group.

Thus, the term "functionalized cationic polymer" is meant to include any polymer which contains a plurality of positively charged groups and a plurality of other functional groups which are capable of being crosslinked by the application of heat. Particularly useful examples of such polymers are epichlorohydrin-functionalized polyamines and epichlorohydrin-functionalized polyamido-amines. Both types of polymers are exemplified by the Kymene® resins which are available from Hercules Inc., Wilmington, Delaware. Other suitable materials include cationically modified starches, such as RediBond, from National Starch.

As used herein, the term "thermally crosslinked" means the coating of the functionalized cationic polymer has been heated at a temperature and for a time sufficient to crosslink the above-noted functional groups. Heating temperatures typically may vary from about 50°C to about 150°C. Heating times in general are a function of temperature and the type of functional groups present in the cationic polymer. For example, heating times may vary from less than a minute to about 60 minutes or more.

As discussed briefly above, a nonwoven charge-modified meltblown web may consist of hydrophobic polymer fibers, amphiphilic macromolecules adsorbed onto at least a portion of the surfaces of the hydrophobic polymer fibers, and a crosslinkable, functionalized cationic polymer associated with at least a portion of the amphiphilic macromolecules, in which the functionalized cationic polymer has been crosslinked. Crosslinking may be achieved through the use of a chemical crosslinking agent or by the application of heat. Desirably, thermal crosslinking, i.e., the application of heat, will be employed. In general, the amphiphilic macromolecules may be of one or more of the following types: proteins, poly(vinyl alcohol), monosaccharides, disaccharides, polysaccharides, polyhydroxy compounds, polyamines, polylactones, and the like. Desirably, the amphiphilic macromolecules will be amphiphilic protein macromolecules, such as globular protein or random coil protein macromolecules. For example, the amphiphilic protein macromolecules may be milk protein macromolecules. The functionalized cationic polymer typically may be any polymer which contains a plurality of positively charged groups and a plurality of other functional groups which are capable of being crosslinked by, for example, chemical crosslinking agents or the application of heat. Particularly useful examples of such polymers are epichlorohydrin-functionalized polyamines and epichlorohydrin-functionalized polyamido-amines. Other suitable materials include cationically modified starches.

The nonwoven charge-modified meltblown web may be prepared by a method which involves providing a fibrous meltblown filter media which includes hydrophobic polymer fibers, passing a solution containing amphiphilic macromolecules through the fibrous filter under shear stress conditions so that at least a portion of the amphiphilic macromolecules are adsorbed onto at least some of the hydrophobic polymer fibers to give an amphiphilic macromolecule-coated fibrous web, passing a solution of a crosslinkable, functionalized cationic polymer through the amphiphilic macromolecule-coated fibrous web under conditions sufficient to incorporate the functionalized cationic polymer onto at least a portion of the amphiphilic macromolecules to give a functionalized cationic polymer-coated fibrous web in which the functionalized cationic polymer is associated with at least a portion of the amphiphilic macromolecules, and treating the resulting coated fibrous filter with a chemical crosslinking agent or heat. Desirably, the coated fibrous filter will be treated with heat at a temperature and for a time sufficient to crosslink the functionalized cationic polymer.

In general, the present invention relates to a filtering cap for bottled fluids. A filter media is provided within a chamber that may be resealably connectable to fluid containers such as jars, bottles, and the like used to retail various fluids. A chamber that is reasealably connectable to either conventional or non-conventional containers may be constructed. The filter media is positioned within the chamber so that fluid entering the chamber flows through the filter media and into a spout. While the background of the present invention has been discussed in terms of water filtration, the present invention is not limited to water filtration and may be used to filter other fluids as appropriate and desired by the user.

An embodiment of a filtering cap for bottled fluids 20 is depicted in Figure 1A connected to a conventional container 36. The present invention includes a chamber 22 that is resealably connectable to the conventional container 36. This connection may be made using threads 30. Alternatively, the chamber 22 may have a snap-fit, locking tabs, and the like for making a resealable connection to a conventional container 36, or to various nonconventional containers. The conventional container 36 may be for bottled water, bottled juices, or any other fluids appropriate for filtration or consumption. Additionally, a variety of container sizes may be used with the present invention. For example, the diameter and height of chamber 22 may be varied to accept conventional containers 36 having different diameters, heights, thicknesses, or other variations that may require dimensional changes to chamber 22.

A filter media 24 is positioned within the chamber 22 such that unfiltered fluid may enter the filter media 24 only after exiting the container 36. More specifically, the filter media 24 is located within the chamber 22 and does not reside within the container 36. The filter media 24 may be selected from a variety of available materials that can be constructed to fit within chamber 22. For example, for water filtration applications, the filter media 24 may be constructed of activated carbon, zeolite, charge-modified materials, ion exchange resins, or other media acceptable for water filtration. Charge-modified materials may include a nonwoven charge-modified meltblown web, a charge-modified microfiber glass web, and the like. In addition, filter media 24 may consist of materials that are laminated, extruded, pressed, or otherwise constructed.

The chamber 22 can also be modified to accept multiple different filter media 24. For example, several layers of different filter media may be located within chamber 22. This embodiment may be desirable where the fluid to be filtered contains several different constituents that may be removed by different filter media. In Figure 1A, filter media 24 is relatively flat and is held in place by a groove 31 formed by a pair of ridges 32. Similarly, additional grooves 31 may be added above or below filter media 24 so that additional filter media may be added to the invention. For example, a filter media 24 that may be used with the present invention is a media manufactured by K-X Industries under the name of PLEKX. This filter media includes three layers: A charge-modified layer is laminated onto both the top and bottom of a layer containing activated carbon. The thickness of the entire laminate is approximately 0.050 inches. Accordingly, several layers of PLEKX and/or additional filter media 24 may be used within the chamber 22.

Instead of having the grooves 31, the chamber 22 may be constructed with other features to enclose and position the filter media 24. For example, for a filter media consisting of particulate materials, such as beads or a granular material, chamber 22 may include a mesh, screen, bridge, or other feature for retaining the filter media 24.

The present invention also includes a spout 34 in fluid communication with the chamber 22. During operation of the invention, filtered fluid enters the chamber 22 from the container 36, flows through the filter media 24, and then flows into the spout 34 from which filtered fluid may exit the filtering cap 20. The spout 34 may be constructed as depicted in Figure 1A or may be shaped into any form commensurate with consumption or other use of the filtered fluid. The spout 34 may also be structured so that by positioning the spout 34, the flow of filtered fluid from the filtering cap 20 may be controlled. For example, the spout 34 may be structured so that when in a first position away from chamber 22, filtered fluid may flow through the spout 34. When pressed into a second position near the chamber 22, the flow of filtered fluid is prevented. This serves as only one example; the construction of the spout 34 may be selected from any of a variety of possible configurations suitable for use with the present invention.

The chamber 22 and spout 34 may be constructed from any materials suitable for contact with the fluid to be filtered. For water filtration, the materials should also be compatible with human contact and consumption of the water contacted with the material. By way of example only, suitable materials may include various plastics, metals, composites, and the like.

Figure 1B shows the filtering cap 20 with an indicator 38 for notifying the user that the filter media 24 has reached the end of its useful life. The indicator 38 may be electronic including a light bar, LED, or LCD to notify the user. Alternatively, the indicator may be mechanically operated based upon the use of the filtering cap 20. For example, the indicator 38 may operate by advancing a mechanical dial each time the chamber 22 is placed onto a container 36. The indicator 38 may include a wheel or other device that is rotated by fluid traveling through the chamber 22 so that the indicator 38 is activated by the amount of fluid filtered. The indicator 38 may also consist of a thumb wheel or dial displaying dates. The user could then simply record the date on which the filter media 24 will be spent or on which a new filtering cap 20 will be installed.

Figure 2A is another embodiment 120 of the present invention depicting a chamber 122 with dimensions that vary from chamber 22 in Figure 1A. The dimensions of chamber 122 may be varied to accept different filter media or to permit connection to a variety of different conventional containers 136. Figure 2B also depicts the incorporation of a relatively flat filter media 124. Alternatively, several layers of filter media may be added within the space provided in the chamber 122 or a single filter media that occupies the entire chamber may be employed. As with Figure 1A, the embodiment of Figure 2A also includes a spout 134 and an indicator 138. A groove 131 formed by a pair of ridges 132 is provided for positioning the filter media 124, as well as threads 130 for resealably connecting the chamber 122 to the container 136.

To operate the embodiment depicted in Figure 2A, the user would connect the filtering cap 120 to the conventional container 136 enclosing the fluid to be filtered. The fluid may be the original fluid placed into the container 136 by a commercial supplier or may be added to a reusable container by the user. Next, the user places the spout 134 into the proper position to allow flow and then applies pressure to the fluid by inverting or squeezing the container 136. Filtered fluid then enters the chamber 122 and flows through the filter media 124 where undesired constituents are removed depending upon the selection of the filter media 124. Filtered fluid then exits the filtering cap 120 through the opened spout 134.

Figure 3 depicts a filtering cap 220 employing a filter media 224 with a block or cake-like shape. A spout 234 extends into the center of the filter media 224. A bridge 244 provides support for the filter media 224 and retains it within a chamber 222. The bridge 244 is connected to the chamber 222 by a series of girders 242. In operation, unfiltered fluid flows into the chamber 222 and flows into the filter media 224. Filtered fluid then enters the opened spout 234 and exits the filtering cap 220.

Although preferred embodiments of the invention have been described using specific terms, devices, and methods, such description is for illustrative purposes only. The words used are words of description rather than of limitation. It is to be understood that changes and variations may be made by those of ordinary skill in the art without departing from the spirit or the scope of the present invention, which is set forth in the following claims. In addition, it should be understood that aspects of the various embodiments may be interchanged both in whole or in part. Therefore, the spirit and scope of the appended claims should not be limited to the description of the preferred versions contained therein.

WHAT IS CLAIMED IS:

1. A filtering cap for bottled fluids, comprising:

a chamber, said chamber being resealably connectable to a fluid container;

a filter media, said filter media being positioned within said chamber such that after exiting said container the fluid may then flow into said filter media; and,

a spout, said spout being in fluid communication with said chamber so that when fluid is caused to flow through said chamber, the fluid flows through said filter media and exits the chamber through said spout.

2. A filtering cap for bottled fluids as in claim 1, wherein said spout is structured so that by positioning a portion of said spout the flow of filtered fluid through said spout may be controlled.

3. A filtering cap for bottled fluids as in claim 1, further comprising an indicator for notifying a user of when the filter media has reached the end of its useful life.

4. A filtering cap for bottled fluids as in claim 1, wherein said filter media comprises activated charcoal.

5. A filtering cap for bottled fluids as in claim 1, wherein said filter media comprises zeolite.

6. A filtering cap for bottled fluids as in claim 1, wherein said filter media comprises a charge-modified material.

7. A filtering cap for bottled fluids as in claim 1, wherein said filter media comprises a packed bed of charge-modified particles.

8. A filtering cap for bottled fluids as in claim 1, wherein said filter media comprises a laminate.

9. A filtering cap for bottled fluids as in claim 1, wherein said chamber is comprised of a plastic.

10. A filtering cap for bottled fluids as in claim 1, wherein said container is a conventional bottled water container.

11. A filtering cap for bottled fluids as in claim 1, wherein said fluid is water.

12. A filtering cap for bottled fluids as in claim 1, wherein said filter media comprises more than one layer of filter media.

13. A filtering cap for bottled fluids as in claim 12, wherein said layers selectively filter undesired constituents from the fluid.

14. A filtering cap for bottled fluids as in claim 1, wherein said filter media is less than about 0.1 inch in thickness.

15. A filtering cap for bottled fluids, comprising:

a filter support, said filter support being resealably connectable to a fluid container;

a filter media, said filter media being positioned by said filter support such that after exiting said container the fluid may then flow into said filter media; and,

a spout, said spout being in fluid communication with said filter support so that when fluid is caused to flow through the filter support, the fluid flows through said filter media and exits the filter support through said spout.

16. A filtering cap for bottled fluids as in claim 15, wherein said filter support comprises a wall defining a groove for positioning the filter media.

17. A filtering cap for bottled fluids as in claim 15, wherein said filter support comprises a wall surrounding the filter media and a bridge attached to said wall.

18. A filtering cap for bottled fluids as in claim 15, wherein said filter media comprises more than one layer.

19. A filtering cap for bottled fluids as in claim 18, wherein said

layers selectively filter undesired constituents from the fluid.

20. A filtering cap for bottled fluids as in claim 15, wherein said filter media is less than about 0.1 inch in thickness.

Fig. 1A

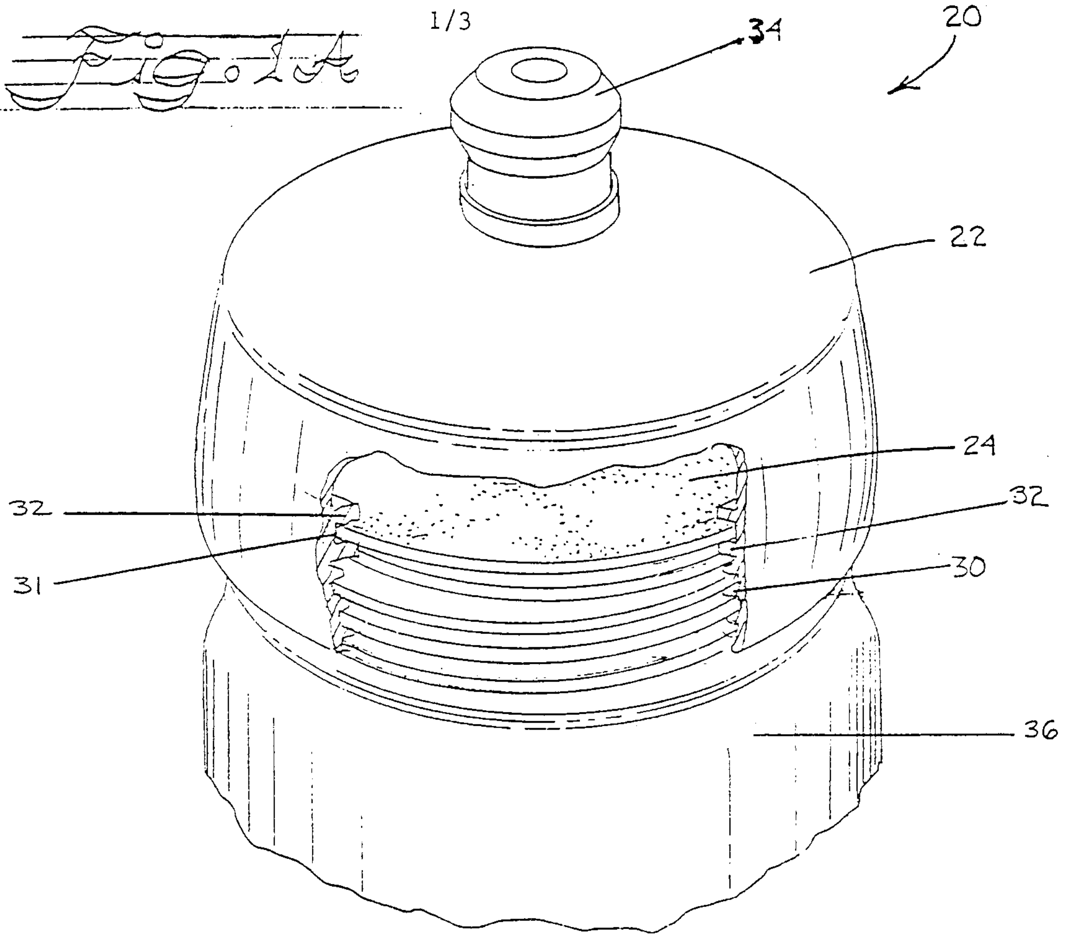
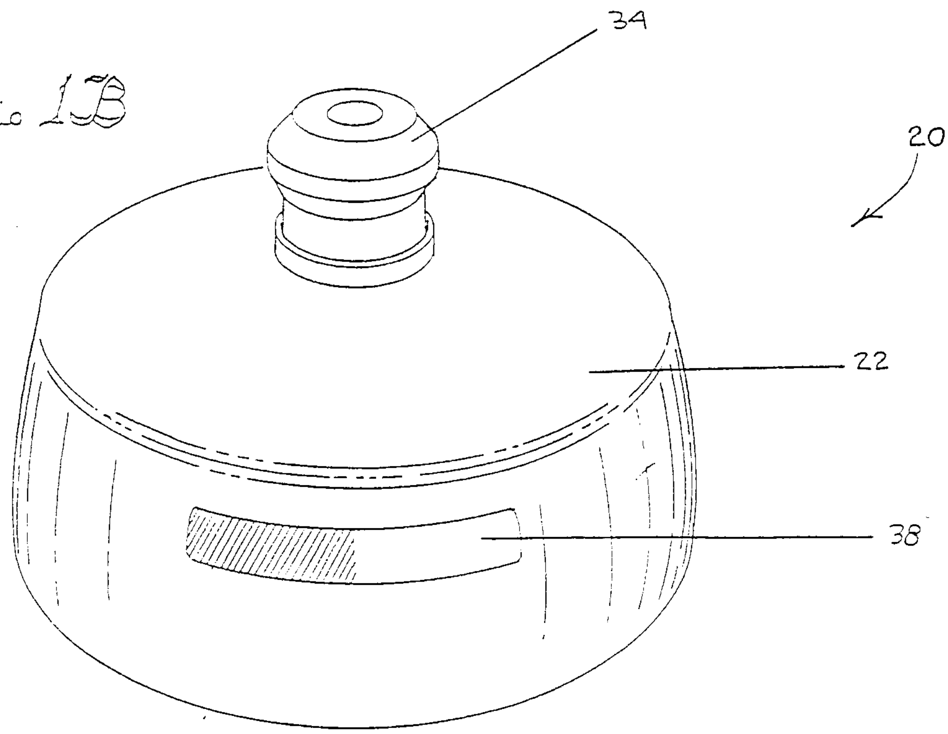


Fig. 1B



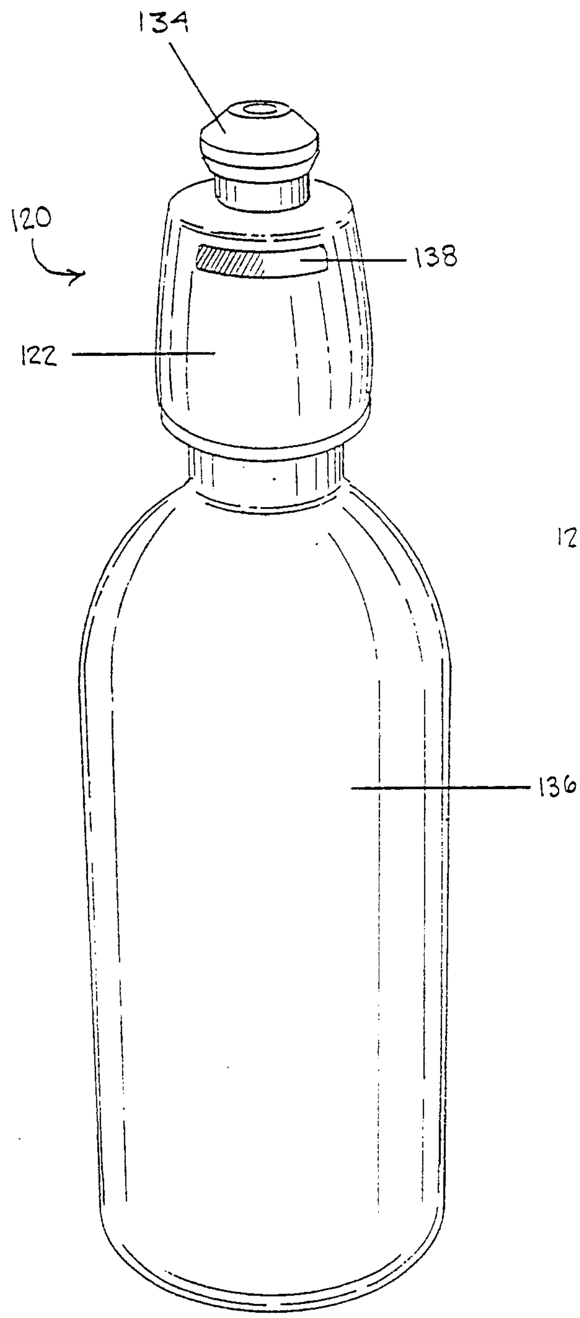


Fig. 2A

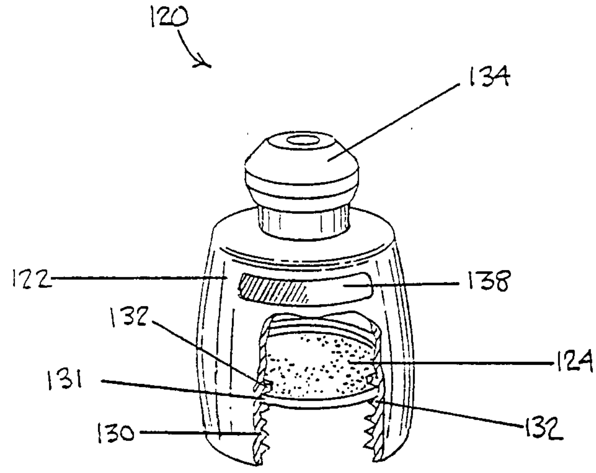


Fig. 2B

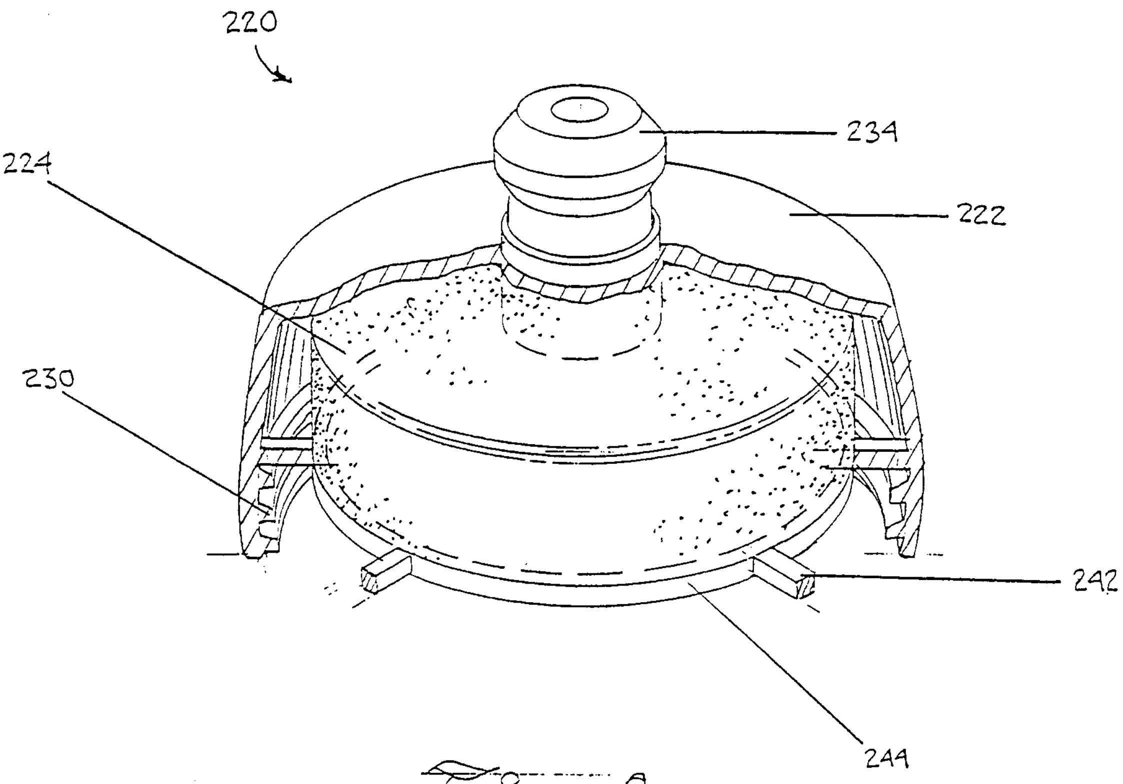


Fig. 3