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(54) **SOLUTE-DISPENSING CLOSURE**

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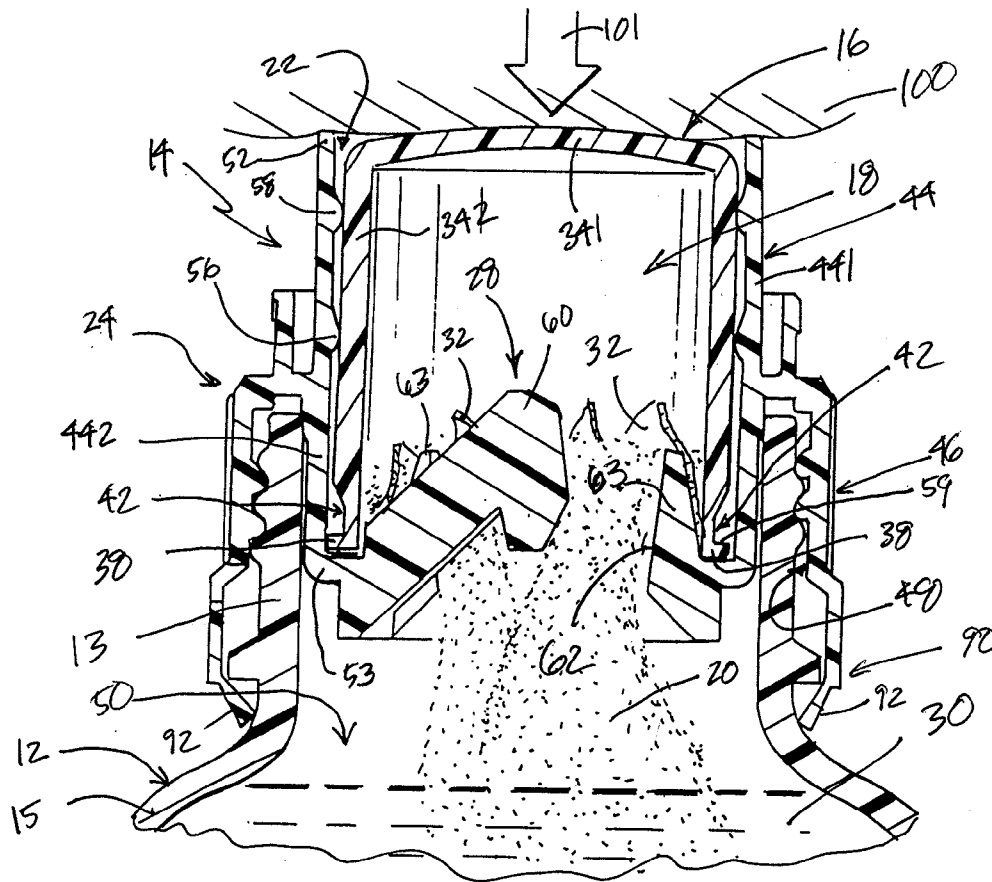
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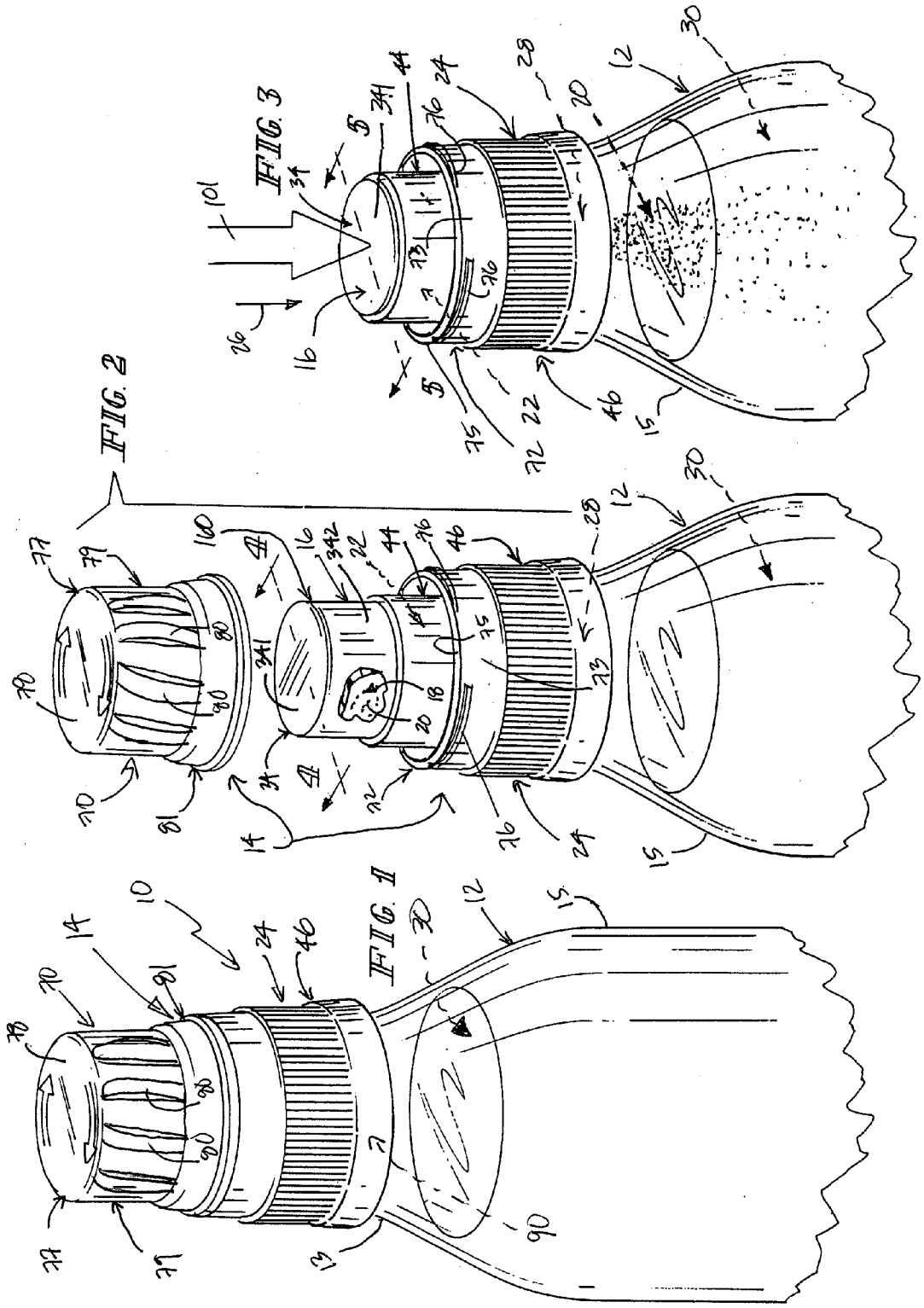
(57) **ABSTRACT**

A solute-dispensing closure is configured to mount on a filler neck of a container. Solute-dispensing closure can be operated by a user to discharge solute into solvent stored in a solvent reservoir provided in the container.

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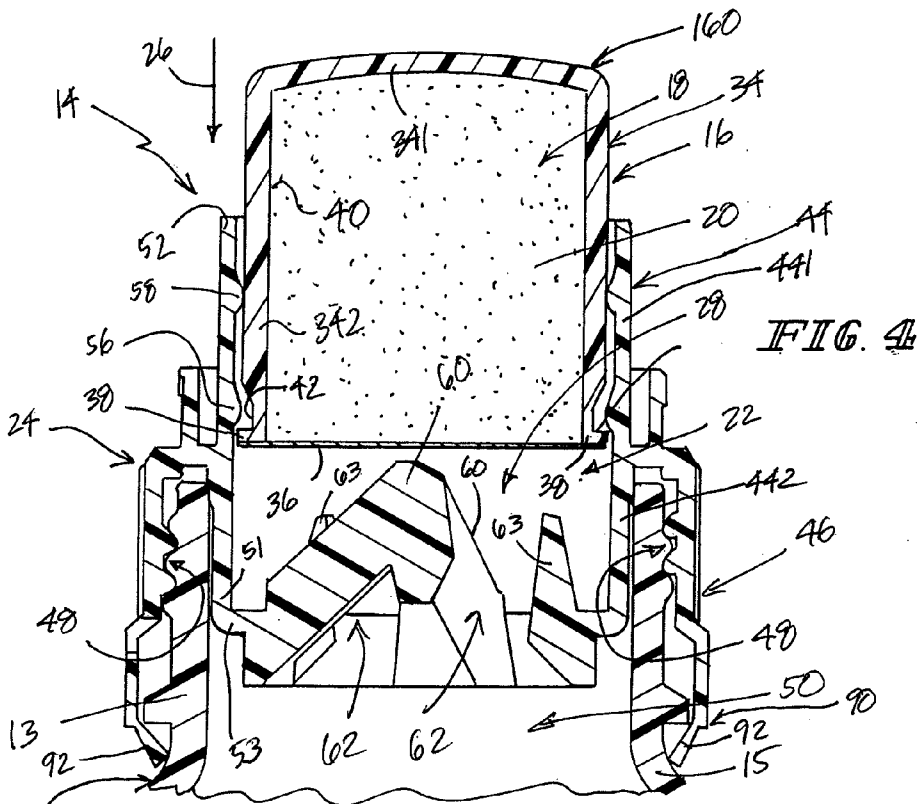


FIG. 4

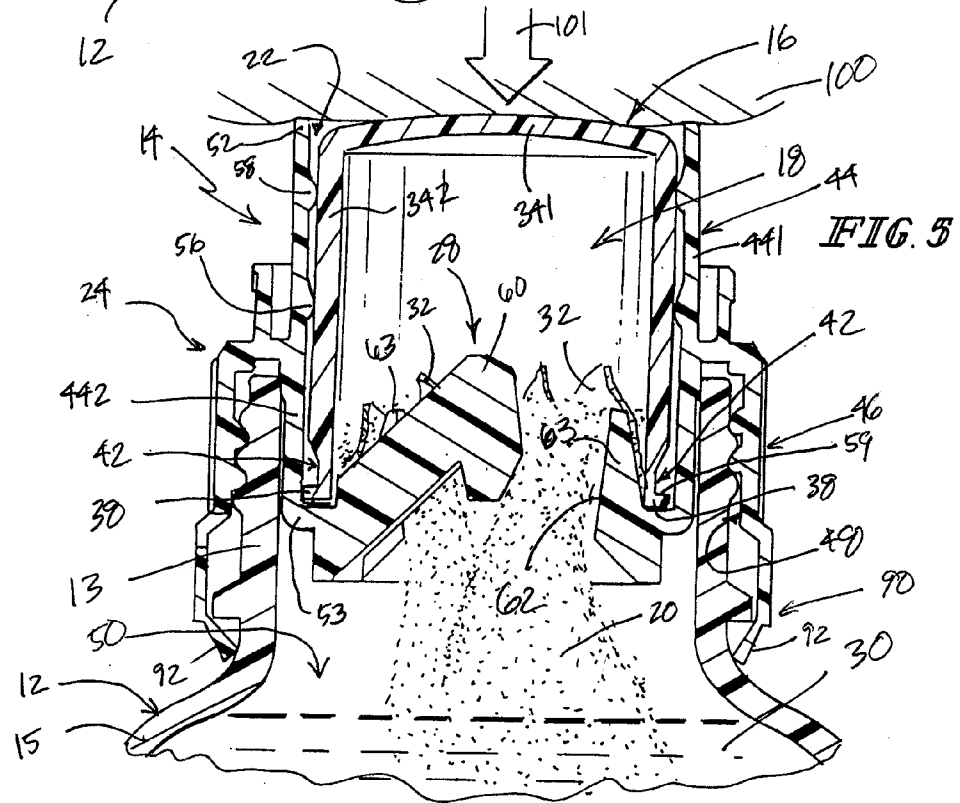
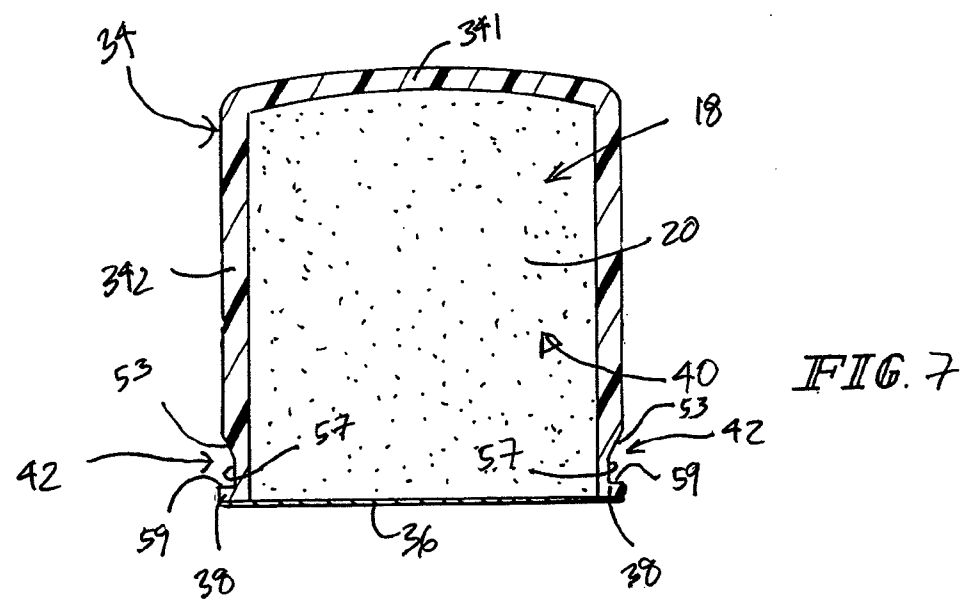
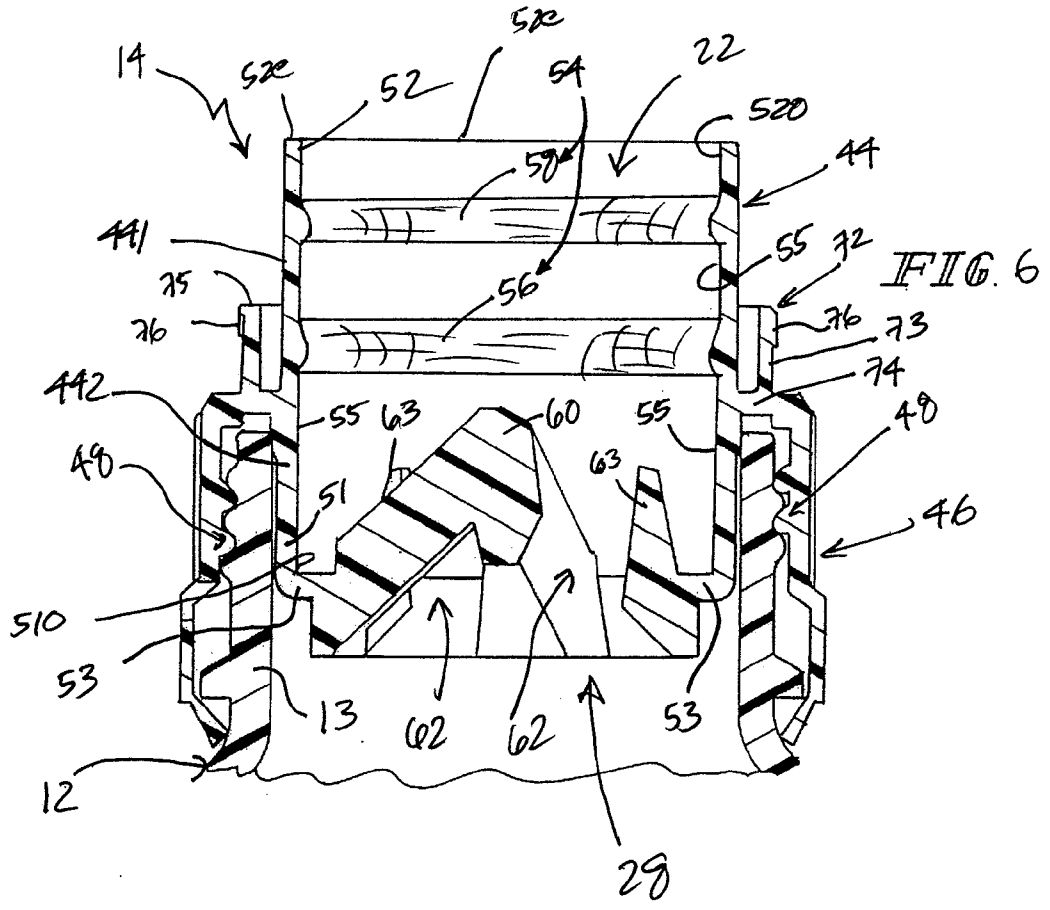
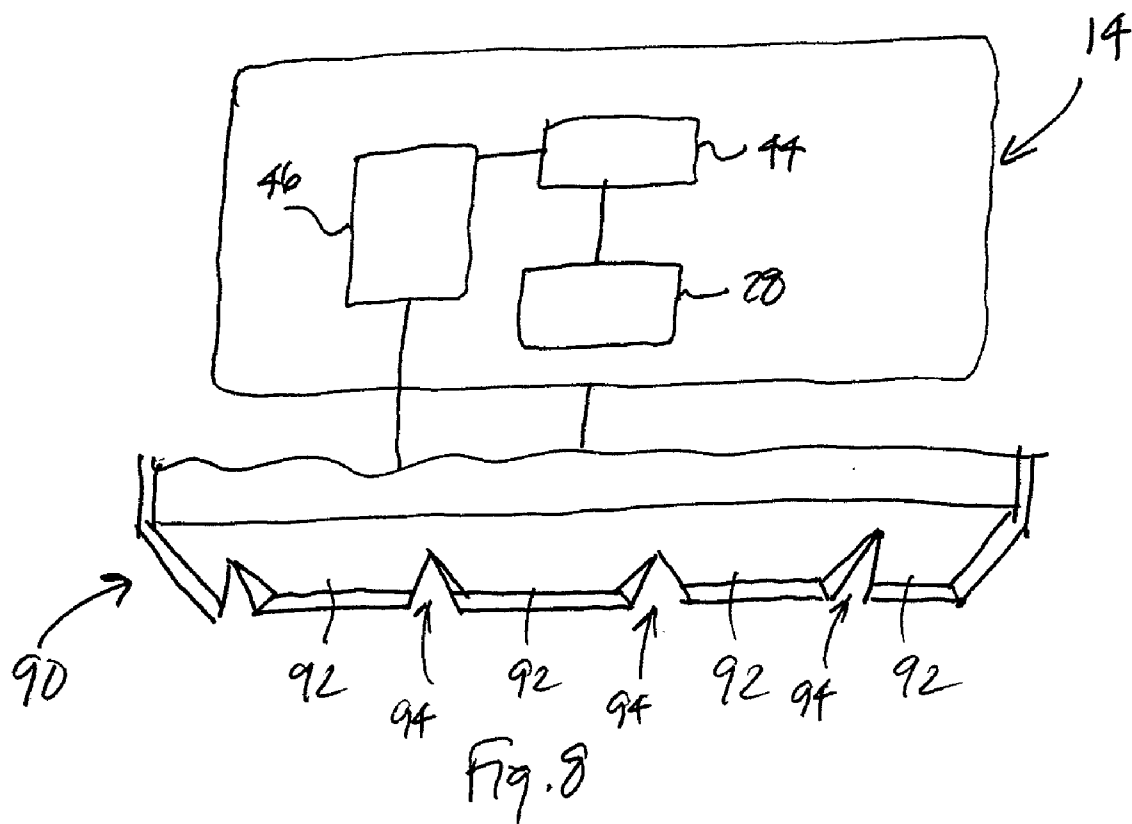


FIG. 5





SOLUTE-DISPENSING CLOSURE

[0001] This application is a continuation of U.S. application Ser. No. 12/418,498 filed Apr. 3, 2009 which claims is a continuation-in-part of U.S. application Ser. No. 11/024,026, filed Dec. 24, 2004 and claims priority under 35 U.S.C. § 119 (e) to U.S. Provisional Application Ser. No. 61/042,306, filed Apr. 4, 2008, which is expressly incorporated by reference herein.

BACKGROUND

[0002] The present disclosure relates to closures, and particularly to closures for mounting on the top of bottles or other containers. More particularly, the present disclosure relates to a closure configured to dispense a solute into a solvent contained in a container coupled to the closure.

SUMMARY

[0003] A solute-dispensing closure in accordance with the present disclosure is adapted to be coupled to a filler neck of a container. The solute-dispensing closure can be operated to discharge a solute into a solvent stored in the container.

[0004] In illustrative embodiments, the solute-dispensing closure includes a solute-carrier cartridge mounted for movement in a tubular inner guide from a raised solute-storage position to a lowered solute-dispensing position. The tubular inner guide is included in a cartridge-support body that is adapted to mount on a container filler neck to place the tubular inner guide in fluid communication with any solvent stored in an underlying container. A cartridge-piercing unit is coupled to a lower end of the tubular inner guide and arranged to puncture a downwardly moving solute-carrier cartridge to produce a solute-dispensing opening in the solute-carrier cartridge freeing any solute carried in the cartridge to flow into the solvent stored in the container.

[0005] In illustrative embodiments, the solute-carrier cartridge is arranged in the tubular inner guide to extend upwardly through a top aperture formed in the tubular inner guide to cause an exposed portion of the solute-carrier cartridge to lie outside the tubular inner guide when the solute-carrier cartridge is retained in the raised solute-storage position. In use, a consumer can easily apply an external impact force (using, for example, the palm of the consumer's hand) to dislodge the solute-carrier cartridge and move it downwardly in a cartridge-guiding passageway formed in the tubular inner guide to engage and be punctured by the cartridge-piercing unit. Once solute carried in the solute-carrier cartridge is discharged into solvent extant in the companion container, the consumer can shake the container vigorously to dissolve the solute in the solvent to produce a drink mixture in a solvent reservoir formed in the container.

[0006] In illustrative embodiments, a removable outer lid is coupled to the cartridge-support body. The outer lid is configured to cover the exposed portion of the movable solute-carrier cartridge to shield the movable solute-carrier cartridge from exposure to a premature external impact force to block premature movement of the solute-carrier cartridge to engage the cartridge-piercing unit and cause premature puncture of the solute-carrier cartridge and discharge of solute carried therein into an underlying pool of solvent in a container coupled to the cartridge-support body.

[0007] Additional features of the present disclosure will become apparent to those skilled in the art upon consideration of illustrative embodiments exemplifying the best mode of carrying out the disclosure as presently perceived.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The detailed description particularly refers to the accompanying figures in which:

[0009] FIG. 1 is a partial perspective view of a package including a container filled with a solvent such as drinking water and a solute-dispensing closure in accordance with the present disclosure mounted on a filler neck included in the container;

[0010] FIG. 2 is a view similar to FIG. 1 after removal of an outer lid included in the solute-dispensing closure to expose a cylinder-shaped upper portion of a movable solute-carrier cartridge arranged to project upwardly above a cylindrical rim of a cartridge-support body included in the solute-dispensing closure and coupled to the filler neck of the container;

[0011] FIG. 3 is a view similar to FIGS. 1 and 2 showing downward movement of the movable solute-carrier cartridge relative to the cartridge-support body from a raised solute-storage position shown in FIGS. 2 and 4 to a lowered solute-dispensing position shown in FIGS. 3 and 5 in response to application of a downwardly directed extended impact force to the exposed portion of the movable solute-carrier cartridge and showing powdered solute discharged from the solute-dispensing closure into solvent contained in a solvent reservoir provided in the underlying container;

[0012] FIG. 4 is an enlarged sectional view taken along line 4-4 showing the movable solute-carrier cartridge retained in the raised solute-storage position by engagement with retention ribs coupled to an interior wall included in the cartridge-support body and located above several angled radial blades included in a cartridge-piercing unit coupled to the cartridge-support body and arranged to underlie the solute-carrier cartridge;

[0013] FIG. 5 is an enlarged sectional view taken along line 5-5 showing puncture of a sealing member defining a lower end of the solute-carrier cartridge as suggested in FIG. 4 to produce an opening in the sealing member and cause discharge of powdered solute from the solute-carrier cartridge through the opening in the sealing member into a solvent (such as drinking water) stored in a solvent reservoir formed in the container coupled to the cartridge-support body included in the solute-dispensing closure before the package is shaken by a user to dissolve the solute in the solvent to produce a drink mixture in the solvent reservoir formed in the container;

[0014] FIG. 6 is a sectional view similar to FIGS. 4 and 5 but before the solute-carrier cartridge is installed in the cartridge-support body of the solute-dispensing closure;

[0015] FIG. 7 is a sectional view of the solute-carrier cartridge shown in FIG. 4 before it is installed in the cartridge-support body of the solute-dispensing closure; and

[0016] FIG. 8 is a diagrammatic view of a solute-dispensing closure in accordance with the present disclosure and an illustrative view of a tamper-evident band included in the solute-dispensing closure.

DETAILED DESCRIPTION

[0017] A package 10 in accordance with the present disclosure includes a container 12 and a solute-dispensing closure

14 coupled to container 12. As suggested in FIGS. 2 and 4, solute-dispensing closure 14 includes a solute-carrier cartridge 16 formed to include an interior solute-storage region 18 containing a solute 20. As suggested in FIGS. 3 and 5, solute-carrier cartridge 16 is mounted for movement in vertical cartridge-guiding passageway 22 formed in a cartridge-support body 24 included in solute-dispensing closure 14 and coupled to container 12. Once solute-carrier cartridge 16 is moved in a downward direction 26 in cartridge-guiding passageway 22, it is punctured by a cartridge-piercing unit 28 included in solute-dispensing closure 14 to cause solute 20 to be dispensed into solvent 30 stored in container 12 through an opening 32 formed in solute-carrier cartridge 16 as shown best in FIG. 5.

[0018] Once a user has applied a downward external impact force 101 to cause solute-carrier cartridge 16 to move downwardly and be punctured by underlying cartridge-piercing unit 28 to cause solute 20 to be dispensed into solvent 30, the user is instructed to shake package 10 to hasten the rate at which solute 20 dissolves in solvent 30 to produce a drink mixture in an interior solvent-storage region 50 formed in container 12. The user then removes solute-dispensing closure 14 from a filler neck 13 included in container 12 so that the user can access and consume the drink mixture. Should the user elect to store unconsumed drink mixture in container 12, solute-dispensing closure 14 or any other suitable filler-neck closure can be coupled to filler neck 13 to close an opening into the interior solvent-storage region 50 formed in container 12.

[0019] Solute-carrier cartridge (or cap) 16 includes an inverted cup 34 and a sealing member 36 coupled to a brim 38 of cup 34 to define interior region 18 of solute-carrier cartridge 16 as shown, for example, in FIGS. 4 and 7. Solute 20 is deposited into a cavity 40 formed in cup 34 before sealing member 36 is coupled to brim 38 of cup 34 to retain solute 20 in interior region 18. It is within the scope of this disclosure to use a powdered (as shown) or liquid solute to define solute 20 or to use any other suitable fluid solute.

[0020] Cup 34 in solute-carrier cartridge 16 includes a round end wall 341 and a cylindrical side wall 342 coupled to a perimeter edge of round end wall 341 in an illustrative embodiment as shown, for example, in FIG. 1. End wall 341 and side wall 342 cooperate to form cavity 40 as suggested in FIGS. 4 and 7. A radially outwardly opening annular detent-receiver notch 42 is formed in an outer portion of cylindrical side wall 342 located in close proximity to brim 38 and between brim 38 and bottom wall 341 as suggested in FIGS. 4 and 7. Notch 42 is bounded, for example, by a downwardly facing, frustoconical cam ramp 53, an annular upwardly facing annular surface 59, and a cylindrical radially outwardly facing surface 57 interconnecting cam ramp 53 and surface 59 as suggested in FIG. 7.

[0021] Sealing member 36 is coupled to cup 34 using any suitable means to close an opening into cavity 40 as shown, for example, in FIGS. 4 and 7. Sealing member 36 is coupled to brim 38 of cup 34 as suggested in FIGS. 4 and 7. Sealing member 36 remains intact in a solute-retaining state as suggested, for example, in FIG. 4 until punctured by cartridge-piercing unit 28 to produce solute-discharge opening 32 during downward movement of solute-carrier cartridge 16 in cartridge-guiding passageway 22 in direction 26 toward solvent 30 in container 12 as suggested, for example, in FIG. 5.

Sealing member 36 is, for example, a metallic foil (as shown) or a film made of a plastics material or other suitable pierceable closure.

[0022] Solute-dispensing closure 14 includes a tubular inner guide 44 formed to include cartridge-guiding passageway 22 and an outer skirt 46 coupled to tubular inner guide 44 and arranged to surround tubular inner guide 44 as shown, for example, in FIGS. 4 and 5. Outer skirt 46 is formed to include any suitable closure-attaching mechanism 48 configured to mount on container 12 to cause tubular inner guide 44 to communicate with an interior solvent-storage region 50 formed in container 12 as shown, for example, in FIGS. 4 and 5. In an illustrative embodiment, closure-attaching mechanism 48 is configured to mate with a filler neck 13 included in container 12 and coupled to a vessel 15 formed to store solvent 30 therein as suggested in FIGS. 4 and 5.

[0023] Tubular inner guide 44 of solute-dispensing closure 14 includes an open lower end 51 and opposite open upper end 52, and a cartridge-receiving space defined by cartridge-guiding passageway 22 extending therebetween as suggested in FIGS. 4 and 5. In an illustrative embodiment, cartridge-piercing unit 28 is arranged to lie in a stationary position adjacent to open lower end 51 of tubular inner guide 44 and arranged to extend upwardly in cartridge-guiding passageway 22 from open lower end 51 in a direction toward open upper end 52 as suggested in FIGS. 4 and 5. It is within the scope of this disclosure to couple cartridge-piercing unit 28 directly to tubular inner guide 44.

[0024] A cartridge retainer 54 is coupled to an interior wall 55 of tubular inner guide 44 as shown, for example, in FIG. 6. Cartridge retainer 54 includes a first retention rib 56 coupled to a middle section of interior wall 55 and a second retention rib 58 coupled to an upper section of interior wall 55 and arranged to lie between first retention rib 56 and open upper end 52 of tubular inner guide 44 as shown, for example, in FIG. 6. First retention rib 56 is positioned to lie between cartridge-piercing unit 28 and second retention rib 58 in an illustrative embodiment. Each of first and second retainer ribs 56, 58 is an annular protuberance extending radially inwardly from cylindrical interior wall 55 into cartridge-guiding passageway 22 in an illustrative embodiment shown in FIG. 6.

[0025] Cartridge retainer 54 is configured normally to retain solute-dispensing cartridge 16 in a raised solute-storage position as shown, for example, in FIG. 4 until a user 100 elects to contact end wall 341 of cup 34 and apply a downward external impact force 101 to an exposed portion 160 of cup 34. First retention rib 56 extends radially inwardly into annular notch 42 formed in side wall 342 of cup 34. First retention rib 56 acts as a detent to engage an annular upwardly facing surface 59 included in cup 34 at notch 42 to block withdrawal of cup 34 from cartridge-guiding passageway 22 formed in tubular inner guide 44. Second retention rib 56 is configured and sized to provide means for establishing an interference fit with an outer surface of side wall 342 of cup 34 normally to retain solute-carrier cartridge 16 in the raised solute-storage position shown in FIG. 4 yet allow downward movement of solute-carrier cartridge 16 in direction 26 in cartridge-guiding passageway 22 toward cartridge-piercing unit 28 in response to application of an external impact force 101 to end wall 341 of cup 34 that has a magnitude in excess of a predetermined threshold level. It is also within the scope of this disclosure to cause first retention rib 56 to extend into notch 42 to establish or to help establish the raised solute-storage position of solute-carrier cartridge 16.

[0026] Cartridge-piercing unit 28 comprises a plurality of angled radial blades 60 that are coupled at a lower end thereof to open lower end 51 of tubular inner guide 44 as shown in FIGS. 4 and 6 by means, for example, of one or more radially extending cartridge stops 53 arranged to interconnect tubular inner guide 44 and cartridge-piercing unit 28. Blades 60 are arranged to converge at upper ends thereof and extend upwardly toward open upper end 52 of tubular inner guide 44. The upper ends of angled radial blades 60 are arranged to face toward and lie in closely confronting relation to sealing member 36 of solute-carrier cartridge 16 as suggested in FIG. 4 when solute-carrier cartridge 16 is retained by cartridge retainer 54 in the raised solute-storage position as shown, for example, in FIG. 4.

[0027] Cartridge-piercing unit 28 further includes several upwardly extending sealing-member folders 63 arranged to lie in spaces provided between adjacent pairs of angled radial blades 60. Folders 63 cooperate to provide means for moving and separating portions of the punctured sealing member 36 after sealing member 36 has been punctured by blades 60 to expand opening 32 to maximize flow of solute 20 out of solute-carrier cartridge 16 and into solvent 30.

[0028] Solute-carrier cartridge 16 is mounted for movement in cartridge-guiding passageway 22 formed in tubular inner guide 44 to present sealing member 36 in confronting relation to angled radial blades 60 of cartridge-piercing unit 28 as suggested in FIG. 4. Solute-carrier cartridge 16 is movable between a closed sealed position (i.e., raised solute-storage position) in which sealing member 36 is separated from cartridge-piercing unit 28 as shown in FIG. 4 and an opened solute-dispensing position in which sealing member 36 is punctured or otherwise pierced by cartridge-piercing unit 28 to free any dispensable material (i.e., solute 20) stored in interior region 18 of solute-carrier cartridge 16 to flow through passageways 62 formed between angled radial blades 60 and open lower end 51 of tubular inner guide 44 into interior solvent-storage region 50 of container 12 to mix with any solvent 30 stored therein. In an illustrative embodiment, cartridge stops 53 are coupled to lower end 51 of tubular inner guide 44 and arranged to engage solute-carrier cartridge 16 after cartridge-piercing unit 28 has punctured solute-carrier cartridge 16 to produce solute-discharge opening 32 so as to limit any further downward movement of solute-carrier cartridge 16 in direction 26 toward interior solvent-storage region 50 in container 12.

[0029] As suggested in FIG. 6, tubular inner guide 44 includes an upper guide portion 441 and a lower guide portion 442. Upper guide portion 441 is arranged to extend upwardly from outer skirt 46 and cartridge-piercing unit 28 and terminate at open upper end 52. First and second retention ribs 56, 58 included in cartridge retainer 54 are coupled to upper guide portion 441 as shown in FIG. 6. Upper guide portion 441 is configured to form an upper portion of cartridge-guiding passageway 22. Lower guide portion 442 is surrounded in part by closure-attaching mechanism 48 and arranged to extend downwardly from upper guide portion 441 and terminate at open lower end 51. Lower guide portion 442 is configured to form a lower portion of cartridge-guiding passageway 22. Solute-carrier cartridge 16 is arranged to extend into upper guide portion 441 but lie outside of lower guide portion 442 when solute-carrier cartridge 16 is arranged to lie in the raised solute-storage position as shown, for example, in FIG. 4. Solute-carrier cartridge 16 is arranged to lie partly in each of upper and lower guide portions 441, 442 when solute-

carrier cartridge 16 is moved to engage cartridge stop(s) 53 and assume the lowered solute-dispensing position as shown, for example, in FIG. 5.

[0030] A removable outer lid 70 is configured to be mounted on solute-dispensing closure 14 to cover solute-carrier cartridge 16 as suggested in FIGS. 1 and 2. Outer lid 70 functions both as a dust cover and means for blocking inadvertent puncture of solute-carrier cartridge 16. When outer lid 70 is mounted in place as suggested in FIG. 1, solute-carrier cartridge 16 is covered and shielded and thus not exposed to any external impact forces such as downward force 101.

[0031] An upstanding lid mount 72 is coupled to outer skirt 46 and configured to mate with removable outer lid 70 as suggested in FIGS. 2, 4, and 6. In an illustrative embodiment, lid mount 72 includes an annular sleeve 73 having a lower end coupled to a radially outwardly extending annular platform 74 included in outer skirt 46. Annular platform 74 is arranged to surround and mate with a middle portion of tubular inner guide 44 and define a boundary between upper and lower guide portions 441, 442 as shown best in FIG. 6. Annular sleeve 73 is arranged to surround and lie in spaced-apart relation to upper guide portion 441 of tubular inner guide 44 and terminate at an open upper end 75 as shown best in FIG. 6. Lid mount 72 also includes one or more helical lid-retention flanges 76 coupled to an exterior surface of annular sleeve 73 and arranged to mate with companion flanges (not shown) included in outer lid 70 to retain outer lid 70 in place on solute-dispensing closure 14 as suggested in FIG. 1.

[0032] In an illustrative embodiment, removable outer lid 70 is a twist-off lid and includes a top dome 77 having a round top wall 78 and a depending cylindrical side wall 79 as shown, for example, in FIGS. 1 and 2. Outer lid 70 also includes a series of circumferentially spaced-apart, vertically extending, top load/support ribs 80 formed in side wall 79. These ribs 80 cooperate to provide means for rigidifying top dome 77 so that it can support the weight of other packages stacked on top of top dome 77 to enhance the stacking strength of outer lid 77 and avoid premature downward movement of solute-carrier cartridge 16 in downward direction 26 relative to cartridge-support body 24 that could lead to premature puncture of solute-carrier cartridge 16. Outer lid 70 also includes a lower rim 81 coupled to a lower edge of cylindrical side wall and formed to include flanges (not shown) configured to mate with lid-retention flanges in lid mount 72. It is within the scope of this disclosure to use any suitable means to retain removable outer lid 70 on cartridge-support body 24.

[0033] A tamper-evident band 90 is included in a lower-most portion of solute-dispensing closure 14 as suggested in FIG. 8 (and in FIG. 1). Band 90 is coupled to outer skirt 46 as suggested diagrammatically in FIG. 8. Band 90 comprises a series of folded tabs 92 separated by V-shaped channels 94 as shown, for example, in FIG. 8. Tamper-band 90 is shown in place on filler neck 13 of container 12 in FIGS. 4 and 5.

[0034] Cartridge-support body 24 includes a tubular inner guide 44 formed to include a cartridge-guiding passageway 22 and a guide mount 46 coupled to tubular inner guide 44. Guide mount 46 is adapted to be coupled to a container 12 to hold tubular inner guide 44 in a stationary position relative to container 12 placing cartridge-guiding passageway 22 in fluid communication with an interior solvent-storage region 50 formed in container 12. Tubular inner guide 44 is formed to include a top aperture 520 opening into cartridge-guiding passageway 22 as suggested in FIG. 6 and a bottom aperture 510 opening into cartridge-guiding passageway 22 and com-

municating with interior solvent-storage region 50 of a container 12 coupled to guide mount 46.

[0035] Cartridge-piercing unit 28 is associated with bottom aperture 510 formed in tubular inner guide 44. Solute-carrier cartridge 16 is mounted for movement in tubular inner guide 44 toward cartridge-piercing unit 28.

[0036] Cartridge retainer 54 is coupled to tubular inner guide 44. Cartridge retainer 54 is configured to provide means for normally retaining solute-carrier cartridge 16 in a raised solute-storage position lying in spaced-apart relation to cartridge-piercing unit 28 and extending outwardly through top aperture 520 formed in tubular inner guide 44 to cause an exposed portion 160 of solute-carrier cartridge 16 to lie outside of cartridge-guiding passageway 22 until an external impact force 101 is applied to exposed portion 160 to cause solute-carrier cartridge 16 to move in cartridge-guiding passageway 22 to engage cartridge-piercing unit 28 and cause cartridge-piercing unit 28 to puncture solute-carrier cartridge 16 and establish a solute-discharge opening 32 in solute-carrier cartridge 16 freeing any solute 20 carried in solute-carrier cartridge 16 to flow out of solute-carrier cartridge 16 into any solvent 30 stored in an interior solvent-storage region 50 formed in a container 12 coupled to guide mount 46.

[0037] Tubular inner guide 44 includes a top edge 52e deformed to define top aperture 520 as suggested in FIG. 6. Solute-carrier cartridge 16 includes a cup 34 formed to include an end wall 341 and a side wall 342. End wall 341 is arranged to lie outside cartridge-guiding passageway 22 and in spaced-apart relation to top edge 52e of tubular inner guide 44. Side wall 342 is coupled to end wall 341 and arranged to extend into cartridge-guiding passageway 22 and terminate at a brim 38 when solute-carrier cartridge 16 is retained in the raised solute-storage position.

[0038] Solute-carrier 16 cartridge further includes a sealing member 36 coupled to brim 38 and arranged to lie in spaced-apart relation to end wall 341 of cup 34. Sealing member 36 cooperates with the end and side walls 341, 342 of cup 34 to define an interior solute-storage region 18 therebetween. Sealing member 36 is arranged to lie in confronting relation to cartridge-piercing unit 28 when solute-carrier cartridge 16 is retained in the raised solute-storage position and to be punctured by cartridge-piercing unit 28 upon movement of solute-carrier cartridge 16 in cartridge-guiding passageway 22 to engage cartridge-piercing unit 28.

[0039] Tubular inner guide 44 is cylinder-shaped as suggested in FIGS. 2, 4, and 6. Top edge 52e has an annular shape. A portion of side wall 342 included in exposed portion 160 of solute-carrier cartridge 16 is cylinder shaped.

[0040] Removable outer lid 70 is coupled to cartridge-support body 24 to cover exposed portion 160 of solute-carrier cartridge 16 to provide means for shielding exposed portion 160 of solute-carrier cartridge 16 from the raised solute-storage position to a lowered solute-dispensing position in engagement with cartridge-piercing unit 28 to establish solute-discharge opening 32 in solute-carrier cartridge 16. Cartridge-support body 24 further includes an upstanding lid mount 72 coupled to outer skirt 46. Upstanding lid mount 72 is arranged to surround tubular inner guide 44. Removable outer lid 70 is configured to mate with upstanding lid mount 72 to lie in spaced-apart relation to exposed portion 160 of solute-carrier cartridge 16. Top edge 52e of tubular inner guide 44 is arranged to lie above upstanding lid mount 72 and

below end wall 341 of cup 34 in solute-carrier cartridge 16 when solute-carrier cartridge 16 is retained in the raised solute-storage position.

[0041] Cartridge retainer 54 includes a first retention rib 56 coupled to tubular inner guide 44 and arranged to lie in cartridge-guiding passageway 22. Solute-carrier cartridge 16 is formed to include an outwardly opening notch 42. First retention rib 56 is arranged to extend into the outwardly opening notch 42 to establish the raised solute-storage position of the solute-carrier cartridge 16 in cartridge-guiding passageway 22. First retention rib 56 is arranged to extend into outwardly opening notch 42 and to confront an upwardly facing surface 59 included in solute-carrier cartridge 16 to provide means for engaging upwardly facing surface 59 to block withdrawal of solute-carrier cartridge 16 from cartridge-guiding passageway 22 through top aperture 520 formed in tubular inner guide 44.

[0042] Cartridge retainer 54 further includes a second retention rib 58 coupled to tubular inner guide 44 and arranged to lie in cartridge-guiding passageway 22. Second retention rib 58 is configured and sized to provide means for establishing an interference fit with an outer surface of solute-carrier cartridge 16 normally to retain solute-carrier cartridge 16 in the raised solute-storage position in cartridge-guiding passageway 22. Tubular inner guide 44 includes a top edge 52e formed to define top aperture 520 and second retention rib 58 is arranged to lie between top edge 52e and first retention rib 56.

[0043] Cartridge-support body 24 further includes a cartridge stop 53 coupled to tubular inner guide 44. Cartridge stop 53 is arranged to engage solute-carrier cartridge 16 after cartridge-piercing unit 28 has punctured solute-carrier cartridge 16 to produce solute-discharge opening 32 in solute-carrier cartridge 16. First retention rib 56 is arranged to lie between second retention rib 58 and cartridge stop 53. Cartridge stop 53 is arranged to interconnect tubular inner guide 44 and cartridge-piercing unit 28 and to support cartridge-piercing unit 28 in a stationary position extending into cartridge-guiding passageway 22.

1. A solute-dispensing closure comprising
 - a cartridge-support body including a tubular inner guide formed to include a cartridge-guiding passageway and a guide mount coupled to the tubular inner guide and adapted to be coupled to a container to hold the tubular inner guide in a stationary position relative to the container placing the cartridge-guiding passageway in fluid communication with an interior solvent-storage region formed in the container, the tubular inner guide being formed to include a top aperture opening into the cartridge-guiding passageway and a bottom aperture opening into the cartridge-guiding passageway and communicating with the interior solvent-storage region of a container coupled to the guide mount,
 - a cartridge-piercing unit associated with the bottom aperture formed in the tubular inner guide,
 - a solute-carrier cartridge mounted for movement in the tubular inner guide toward the cartridge-piercing unit, and
 - a cartridge retainer coupled to the tubular inner guide and configured to provide means for normally retaining the solute-carrier cartridge in a raised solute-storage position lying in spaced-apart relation to the cartridge-piercing unit and extending outwardly through the top aperture formed in the tubular inner guide to cause an

exposed portion of the solute-carrier cartridge to lie outside of the cartridge-guiding passageway until an external impact force is applied to the exposed portion to cause the solute-carrier cartridge to move in the cartridge-guiding passageway to engage the cartridge-piercing unit and cause the cartridge-piercing unit to puncture the solute-carrier cartridge and establish a solute-discharge opening in the solute-carrier cartridge freeing any solute carried in the solute-carrier cartridge to flow out of the solute-carrier cartridge into any solvent stored in an interior solvent-storage region formed in a container coupled to the guide mount.

2. The solute-dispensing closure of claim 1, wherein the tubular inner guide includes a top edge formed to define the top aperture and the solute-carrier cartridge includes a cup formed to include an end wall arranged to lie outside the cartridge-guiding passageway and in spaced-apart relation to the top edge of the tubular inner guide and a side wall coupled to the end wall and arranged to extend into the cartridge-guiding passageway and terminate at a brim when the solute-carrier cartridge is retained in the raised solute-storage position.

3. The solute-dispensing closure of claim 2, wherein the solute-carrier cartridge further includes a sealing member coupled to the brim and arranged to lie in spaced-apart relation to the end wall of the cup and cooperate with the end and side walls of the cup to define an interior solute-storage region therebetween and the sealing member is arranged to lie in confronting relation to the cartridge-piercing unit when the solute-carrier cartridge is retained in the raised solute-storage position and to be punctured by the cartridge-piercing unit upon movement of the solute-carrier cartridge in the cartridge-guiding passageway to engage the cartridge-piercing unit.

4. The solute-dispensing closure of claim 2, wherein the tubular inner guide is cylinder-shaped, the top edge has an annular shape, and a portion of the side wall included in the exposed portion of solute-carrier cartridge is cylinder-shaped.

5. The solute-dispensing closure of claim 2, further comprising a removable outer lid coupled to the cartridge-support body to cover the exposed portion of the solute-carrier cartridge to provide means for shielding the exposed portion of the solute-carrier cartridge from the raised solute-storage position to a lowered solute-dispensing position in engagement with the cartridge-piercing unit to establish the solute-discharge opening in the solute-carrier cartridge.

6. The solute-dispensing closure of claim 5, wherein the cartridge-support body further includes an upstanding lid mount coupled to the outer skirt and arranged to surround the tubular inner guide and the removable outer lid is configured to mate with the upstanding lid mount to lie in spaced-apart relation to the exposed portion of the solute-carrier cartridge.

7. The solute-dispensing closure of claim 6, wherein the top edge of the tubular inner guide is arranged to lie above the upstanding lid mount and below the end wall of the cup in the solute-carrier cartridge when the solute-carrier cartridge is retained in the raised solute-storage position.

8. The solute-dispensing closure of claim 1, wherein the cartridge retainer includes a first retention rib coupled to the tubular inner guide and arranged to lie in the cartridge-guiding passageway, the solute-carrier cartridge is formed to include an outwardly opening notch, and the first retention rib is arranged to extend into the outwardly opening notch to

establish the raised solute-storage position of the solute-carrier cartridge in the cartridge-guiding passageway.

9. The solute-dispensing closure of claim 8, wherein the first retention rib is arranged to extend into the outwardly opening notch and to confront an upwardly facing surface included in the solute-carrier cartridge to provide means for engaging the upwardly facing surface to block withdrawal of the solute-carrier cartridge from the cartridge-guiding passageway through the top aperture formed in the tubular inner guide.

10. The solute-dispensing closure of claim 8, wherein the cartridge retainer further includes a second retention rib coupled to the tubular inner guide and arranged to lie in the cartridge-guiding passageway and the second retention rib is configured and sized to provide means for establishing an interference fit with an outer surface of the solute-carrier cartridge normally to retain the solute-carrier cartridge in the raised solute-storage position in the cartridge-guiding passageway.

11. The solute-dispensing closure of claim 10, wherein the tubular inner guide includes a top edge formed to define the top aperture and the second retention rib is arranged to lie between the top edge and the first retention rib.

12. The solute-dispensing closure of claim 10, wherein the cartridge-support body further includes a cartridge stop coupled to the tubular inner guide and arranged to engage the solute-carrier cartridge after the cartridge-piercing unit has punctured the solute-carrier cartridge to produce the solute-discharge opening in the solute-carrier cartridge and wherein the first retention rib is arranged to lie between the second retention rib and the cartridge stop.

13. The solute-dispensing closure of claim 12, wherein the cartridge stop is arranged to interconnect the tubular inner guide and the cartridge-piercing unit and to support the cartridge-piercing unit in a stationary position extending into the cartridge-guiding passageway.

14. The solute-dispensing closure of claim 1, wherein the cartridge retainer further includes a retention rib coupled to the tubular inner guide and arranged to lie in the cartridge-guiding passageway and the retention rib is configured and sized to provide means for establishing an interference fit with an outer surface of the solute-carrier cartridge normally to retain the solute-carrier cartridge in the raised solute-storage position in the cartridge-guiding passageway and yielding in response to application of an external impact force to the exposed portion of the solute-carrier cartridge to allow movement of the solute-carrier cartridge in the cartridge-guiding passageway to engage the cartridge-piercing unit so that the solute-discharge opening is produced in the solute-carrier cartridge.

15. The solute-dispensing closure of claim 1, wherein the solute-carrier cartridge includes a cup formed to include a cavity and a sealing member coupled to a brim of the cup to close an aperture defined by the brim of the cup and arranged to open into the cavity to form an interior solute-storage region of the solute-carrier cartridge and the exposed portion of the solute-carrier cartridge is defined by the cup.

16. The solute-dispensing closure of claim 15, wherein the cup includes an end wall and a side wall coupled to a perimeter edge of the end wall, the end and side walls cooperate to form the cavity, a terminal end of the side wall is located in spaced-apart relation to the end wall and formed to include the brim, and the exposed portion of the solute-carrier cartridge is defined by the end wall and an upper portion of the side wall appendant to the end wall and arranged to lie in spaced-apart relation to the brim.