A DISPENSING BOTTLE CAP COMPRISING A STRESS-RUPTURABLE CHAMBER

TECHNICAL FIELD

[0001] The present invention belongs to the technical field of bottle caps and, in particular, relates to a dispensing bottle cap operable to release substance prestored inside the bottle cap.

BACKGROUND

[0002] The following discussion of the background to the invention is intended to facilitate an understanding of the present invention only. It should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was published, known or part of the common general knowledge of the person skilled in the art in any jurisdiction as at the priority date of the invention.

[0003] Many products are sold in concentrated liquid, crystalline, or powder forms and require mixing with a liquid before consumption or use. These products include food, medicine, cosmetics, adhesives, polishes, cleaning agents, infant formula, mixed beverages, meat substitutes, nutritional powders, energy mixtures, supplements, and other substances. While these products are stable when stored separately, they often degrade in stability, potency, and effectiveness after being mixed into a solution or suspension. To preserve their quality and shelf life, these substances are typically stored in separate compartments and only combined when needed.

[0004] With the increasing demand for on-the-go convenience, modern consumers seek portable, user-friendly packaging that simplifies the mixing process. To meet this demand, pre-measured ingredient packaging has become essential, ensuring that each component is precisely portioned for mixing with a predetermined volume of liquid to maintain the desired solution concentration. However, for manufacturers, designing such dual-compartment packaging presents challenges, as consumers prefer a single integrated package that can store, dispense, and mix components efficiently while eliminating the need for multiple containers.

[0005] To address these challenges, the US Patent Application document US20110174642A1 discloses a dispensing bottle cap featuring a membrane button, an insertion post, and a frangible membrane, forming a system that selectively dispenses a preloaded substance from the cap into an attached bottle. In this disclosure, pressing the button on the cap's membrane drives the insertion post toward the frangible membrane, applying axial force to break it. This process then releases the preloaded substance into the bottle.

[0006] However, this existing solution has various limitations. The button often requires substantial force to press, making it difficult for children and individuals with limited hand strength to puncture the membrane. Additionally, inefficient force distribution may lead to inconsistent puncturing, potentially affecting the controlled release of the preloaded substance.

[0007] There exists a need to develop an improved dispensing bottle cap that offers easier operation, reduces the force required for puncturing the membrane, addressing at least one of the problems associated with conventional systems.

SUMMARY

[0008] Specifically, to address the above-mentioned technical problems, the present invention specifically uses the following technical solutions:

[0009] Accordingly, an aspect of the invention refers to a dispensing bottle cap, comprising a base (1), a pressing key (2), and a chamber bottom (3) disposed inside the base (1), wherein the two ends of the base (1) are respectively provided with a first opening (102) and a second opening (103);

[0010] the pressing key (2) comprises a flexible pressing portion (21), a connecting portion (22), and a stress-actuated portion (23); the connecting portion (22) is circumferentially disposed around the pressing portion (21), and the stress-actuated portion (23) is connected to the pressing portion (21); the connecting portion (22) is disposed at the first opening (102), and the pressing portion (21), the base (1), and the chamber bottom (3) enclose a sealed accommodating chamber (101);

[0011] the stress-actuated portion (23) comprises a stress post (231) and at least three stress ribs (232) circumferentially disposed on the sidewall of the stress post (231), wherein the second ends of the stress ribs (232) extend along the height direction of the stress post (231) and enclose a limiting space (234) with the stress post (231);

[0012] the chamber bottom (3) is provided with at least three rupture slits (31), which divide the chamber bottom (3) into at least three rupture flaps (32), wherein a stress concentration point (33) is arranged at the common junction of the at least three rupture flaps (32), and a rupture groove (34) is formed at the junction of the stress concentration point (33) and the rupture flaps (32), wherein the thickness of the rupture groove (34) at the junction of one rupture flap (32) is greater than that of the other portions of the rupture groove (34), and the thicknesses of the rupture slits (31) and the rupture groove (34) are both smaller than that of the rupture flaps (32);

[0013] the thickness of the stress concentration point (33) is configured to be greater than that of the rupture flaps (32), and at least a portion of the stress concentration point (33) is configured to protrude into the accommodating chamber (101) to form a stress structure corresponding to the limiting space (234);

[0014] when the pressing portion (21) is pressed downward, the pressing portion (21) is operable to deform downward and to drive the stress-actuated portion (23) downward, wherein the at least three stress ribs (232) respectively contact the at least three rupture slits (31) and gradually tear them apart, the thinner portion of the rupture groove (34) breaks, and simultaneously, the inner wall of the limiting space (234) contacts the stress concentration point (33) and drives the stress concentration point (33) downward, thereby pushing the stress ribs (232) connected to the stress concentration point (33) outward, so that the chamber bottom (3) forms an opening and the preloaded substance In the accommodating chamber (101) is operable to leak out from the opening.

[0015] In some embodiments, a push rib (237) is configured to be disposed between at least two adjacent stress ribs (232), and the number of push ribs (237) is less than or equal to the number of stress ribs (232);

[0016] when the stress ribs (232) contact and tear the rupture slits (31), and pressing continues on the pressing portion (21), the push rib (237) presses against the rupture flaps (32) and drives the rupture flaps (32) downward to enlarge the area of the opening.

[0017] In some embodiments, wherein when no external force is applied to the pressing portion (21), the pressing portion (21) is higher than the height of the connecting portion (22) to form a pressing protrusion above the first opening (102).

[0018] In some embodiments, the dispensing bottle cap further comprises a protective cover (4), wherein the protective cover (4) is detachably connected to the base (1) and surrounds the pressing protrusion to enclose the pressing protrusion.

[0019] In some embodiments, the sidewall of the protective cover (4) is circumferentially provided with multiple anti-slip elements (401).

[0020] In some embodiments, the second end of the stress rib (232) is provided with a stress slope (238), wherein the stress slope (238) extends along the axial direction of the stress post (231), and its width gradually decreases from a first end to a second end, such that the second end of the stress rib (232) forms a sharp bearing point (233) adjacent to the limiting space (234);

[0021] the acute angle α1 between the stress slope (238) and the horizontal plane is greater than the acute angle α2 between the rupture flap (32) and the horizontal plane;

[0022] when the pressing portion (21) is pressed downward, the pressing portion (21) deforms downward and drives the stress-actuated portion (23) downward, wherein the sharp bearing point (233) first contacts the rupture groove (34) or the rupture slit (31) and then progressively separates multiple rupture flaps (32) along the extension direction of the rupture slit (31).

[0023] In some embodiments, the chamber bottom (3) is circumferentially disposed along the inner wall of the base (1) and gradually extends downward to form a conical structure, wherein the conical structure is provided with a polygonal mounting hole, and multiple rupture flaps (32) are respectively connected to multiple edges of the mounting hole, sequentially blocking the mounting hole.

[0024] In some embodiments, the stress concentration point (33) is located at the center of the chamber bottom (3), and the height of the stress concentration point (33) is lower than that of the mounting hole, such that the height of the rupture flaps (32) gradually decreases from the end connected to the mounting hole to the end connected to the stress concentration point (33), enabling the preloaded substance to flow out along

the guiding slope and/or the rupture flaps (32).

[0025] In some embodiments, one end of the rupture slit (31) is configured to be connected to the rupture groove (34), and the other end extends to the chamber bottom (3) and the base (1) connection portion.

[0026] In some embodiments, a rotation groove (35) is provided at the connection between the rupture flaps (32) and the mounting hole, wherein the thickness of the rotation groove (35) is smaller than that of the rupture flaps (32) and the conical structure;

[0027] when the stress-actuated portion (23) punctures the chamber bottom (3), the rupture flaps (32) is operable to rotate around the conical structure via the rotation groove (35).

[0028] In some embodiments, at least one locking tooth (235) is provided on the side of the stress rib (232) opposite to the stress post (231);

[0029] when the stress-actuated portion (23) punctures the chamber bottom (3), the locking tooth (235) engages with one sidewall of a rupture flap (32) to restrict its movement, keeping the opening in an open state.

[0030] In some embodiments, at least one locking tooth (235) is provided on the side of the push rib (237) opposite to the stress post (231);

[0031] when the stress-actuated portion (23) punctures the chamber bottom (3), the locking tooth (235) engages with one sidewall of a rupture flap (32) to restrict its movement, keeping the opening in an open state.

[0032] In some embodiments, at least one serration (236) is provided on the stress slope (238) to enhance rupturing efficiency.

[0033] Other aspects and features of the present invention will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

[0034] The present invention achieves various technical advantages, alleviating at least some technical problems in the conventional arts:

[0035] For users with limited hand strength, such as children or the elderly, pressing

a button to puncture a thick and rigid membrane (which may be necessary to effectively isolate the stored substance from the liquid for a prolong period) can be challenging. Even for the average adult user, pressing a button to puncture the membrane or separation layer may cause some discomfort to the fingers and hand.

[0036] To address this issue, conventional arts utilize materials such as aluminum film to construct the chamber bottom (3), as it is easier to penetrate while still providing a sealed barrier to protect the stored substance. However, aluminum film is not suitable for temperature-sensitive substances. Additionally, the manufacturing process requires careful handling, as aluminum film is fragile and prone to accidental damage. Scratches, unintended punctures, or improper installation of the stress-actuated portion (23) can compromise the aluminum film's integrity, leading to leakage that may damage the stored substance.

[0037] In clear contrast to conventional solutions that attempt to address this issue by using easily breakable materials such as aluminum film, the present invention provides a dispensing bottle cap featuring a protruding button, along with a uniquely configured stress-actuated portion (23) and chamber bottom (3). This configuration enables a progressive, directed puncturing mechanism, referred to as "simultaneous rupturing and pushing", even when the chamber bottom (3) is constructed from relatively thick and rigid materials, such as molded polypropylene (PP) structures, which offer enhanced protection for the stored substance.

[0038] In other words, this configuration, at least to some extent, alleviates the force required for activation (i.e., causing the chamber bottom (3) of the accommodating chamber (101) to rupture) without compromising the thickness or robustness of the chamber bottom (3), which separates the stored substance in the accommodating chamber (101) from the liquid in the bottle. As a result, the present invention provides a dispensing bottle cap, comprising a stress-rupturable chamber, that can be conveniently ruptured or punctured under applied stress in a controlled manner, allowing the controlled release of the preloaded substance stored within the accommodating chamber (101).

[0039] The present invention is able to enhance usability, accessibility, and the overall user experience while also improving the preservation and storage of various preloaded substances, including, but not limited to, those that are sensitive to temperature and moisture.

[0040] The present invention integrates rupture slits (31) that correspond to stress ribs (232), ensuring a controlled and efficient puncturing process. When the rupturing process begins, the second end of each stress rib (232) directly contacts and punctures the rupture slits (31), which are configured with a relatively reduced thickness to facilitate rupture. As the stress-actuated portion (23) moves downward, the rupture slits (31) progressively tear along their length, ensuring a smooth expansion of the opening. Simultaneously, the stress concentration point (33) remains confined within a limiting space (234), preventing unintended displacement. Under the thrust force of the stress-actuated portion (23), the stress concentration point (33), along with the attached rupture flap (32), is gradually pushed outward, resulting in a larger rupture opening (36) that facilitates the controlled release of the preloaded substance.

[0041] To further enhance rupturing efficiency, the second end of each stress rib (232) is equipped with a stress slope (238), terminating in a sharp bearing point (233). The rupture flaps (32) are positioned at a specific inclination angle relative to the stress slopes (234) to optimize force distribution. During downward movement, the sharp bearing point (233) initially makes "point contact" with the rupture slit (31), functioning similar to a pivot point of a lever mechanism, and concentrating stress at the tip to facilitate rupture with minimal force. Concurrently, the stress concentration point (33), constrained within the limiting space (234), enhances the downward force application, promoting efficient puncturing. As the stress ribs (232) move further downward, the rupture flaps (32) rotate, eventually aligning parallel to the rupturing plane, enabling the stress ribs (232) to transition from "point contact" to "line contact", effectively separating the rupture slits (31) while minimizing resistance.

[0042] Furthermore, the pressing portion (21) adopts a protruding design, providing a clear pressing surface for easy user engagement. To prevent accidental chamber bottom (3) puncturing, the pressing portion (21) is paired with a removable sealed protective cover (4). This cover safeguards the chamber bottom (3) against unintended activation and ensures that users can conveniently remove the cover before pressing the protruding button, thereby reducing the effort required for operation and improving user experience and safety.

BRIEF DESCRIPTION OF THE DRAWINGS

[0043] In the figures, which illustrate, by way of non-limiting examples only, embodiments of the present invention,

[0044] **[FIG. 1]:** illustrates a perspective view of the dispensing bottle cap, according to various embodiments of the present invention.

[0045] **[FIG. 2]:** illustrates another perspective view of the dispensing bottle cap, according to various embodiments of the present invention.

[0046] **[FIG. 3]:** illustrates a perspective view of another exemplary dispensing bottle cap, according to various embodiments of the present invention.

[0047] **[FIG. 4]:** illustrates a perspective view showing the bottom structure of the dispensing bottle cap, according to various embodiments of the present invention.

[0048] **[FIG. 5]:** illustrates a bottom view of the dispensing bottle cap, according to various embodiments of the present invention.

[0049] **[FIG. 6]:** illustrates a perspective view of the dispensing bottle cap with the protective cover removed, according to various embodiments of the present invention.

[0050] **[FIG. 7]:** illustrates a perspective view of the base of the dispensing bottle cap, according to various embodiments of the present invention.

[0051] **[FIG. 8]:** illustrates another perspective view of the base, according to various embodiments of the present invention.

[0052] **[FIG. 9]:** illustrates a front view of the pressing key, according to various embodiments of the present invention.

[0053] **[FIG. 10]:** illustrates a perspective view of the pressing key, according to various embodiments of the present invention.

[0054] **[FIG. 11]:** illustrates another perspective view of the pressing key, according to various embodiments of the present invention.

[0055] **[FIG. 12]:** illustrates a front view of another exemplary pressing key, according to various embodiments of the present invention.

[0056] **[FIG. 13]:** illustrates a perspective view of the membrane after being punctured, according to various embodiments of the present invention.

[0057] **[FIG. 14]:** illustrates another perspective view of the membrane after being punctured, according to various embodiments of the present invention.

[0058] **[FIG. 15]:** illustrates a cross-sectional view of the dispensing bottle cap in its initial (unpunctured) state, according to various embodiments of the present invention.

[0059] **[FIG. 16]:** illustrates a cross-sectional view of the dispensing bottle cap after the membrane has been punctured, according to various embodiments of the present invention.

[0060] **DETAILED DESCRIPTION**

[0061] Throughout this document, unless otherwise indicated to the contrary, the terms "comprising", "consisting of", "having" and the like, are to be construed as non-exhaustive, or in other words, as meaning "including, but not limited to".

[0062] Furthermore, throughout the document, unless the context requires otherwise, the word "include" or variations such as "includes" or "including" will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

[0063] Throughout this document, terms such as "module", "component", or "unit" are used solely for descriptive purposes and do not imply specific limitations. These terms may be used interchangeably. Additionally, positional or directional terms such as "upper", "lower", "inner", "outer", "front", "back", "one end", and "another end" are based on the orientations shown in the figures and are not intended to impose structural limitations. Furthermore, terms such as "first" and "second" are used for distinction rather than indicating relative importance.

[0064] Throughout this document, unless explicitly defined otherwise, terms such as "install", "configured with", and "connected" should be interpreted broadly. For example, "connected" may refer to fixed, detachable, or integral connections, and may involve mechanical or direct connections, as well as indirect connections via intermediate

components. The term "multiple" means two or more, including but not limited to two, three, four, five, etc.

[0065] As shown in FIG. 1, the dispensing bottle cap comprises a base (1), a pressing key (2), and a chamber bottom (3) positioned inside the base (1). The base (1) has a first opening (102) at one end and a second opening (103) at the opposite end. When the dispensing bottle cap is fitted onto a bottle, the base (1) serves as a secure fastening ring, enabling that the dispensing bottle cap remains firmly attached to the bottle As shown in FIG. 9, the pressing key (2) includes a flexible pressing portion (21), a connecting portion (22), and a stress-actuated portion (23). The connecting portion (22) is circumferentially arranged around the pressing portion (21), while the stress-actuated portion (23) is connected to the pressing portion (21). The connecting portion (22) is positioned at the first opening (102), and as shown in FIG. 15, the pressing portion (21), the base (1), and the chamber bottom (3) together enclose a sealed accommodating chamber (101). This sealed accommodating chamber (101), as described in the present invention, can be conveniently ruptured at the chamber bottom (3) when subjected to applied stress (e.g., from a pressing finger) and is therefore also referred to as a "stress-rupturable chamber".

[0066] As shown in FIGS. 10 and 11, the stress-actuated portion (23) comprises a stress post (231) and at least three stress ribs (232) circumferentially disposed on the sidewall of the stress post (231). The second ends of the stress ribs (232) extend along the height direction of the stress post (231) and enclose a limiting space (234) together with the stress post (231).

[0067] The stress post (231) is configured to direct the applied stress from above the pressing portion (21) downward, thereby driving the movement of the entire stress-actuated portion (23) toward the chamber bottom (3). The stress post (231) can be configured in various forms, such as a rod or a pole-like structure, and may accordingly be referred to as a stress rod or stress pole. The stress ribs (232) can be configured in various shapes and forms, such as plate structure. It should be noted that the limiting space (234) is an open-bottom cavity, and its sidewalls also contain multiple openings. This space is enclosed at the top by the bottom of the stress post (231) and the sidewalls of the stress ribs (232), forming a confined structure with openings on all sides and at the bottom. In some embodiments, the limiting space (234) may be configured as a clamp-

like structure, designed to securely engage with the stress concentration point (33). Accordingly, in certain embodiments, the limiting space (234) may also be referred to as a stress-activated clamp, as it is actuated by applied stress (e.g., a user pressing the pressing portion (21)) to clamp onto the stress concentration point (33). The stress concentration point (33) is specifically designed to fit within the specialized configuration of the limiting space (234), ensuring effective engagement and controlled operation.

[0068] As shown in FIG. 5, the chamber bottom (3) is provided with at least three rupture slits (31), which divide the chamber bottom (3) into at least three rupture flaps (32) (for illustrative purposes, three rupture slits are shown in the figures). The common junction of the three rupture flaps (32) is provided with a stress concentration point (33). A rupture groove (34) is formed at the junction of the stress concentration point (33) and the rupture flaps (32). The thickness of the rupture groove (34) at the junction with one rupture flap (32) is greater than at other parts of the rupture groove (34), while the thicknesses of the rupture slits (31) and the rupture groove (34) are both smaller than the thickness of the rupture flaps (32).

[0069] As shown in FIG. 8, the stress concentration point (33) has a greater thickness or height than the rupture flaps (32), and at least a portion of the stress concentration point (33) extends into the accommodating chamber (101) to form a stress structure corresponding to the limiting space (234). In some embodiments, the stress concentration point (33) may be configured as a protruding structure to facilitate the rupture of the chamber bottom (3) and is therefore also referred to as a rupture-assisting protrusion in those embodiments. When the pressing portion (21) is pressed downward, it deforms downward and drives the stress-actuated portion (23) downward. At least three stress ribs (232) respectively contact the rupture slits (31) and progressively tear them apart. Simultaneously, the thinner section of the rupture groove (34) breaks, and the inner wall of the limiting space (234) contacts the stress concentration point (33), driving it downward. This downward motion further pushes the stress ribs (232) outward, causing the chamber bottom (3) to rupture, forming an opening that allows the preloaded substance inside the accommodating chamber (101) to flow out through the opening.

[0070] In some embodiments, the stress concentration point (33) may be cylindrical, with the rupture groove (34) arranged circumferentially around the sidewall of the cylindrical stress concentration point (33). Additionally, the thickness of the cylindrical

stress concentration point (33) is greater than that of the rupture flaps (32). In other embodiments, the stress concentration point (33) may be spherical. Preferably, the rupture groove (34) aligns with one of the diameters of the spherical stress concentration point (33). In other words, the plane containing the rupture groove (34) divides the spherical stress concentration point (33) into two symmetrical hemispheres. Of course, these are two examples of possible shapes for the stress concentration point (33) and should not be construed as limiting the scope of the present application. That is, the stress concentration point (33) may take other possible shapes, such as a cube, rectangular prism, or any other feasible configurations.

[0071] During this process, the stress concentration point (33) first contacts the top of the limiting space (234), while the sidewalls of the stress ribs (232) provide lateral restriction, preventing the stress concentration point (33) from becoming dislodged from the limiting space (234).

[0072] In some embodiments, as shown in FIG. 11, at least one push rib (237) is provided between at least two adjacent stress ribs (232). The number of push ribs (237) is less than or equal to the number of stress ribs (232). When the stress ribs (232) come into contact with the rupture slits (31) and begin tearing them apart, further downward pressing of the pressing portion (21) causes the push rib (237) to press against the rupture flaps (32), driving them downward to enlarge the rupture opening (36). By incorporating a push rib (237), at least one rupture flap (32) is lifted synchronously with the downward movement of the stress ribs (232), thereby further increasing the size of the rupture opening (36). In various embodiments, the push rib (237) may adopt different configurations, some of which are similar or identical to the stress rib (232), while others differ in shape. In certain specific embodiments, both the push ribs (237) and stress ribs (232) are configured as plate-like or semi-plate structures. For preloaded substances with high fluidity, such as liquids, an exemplary configuration includes three rupture slits (31), three rupture flaps (32), and three stress ribs (232), with each rupture slit (31) corresponding to a stress rib (232). In this case, one push rib (237) is provided and corresponds to one of the stress ribs (232). When the stress-actuated portion (23) is pressed downward, the three stress ribs (232) tear apart the three rupture slits (31) while one push rib (237) lifts one of the rupture flaps (32). This setup ensures efficient chamber bottom (3) rupture while preventing accumulation of the preloaded substance inside the accommodating chamber (101).

[0073] For preloaded substances with low fluidity, such as powders or granular materials, an exemplary configuration also includes three rupture slits (31), three rupture flaps (32), and three stress ribs (232), with each rupture slit (31) corresponding to a stress rib (232). However, in this case, three push ribs (237) are included, with each push rib (237) corresponding to a rupture flap (32). When the stress-actuated portion (23) is pressed downward, the three stress ribs (232) tear the three rupture slits (31), and simultaneously, the three push ribs (237) lift the three rupture flaps (32) at the same time. This configuration ensures that the chamber bottom (3) forms a sufficiently large rupture opening (36), allowing low-flowability substances to be completely dispensed from the bottle cap without residue accumulation.

[0074] In some embodiments, as shown in FIG. 15, when no external force is applied to the pressing portion (21), it remains elevated relative to the connecting portion (22), thereby forming a pressing protrusion above the first opening (102).

[0075] By incorporating a protruding button design (i.e., a convex design) for the pressing key (2), these embodiments of the present invention offer two main advantages. First, these embodiments of the present invention allow users to quickly locate and press the protruding button with ease. Second, these embodiments of the present invention alleviate issues encountered by users with long fingernails or those who have undergone manicures, where a flush or recessed button may be difficult to press. This design ensures that all users can easily operate the dispensing bottle cap without requiring excessive force. However, a person skilled in the art will recognize that in embodiments where these concerns are negligible, the pressing key (2) may alternatively adopt a concave design, wherein the pressing portion (21) is positioned lower than the connecting portion (22). This configuration would still fall within the scope of the present invention. In some embodiments, as shown in FIGS. 1–3, the dispensing bottle cap further comprises a protective cover (4) that is detachably connected to the base (1). The protective cover (4) surrounds and encloses the pressing protrusion, preventing accidental activation when puncturing the chamber bottom (3) is not required. When the user needs to puncture the chamber bottom (3), the protective cover (4) can simply be removed. The protective cover (4) can be configured as a removable and disposable cover. Alternatively, the protective cover (4) can incorporate a linking element that tethers the protective cover (4) to the base (1), ensuring that after removal, the protective cover (4) remains loosely attached to the base (1) rather than being completely detached. This configuration allows

the protective cover (4) to be conveniently repositioned or retained after exposing the pressing key (2).In certain embodiments, as shown in FIGS. 1 and 2, the upper surface of the protective cover (4) may be flat. In other embodiments, it may adopt a shape similar to that of the pressing protrusion, meaning the middle section of the upper surface protrudes outward, forming a raised structure.

[0076] To enhance grip and usability, some embodiments provide the protective cover (4) with multiple anti-slip elements (401), which are circumferentially arranged along its sidewall. The anti-slip elements (401) can be designed in various configurations to enhance grip and facilitate the removal of the protective cover (4). For example, these anti-slip elements (401) may be shaped as tooth-like structures or raised dotted protrusions, increasing friction and improving handling stability, thereby making it easier for users to grasp and detach the protective cover (4).

[0077] In some embodiments, the anti-slip elements (401) are positioned at the top portion of the protective cover (4), near its upper surface. This allows users to grip the anti-slip elements (401) while removing the cover, ensuring a secure hold during detachment. Additionally, users can also grip below the anti-slip elements (401) when removing the cover. Even if the user's hand slips during removal, the anti-slip elements (401) will help regain traction and prevent further slippage.

[0078] In some embodiments, the base (1) is also provided with circumferentially arranged anti-slip structures (104) (such as teeth or dotted-protrusions, to increase friction and enhance grip, thereby facilitating convenient handling of the base (1)). For example, when the base (1) is threaded and connected to a bottle body (not shown in the figures), the user may need to unscrew the bottle cap after puncturing the chamber bottom (3) to consume the beverage inside the bottle. The anti-slip structure enhances grip, making it easier to twist and remove the bottle cap from the bottle body.

[0079] In some embodiments, as shown in FIGS. 10 and 11, the second end of the stress rib (232) is provided with a stress slope (238) (i.e., a sloped structural feature configured to effectively direct the applied stress towards the stress concentration point (33)), which extends along the axial direction of the stress post (231). The width of the stress slope (238) gradually decreases from its first end to its second end, forming a sharp bearing point (233) on the side of the stress rib (232) adjacent to the limiting space (234). The acute angle ($\alpha 1$) between the stress slope (238) and the horizontal plane is greater

than the acute angle (α2) between the rupture flaps (32) and the horizontal plane.

[0080] For example, the stress slope (238) is parallel to the axial direction of the stress post (231) on the side closer to the stress post (231). On the side farther from the stress post (231), the stress slope (238) gradually converges toward the center axis of the stress post (231) from its first end to its second end, forming an inclined slope with a certain gradient.

[0081] When the pressing portion (21) is pressed downward, it undergoes deformation and drives the stress-actuated portion (23) downward. The sharp bearing point (233) first comes into contact with the rupture groove (34) or rupture slit (31) and then progressively separates the rupture flaps (32) along the extension direction of the rupture slit (31).

[0082] With this structural configuration, during downward movement, the sharp bearing point (233) initially makes "point contact" with the rupture slit (31), which concentrates stress at the tip, making it easier to puncture the rupture slit (31). Simultaneously, the stress concentration point (33) is restricted within the limiting space (234), thereby enhancing the downward force applied when pressing. Once the stress ribs (232) move farther downward, the rupture flaps (32) rotate until they align parallel to the rupturing plane. At this stage, the stress ribs (232) transition from point contact to "line contact", effectively separating the rupture slits (31) and ensuring efficient membrane rupture.

[0083] In some embodiments, as shown in FIG. 15, the chamber bottom (3), configured as a membrane or structural layer in some embodiments of the present invention, is circumferentially arranged along the inner wall of the base (1) and gradually extends downward to form a conical structure. The conical structure is provided with a polygonal mounting hole, and multiple rupture flaps (32) are respectively connected to the multiple edges of the mounting hole. The rupture flaps (32) are also sequentially connected, thereby sealing the mounting hole.

[0084] In some embodiments, the rupture flaps (32) extend downward along the conical structure, such that the combination of the rupture flaps (32) and the conical structure forms a complete cone. This inclined membrane structure further ensures that the preloaded substance smoothly slides down through the chamber bottom (3) during dispensing.

[0085] As shown in FIG. 8, in some embodiments, the stress concentration point (33) is positioned at the center of the chamber bottom (3) and has a height lower than that of the mounting hole. This design causes the height of the rupture flaps (32) to gradually decrease from the end connected to the mounting hole to the end connected to the stress concentration point (33). As a result, the preloaded substance can flow out along the guiding slope and/or the rupture flaps (32).

[0086] As shown in FIG. 5, in some embodiments, one end of the rupture slit (31) is connected to the rupture groove (34), while the other end extends to the junction between the chamber bottom (3) and the base (1). In other words, the rupture flaps (32) occupy most of the surface area of the chamber bottom (3). This ensures that when the rupture flaps (32) open, a larger rupture opening (36) is formed, facilitating the complete release of the preloaded substance.

[0087] In some embodiments, a rotation groove is provided at the junction between the rupture flaps (32) and the mounting hole. The thickness of the rotation groove is less than the thickness of both the rupture flaps (32) and the conical structure. When the stress-actuated portion (23) punctures the chamber bottom (3), the rupture flaps (32) can rotate around the conical structure via the rotation groove, allowing unobstructed dispensing.

[0088] As shown in FIG. 12, in some embodiments, at least one locking tooth (235) is provided on the side of the stress rib (232) opposite to the stress post (231). After the stress-actuated portion (23) punctures the chamber bottom (3), the locking tooth (235) engages with one sidewall of a rupture flap (32), thereby restricting its movement and keeping the rupture opening (36) in an open state.

[0089] In some embodiments, at least one locking tooth (235) is also provided on the side of the push rib (237) opposite to the stress post (231). After the stress-actuated portion (23) punctures the chamber bottom (3), the locking tooth (235) engages with one sidewall of a rupture flap (32) to hold it in the open position, ensuring that the rupture opening (36) remains open for effective substance discharge. This feature is useful for circumstances when the applied force, for example, by children, the elderly, or average adult user who inadvertently press the pressing key (2) softly, is just sufficient to puncture through the chamber bottom (3) and move the rupture flaps (32) into their open positions. These locking teeth (235) help by holding and gripping the rupture flaps (32), ensuring

that they remain in the open position for effective substance discharge.

[0090] In some embodiments, at least one serration (236) is provided on the stress slope (238) to enhance rupturing efficiency. The serration (236) helps improve penetration when the stress-actuated portion (23) moves downward, reducing the force required to puncture the chamber bottom (3) while ensuring a clean and effective rupture.

[0091] In summary, for users with limited hand strength, such as children and the elderly, pressing a button to puncture the chamber bottom (3) may be challenging. Even for the average adult user, this action may cause noticeable discomfort to the fingers and hand.

[0092] To address this issue, rather than relying on thin and easily breakable materials such as aluminium film, the present application provides a dispensing bottle cap featuring a protruding button, along with a uniquely configured stress-actuated portion (23) and chamber bottom (3). As explained above, this configuration enables a progressive, directed puncturing mechanism, referred to as "simultaneous rupturing and pushing", while maintaining the thickness and robustness of the chamber bottom (3) structure for enhanced durability and protection of the stored substance.

[0093] More specifically, this design of the present invention incorporates corresponding rupture slits (31) and stress ribs (232) to ensure efficient puncturing. During operation, the second end of each stress rib (232) directly punctures through the thinner rupture slits (31). As the stress-actuated portion (23) moves downward, the rupture slits (31) continue to tear progressively along their length, ensuring a controlled and uniform rupture. Simultaneously, the stress concentration point (33) remains confined within the limiting space (234), preventing unintended displacement. Under the thrust force of the stress-actuated portion (23), the stress concentration point (33) and the attached rupture flap (32) are gradually pushed outward, resulting in a larger rupture opening (36), facilitating the release of the preloaded substance.

[0094] Furthermore, the second end of each stress rib (232) is configured with a stress slope (238) that gradually narrows into a sharp bearing point (233). The rupture flaps (32) are positioned at a specific angle relative to the stress slopes (234) to optimize force distribution. As the stress-actuated portion (23) moves downward, the sharp bearing point (233) initially makes "point contact" with the rupture slit (31), functioning similar to a pivot

point of a lever, and accordingly concentrating stress at the bearing point (233)/stress concentration point (33) and facilitating easier rupture, starting from the stress concentration point (33). Simultaneously, the stress concentration point (33) remains confined within the limiting space (234), enhancing the downward force application for more effective puncturing. As the stress ribs (232) continue moving downward, the rupture flaps (32) rotate, eventually aligning parallel to the rupturing plane. At this stage, the stress ribs (232) transition from point contact to "line contact",, effectively separating the rupture slits (31) and ensuring a clean and efficient rupture.

[0095] Additionally, the pressing portion (21) features a protruding design, which, when paired with a sealed protective cover (4), prevents accidental puncturing of the chamber bottom (3). The protective cover (4) ensures safety during storage and transport. When removal is required, users can easily press the protruding button, reducing effort and improving accessibility.

[0096] The present invention provides an improved dispensing bottle cap that offers enhanced usability and more secure storage of preloaded substances, even for those requiring delicate handling and storage. It should be further appreciated by the person skilled in the art that variations and combinations of features described above, not being alternatives or substitutes, may be combined to form yet further embodiments falling within the intended scope of the invention.

[0097] As would be understood by a person skilled in the art, each embodiment, may be used in combination with other embodiment or several embodiments.

[0098] **Reference Numerals:**

1 - Base
101 - Accommodating chamber
102 - First opening
103 - Second opening
104 – Anti-slip structure
2 - Pressing key
21 - Pressing portion
22 - Connecting portion
23 - Stress-actuated portion
231 - Stress post

232 - Stress rib
233 - Tip
234 - Limiting space
235 - Locking tooth
236 - Serration
237 - Push rib
238 - Stress slope
3 - Membrane
31 - Rupture slit
32 - Rupture flap
33 - Stress concentration point (33)
34 - Rupture groove
35 - Rotation groove
36 - Rupture opening (36)
4 - Protective cover
401 - Anti-slip elements

Claims

Claim 1. A dispensing bottle cap, comprising a base (1), a pressing key (2), and a chamber bottom (3) disposed inside the base (1), wherein the two ends of the base (1) are respectively provided with a first opening (102) and a second opening (103);

the pressing key (2) comprises a flexible pressing portion (21), a connecting portion (22), and a stress-actuated portion (23); the connecting portion (22) is circumferentially disposed around the pressing portion (21), and the stress-actuated portion (23) is connected to the pressing portion (21); the connecting portion (22) is disposed at the first opening (102), and the pressing portion (21), the base (1), and the chamber bottom (3) enclose a sealed accommodating chamber (101);

the stress-actuated portion (23) comprises a stress post (231) and at least three stress ribs (232) circumferentially disposed on the sidewall of the stress post (231), wherein the second ends of the stress ribs (232) extend along the height direction of the stress post (231) and enclose a limiting space (234) with the stress post (231);

the chamber bottom (3) is provided with at least three rupture slits (31), which divide the chamber bottom (3) into at least three rupture flaps (32), wherein a stress concentration point (33) is arranged at the common junction of the at least three rupture flaps (32), and a rupture groove (34) is formed at the junction of the stress concentration point (33) and the rupture flaps (32), wherein the thickness of the rupture groove (34) at the junction of one rupture flap (32) is greater than that of the other portions of the rupture groove (34), and the thicknesses of the rupture slits (31) and the rupture groove (34) are both smaller than that of the rupture flaps (32);

the thickness of the stress concentration point (33) is configured to be greater than that of the rupture flaps (32), and at least a portion of the stress concentration point (33) is configured to protrude into the accommodating chamber (101) to form a stress structure corresponding to the limiting space (234);

when the pressing portion (21) is pressed downward, the pressing portion (21) is operable to deform downward and to drive the stress-actuated portion (23) downward, wherein the at least three stress ribs (232) respectively contact the at least three rupture slits (31) and gradually tear them apart, the thinner portion of the rupture groove (34) breaks, and

simultaneously, the inner wall of the limiting space (234) contacts the stress concentration point (33) and drives the stress concentration point (33) downward, thereby pushing the stress ribs (232) connected to the stress concentration point (33) outward, so that the chamber bottom (3) forms an opening and the preloaded substance in the accommodating chamber (101) is operable to leak out from the opening.

Claim 2. The dispensing bottle cap according to Claim 1, wherein a push rib (237) is configured to be disposed between at least two adjacent stress ribs (232), and the number of push ribs (237) is less than or equal to the number of stress ribs (232);

when the stress ribs (232) contact and tear the rupture slits (31), and pressing continues on the pressing portion (21), the push rib (237) presses against the rupture flaps (32) and drives the rupture flaps (32) downward to enlarge the area of the opening.

Claim 3. The dispensing bottle cap according to Claim 1, wherein when no external force is applied to the pressing portion (21), the pressing portion (21) is higher than the height of the connecting portion (22) to form a pressing protrusion above the first opening (102).

Claim 4. The dispensing bottle cap according to Claim 3, further comprising a protective cover (4), wherein the protective cover (4) is detachably connected to the base (1) and surrounds the pressing protrusion to enclose the pressing protrusion.

Claim 5. The dispensing bottle cap according to Claim 4, wherein the sidewall of the protective cover (4) is circumferentially provided with multiple anti-slip elements (401).

Claim 6. The dispensing bottle cap according to Claim 1, wherein the second end of the stress rib (232) is provided with a stress slope (238), wherein the stress slope (238) extends along the axial direction of the stress post (231), such that the second end of the stress rib (232) forms a sharp bearing point (233) adjacent to the limiting space (234);

the acute angle $\alpha 1$ between the stress slope (238) and the horizontal plane is greater than the acute angle $\alpha 2$ between the rupture flap (32) and the horizontal plane;

when the pressing portion (21) is pressed downward, the pressing portion (21) deforms downward and drives the stress-actuated portion (23) downward, wherein the sharp bearing point (233) first contacts the rupture groove (34) or the rupture slit (31) and then progressively separates multiple rupture flaps (32) along the extension direction of the

rupture slit (31).

Claim 7. The dispensing bottle cap according to Claim 1, wherein the chamber bottom (3) is circumferentially disposed along the inner wall of the base (1) and gradually extends downward to form a conical structure, wherein the conical structure is provided with a polygonal mounting hole, and multiple rupture flaps (32) are respectively connected to multiple edges of the mounting hole, sequentially blocking the mounting hole.

Claim 8. The dispensing bottle cap according to Claim 7, wherein the stress concentration point (33) is located at the center of the chamber bottom (3), and the height of the stress concentration point (33) is lower than that of the mounting hole, such that the height of the rupture flaps (32) gradually decreases from the end connected to the mounting hole to the end connected to the stress concentration point (33), enabling the preloaded substance to flow out along the guiding slope and/or the rupture flaps (32).

Claim 9. The dispensing bottle cap according to Claim 7, wherein one end of the rupture slit (31) is configured to be connected to the rupture groove (34), and the other end extends to the chamber bottom (3) and the base (1) connection portion.

Claim 10. The dispensing bottle cap according to Claim 7, wherein a rotation groove (35) is provided at the connection between the rupture flaps (32) and the mounting hole, wherein the thickness of the rotation groove (35) is smaller than that of the rupture flaps (32) and the conical structure;

when the stress-actuated portion (23) punctures the chamber bottom (3), the rupture flaps (32) is operable to rotate around the conical structure via the rotation groove (35).

Claim 11. The dispensing bottle cap according to Claim 1, wherein at least one locking tooth (235) is provided on the side of the stress rib (232) opposite to the stress post (231);

when the stress-actuated portion (23) punctures the chamber bottom (3), the locking tooth (235) engages with one sidewall of a rupture flap (32) to restrict its movement, keeping the opening in an open state.

Claim 12. The dispensing bottle cap according to Claim 2, wherein at least one locking tooth (235) is provided on the side of the push rib (237) opposite to the stress post (231);

when the stress-actuated portion (23) punctures the chamber bottom (3), the locking tooth

(235) engages with one sidewall of a rupture flap (32) to restrict its movement, keeping the opening in an open state.

Claim 13. The dispensing bottle cap according to Claim 1, wherein at least one serration (236) is provided on the stress slope (238) to enhance rupturing efficiency.