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(54) **TAMPER-INDICATING ASSEMBLY OF THREADED CLOSURE AND NECK FOR CONTAINERS**

(57) In order to achieve the above-described objectives, the present invention provides a threaded cap (11) and neck (12) set for evidencing tampering with container (13), comprising a neck (12) of a container (13) having a cylindrical shape and an aperture at its top end, said the neck (12) having threads on its outer surface and a sealing collar (14), said the sealing collar (14) comprising a plurality of teeth (15) and a cap (1) having a cylindrical shape and having threads on its inner surface, the cap (11) including a tamper-evident ring (16) attached to the lower rim (17) of the cap (11), said tamper-evident ring (16) having a diameter longer than the diameter of the cap (11). The tamper-evident ring (16) comprises a plurality of reversible grippers (18) projecting longitudinally from the lower rim (17) of the tamper-evident ring (16),

wherein the reversible grippers (18) are coupled to the lower rim (17) of the tamper-evident ring (16) by means of a hingeable membrane. At least one of the reversible grippers (18) comprising a hingeable locking mechanism (22) with respect to the gripper, in which, when the cap (11) undergoes rotational movement towards the cap (11) closure direction in the bottle, the locking mechanism swings to a releasing position allowing the passage thereof on the teeth (15) of the bottle neck (12), and when the cap (11) undergoes rotational movement towards the cap (11) opening direction on the bottle, the locking mechanism swings to a locking position which does not allow the passage thereof on the teeth (15) of the bottle neck (12).

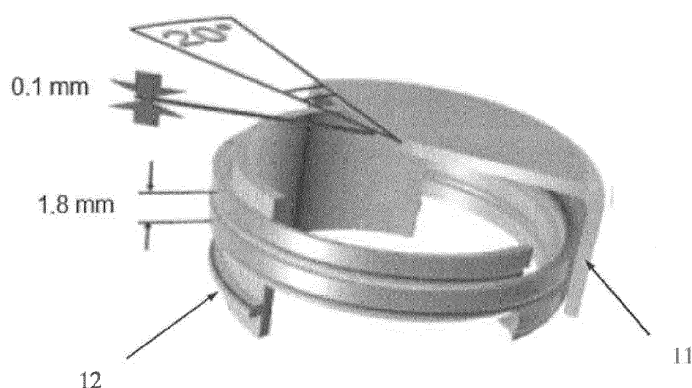


FIG. 2

DescriptionTECHNICAL FIELD

5 **[0001]** The present invention relates to a threaded cap and neck set for indicating tampering of containers, more particularly, a threaded cap and neck set of a container to indicate, by breaking its tamper-evident mechanism, that the contents of a container has been accessed.

DESCRIPTION OF THE STATE OF THE ART

10 **[0002]** With increasing demand for products and increased competitiveness, we have sought ways to minimize production costs and product distribution logistics.

[0003] Over the years, an increasing number of products have been packed in disposable packaging, due to the commercialization, greater assurance regarding the maintenance of asepsis and hygiene, better systematization for the various stages of manufacture and quality control of the products stored therein, greater handling ease by the final consumer.

[0004] The type and format of packaging depends mainly on the type of product to be stored and the way in which the consumer can use its content. In the case of liquid products, flasks and bottles are generally used, while for solid, pasty and/or creamy products containers or pots with caps are used.

20 **[0005]** In the case of bottles, these usually consist of two parts, a container and a cap. The cap is threaded to the bottle to prevent its contents from being accessed, and is moved from the bottle to open it, allowing the contents of the bottle to be accessed.

[0006] Two configurations of bottle caps are generally used in the market, push caps and threaded caps. Push caps are installed by aligning the cap with the opening of a bottle and simply by applying an axial force at the top of the cap.

25 Threaded caps usually require that the cap and the bottle be aligned and that a rotational force be applied to the cap.

[0007] The threaded cap is characterized by having the closing and opening operations by opposing rotational (angular) movements, such that, with the opening being clockwise, the closure will be in the opposite direction, thus counterclockwise and vice-versa. The thread is, in fact, a levering system of the axial movement which makes this closure particularly suitable for promoting high closing pressure and, thus, the impermeability essential for the packing of liquids and gases. Thus, threaded caps are best suited for sealing containers or bottles where it is necessary to prevent any leakage of liquids and/or gases.

[0008] Moreover, one of the problems associated with injection-molded caps relates to the ability of the cap to indicate that the contents of the container have been tampered with. To this end, a mechanism enabling the user to effortlessly recognize that the container has already been opened must be created between the cap and the neck of the bottle.

35 **[0009]** In that regard, a method for forming a mechanism for evidencing that a cap has already been opened is the use of a tamper-evident ring attached to the cap body. The tamper-evident ring should comprise a means for locking the cap on the neck of the bottle and having a fragile attachment to the cap body such that, upon application of a particular force to open the cap, the ring ruptures and allows cap opening, wherein the ruptured ring features evidence of cap tampering.

40 **[0010]** A tamper-evident ring usually locks the cap on the bottle neck through teeth within the ring, which interact with external teeth on the outside of the bottle neck, the cap and neck teeth being shaped as a ramp for sliding one over the other only in the cap closing movement.

[0011] Thus, when the bottle cap is threaded into the neck of the bottle, the ramp portion of the teeth of the bottle cap slide over the ramp portion of the corresponding teeth in the bottle neck, thus allowing the bottle cap to be fully tightened in the neck of the bottle. However, when a user attempts to unscrew the bottle cap using a tensile force from low to medium, the stepped portion of the teeth of the bottle cap engages the step portion of the corresponding teeth of the bottle neck, thereby preventing unscrewing and cap opening.

50 **[0012]** When greater levels of tensile force are applied to the bottle cap in the unscrewing direction, the ring ruptures and separates from the bottle cap. Thus, the bottle cap may be unscrewed from the bottle neck and the tamper-evident ring usually remains locked in the bottle neck. In this sense, the presence of the tamper-evident ring ruptured in the bottle neck serves as visual evidence that the bottle has already been opened.

[0013] While the combination of a bottle cap with tamper-evident ring and a bottle neck with teeth provides an acceptable connection to evidence tampering, this combination has limitations if it is possible to view, access and thus interfere with the teeth locking mechanism. Specifically, when the cap is in the sealing position, one can push the lower end of the tamper-evident ring outwardly and then upward, toward the top of the bottle cap, causing deformation in the cap, in order to prevent the locking action between the teeth of the bottle cap and bottle neck.

55 **[0014]** In this way, it would be possible to unscrew the bottle cap without breaking the tamper-evident ring of the bottle cap and further threading the bottle cap back into the bottle neck. In this case, there would be no visual evidence that

the cap was screwed and subsequently threaded back into the bottle neck. Therefore, current connections with tampering evidence between a bottle cap and neck, under certain circumstances, do not provide protection from tampering.

[0015] In order to solve the problems found regarding safety in detecting bottle cap tampering, various solutions have been developed and correspond to the state of the art of the present application, solutions which will be discussed below.

[0016] Document EP0941938 discloses a bottle cap and neck for improved and tamper-proof bottles. According to the document, the bottle cap includes a circular cap, a skirt 'pending from the periphery of the cap, and a tamper-evident ring with teeth meshing with a corresponding set of teeth on the neck of a bottle. The skirt of the bottle cap includes an inner surface having threads for retaining the cap in a bottle neck and a lower end having a circumferential flange with outwardly extending semicircular tabs. The tamper-evident ring is attached to the flange by frangible connections between the guides extending outward from the flange and the ratchet teeth of the tamper-evident ring.

[0017] The solution proposed by EP0941938 illustrates a standard configuration of a higher security tamper-evident ring, so that one cannot press the tamper-evident ring at specific points to effect an axial displacement of the ring through the neck of the bottle, preventing the occurrence of a fraud without evidence of tampering.

[0018] Document US 5115932 discloses a container and its tamper-proof sealing cap having a cap body and a security strip that can be broken manually. The container comprises a hollow body extended by a shoulder and terminated by an axially symmetrical neck having a hole and on its outer surface of a threaded portion, allowing screwing of said cap body and a portion equipped with teeth is intended to prevent the unscrewing, except in the case of the rupture of the security strip. Said cap has a threaded portion on the inner surface of the cap body and a non-threaded portion having a security strip, integral with the remainder of the cap due to bridges and internally provided with grooves enabling engagement of the teeth.

[0019] The solution proposed by US 5115932 illustrates a standard configuration of a tamper-evident ring with higher breaking strength during its sealing in the neck of the bottle, in order to prevent the tamper-evident ring from rupturing during sealing of the cap in the neck of the bottle.

[0020] Document WO2012018994 discloses a tamper-evident cap having a circular closure member, a cylindrical annular wall generally depending on the periphery of the closure member which encloses with a base and having a plurality of toothed cutouts, and a tamper-evident ring circumferentially positioned around the toothed base connected to a portion of the base. The tamper-evident ring may be mounted to the base by at least one of the teeth or connected by at least one of the toothed cutouts extending below the base. The interior and/or exterior of the cylindrical wall can be intensified. The tamper-evident ring may have a groove between the teeth for retaining the tamper-evident ring over a neck nozzle. The document further discloses a neck nozzle having at least one set of teeth and optional protusion portions to secure the breach tamper ring in place.

[0021] Document US20020096485 discloses a construction of locking guides for tamper-evident rings on the screw closures for containers used for refrigerants and the like. The guides are hinged to a lower edge of the tamper ring, and are held in the axial orientation by resilient engagement within corresponding recesses on an inner surface of the underside of the tamper-evident ring. The closure flaps hingedly mounted on the inner surface have portions that project and engage rectangular recesses, and top surfaces positioned to replace a string during the installation of a closure device. A relatively thin upper portion defines an arcuate cavity, and a relatively thick lower portion has an inner surface defining the rectangular recesses.

[0022] Document PI 0102255-5 discloses a cap comprising a one-piece body injected in plastic material having a cylindrical shape. The body has a first part in the form of a cylindrical, vertical, externally skirt with non-slip surface, while internally it includes a suitable thread interrupted by sections, suitable for pressure relief when the bottle to be closed with the present cap is of the type containing any gasified liquid. The upper end of the cylindrical skirt is completely closed by a circular wall, where it includes an internal seal, while its lower end has an equally circular extension incorporating the tamper-evident ring, which is detachably integrated in said skirt and, so that said ring is separated from the skirt by means of a circular cut line interrupted by stretches that configure bridges or breakable bonds. A set of locking elements are molded directly on the vertical wall portion of the body of the tamper-evident ring and, to this end, said vertical or circular wall portion distributes several quadrangular windows, wherein each lock is flexibly integrated and is inclined inwardly or invading the inner diameter of the ring according to a cooperating angle so that the free end of said lock is positioned under the corresponding lower corner of the usual collar of any flask.

[0023] Thus, nowadays, in spite of the great dynamism and technical development of the sector and the huge demand for caps, plastic injection systems cannot configure mechanisms inside the cap, such as grippers, jaws or any other features ensuring the tamper-resistance of the container when sealed by the cap. Therefore, it is impossible to guarantee to the consumer that the content of the container corresponds to the content packed at the origin

[0024] The configurations of the tamper-evident ring, where the ring is sensitive to the axial movement of the cap relative to the bottle have relatively low accuracy and, thus, they are unable to distinguish and order the events namely: tearing and opening.

[0025] Furthermore, as for the configurations where the tamper-evident ring is sensitive to the rotational movement of the cap and still, the locking mechanism being visible and accessible, a user can access the bottle contents without

breaking the tamper-evident ring, by means of fraudulent techniques.

[0026] A user, familiar with the configuration of the tamper-evident ring, could take advantage of the deformation ability of the ring to press the surroundings of the ring so that the applied pressure allows a tooth to pass from the ring through the tooth of the bottle neck, even in a position contrary to the sealing position. In this way, a user can repeat this process several times until the ring has been completely unscrewed from the cap without any sign of rupture. This would allow this user to access the contents of the container without any evidence of tampering with the container, compromising the security of the device as a whole.

[0027] While there are several known techniques that attempt to solve the technical problem of tamper detection in threaded containers, especially threaded bottles, no technique is capable of guaranteeing tamper-resistance of a bottle contents prior to rupturing the tamper-evident ring.

[0028] In view of the existing limitations of the state of the art, a malicious person may access the inside of a supposedly sealed bottle or container to extract the liquid from the inside of the container, and to insert any new liquid, without leaving any indication that the container or bottle has been tampered with.

[0029] Therefore, there arises the need for a container and cap set, wherein the cap has a tamper-evident ring and mechanisms capable of preventing any access to the contents of the bottle through the cap without tampering with the tamper-evident ring of the cap, thereby ensuring the integrity of the container contents.

OBJECTIVES OF THE INVENTION

[0030] The object of the present invention is to provide a threaded cap and neck set of a container, wherein the cap has a seal to prevent any access to the contents of the bottle through the cap without rupturing the cap seal, thereby ensuring the integrity of the container content.

[0031] It is another object of the present invention to provide a threaded cap and neck set of a container comprising a seal which, after rupture, is not readily removable from the closure and which cannot be replaced or repaired by a user attempting to conceal the tampering of the container.

[0032] It is another objective of the present invention to provide a container and cap set capable of indicating to any user, in a clear manner and without possibilities of dissimulation that the seal thereof was broken and, thus, the container contents was accessed.

[0033] It is yet another object of the present invention to provide a container and cap set capable of indicating the cap rupture, which is relatively simple and manufacturable in industrial scale production, so that the set is economically feasible and appealing for application in a plurality of threaded container and cap sets.

SUMMARY OF THE INVENTION

[0034] In order to achieve the above-described objectives, the present invention provides a threaded cap and neck set for evidencing tampering with containers, comprising a container neck having a cylindrical shape, said neck having threads on its outer surface and a sealing collar, said sealing collar comprising a plurality of teeth and a cap having a cylindrical-shaped threaded portion and having threads on its inner surface, the cap including a tamper-evident ring attached to the lower rim of the cap, said tamper-evident ring having a diameter longer than the cap diameter. The tamper-evident ring comprises a plurality of reversible grippers projecting longitudinally from the tamper-evident ring, wherein the reversible grippers are coupled to the lower rim of the tamper-evident ring by means of a hingeable membrane. At least one of the reversible grippers comprises a hingeable locking mechanism with respect to the gripper, in which, when the cap undergoes rotational movement towards the cap closure direction in the bottle, the locking mechanism swings to a position that allows the passage thereof on the teeth of the bottle neck, and when the cap undergoes rotational movement towards the cap opening direction on the bottle, the locking mechanism swings to a locking position which does not allow the passage thereof on the teeth of the bottle neck.

DESCRIPTION OF THE FIGURES

[0035] The detailed description shown below refers to the attached figures, wherein:

- figure 1 shows a cross-sectional view of a threaded cap configuration of the state of the art, which could be tampered with without breaking the tamper-evident ring by fraudulent techniques. According to the figure, it would be possible to apply an "F" force in the vicinity of the fitting "E" socket, so that the compression of the vicinity where the force was applied would increase the distance "d" between the cap and the neck to a point that the tooth of the cap could pass through the tooth of the neck even during the cap opening movement. Thus, if this process were repeated for each lock of teeth during the bottle opening movement, it would be possible to open the cap without rupturing the tamper-evident ring;

- figure 2 shows a perspective view of the threaded cap and neck set according to the preferred embodiment of the present invention, wherein the characteristics of the axial and rotational displacement of the threaded cap are analyzed;
- figure 3 shows a perspective view of the threaded cap and neck set according to the preferred embodiment of the present invention, where a numerical example of the characteristics of the axial and rotational displacement of the threaded cap is shown;
- figure 4 shows a top perspective view of the threaded cap, according to the preferred embodiment of the present invention, wherein the cap is in its resting or mounting position;
- figure 5 shows a bottom perspective view of the threaded cap, according to the preferred embodiment of the present invention, wherein the cap is in its resting or mounting position;
- figures 6 and 7 illustrate a plurality of threaded closures of the present invention stacked one above the other;
- figures 8 and 9 illustrate a plurality of threaded closures of the present invention stacked one above the other, wherein the caps are guided by a guide tube;
- figures 10, 11 and 12 illustrates perspective views of the threaded cap, according to the preferred embodiment of the present invention, wherein the reversing process of reversible gripper is shown with the aid of an external tool;
- figure 13 shows a bottom perspective view of the threaded cap, according to the preferred embodiment of the present invention, wherein the cap is in its armed position, that is, the grippers are fully reversed into the cap;
- figure 14 shows a perspective view of the threaded cap and neck set according to the preferred embodiment of the present invention, where the coupling of the cap in the bottle neck is shown.
- figure 15 shows the configuration of a reversible gripper including a locking mechanism, according to the preferred embodiment of the present invention;
- figure 16 shows a cross-sectional view of the threaded cap and neck set, according to the preferred embodiment of the present invention, where the action of the locking elements during rotational movement of the cap can be observed;
- Figure 17 shows a cross-sectional view of the threaded cap and neck set, according to the optional embodiment of the present invention, wherein the bottle neck has a greater number of teeth to provide less movement tolerance prior to the rupture of the tamper-evident ring.

DETAILED DESCRIPTION OF THE INVENTION

[0036] The following description will begin from a preferred embodiment of the invention, applied to a cap and neck set for containers, in particular for plastic bottles. However, as will be apparent to any person skilled in the art, the invention is not limited to this particular embodiment and can be used in a wide variety of threaded containers to ensure the untamperability of the container contents.

[0037] According to the present invention, there is disclosed a threaded cap and neck set for evidence tampering of containers. Said set comprises a container neck having a cylindrical shape and an aperture at its upper end, the neck having threads on its outer surface and a sealing collar, wherein the sealing collar comprises a plurality of teeth. The set further comprises a cap having a cylindrical shape and having threads on its inner surface, said cap including a tamper-evident ring coupled to the lower rim of the cap, wherein said tamper-evident ring has a diameter greater than the cap diameter.

[0038] Figure 2 shows a set of threaded cap 11 and neck 13 of the container, where the properties of the tamper-evident ring 16 are studied based on an example with numerical values.

[0039] The closure of the cap 11 on the neck 12 of the container 13 is completed upon reaching a sealing point, which is the minimum threading point of the cap 11 on the neck 12 of the container 13 necessary to prevent exchange or leakage of fluids from the interior of the container 13. To provide additional safety, an additional rotation angle is usually added to the sealing point which, together with an additional axial displacement, reaches a saturation point, where it is no longer possible to move the cap 11 in the closing direction without causing deformities. The additional angle of rotation refers to that "final tightening" that promotes greater torque than the one necessary to reach the sealing point, thus ensuring a safety margin.

[0040] As the cap 11 is turned in the direction of the aperture, it starts from the saturation point and there is initially a strong voltage which decreases until, approximately in the following 20° gradually, the transit of liquids and gases begins. The moment at which the exchange of liquids and gases begins is defined as the opening point, which is approximately the initial of these 20°.

[0041] According to Figure 2, the distance between the turns of the neck 12 of the container 13 is 1.8 mm. Accordingly, each 360° rotation of the cap 11 in the neck 12 corresponds to a turn and a consequent axial displacement of 1.8 mm or one tenth of a millimeter every 20°. By coupling a tamper-evident ring 16 to the cap 11 of the container 13 to be ruptured by opening the cap 11, a breaking point should be defined, which is the limit point of the rotation of the cap 11 towards the aperture where the tamper-evident ring 16 is broken. The rupturing point may be sensitive to the axial

displacement of the cap 11 or to the angular displacement of the cap 11.

[0042] In case of using the tamper-evident ring 16 sensitive to the axial movement, in order to insert the breaking point before the opening point it is necessary to create means with accuracy equal to or greater than the order of magnitude of the rupture point and aperture point to perceive them and put them in the desired order. Thus, applications with tamper-evident ring 16 sensitive to the axial movement of the cap 11 tend not to have the precision required to ensure that there is no exchange of fluids between the container 13 and the external means before ring rupture.

[0043] Figure 3 shows in more detail the situation of Figure 2, where the threaded cap 11 has a radius of 15.0 mm and a perimeter of 94.25 mm. Based on these data, it was possible to observe that there is a ratio of 52.36 to 1 between the perimeter of the cap 11, which is traveled through the rotational movement of the cap 11, and the axial displacement of the cap 11 in the neck 12.

[0044] Thus, it is concluded that configuring the tamper-evident ring 16 to be responsive to the rotational movement of the cap 11 imparts an accuracy 50 times greater than the standard use sensitive to axial movement. Thus, all embodiments of the present invention utilize tamper-evident ring 16 responsive to the rotational movement of the cap 11 relative to the bottle neck 12.

[0045] However, as discussed above, even using the configuration of the cap 11 with tamper-evident ring 16 sensitive to the rotational movement of the cap 11, it is possible that the contents of the container 13 are accessed without leaving any evidence of tampering.

[0046] In view of this, the present invention proposes that the sealing mechanism of tamper-evident ring 16 and its rupture point be inaccessible by the user in order to provide security against attempted fraud.

[0047] Figure 4 shows a preferred embodiment of the threaded cap 11 of the present invention, where it is possible to observe the cylindrical-shaped body of the cap 11 and its lower rim coupled to a tamper-evident ring 16 with a diameter larger than the diameter of the cap 11. The tamper-evident ring 16 is attached to the body of the cap 11 through a fragile bond, enabling rupture and consequent separation of the ring and the cap 11. There is no gap between the cap 11 and the ring and any radial pressure in any sense and/or direction will cause rupture and consequent separation.

[0048] The tamper-evident ring 16 comprises a plurality of reversible grippers 18 projecting longitudinally from the tamper-evident ring 16, wherein the reversible grippers 18 are coupled to the tamper-evident ring by means of a hingeable membrane 10. Thus, by applying a force on the outside of the reversible grippers 18, the grippers will be reversed into the tamper-evident ring 16. This reversal of the grippers is accomplished by a tool capable of applying a force on the upper part of the grippers.

[0049] According to the preferred embodiment, each of the reversible grippers 18 consists of a set of a fin 19 and a jaw 20, which are single-piece molded, wherein the fin 19 is coupled to the hingeable membrane 10 of the tamper-evident ring 16, and the jaw 20 protrudes from the fin 19 downwards.

[0050] Figure 5 shows a bottom perspective view of the cap 11 of the preferred embodiment of the present invention. According to Figure 5, the fins 19 are triangular in shape with the rounded base, and the jaws 20 are parallelepiped-shaped with a sloping lower surface, forming a tip of the gripper. Coupling of the fin 19 with the jaw 20 defines a substantially "T" shaped gripper.

[0051] The inner surface of tamper-evident ring 16 comprises notches 26 of correspondingly shaped shape to accommodate the reversible grippers 18 in their reversed position, which in the rotational movements imparts additional resistance to the membrane versus gripper attachment and, as a consequence, to the system. Additionally, the lower rim of tamper-evident ring 16 is inclined to better accommodate the fins 19 when the gripper 18 is in the reverse position.

[0052] From Figure 5, it is possible to observe in detail the configuration of the reversible grippers 18 of the cap 11. The configuration of the body of the cap 11 and the grippers 18 occurs at precisely determined positions, distances and angles, and yet this assembly is designed for a series of motions that precede and prepare the assembly, which has unique features aggregated to the body of the cap 11 with simple movements of the grippers strategically repositioned for screwing to the container 13. The grippers 18 are attached to the body of the cap 11 by a flexible membrane 10 transversely at the point over which the axis perpendicular to the membrane passes and tangent to the body of the cap 11 and around which the gripper is to rotate to engage the located seat on the inner wall of the tamper-evident ring 16.

[0053] Said membrane 10 has a broad, flat cross-section which guides and constrains the joint at the transversely-grooved point to a path perpendicular to the groove. The trajectory of the gripper 18 is in a plane containing the axis of the cap 11. Tangent to the body of the cap 11, coincident/congruent with the transverse groove, the gripper attachment membrane to the body of the cap 11, construction which constrains the rotation path of the gripper to the plane perpendicular to the tangent and directs it precisely to the seat.

[0054] It is important to note that a number of other fin and jaw configurations may be combined to form the reversible grippers 18 required by the present invention, in which it would be obvious to one skilled in the art to substantially modify the shape of the fins and jaws to fit a practical need of use and/or production.

[0055] Optionally, the fins have a parallelepiped shape with a rounded upper surface, while the fingers have a parallelepiped shape, with or without an inclined lower surface. Optionally, the jaws are triangular in shape.

[0056] Optionally, the reversible gripper 18 consists of a triangular jaw, which is directly connected to the rim of the

tamper-evident ring 16 through the hingeable membrane 10.

[0057] The threaded cap 11 of the present invention is still advantageous since it is adapted for large-scale manufacturing. Figure 6 illustrates a plurality of caps 11 stacked one on top of the other. The caps 11 fit one on top of the other, preserving their fragile parts free and thus avoiding deformations during storage and transport. The stacked caps 11 behave as vertebrae and can make smooth turns as spirals to increase the capacity of a dispenser in reduced space. This facilitates all transport logistics and storage of caps 11.

[0058] Figure 7 further shows an alternative embodiment where the tubes are transported with the aid of guide tubes. The use of tubes prevents deformation during storage and transport, facilitates the supply of a dispenser of caps 11 with simple tube engagement.

[0059] Figures 8 and 9 illustrate the cap 11 in the form that it is manufactured by molding, referred to as the mounting or resting position. From the resting position, the cap 11 should be prepared for coupling with the bottle neck 12. According to the preferred embodiment of the present invention, the cap 11 is prepared to engage the container neck 12 by partially reversing the grippers 18 toward the interior of the tamper-evident ring 16, which is carried out through a suitable tool.

[0060] Figures 10-12 illustrate in a simple manner the process of reversing the grippers 18 of the cap 11, which is not the object of the present invention. Initially, the grippers are reversed out of the cap 11, forming a rest or mounting position, as shown in Figure 10. In this position, by positioning the tool on the cap 11, the lower tool ring contacts the upper part of the grippers 18. As the tool is pressed against the fins 19, the hingeable membrane 10 of the fins 19 allows the grippers to pivot towards the inside of the tamper-evident ring 16, as shown in Figure 11. As the gripper 18 moves towards the inside of the ring, the arcuate end of the tool slides along the upper surface of the gripper 18 until the grippers are reversed into the inside of the cap 11, forming an arched position as shown in Figure 12.

[0061] Figure 13 shows the cap 11 with the reversible grippers 18 fully reversed and accommodated within the tamper-evident ring 16, configuring the locked position of the cap 11. It is possible to note that there is a depression 29 at the end of the gripper 18 opposite the cap prior to reversal caused by the configuration of the fin 19 and jaw 20 of the preferred embodiment of the present invention. This depression 29 configures an outer ring on the cap 11 in its locked configuration which provides additional security to the system since it prevents the display and access to the lock mechanism of the tamper-evident ring 16.

[0062] During the armed position, the cap 11 is ready to be engaged in the neck 12 of the container 13, in which the axial movement of the cap 11 towards the container 13 causes the upper ring of the neck 12, that is, the mouthpiece of the container 13, to contact the grippers 18 in the armed position and to push them further into the interior of the cap 11. From a certain point, the axial displacement of the cap 11 against the neck 12 should be accomplished by the rotational movement of the cap 11 in the neck 12 of the container 13, since there will occur the contact of the turns of the neck 12 and the cap 11 of the container 13. Upon completion of rotational movement of the cap 11 in the bottle neck 12, the grippers will be completely reversed into the tamper-evident ring 16.

[0063] Figure 14 shows the set of the threaded cap 11 and neck 12 according to the preferred embodiment of the present invention. It will be appreciated that, after the cap 11 is coupled to the bottle neck 12, the reversible grippers 18 are trapped between the cap 11 and the bottle neck 12, being concealed and inaccessible to an external user.

[0064] Optionally, neck 12 of the container 13 comprises an annular seal 27 at the bottom of its locking ring. The diameter of the annular seal 27 is long enough to accommodate the rim formed by the tamper-evident ring 16 in its locked position, so that the contact of the rim of the tamper-evident ring 16 with the annular seal 27 of the neck of the container 12 prevents visualization and, much less, access to the inside of the tamper-evident ring 16.

[0065] Since cap 11 is coupled to the neck 12 of the container 13, a locking position is configured, in which there should be a mechanism for locking the cap 11 on the container neck 12, which should be able to prevent the reverse process to the process described above from being performed, that is, detachment of cap 11 from the neck 12 of the container. Cap 11 may only be disengaged by rupturing the tamper-evident ring 16. Still, the mechanism will continue to lock the tamper-evident ring 16 on the container neck 12, not preventing the opening and closing of the cap 11, but its presence will indicate that the container 13 has been opened and will prevent any type of fraud.

[0066] In the case of the use of ramp teeth 15 as in the state of the art, even if it is reversed into the tamper-evident ring 16, a person skilled in the cap 11 could fraudulently tamper with said tamper-evident ring 16.

[0067] Between said tamper-evident ring 16 and the neck 12 of the container 13 there is a necessary clearance capable of bringing the respective protusions (teeth, ramps) in the rotational closing movement. When a tension is applied in the rotational direction of the aperture, until the teeth 15 are at their smallest distance, the clearance, distributed along the ring, will also be along any groups of three teeth 15 of the tamper-evident ring 16. In this way, the fraudster could press the anterior and posterior half-circles to deform them, in which the decrease of the clearance in the positions anterior and posterior to said tooth would cause an increase in the clearance of the tooth, creating a "belly", which would allow the ring tooth to extend beyond the corresponding tooth of the neck 12.

[0068] If this procedure were repeated several times, it would be possible to pass all the teeth 15 or ramps of the tamper-evident ring 16 by the teeth 15 of the neck 12 of the container 13, removing the cap 11 without rupturing the ring 16.

[0069] Figure 1 illustrates a limitation of the state of the art with respect to this type of fraud, where, in the event the

proposed solution only use ramp-shaped teeth 15, it would also be vulnerable to this type of fraud. Although the reversible grippers 18 make this process difficult, a user would still be able to apply the described procedure if he or she is aware of the mechanism, or even through trial and error.

[0070] Thus, the present invention proposes an innovative locking mechanism 22 capable of solving the shortcomings of known solutions. The mechanism 22 for locking the tamper-evident ring 16 proposed by the present invention can be seen in Figures 15-17, wherein each of the reversible grippers 18 comprises a pivotal locking mechanism 22 relative to a lateral end of its jaws 20. Said locking mechanism is further detailed in Figure 15.

[0071] Figure 15 shows a loading means according to a preferred embodiment of the instant invention; The locking mechanism 22 consists of a flap coupled to the jaw 20 of the gripper 18 by means of a flexible membrane 24, wherein the length of the fin is slightly shorter than the length of the jaw 20 and has a diamond-shaped cross-section.

[0072] Optionally, in order to provide a better accommodation of the reversible gripper in tamper-evident ring 16, the jaw 20 further comprises an extended portion 25 at its lateral end, and wherein the locking mechanism 22 consists of a fin coupled to the extended portion 25 of the jaw 20 by means of a flexible membrane 24.

[0073] The locking mechanism is used to prevent the cap 11 from being unscrewed from the container 13 without rupturing the tamper-evident ring 16. Coupling by means of a flexible membrane 24 allows the locking mechanism 22 to be able to pivot with respect to the jaw 20, having as its pivoting ends a releasing position and a locking position.

[0074] Figure 16 shows a cross-sectional view of the cap 11 coupled to the neck 12 of the container 13, where it is possible to observe the action of the locking mechanisms 22 of each of the reversed grippers 18. The internal red arrow indicates that the container neck 12 does not undergo any rotational movement. The outer red arrow indicates the direction of rotation for closing the cover 11, counterclockwise.

[0075] As shown, as the cap 11 undergoes rotational movement toward the closure of the cap 11 in the container, the contact of the locking mechanism 22 with the neck 12 of the container 13 causes the locking mechanism 22 to pivot to a releasing position, which allows the passage thereof on the teeth 15 of the neck 12 of the container 13. On the other hand, when the cap 11 undergoes rotational movement in the opening direction of the cap 11 in the container 13, the contact of the locking mechanism 22 with the neck 12 of the container 13 causes the locking mechanism 22 to pivot to a locking position, which does not allow the passage thereof on the ratchet teeth 15 of the neck 12 of the container 13.

[0076] It is important to note that a number of other locking mechanism configurations may be used to exert the unidirectional locking required by the present invention, wherein it would be obvious to one skilled in the art to substantially modify the shape of the fins to fit a practical production need.

[0077] Optionally, the locking mechanism 22 consists of a flap coupled to the jaw 20 of the cap 11 by means of a flexible membrane 24, wherein the length of the fin is slightly shorter than the length of the jaw 20 and has a triangular-shaped cross-section.

[0078] While in the embodiment shown in Figures 15 and 16 all of the reversible grippers 18 have a locking mechanism 22 engaged at its lateral end, the present invention requires only one locking mechanism 22 to achieve the proposed solution. Thus, it is possible that only one reversible gripper 18 has a pivotal locking mechanism 22 at its lateral end and the other grippers 18 are only reversible into the tamper-evident ring 16.

[0079] Additionally, the number of teeth 15 in the sealing collar 14 of the neck 12 can be varied to decrease the movement tolerance prior to rupture of the tamper-evident ring 16. The number of teeth 15 of the sealing collar 14 of the container 13 will define the tolerance angle between the saturation point and the rupture point of the tamper-evident ring 16.

[0080] According to the preferred embodiment of the present invention, tamper-evident ring 16 has eighteen reversible grippers 18 with locking mechanisms 22 and the collar 14 of the neck 12 has eighteen teeth 15. As already described, when the cap 11 is turned in the direction of the aperture, it starts from the saturation point and there is initially a strong tension which decreases until, approximately in the following 20° gradually, the transit of liquids and gases begins. The aperture point is approximately the initial of these 20°. The 20° tolerance is defined precisely by the number of teeth 15 of the sealing collar 14 of the neck 12 of the container 13.

[0081] Figure 17 illustrates an optional embodiment where the tamper-evident ring 16 has eighteen reversible grippers 18 with locking mechanisms 22 and the sealing collar 14 of the neck 12 has thirty-six teeth 15. In this case, the tolerance of tamper-evident ring 16 will be 10°, defined by 360° divided by thirty-six teeth 15. In this sense, as eighteen is a submultiple of thirty-six, all the oscillating knives coincide with teeth 15.

[0082] It is important to note that any number of locking mechanisms 22 and teeth 15 on the collar 14 may be used to exert the unidirectional locking required by the present invention, and it would be obvious to one skilled in the art to substantially modify the number of teeth 15 to obtain a desired tolerance.

[0083] If a lower tolerance is desired, it is possible to use a number of teeth 15 on the collar 14 and the number of locking mechanisms 22 having submultiples that are prime to each other. For instance, for a number of teeth 15 of the sealing collar 14 equal to ninety-nine and a number of locking mechanisms 22 equal to 18, as these numbers are not prime to each other, 3² is the common maximum divisor of 18 and 99, which means that a locking mechanism 22 and a tooth 15 of the sealing collar 14 of the neck 12 will always coincide at 9 points. However, 18 is not divisible by 11,

which is a submultiple of ninety-nine so the tolerance will be defined by 360° divided by 11×18 , as well as by:

$$\frac{360^\circ}{11 \times 18} = 1,818^\circ, \text{ or even } \frac{1,8 \text{ mm}}{11 \times 18} = 0,009 \text{ mm}$$

[0084] As can be seen, the tolerance found in the above example is micrometric and there is no practical need for such a low value. The purpose of the example is to show that there are features for obtaining the most diverse tolerance values and hence accuracy by varying the number of locking mechanisms 22 and teeth 15 of the sealing collar 14 of the collar 12.

[0085] Thus, the present invention solves the technical problem of fraud of the tamper-evident mechanism of a set of cap 11 and neck 12 of a container 13. The proposed invention provides a set of threaded cap 11 and neck 12 having a security mechanism in the form of a tamper-evident ring 16, which will be ruptured to indicate tampering before any fluid exchange is possible between the container 13 and the external environment.

[0086] The use of locking means which modify its configuration according to the direction of the rotational movement allows the configuration of the present invention to reach a level of inviolability not yet achieved by the state of the art.

[0087] Initially, a study on tamper-evident ring 16 was presented, in which it was shown that the ring should have a tear-off mechanism sensitive to axial or rotational movement of the cap 11 relative to the neck 12 of the container 13. It has been shown that the tear-off mechanism sensitive to rotational movement allows greater precision in the definition of the sealing, rupture and saturation points, ensuring greater safety that during the opening of the cap 11, there is no exchange of fluids from the interior of the container 13 before rupture of the tamper-evident ring 16.

[0088] Next, it has been demonstrated that the tamper-evident ring configuration 16 is sensitive to tampering by a malicious user, who may apply stresses to deform the ring so as to create a gap between the ring threads and closure turns 11, until it is possible to move the cap 11 axially upwards, it being possible to remove the cap 11 without tearing off the tamper-evident ring 16.

[0089] As a solution, the use of reversible grippers 18 has been described for the inside of the cap 11, when it is sealed in the neck 12 of the container 13. This configuration allows the tear-off mechanism of the tamper-evident ring 16 to be inaccessible and hidden from the user after it is sealed to the neck 12 of the container 13. This configuration prevents the disclosure and access to the tear-off mechanism of the tamper-evident ring 16, hindering any attempts to circumvent said ring.

[0090] Finally, it has been described that even though a tear-off mechanism is sensitive to rotational movement, and even if it is reversed into the tamper-evident ring 16, a person could defraud said mechanism by applying forces to cause precise deformations at points of the tamper-evident ring 16.

[0091] To overcome this problem, the present invention features a tamper-evident ring 16 with hinged locking mechanism 22, which assumes different configurations in the opening and closing movements of the cap 11 in the neck 12 of the container 13. During the closure movement of the cap 11, the locking mechanism is configured to provide a clearance capable of allowing the passage of the mechanism over the teeth 15 of the neck 12 of the container 13. However, during the opening movement of the cap 11, the locking mechanism 22 is configured so that there is no clearance between it and the tooth 15 of the neck 12, so that there is no possibility of passing the locking mechanism 22 by the teeth 15 the neck 12 of the container 13, even by applying small deformations on the cap 11.

[0092] Moreover, the present invention is advantageous in that its shape allows it to be molded into a simple single-piece mold having a low production cost, and is favorable to large scale production. Thus, the set of the threaded cap 11 and neck 12 proposed by the present invention becomes economically feasible and appealing for large-scale production in a variety of industrial facilities for the production of sealed containers 13.

[0093] Countless variations affecting the scope of protection of this application are allowed. The set of the threaded cap 11 and neck 12 of the present invention has an application of particular interest in containers 13 for storing liquids, such as beverage bottles and cleaning products.

[0094] However, the cap assembly 11 and threaded neck 12 of the present invention may be used to perform the sealing of any container 13 where it is necessary to ensure the integrity of its contents. Therefore, it is to be emphasized that this invention is not limited to the specific configurations/embodiments described above.

Claims

1. A threaded cap (11) and neck (12) set for evidencing tampering with containers (13), comprising:

a neck (12) of a container (13) having a cylindrical shape and an aperture, said neck (12) having threads on its outer surface and a sealing collar (14), wherein said collar (14) comprises a plurality of teeth (15); and

a cap (11) with a thread portion having a cylindrical shape and having threads on its inner surface, said cap (11) including a tamper-evident ring (16) coupled to the lower rim of the cap (11), wherein said tamper-evident ring (16) has a diameter greater than the diameter of the cap (11).

wherein the tamper-evident ring (16) comprises a plurality of reversible grippers (18) projecting longitudinally from the tamper-evident ring (16), wherein the reversible grippers (18) are coupled to the lower rim (17) of the tamper-evident ring (16) by means of a hingeable membrane (10).

the set being **characterized in that** at least one of the reversible grippers (18) comprises a hingeable locking mechanism (22) relative to the gripper, wherein:

when the cap (11) rotates in the direction for closing the cap (11) on the bottle, the locking mechanism articulates to a releasing position that allows passage thereof on the teeth (15) of the bottle neck (12), and when the cap (11) rotates in the direction for opening the cap (11) on the bottle, the locking mechanism articulates to a locked position that does not allow passage thereof on the teeth (15) of the bottle neck (12).

2. The threaded cap (11) and neck (12) set, according to claim 1, **characterized in that** each one of the reversible grippers (18) consists of a set of a fin (19) and a jaw (20), wherein the fin (19) is coupled to the hingeable membrane (10) of the tamper-evident ring (16), and the jaw (20) protrudes from the fin (19) downwards.

3. The threaded cap (11) and neck (12) set, according to claim 2, **characterized in that** the fins (19) have a triangular shape with rounded base, and the jaws (20) have a parallelepiped shape with an inclined lower surface, wherein the coupling of the fin (19) with the jaw (20) defines a substantially "T"-shaped gripper.

4. The threaded cap (11) and neck (12) set, according to any of claims 1-3, **characterized in that** the locking mechanism consists of a flap coupled to the jaw (20) of the cap (11) by means of a flexible membrane (24), in which the flap has a diamond-shaped cross-section.

5. The threaded cap (11) and neck (12) set, according to any of claims 1-4, **characterized in that** the jaw (20) further comprises an extended portion (25) at its lateral end, and wherein the locking mechanism (22) consists of a flap coupled to the extended portion (25) of the jaw (20) by means of a flexible membrane (24).

6. The threaded cap (11) and neck (12) set, according to any of claims 1-5, **characterized in that** the inner surface of the tamper-evident ring (16) comprises notches (26) adapted to accommodate the reversible grippers (18) in their reversed position.

7. The threaded cap (11) and neck (12) set, according to any one of claims 1-6, **characterized in that** the tamper-evident ring (16) is coupled to the lower rim of the cap (11) through a fragile connection, wherein when the rotational movement in the aperture direction of the cap (11) exceeds a force threshold, the tamper-evident ring (16) breaks and is disengaged from the cap (11).

8. The threaded cap (11) and neck (12) set, according to any one of claims 1-7, **characterized in that** the tamper-evident ring (16) remains in the locking position even after being torn off and disengaged from the cap (11).

9. The threaded cap (11) and neck (12) set, according to any one of claims 1-8, **characterized in that** the neck (12) further comprises an annular seal (27) in the bottom part of the sealing collar (14).

10. The threaded cap (11) and neck (12) set, according to any one of claims 1-9, **characterized in that** the reversible grippers (18) comprise a depression (29) at its end opposite the cap (11), wherein, when the grippers (18) are reversed into the cap, the gripper depressions form an outer rim on the cap (11).

11. The threaded cap (11) and neck (12) set, according to any one of claims 1-10, **characterized in that** the sealing collar (14) of the neck (12) comprises 18 teeth (15) and the tamper-evident ring (16), comprises X reversible grippers (18).

12. The threaded cap (11) and neck (12) set, according to any one of claims 1-10, **characterized in that** the sealing collar (14) of the neck (12) comprises 18 teeth (15) and the tamper evidence ring (16) comprises 36 reversible grippers (18).

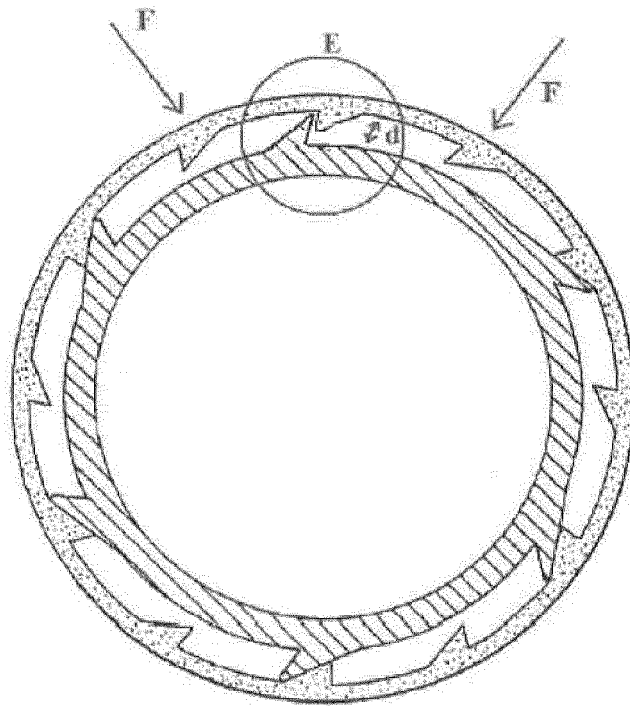


FIG. 1

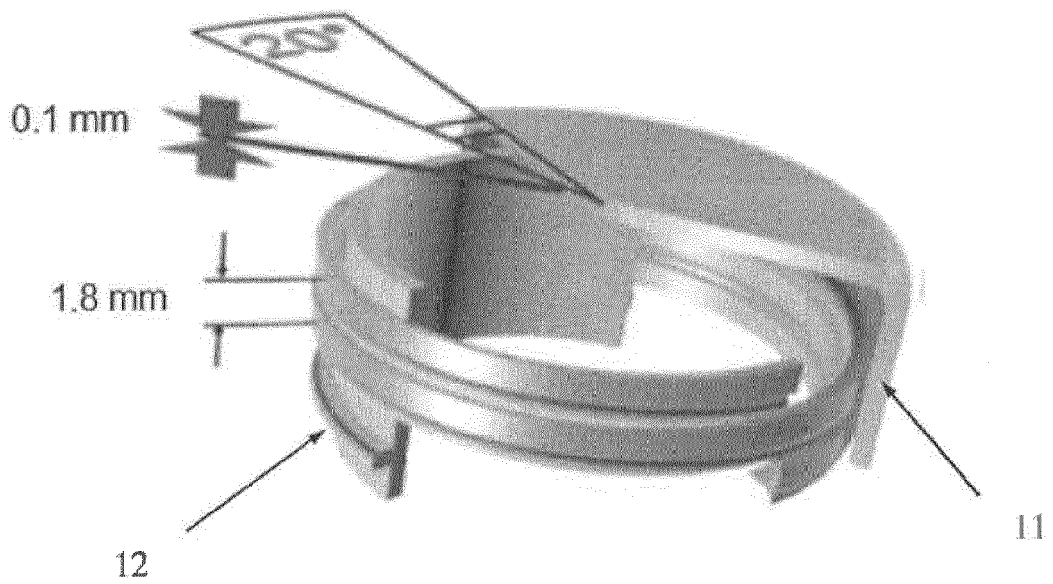


FIG. 2

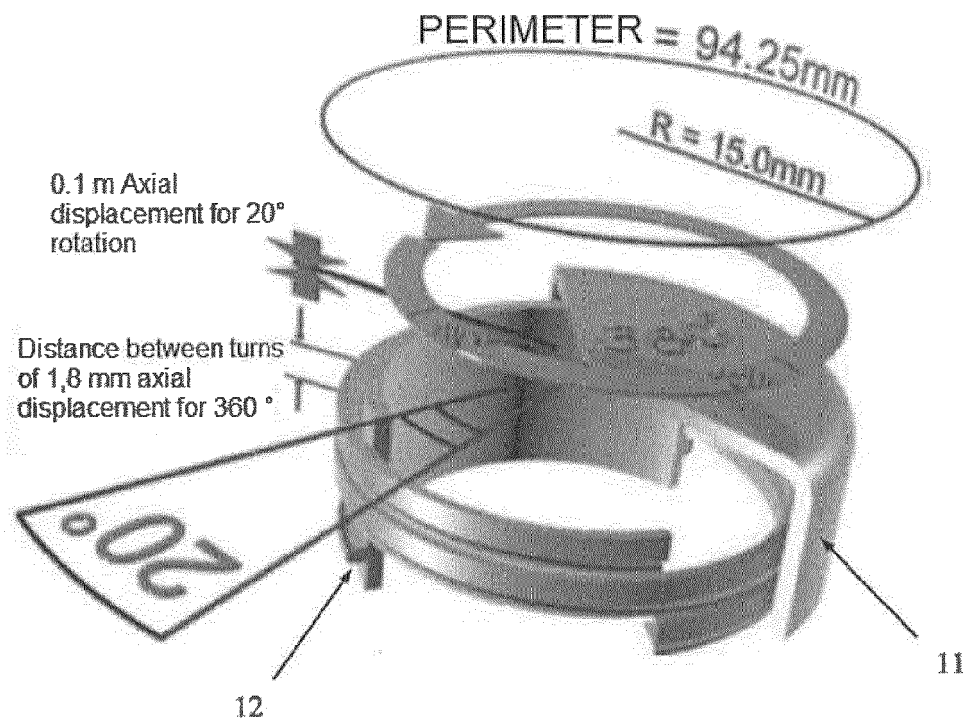


FIG. 3

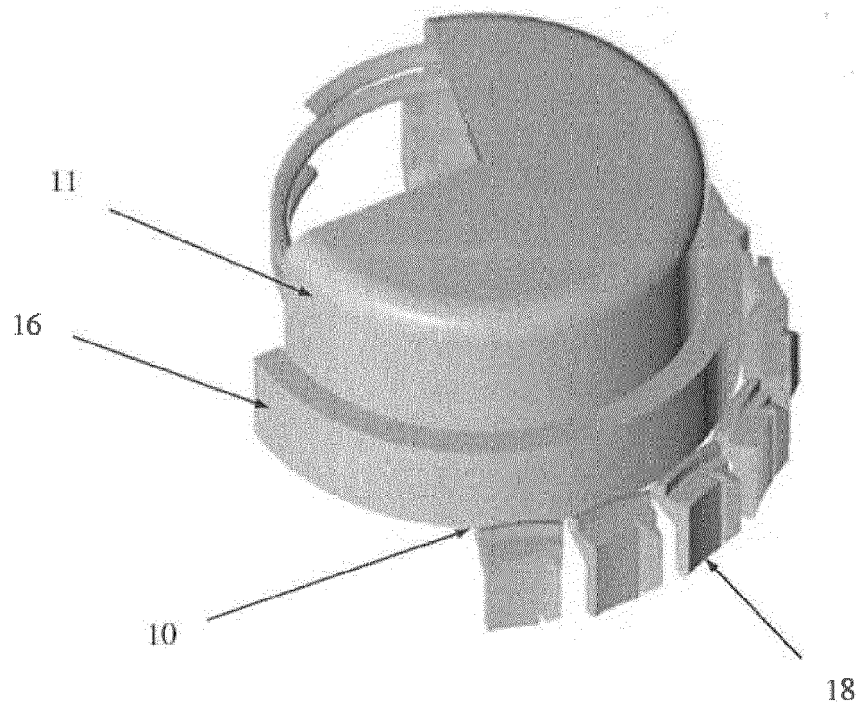


FIG. 4

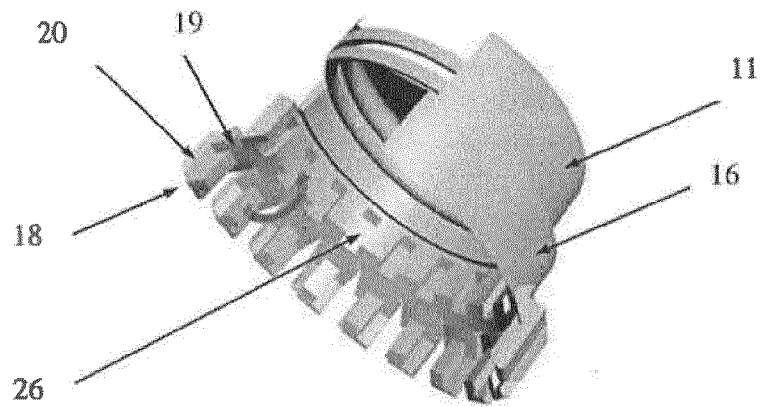


FIG. 5

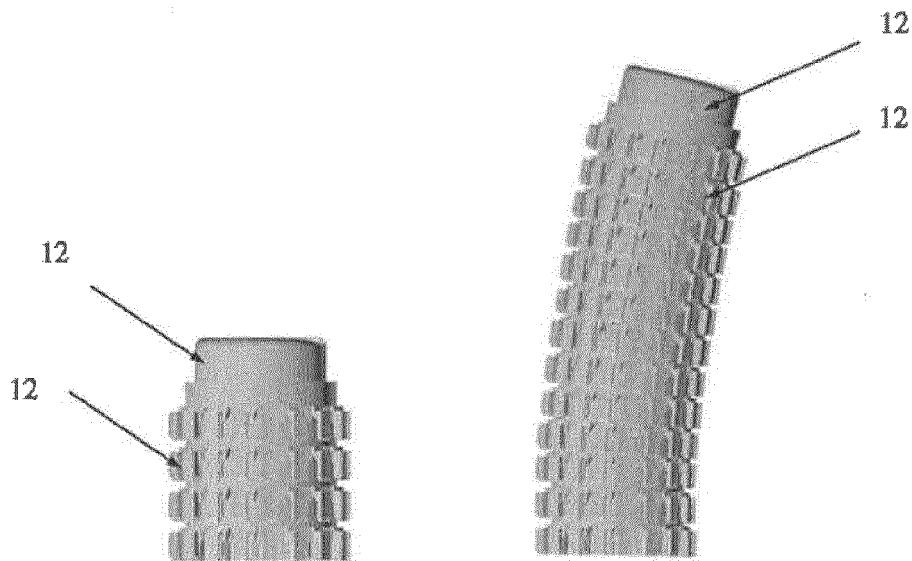


FIG. 6

FIG. 7

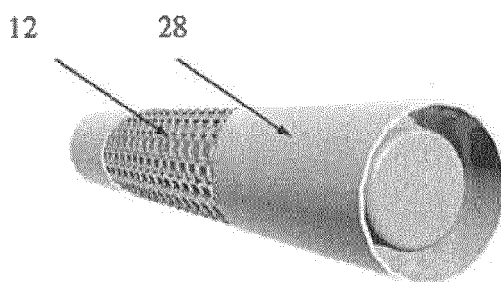


FIG. 8

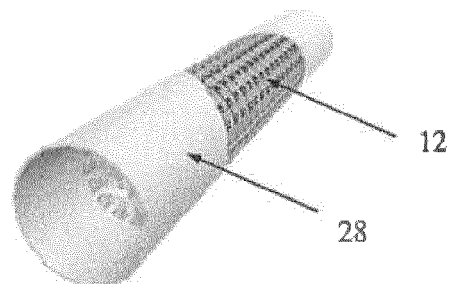
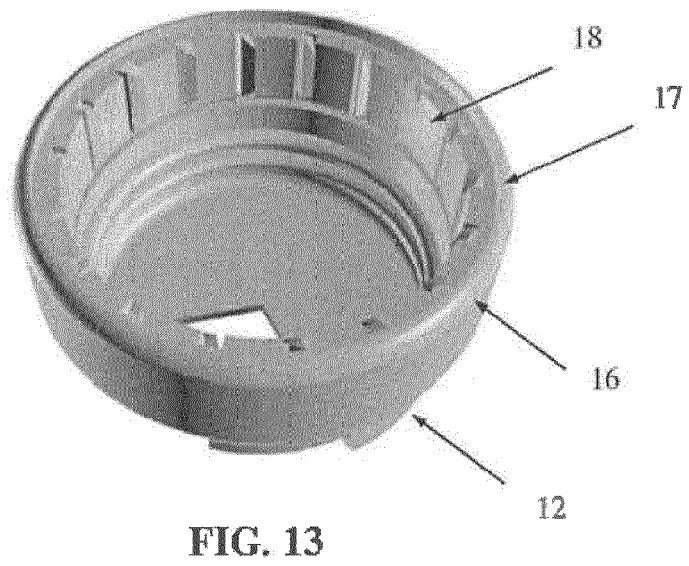
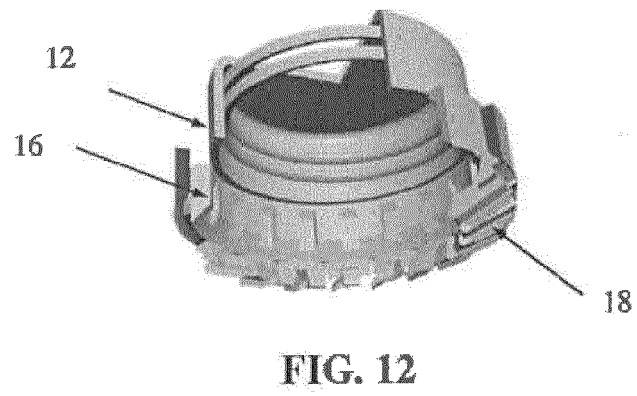
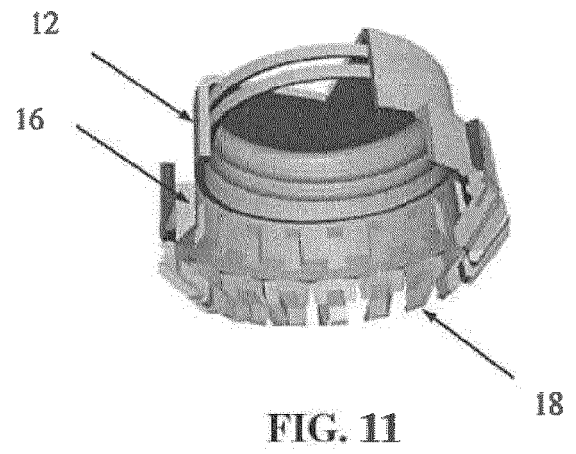
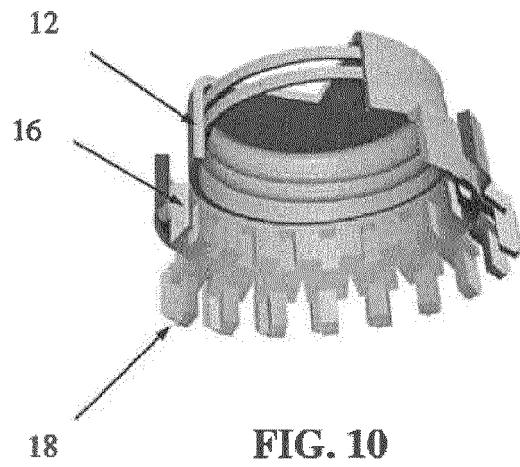


FIG. 9



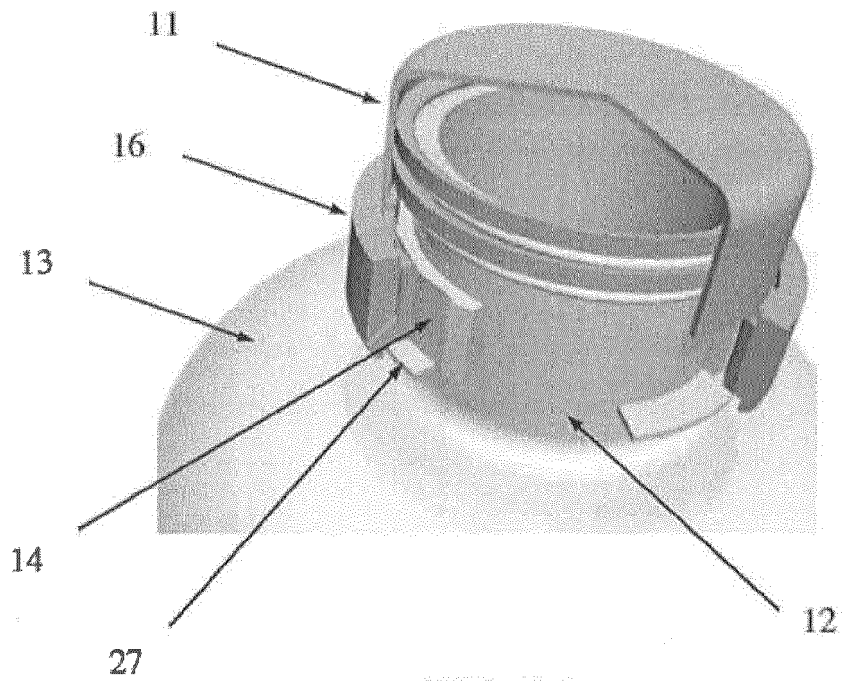


FIG. 14

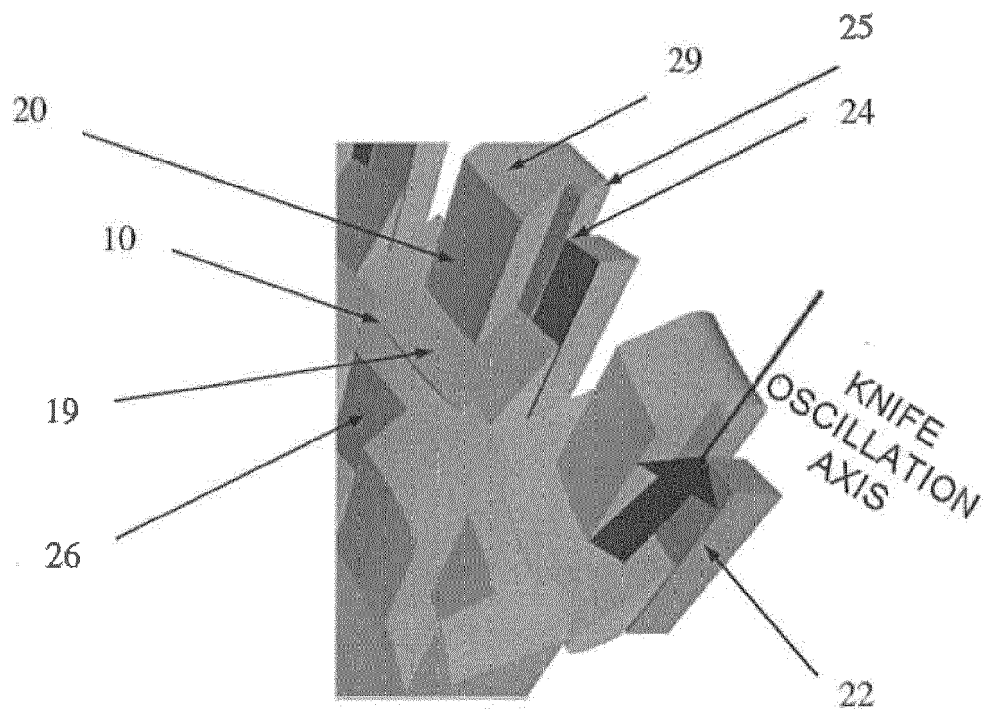


FIG. 15

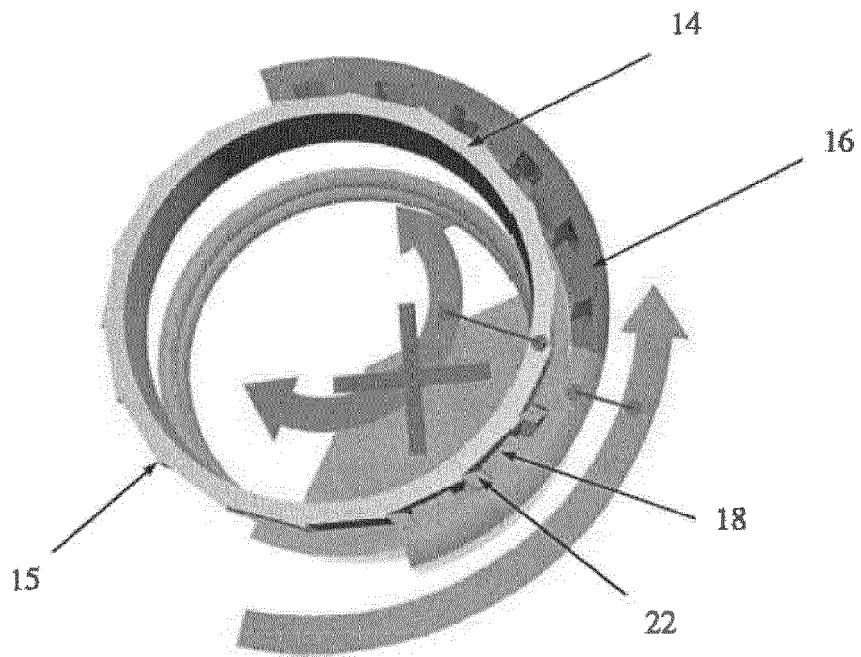


FIG. 16

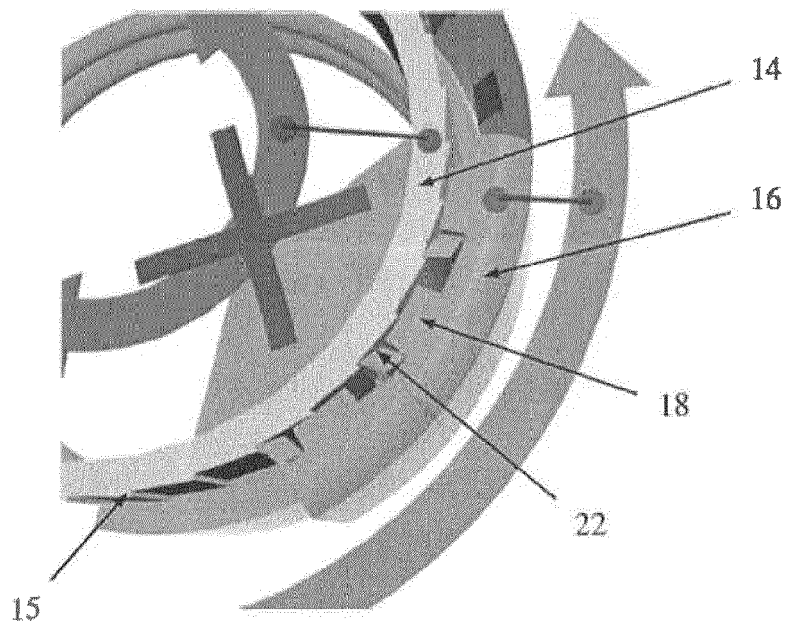


FIG. 17

INTERNATIONAL SEARCH REPORT

International application No.

PCT/BR2016/050076

A. CLASSIFICATION OF SUBJECT MATTER

B65D41/34 (2006.01), B65D41/38 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B65D41/34, B65D41/38 - IPC. B65D41/3442, B65D41/1447 - CPC

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

GOOGLE PATENTS, SITE DO INPI

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, ESPACENET

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002096485 AI 25 July 2002 (2002-07-25) See abstract, description col. 3, lines 28 to 68 and col. 4, lines 1 to 49, claim 1 and figures 1, 2, 3, 5, 6, 7 e 10. -----	2, 3, 6 - 10
X	US 4801030 A (OWENS ILLINOIS CLOSURE INC [US]) 31 January 1989 (1989-01-31) See abstract, figures 1 and 2. -----	2, 3, 6 - 10
X	WO 2012018994 A2 (CRISCI ROBERT E [US]) 09 February 2012 (2012-02-09) See abstract, descritivo [0016] [0017] and figure 2. -----	11 e 12
A	US 8353413 B2 (EKKERT LEN [US]) 15 January 2013 (2013-01-15) Ver abstract and figures 1, 2 and 5	2 a 12

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

03/08/2016

Date of mailing of the international search report

24/08/2016

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/BR2016/050076

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

Claim 1 does not meet the requirements of PCT Article 6 because the matter for which protection is sought is not clearly defined. The claim attempts to define the subject matter in terms of the result to be achieved, but in so doing merely states the problem to be solved, without indicating the technical features necessary for achieving this result.
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/BR2016/050076

5

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

10

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2006160301 A (NIHON YAMAMURA GLASS CO LTD) 22 june 2006 (2006-06-22) See figures 1 to 3 -----	2 a 12

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Form PCT/ISA/210 (continuation of second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/BR2016/050076

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Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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- US 5115932 A [0018] [0019]
- WO 2012018994 A [0020]
- US 20020096485 A [0021]