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(54) **MECHANISM FOR ASSISTING OPENING AND CLOSING OF SCREW CAP**

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(57) **ABSTRACT**

A screw cap opening/closure assistance mechanism (10) assists in opening and closure of a screw cap (20) in a screw cap mechanism. The screw cap opening/closure assistance mechanism includes a coupling part (13) provided on the screw cap (20) and an opening/closure assistance part (14) connected to the coupling part (13). One end of the coupling part is adapted to be rotated in unison with the screw cap (20). This opening/closure assistance part is positioned in proximity to an outer surface of the screw cap (20) when the screw cap opening/closure assistance mechanism has not been used or when it is not in use. For opening/closure, the screw cap opening/closure assistance part is moved away from the screw cap (20) so as to form a large diameter moving part rotatable in unison with the screw cap (20). An arrangement is so made that the force of rotation needed for the opening/closure operation for the screw cap (20) may be smaller.

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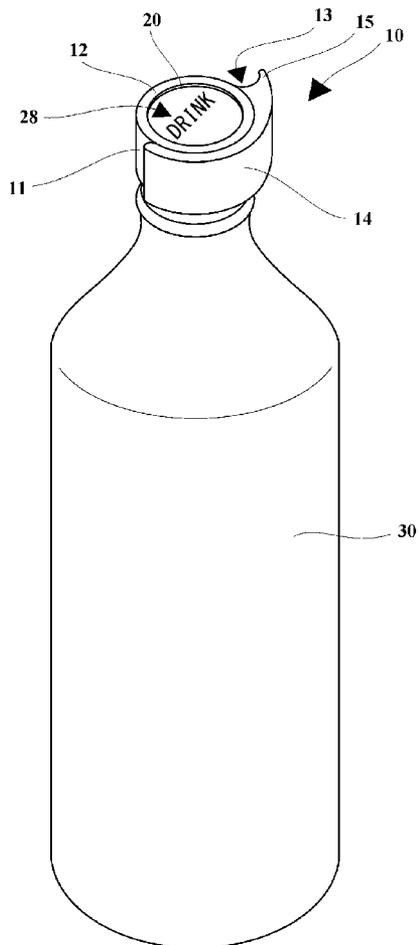
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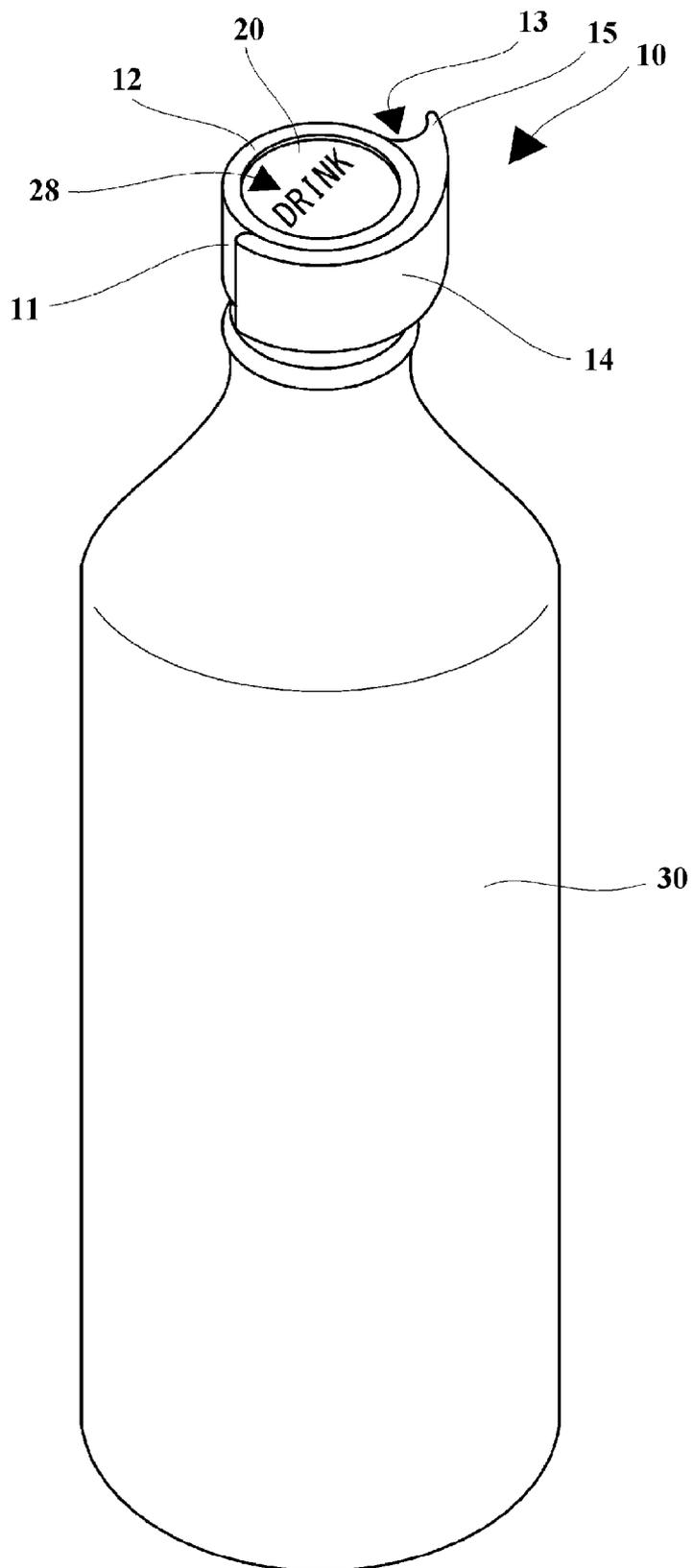
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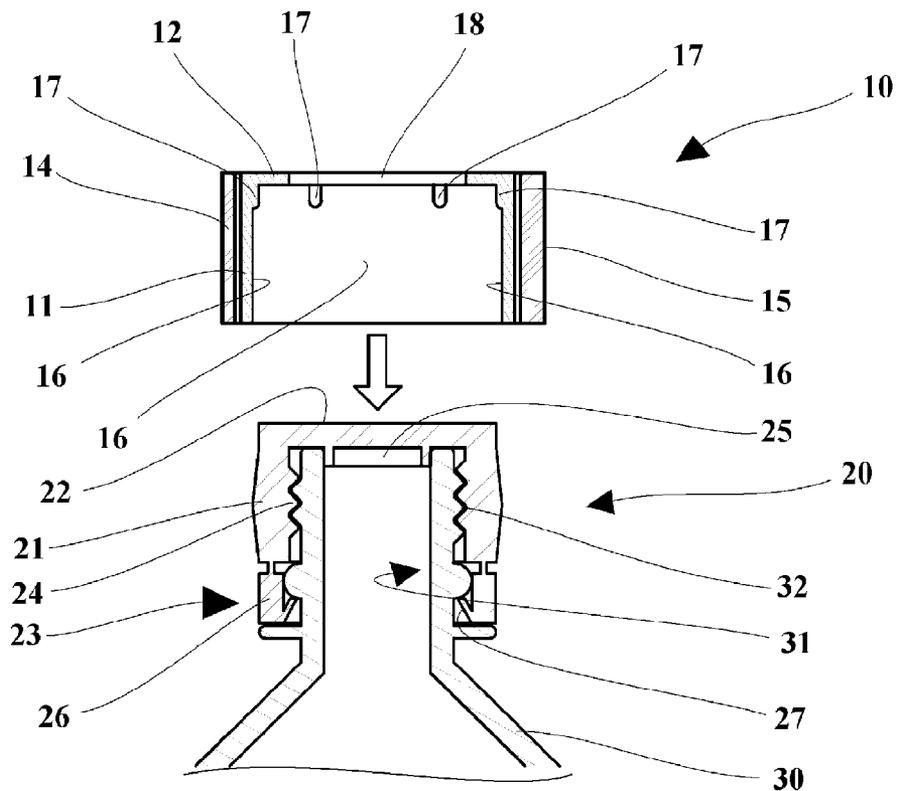
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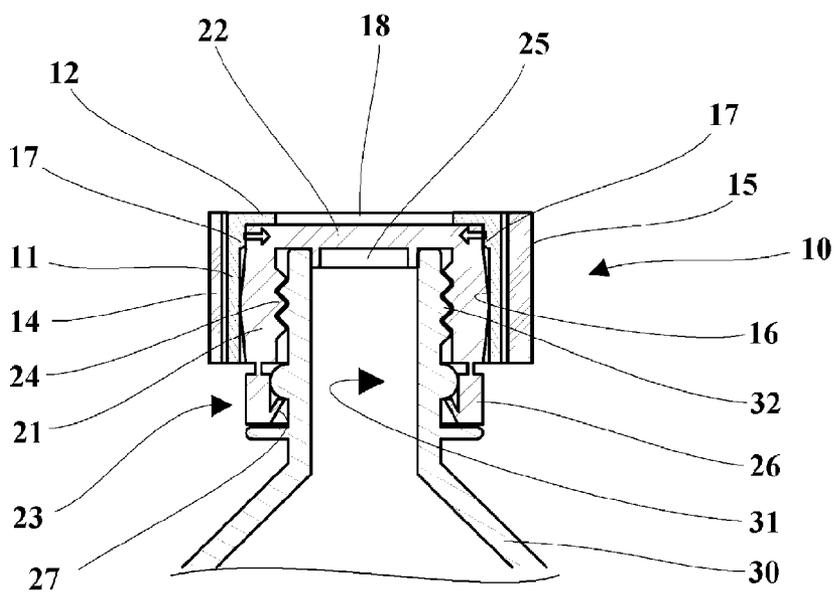
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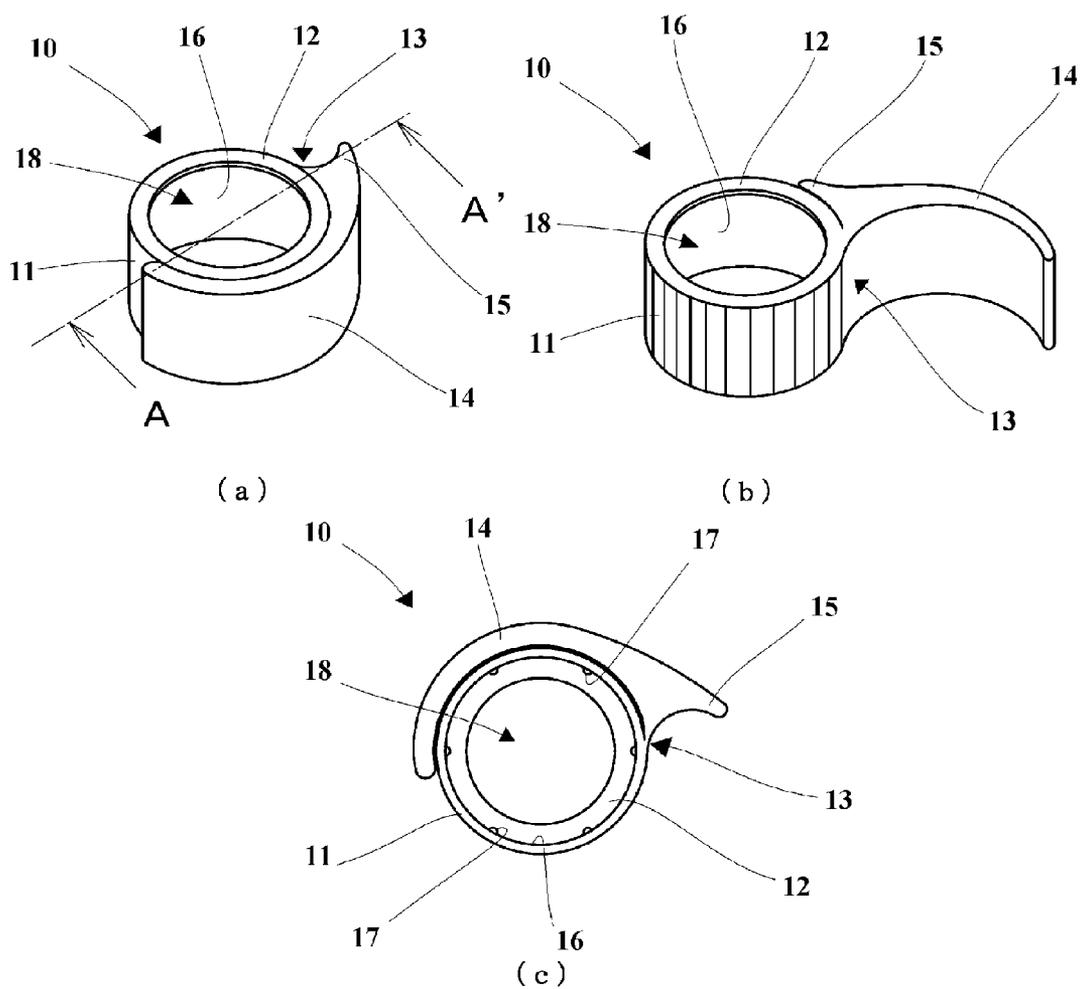


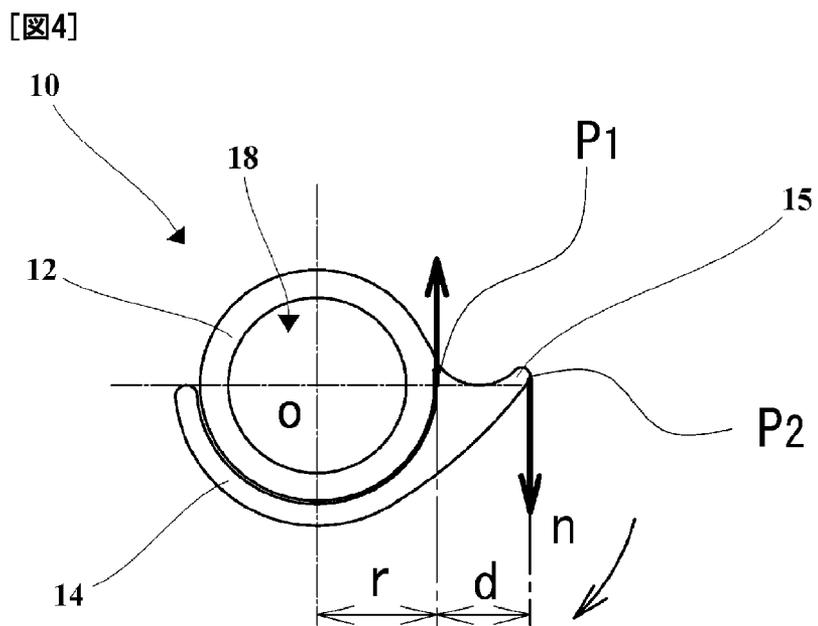
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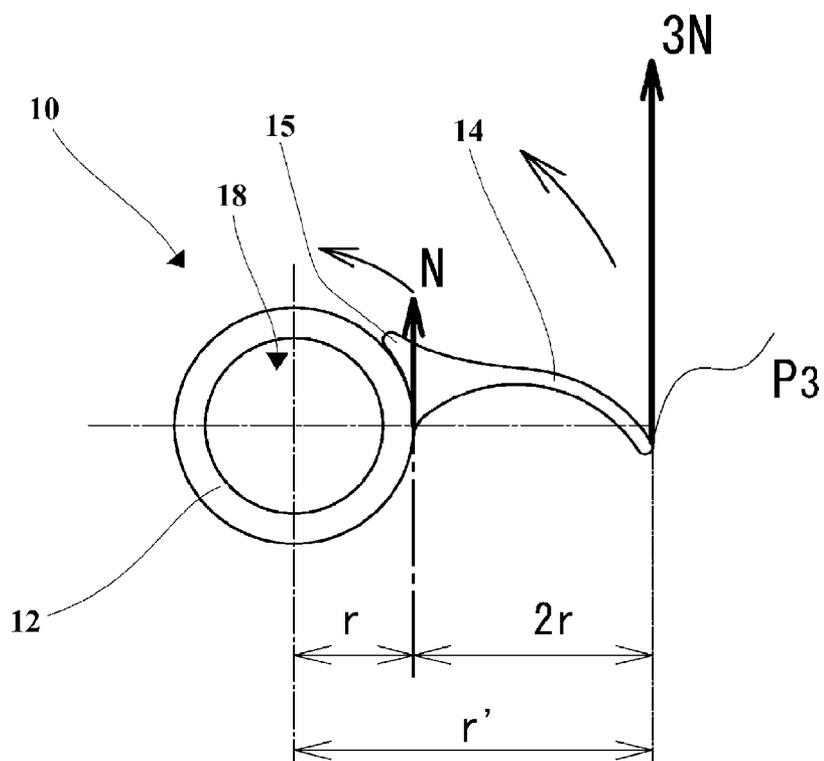
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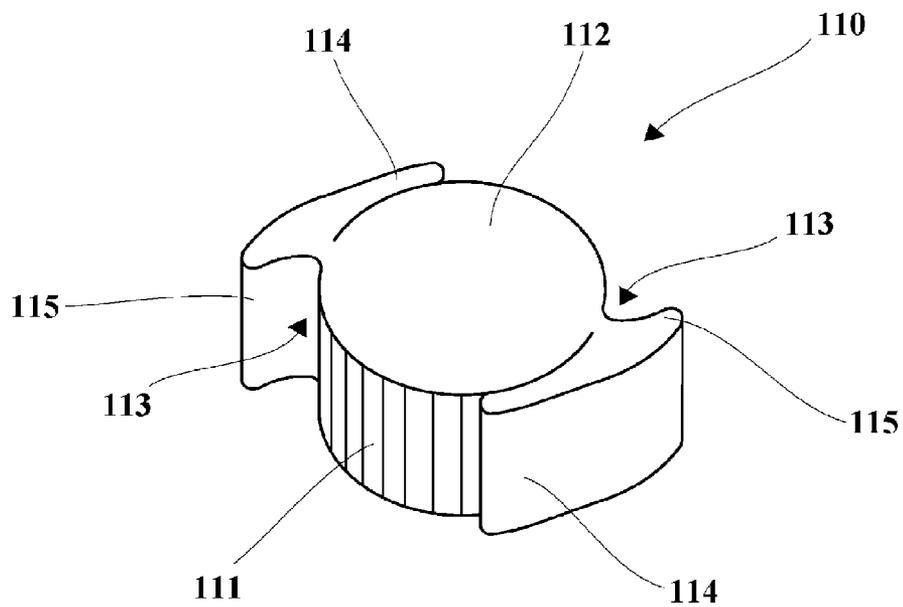


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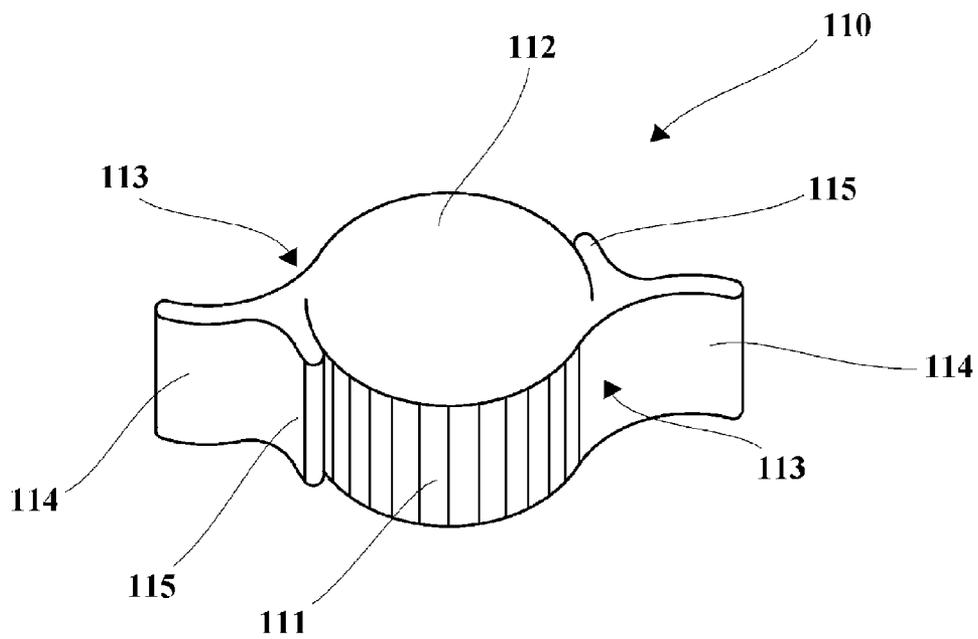


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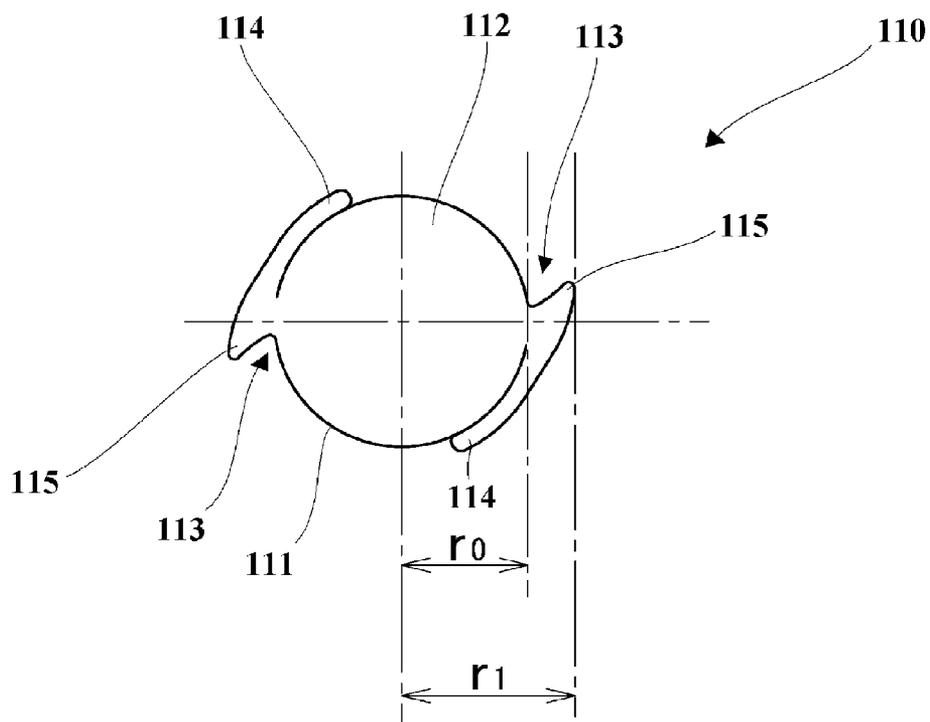


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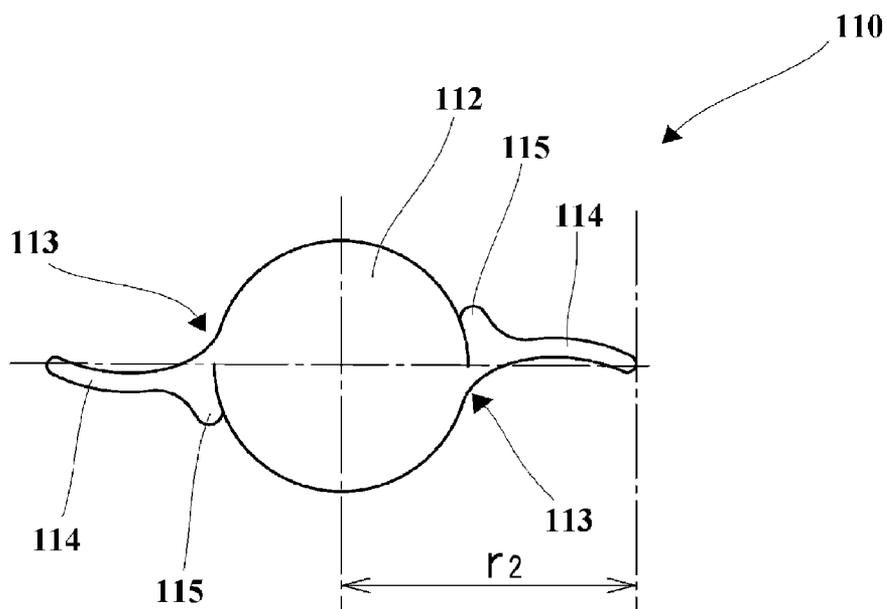


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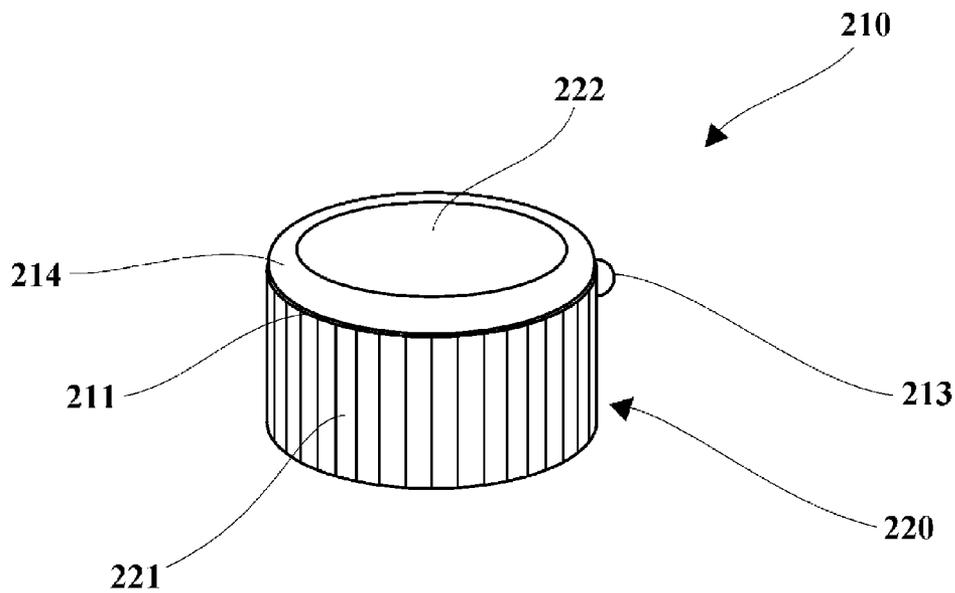


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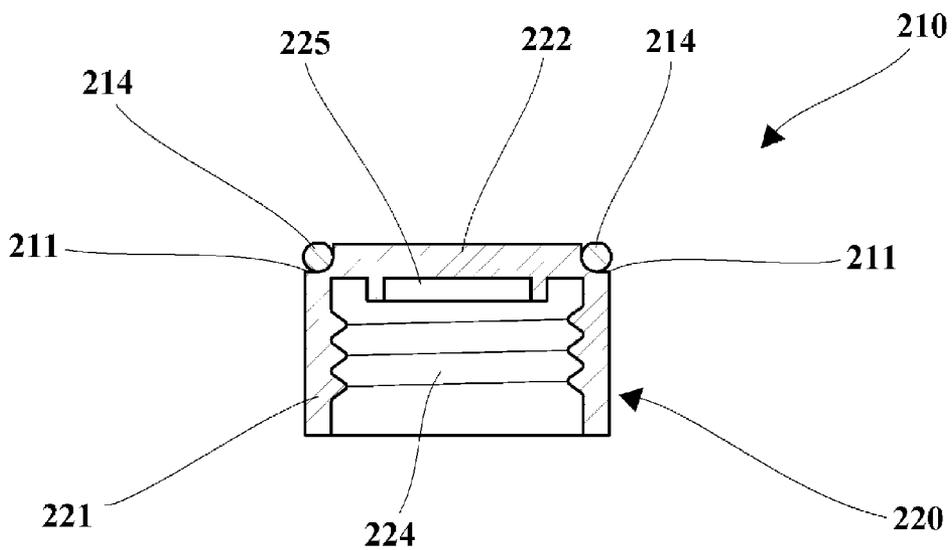


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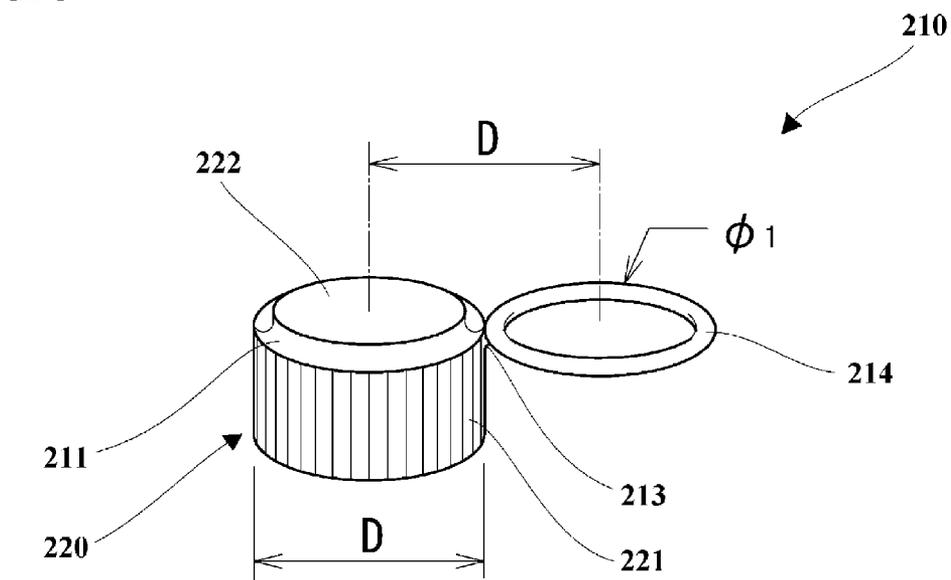


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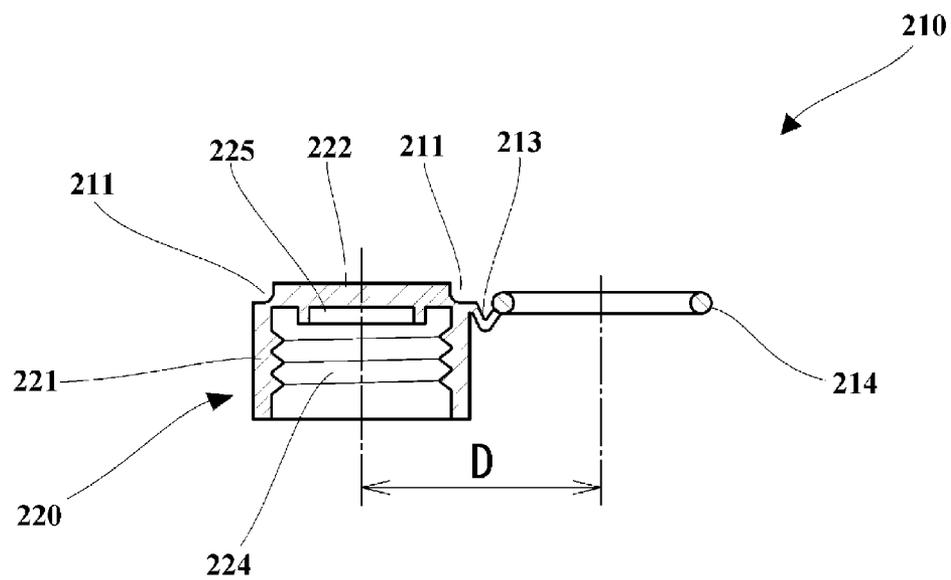


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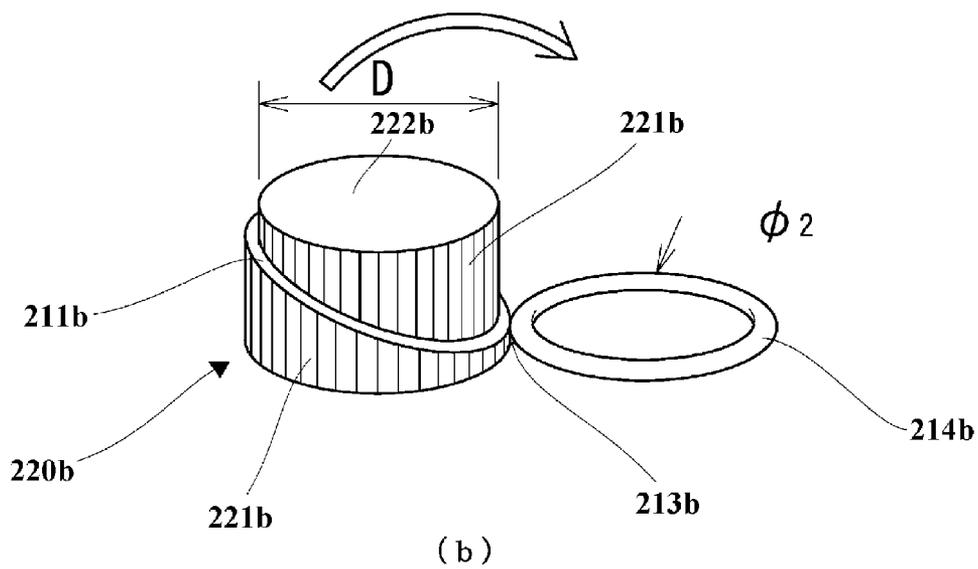
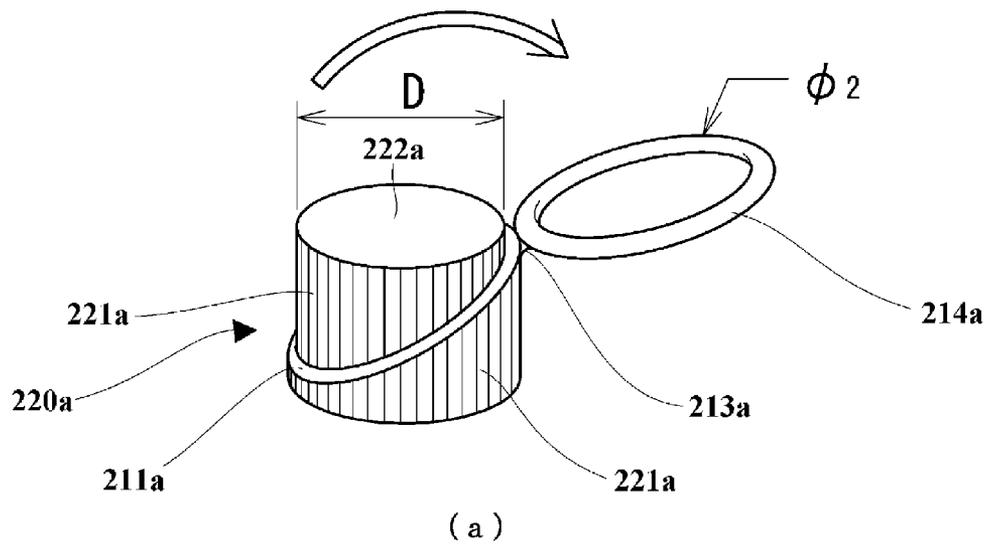


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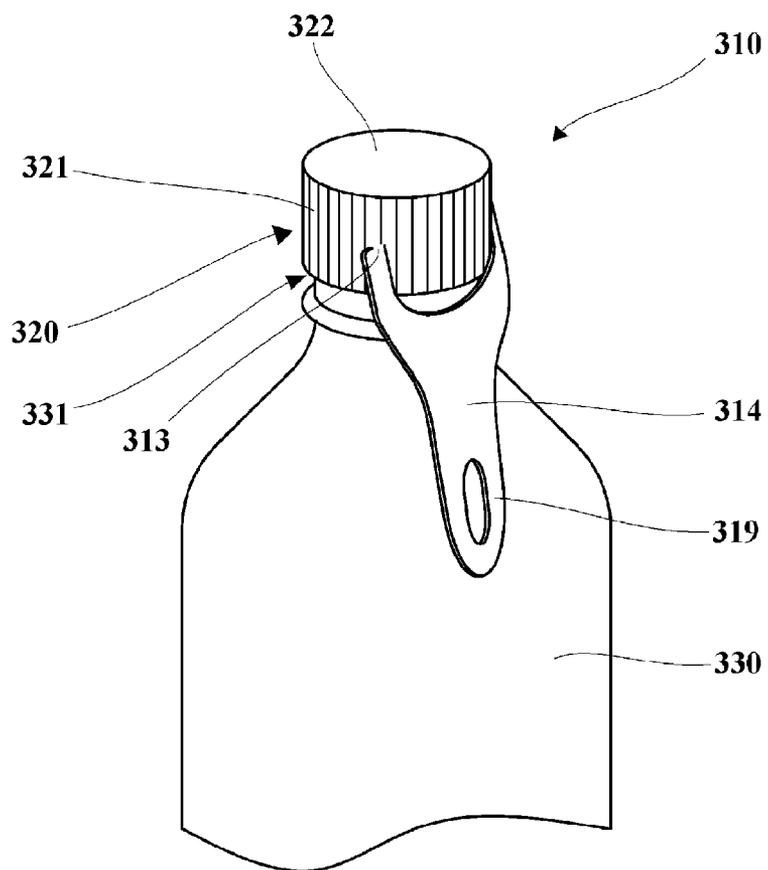


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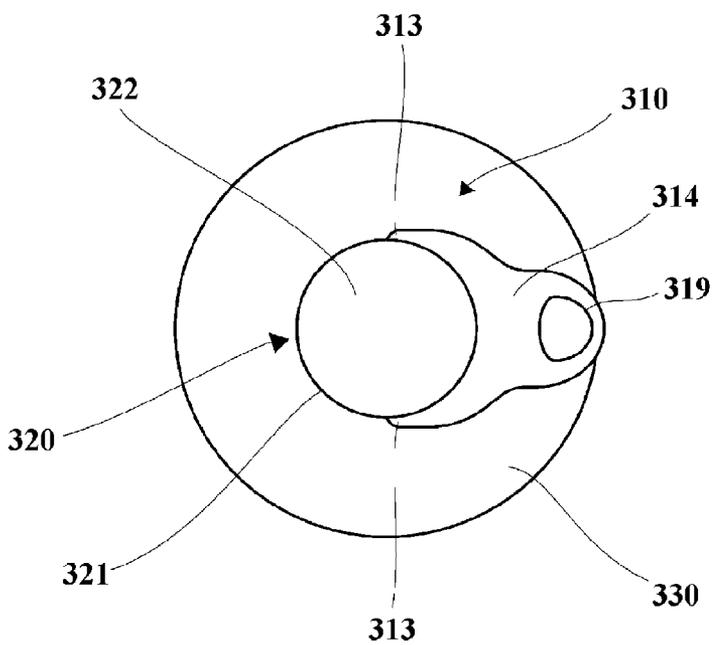
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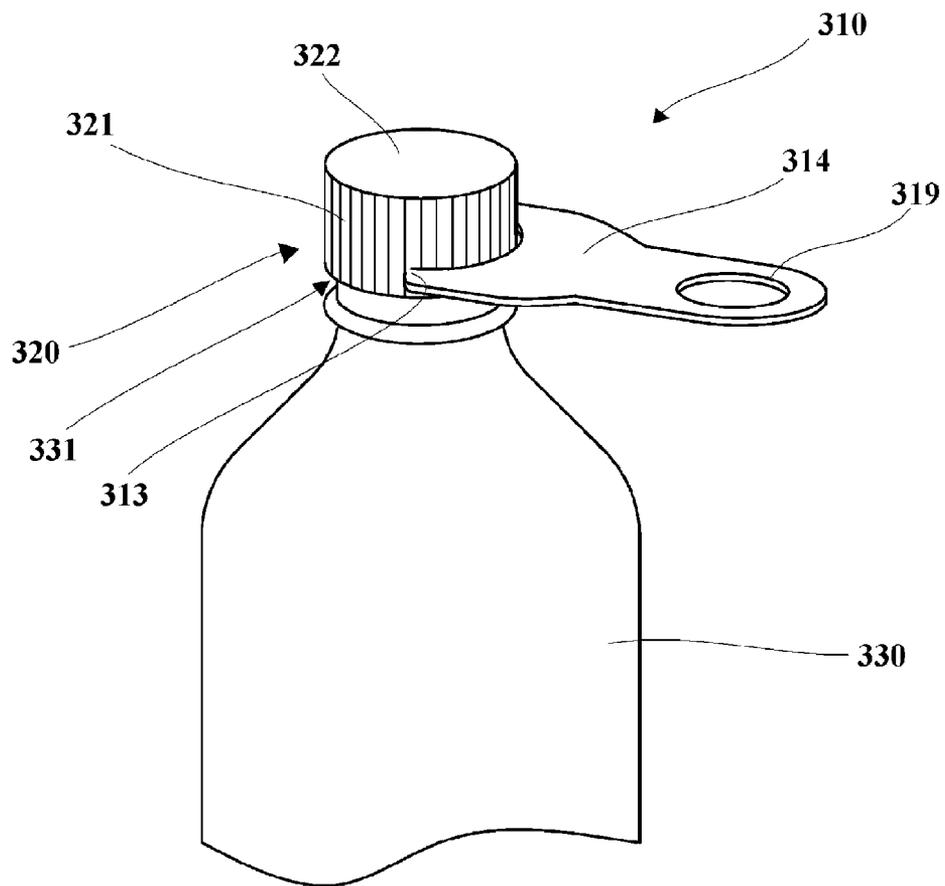


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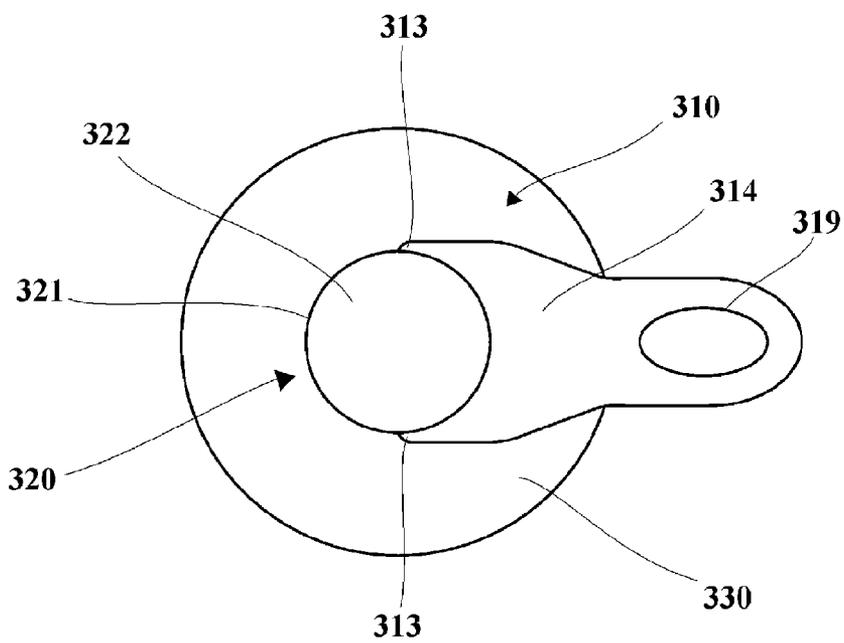


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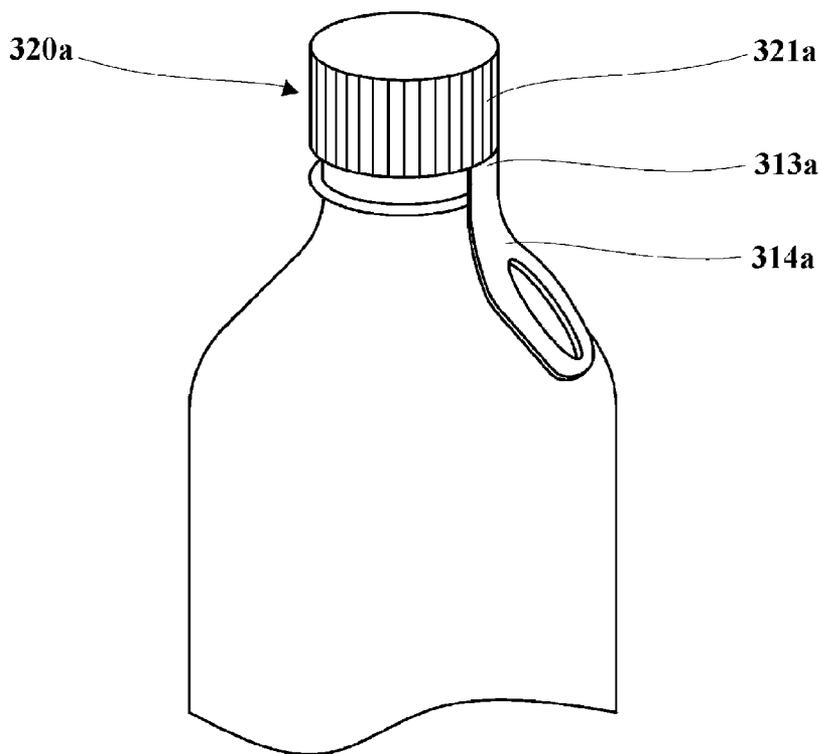


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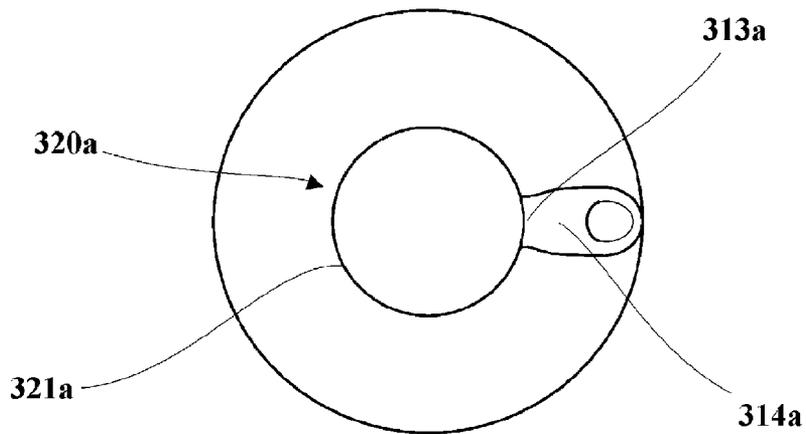


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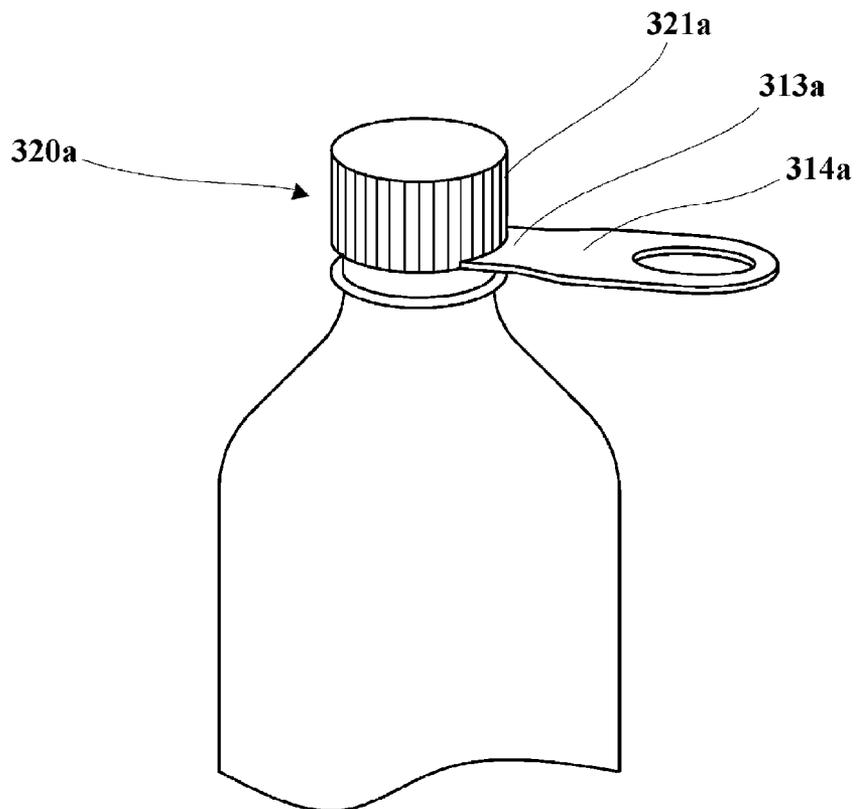


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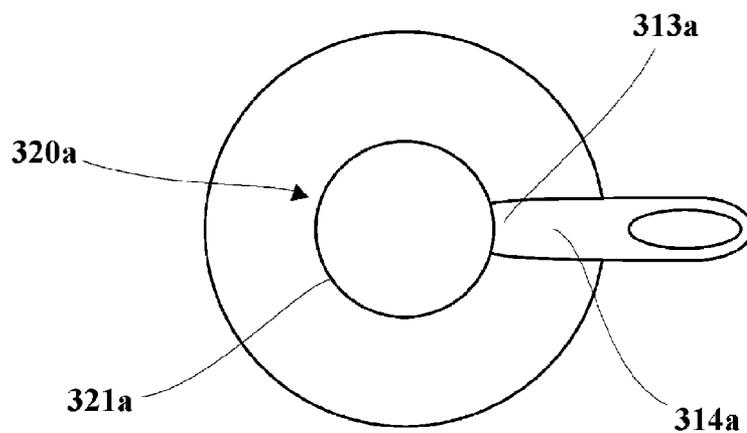


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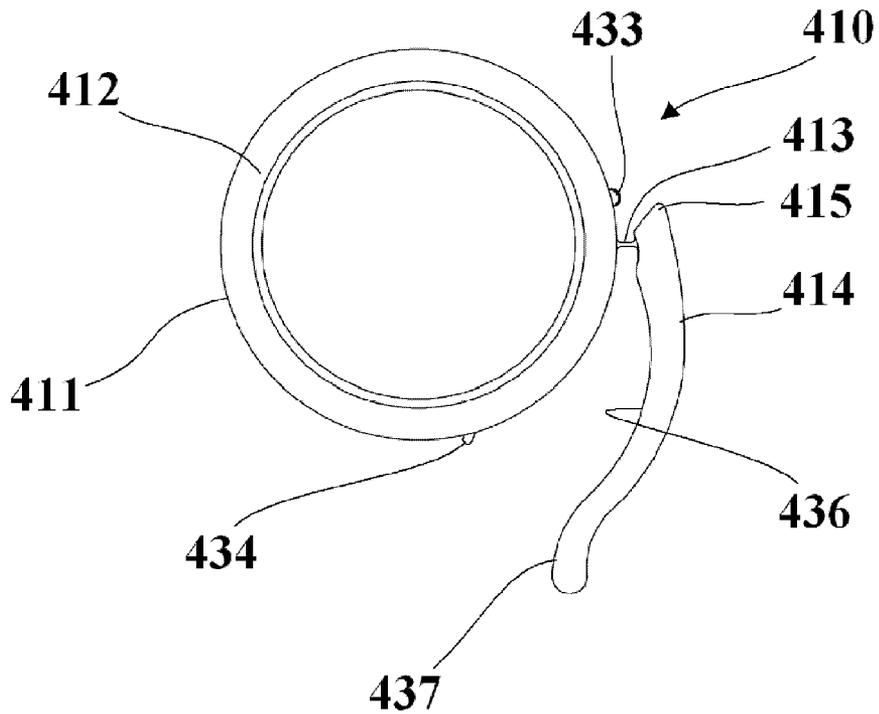


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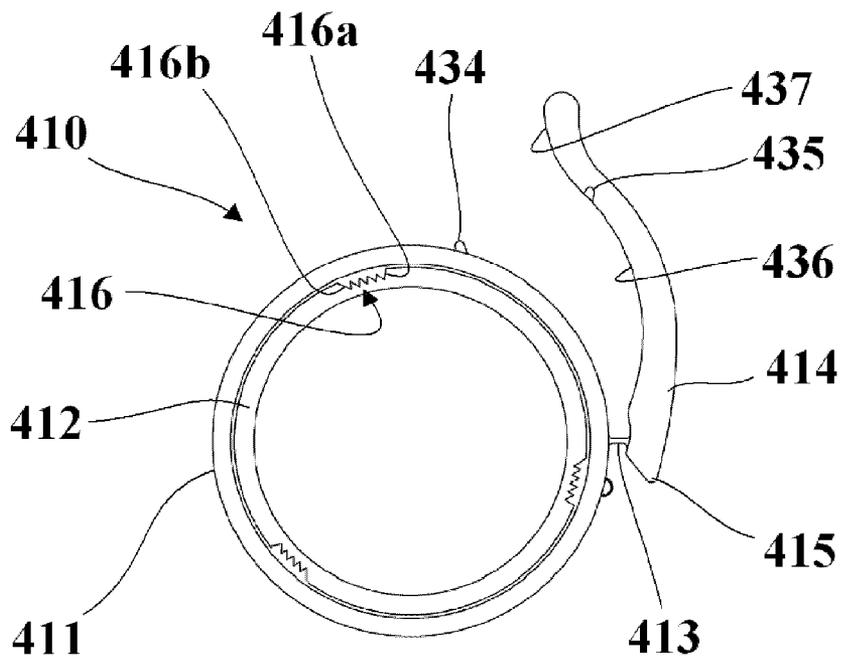


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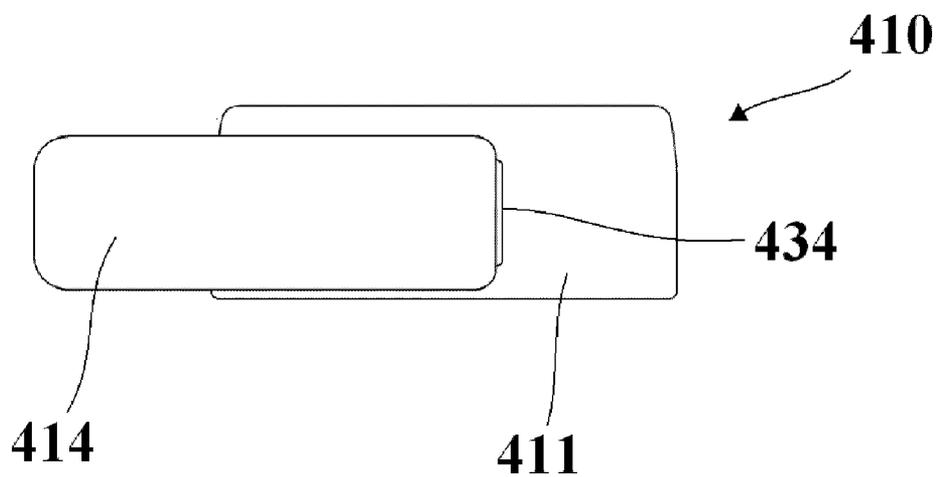


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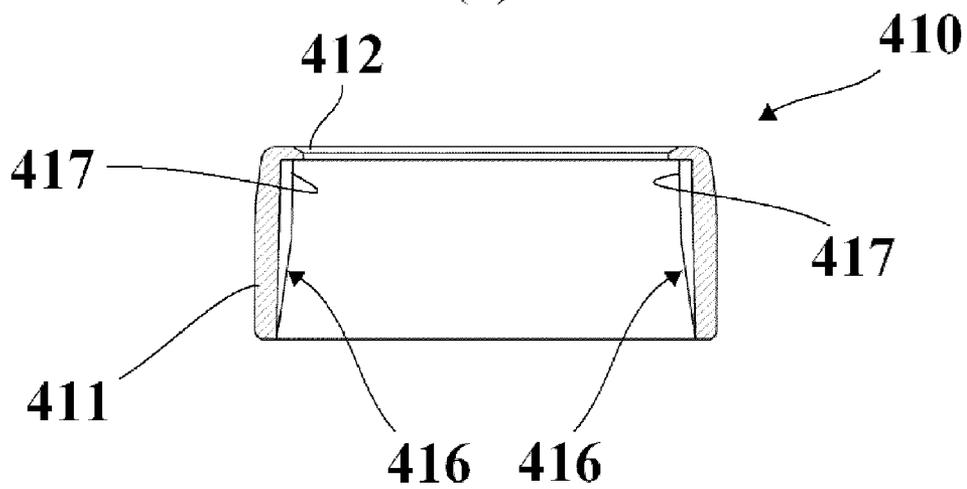


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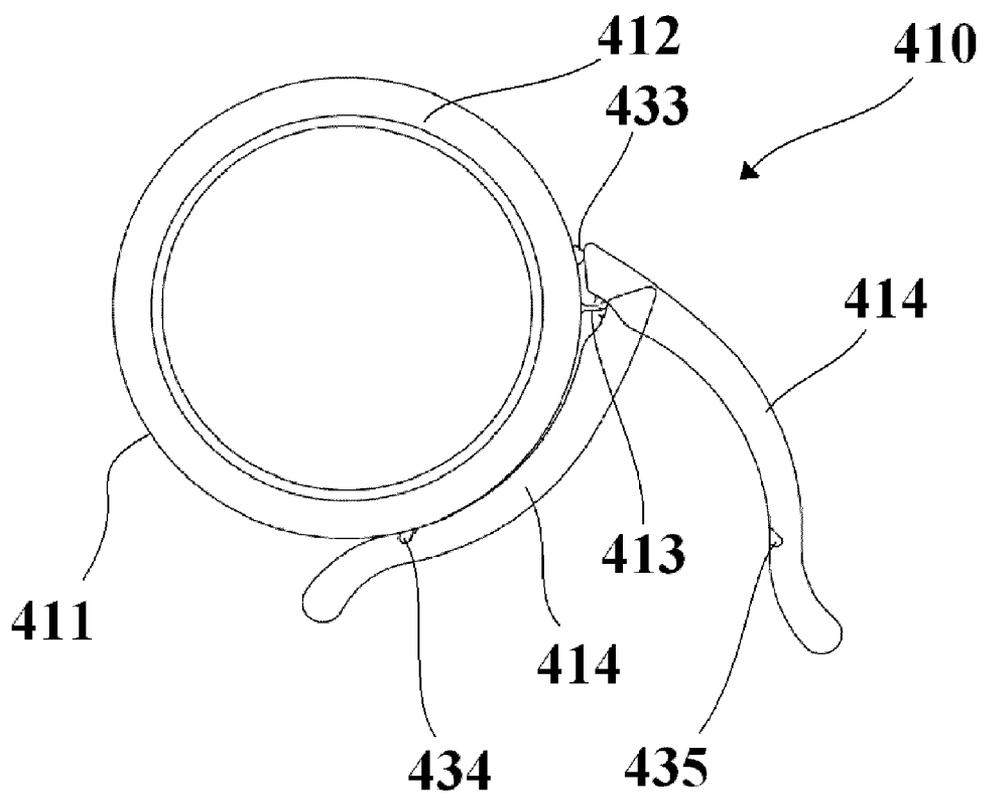


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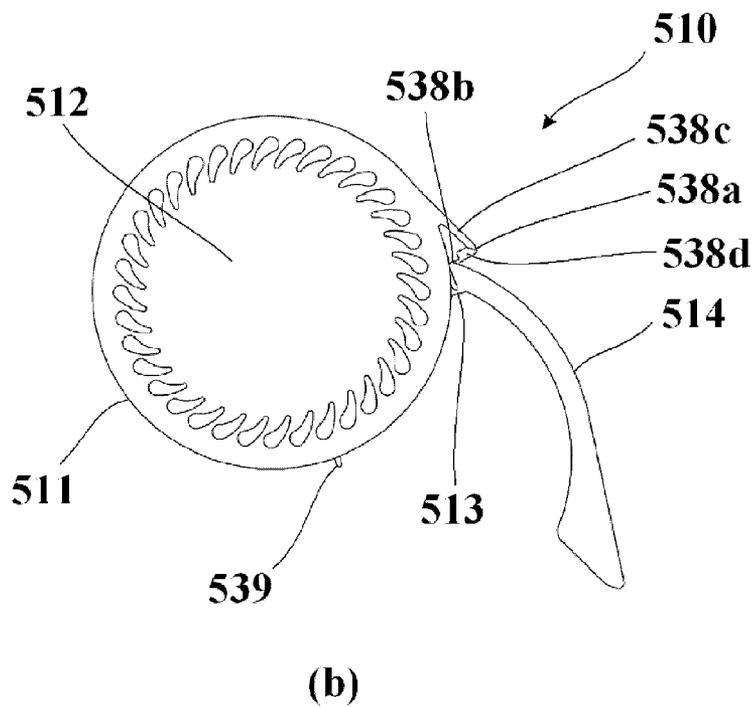
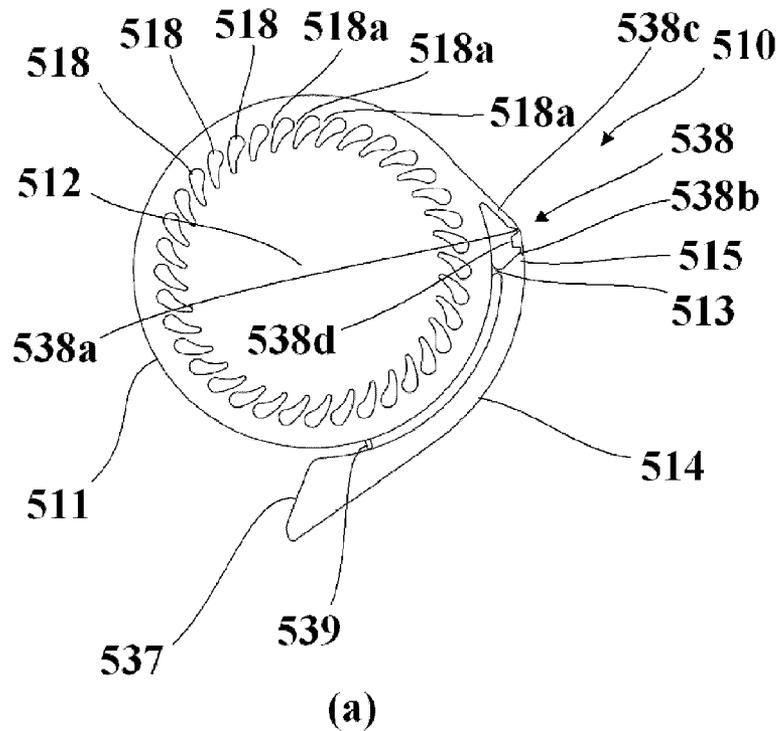


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## MECHANISM FOR ASSISTING OPENING AND CLOSING OF SCREW CAP

### TECHNICAL FIELD

[0001] This invention relates to a screw cap opening/closure assistance mechanism for assisting the opening/closure of a screw cap in a vessel provided with a screw cap mechanism.

### BACKGROUND ART

[0002] A vessel provided with a screw cap mechanism including a so-called screw cap is used in variable formulations and is in widespread use because it has a high hermetic sealing characteristic and also because it allows for reiterative opening/closure operations. Such screw cap mechanism includes a mating engagement part provided in the form of a helix on an outer peripheral surface of an opening of a vessel. The screw cap mechanism also includes a tubular base part whose inner peripheral surface carries an engagement part that engages with the mating engagement part, and a closure part that stops up one end of the tubular base part and that openably closes the opening. The vessel may be exemplified first of all by glass bottles or bottles of plastics.

[0003] Such vessels that hold food or beverages are used by users at large. For example, as a vessel for holding a viscous fluid, such as jam, containing sugar, a wide-mouthed glass bottle is used. To open or close the glass bottle, a screw cap of metal of a larger radius is preferentially used. However, in the glass vessel for jam, fitted with the screw cap mechanism, the sugar of the jam, the highly viscid food contents, tends to become affixed to a space between the opening of the vessel and a lid. Hence, a stronger force is needed to open or close the screw cap mechanism despite the fact that a screw cap of a larger diameter is used.

[0004] Recently, a so-called PET bottle, composed of a resin bottle, formed of polyethylene terephthalate, and a resin cap, screwed onto the resin bottle, as disclosed in Patent Document 1, has come to be used widely for beverages. The resin cap of the PET bottle is formed of polyethylene or polypropylene and has an unauthorized unsealing inhibiting function or a virginity warranting function, denoted as a tamper evidence characteristic. With such PET bottle, it is necessary to cope with rise in the internal pressure of the contents such as carbonic acid beverages or rise in the temperature in a gas space in the vessel. Hence, the PET bottle is required to possess a high hermetic sealing characteristic, and a large force of closure is needed for a cap fitted to the vessel's opening. However, since ease in drinking is prioritized in a PET bottle, the outer diameter of the opening of the vessel and hence the outer diameter of the cap are necessarily smaller, as a result of which a larger force is needed for unsealing the cap. Hence, a problem is raised that, for persons of weaker physical power, such as children, women, aged persons, those suffering from diseases, or physically handicapped persons, a PET bottle cannot be unsealed with ease, or the PET bottle, once unsealed and closed, cannot be opened or closed with ease.

[0005] To cope with such deficiencies of the screw cap mechanism of the prior art technique, there is known an unsealing assisting tool such as is disclosed in Patent Publication 2. This assisting tool is a rubber band like member of a thicker thickness that presents on the whole a shape of a curve closed on itself and that carries an antislip on its inner peripheral

surface. In use, the outer peripheral surface of the screw cap is surrounded by part or all of the rubber band like member and clamped as the antislip effect of the rubber band like member is displayed. The apparent radius of rotation of the screw cap is increased in an amount corresponding to the thickness of the rubber band like member, thereby decreasing the force needed for opening/closure of the screw cap.

[0006] However, in use of the rubber band like member, as the unsealing assisting tool, a screw cap's tubular base part is clamped from its outer peripheral side. Hence, it may sometimes occur that the inner peripheral surface of the screw cap, or engagement parts formed on this inner peripheral surface, are clamped strongly by the outer peripheral surface or mating engagement parts formed thereon. Hence, the force of friction is increased, thus sometimes leading to the opposite effect of increasing the force needed for opening/closure. In a screw cap, formed of plastics, inter alia, the screw cap's tubular base part is liable to be deformed, with the result that the force of friction between the screw cap and the vessel's opening is appreciably increased to increase the force required in opening/closure.

Patent Document 1: Japanese Laid-Open Patent Publication 2006-182357

Patent Document 2: Japanese Registered Utility Model 3048082

### DISCLOSURE OF THE INVENTION

#### Problem to be Solved by the Invention

[0007] To respond to the above mentioned deficiencies of the screw cap of plastics of the related art, it is necessary to use a radially elongated opening/closure assistance tool for opening/closure as only an upper portion of the screw cap is thrust towards the center of the moving radius. If only the upper portion of the screw cap is thrust and the screw cap is rotated for opening/closure, the opening/closure assistance tool tends to be disengaged. It is thus necessary to rotate the opening/closure assistance tool in the direction of the moving radius as the upper portion of the opening/closure assistance tool is thrust downwards. However, if the opening/closure assistance tool is thrust downwards, the engagement part provided on the inner peripheral surface of the cap and the mating engagement part on the outer peripheral surface of the vessel's opening thrust each other. This increases the force of friction in-between, and hence the force of resistance against rotation in the direction of the moving radius is increased, with the result that the force necessary for opening/closure is increased.

[0008] In addition, in the conventional opening/closure assistance tool, the unsealing assistance tool is an independent member. Hence, in using, a user has to carry the assistance tool, which means an onerous operation. Moreover, the assistance tool tends to be bulky.

[0009] In consideration of the above mentioned deficiencies of the related art, it is desirable for the present invention to provide an opening/closure assistance mechanism that assists a user in opening/closing a screw cap in a vessel provided with a screw cap mechanism. In a state in which the screw cap mechanism is still fresh from the plant, viz., has not been as yet used for opening/closure, the opening/closure assistance mechanism is to be in a compact state. In use, the radius of rotation in opening/closure is to be increased to decrease the force of rotation necessary for the opening/

closure operation. In addition, the opening/closure assistance mechanism is to be inexpensive and may be put to repeated opening/closure operations.

#### Means to Solve the Problem

**[0010]** According to an embodiment of the present invention, there is provided a screw cap opening/closure assistance mechanism for assisting opening/closure of a screw cap in a screw cap mechanism. The screw cap mechanism includes an opening of a vessel whose outer peripheral surface carries a mating engagement part in the form of an interrupted or uninterrupted helix, and a screw cap composed of a tubular base part and a closure part. The inner peripheral surface of the tubular base part carries an engagement part in the form of an interrupted or uninterrupted helix engaging with the mating engagement part. The closure part stops up one end of the tubular base part and that openably closes the opening.

**[0011]** The screw cap opening/closure assistance mechanism includes one or more coupling part(s) provided on the screw cap and having one end rotated in unison with the screw cap, and one or more opening/closure assistance part(s) connected to the coupling part(s). During the time other than the opening/closure time, the opening/closure assistance part(s) are positioned in proximity to an outer surface of the screw cap. During the opening/closure time, the opening/closure assistance part(s) are moved away from the screw cap to create a large diameter moving part to increase the radius of rotation during the time of rotation as one with the screw cap. An arrangement is so made that a smaller force of rotation necessary for relative rotation between the opening and the screw cap will suffice during the operation of opening/closure of the screw cap.

**[0012]** The screw cap opening/closure assistance mechanism is formed as a separate entity from the screw cap for attachment or detachment to or from the screw cap, and includes an annular part that circumferentially encircles the lateral side of the closure part of the screw cap. In the state of attachment to the screw cap, the annular part may be rotated in unison with the screw cap. The annular part is desirably molded as one with the coupling part(s) and with the opening/closure assistance part(s).

**[0013]** The annular part is formed to a substantially cylindrical shape.

**[0014]** The annular part includes an abutment part on an inner peripheral surface thereof for abutting against the tubular base part. Preferably, the abutment part includes a pressuring part that thrusts and abuts against a portion of the tubular base part. Preferably, the pressuring part pressures the lateral surface of the closure part of the screw cap. During the opening/closure operation, the pressuring part abuts against and thrusts the closure part, as the pressuring part thrusts the closure part from the lateral side towards the center of the closure part, without the pressuring part thrusting the tubular base part. Preferably, an arrangement is so made that the screw cap and the annular part are rotated in unison with each other without increasing the frictional resistance in the threaded engagement of the engagement part or the mating engagement part. The abutment part includes an idle rotation inhibiting part that is engaged in a vertically extending groove formed in an outer peripheral surface of the tubular base part to inhibit idle rotation of the annular part relative to the screw cap.

**[0015]** The idle rotation inhibiting part is in the form of a chevron longer in length along the axis of the annular part.

Preferably, the idle rotation inhibiting part is in the form of a chevron longer in length in the direction of the radius of the annular part, with the cross section of the chevron being an approximately non-isosceles triangle. Preferably, a plurality of the idle rotation inhibiting parts is provided in equilibrium at three or more places on the inner peripheral surface of the annular part. However, if the number of the idle rotation inhibiting parts provided is more than is necessary, the annular part is worsened in flexibility to deteriorate the accommodation performance against variations in the outer diameter or size of the screw cap. It is therefore desirable to provide a suitable number of, for example, three to six idle rotation inhibiting parts.

**[0016]** The annular part is set to an average thickness from not less than 0.5 mm to not more than 3.0 mm.

**[0017]** The annular part includes an annular upper portion extending radially inwards along the tubular shape of the annular part, thereby improving the attachment performance of the annular part to the screw cap and elevating the aesthetic sense of the product.

**[0018]** A rotation stop receiver is provided at a site of the annular part where a proximal end of the opening/closure assistance part abuts against the annular part in the course of rotation of the opening/closure assistance part about the coupling part as the center of rotation.

**[0019]** The screw cap opening/closure assistance mechanism includes an upper plate part that closes a substantially entire region of an upper portion of the annular part.

The upper plate part includes larger numbers of through-holes extending through the front and back sides thereof and larger numbers of bridging parts created between these through-holes for bridging the annular part and the upper plate part. Preferably, an arrangement is so made that, even in case the upper plate part is provided, the annular part will exhibit sufficient flexibility.

**[0020]** The coupling part has one end connected to an outer peripheral surface of the tubular base part.

**[0021]** The opening/closure assistance part is formed as a lever rotatable about the coupling part as the center of rotation. During the opening or closure of the screw cap, the free end side of the opening/closure assistance part is moved away from the outer peripheral surface of the annular part to create a large diameter moving part to increase the radius of rotation.

**[0022]** The screw cap opening/closure assistance part(s) are formed as elongated plate pieces or rod pieces.

**[0023]** The screw cap opening/closure assistance part(s) are formed as arches.

**[0024]** The opening/closure assistance part includes a curved portion extending along an outer peripheral surface of the annular or the tubular base part.

**[0025]** The opening/closure assistance part includes a finger support in the vicinity of the foremost part of its free end side. The finger support is curved in a direction deviating from the outer peripheral surface of the annular part or the tubular base part.

**[0026]** The opening/closure assistance part includes a rotation stop in the vicinity of a proximal end thereof connected to the coupling part. The rotation stop prescribes an angle of rotation of the opening/closure assistance part about the coupling part as a fulcrum.

**[0027]** The rotation stop is extended in the direction of a moving radius from the proximal end of the opening/closure assistance part.

[0028] The rotation stop is extended from the proximal end towards a radially outer side of the annular part or the tubular base part. During the opening/closure of the screw cap, the user's finger is set on the rotation stop to render it easy to apply the force of rotation in the closing direction.

[0029] The screw cap opening/closure assistance mechanism includes a temporary bridging part that temporarily bridges the opening/closure assistance part and an outer peripheral surface of the annular part or an outer peripheral surface of the tubular base part. The temporary bridging part may readily be ruptured on application of a force greater than a preset value. During the virginity of the assistance mechanism, the opening/closure assistance part is connected by the temporary bridging part to the annular part or to the tubular base part to maintain the proximity position in stability with respect to the annular part or to the tubular base part. When the assistance mechanism is initially used, the temporary bridging part is first ruptured by applying a force greater than a preset value.

[0030] The opening/closure assistance mechanism includes a retention part formed in the opening/closure assistance part and a mating retention part formed on an outer peripheral surface of the annular part or the tubular base part. The retention part and the mating retention part are engaged with each other to keep the opening/closure assistance part engaged with the annular part or with the tubular base part. During non-use time, the retention part and the mating retention part are engaged with each other and, during the use time, the retention part and the mating retention part are disengaged from each other to enable the assistance mechanism to be used.

[0031] The opening/closure assistance part includes a through-hole extending through the bulk of the opening/closure assistance part. A string, a rubber band or a strap may be placed within the through-hole.

[0032] The opening/closure assistance part includes a cover-shaped coupling part having a plate spring shaped part and a relay part. The plate spring shaped part is extended from the annular part or from the tubular base part. The relay part is connected to the plate spring shaped part via a hinge-shaped joint and extended from the opening/closure assistance part or from the rotation stop via the hinge-shaped joint part.

[0033] The coupling part has one end connected to the annular part or to the tubular base part.

[0034] The length from one end to the other end of the coupling part is set at a value not smaller than 0.5 mm.

[0035] When seen from above, the coupling part presents substantially a band shape with a thickness not less than 0.5 mm.

[0036] Both lateral contour lines of a planar band shape of the coupling part are hyperbolas.

[0037] The opening/closure assistance mechanism is formed of a thermoplastic resin as a principal component. Preferably, the hard thermoplastic resin is one or more selected from the group consisting of polyethylene, polypropylene and polyamide.

[0038] The opening/closure assistance mechanism is formed by double bonding of a hard thermoplastic synthetic resin and a soft thermoplastic synthetic resin. Preferably, the hard thermoplastic resin is one or more selected from the group consisting of polyethylene, polypropylene and polyamide, while the soft thermoplastic resin is one or more selected from the group consisting of an elastomeric material

and rubber. The hard synthetic resin and the soft synthetic resin are formed by double molding.

[0039] The opening/closure assistance part(s) may be formed to a ring shape. The vessel may be held with a user's finger or hung with a hook via the opening/closure assistance part(s) of the ring shape.

#### ADVANTAGEOUS EFFECT OF THE INVENTION

[0040] The screw cap opening/closure assistance mechanism according to an embodiment of the present invention, provided for the screw cap, includes the coupling part having one end rotated in unison with the screw cap, and the opening/closure assistance part coupled to the coupling part(s). During the time other than the opening/closure time, the opening/closure assistance part(s) are positioned in proximity to an outer surface of the screw cap. During the opening/closure time, the opening/closure assistance part(s) are moved away from the screw cap to create a large diameter moving part to increase the axis of rotation for rotation in unison with the screw cap. In the opening/closure assistance mechanism fresh from the plant, or the opening/closure assistance mechanism has once been unsealed and is not in use for the time being, the opening/closure assistance mechanism, simple in structure and inexpensive, may be collapsed in a small compact size state. When in use, the opening/closure assistance mechanism may be enlarged in a radial direction as necessary to render it possible to reduce the force necessary for opening/closing the screw cap.

[0041] In case the opening/closure assistance mechanism is not formed as one with but as an entity separate from the screw cap, the opening/closure assistance mechanism may be formed of any suitable material without dependency on the screw cap material. It is thus possible to improve strength and durability as well as to simplify manufacture and to reduce the cost. In addition, the opening/closure assistance mechanism, as a new system, may be introduced without modifying the routine screw cap. Only the opening/closure assistance mechanism may be dismantled from the screw cap as necessary for re-use.

[0042] In case the screw cap and the closure assistance mechanism are formed separately from each other, it is possible for a retail seller to sell a vessel as an opening/closure assistance mechanism is fitted on its screw cap, or to offer the opening/closure assistance mechanism to a customer so that he/she may attach it to the screw cap as appropriate. That is, a retail seller may selectively use these two sale modes.

[0043] In the opening/closure assistance mechanism according to an embodiment of the present invention, the opening/closure assistance mechanism may be molded as one with the screw cap as necessary. When the opening/closure assistance mechanism is molded as one with the screw cap, the opening/closure assistance mechanism itself may not be re-usable. Or, a screw cap plus the opening/closure assistance mechanism needs slightly more feedstock material than the screw cap per se. However, as compared to a product composed of a screw cap and a separately molded opening/closure assistance mechanism, the amount of the material needed may be smaller, thus saving the resources. In addition, drop-out or loosening of the opening/closure assistance mechanism may be eliminated to improve the stability in use.

[0044] In case the opening/closure assistance part of the opening/closure assistance mechanism is formed to a ring shape, the vessel may be held with a user's finger or hung with a hook by passing the user's finger, the hook or a string

through the ring, thus improving convenience in transportation. If in particular the opening/closure assistance mechanism and the screw cap are molded as one with each other, the opening/closure assistance part may be formed to advantage to a ring shape. In this case, there is no fear that the opening/closure assistance mechanism becomes loosened or dismounted from the screw cap.

#### BEST MODE FOR CARRYING OUT THE INVENTION

**[0045]** A preferred embodiment of the present invention will now be described in detail. The screw cap opening/closure assistance mechanism according to the present invention is used for assisting the opening/closure of a screw cap in a screw cap mechanism. The screw cap mechanism includes a mating engagement part provided in the form of a helix on an outer peripheral surface of an opening part of a vessel. The screw cap mechanism also includes a tubular base part whose inner peripheral surface carries an engagement part that engages with the mating engagement part, and a closure part that stops up one end of the tubular base part and that openably closes the opening part. The vessel may be exemplified first of all by glass bottles or bottles of plastics.

**[0046]** The vessel is capable of holding a material in an optional state, such as a solid, liquid or gaseous state. The vessel includes a substantially cylindrically-shaped opening part, an outer peripheral surface of which carries a mating engagement part. Except for the above, there is no particular limitation to the vessel, such that any suitable material type, size or shape may be used as desired. The mating engagement part is formed on the outer peripheral surface of the opening part of the vessel as grooves or flutes of an interrupted or non-interrupted helix, and is adapted to be threadedly engaged with the engagement part provided on the inner peripheral surface of the screw cap's tubular base part.

**[0047]** The screw cap includes the tubular base part having a substantially cylindrically-shaped inner peripheral surface, and a closure part whose one end along the length of the tube of the tubular base part is closed. The inner peripheral surface of the tubular base part carries interrupted or uninterrupted spirally extending grooves or flutes adapted to be threadedly engaged with the mating engagement part provided on the outer peripheral surface of the vessel's opening. When the engagement part is threadedly engaged with the mating engagement part for engagement of the screw cap with the vessel's opening part, the opening part is closed by the closure part that closes one end of the screw cap's tubular base part, thereby hermetically sealing the vessel. That is, the screw cap is configured to close the vessel's opening part such as to allow repeated opening/closure. It is noted that the screw cap may be provided with a tamper evidence mechanism which is a mechanism for imparting a tamper evidence characteristic to the screw cap.

**[0048]** The screw cap opening/closure assistance mechanism has the function of allowing for reducing the force of rotation necessary for relative rotation between the vessel's opening and the screw cap in the opening or closure operation of the screw cap. In providing the screw cap opening/closure assistance mechanism for the screw cap, the assistance mechanism and the screw cap may be molded as entities distinct from each other, as will be explained later in connection with Example 1. After molding, the screw cap opening/closure assistance mechanism is mounted in position on the screw cap. Or, the screw cap opening/closure assistance

mechanism and the screw cap may be molded as one with each other from the outset, as will be explained later in connection with Example 2.

**[0049]** The screw cap opening/closure assistance mechanism is essentially composed of a coupling part, whose one end is rotated in unison with the screw cap, and an opening/closure assistance part which is partially connected to the other end of the coupling part. Of course, the coupling part and the opening/closure assistance part may be molded as one with each other.

**[0050]** The coupling part has the function of transmitting the force of rotation, externally applied to the opening/closure assistance part, either directly or indirectly to the screw cap to impart the force of rotation to the screw cap. This coupling part may be coupled to a fitting member that is fitted to the screw cap so as to be rotated in unison with the screw cap. Thus, a coupling part-fitting member assembly is formed which may be rotated in unison with the screw cap. Or, the coupling part may directly be formed on a suitable site on the outer surface of the screw cap.

**[0051]** The fitting member has the function of enabling the coupling part to be rotated in unison with the screw cap in case the screw cap opening/closure assistance mechanism is formed as a separate entity from the screw cap. The fitting member is interposed between the screw cap and the coupling part. The fitting member may be formed as a separate entity from the screw cap and fitted to the screw cap for rotation in unison therewith.

**[0052]** The fitting member includes an annular part that encircles the outer peripheral surface of the outer peripheral surface of the screw cap's tubular base part either partially or entirely. The inner peripheral surface of the annular part carries an abutment that abuts against the outer peripheral surface of the screw cap's tubular base part. The abutment preferably includes a pressuring part that pressures the lateral side of the closure part for thrusting an upper portion of the screw cap's tubular base part, viz., a lateral surface site of the closure part, towards the center of the closure part. The height of the annular part is desirably set so as to be about equal to that of the screw cap to improve the stability of the fitting state.

**[0053]** In this manner, the abutment is formed on the inner peripheral surface of the annular part so that a portion of the abutment will operate as a pressuring part. The fitting member is fitted strongly on the screw cap and there retained by the pressuring part. The fitting part may thus be rotated in unison with the screw cap without the fitting member idling relative to the screw cap or without the fitting member clamping the screw cap's tubular base part. If solely the pressuring part sets the attachment state of the fitting part to the screw cap, such state is labile and the fitting part tends to be dislocated from the screw cap. However, the abutment abuts against the screw cap's tubular base part to approximately the height of the screw cap's tubular base part, thus allowing stabilizing the state of attachment of the fitting member to the screw cap.

**[0054]** Although the fitting member may be formed of a sort of material analogous with that of the screw cap, it may also be formed of a different material. Viz., such a material that is effective for repeated use, tough or inexpensive may suitably be selected for use. If the annular part, carrying the fitting member, is formed as a thin-walled cylinder, the annular part may not be bulky, while the amount of the material may be reduced. However, the annular part may be thick-walled or may be of a shape different from the cylindrical shape. The fitting member may be an upper plate provided on

top of the annular part to stop up one end of the annular part along the direction of the cylinder. In this case, the fitting member is to be formed of a transparent material to avoid that printing such as a letter or a picture pattern, provided on the upper surface of the closure part of the screw cap, may not be seen from outside.

**[0055]** The opening/closure assistance amplifies the force of rotation, applied from outside, and transmits the so amplified force via the coupling part to the screw cap.

**[0056]** The opening/closure of the screw cap, which might be in need of a larger force, may thus be made possible with a smaller force. The opening/closure assistance part has its one end connected to the coupling part, while having its other end as a free end. When the opening/closure assistance part is in the state of virginity and has as yet not been opened, it is positioned in proximity to the outer surface of the screw cap or the fitting member. When opened or closed, the opening/closure assistance part is moved so that its free end is away from the outer surface of the screw cap or the fitting member. In this manner, a moving part of a larger diameter is created that enhances the radius of rotation of the opening/closure assistance part during rotation in unison with the screw cap.

**[0057]** When the assistance mechanism has not been used or is currently not in use, it is sufficient that the opening/closure assistance part is in proximity to the outer surface of the screw cap or the fitting member. The opening/closure assistance part may be placed parallel to or at an angle relative to the closure part of the screw cap. During the time of opening/closure, the free end side of the opening/closure assistance part may be turned in a vertical plane so as to be separated away from the annular part or the fitting part. It is however preferred that the opening/closure assistance part is positioned along the outer peripheral surface of the annular part of the fitting member or along the outer peripheral surface of the screw cap's tubular base part. In opening/closure, the opening/closure assistance part is rotated, about the coupling part as the center of rotation, so that its free end is moved within a horizontal plane in a direction away from the outer peripheral surface of the annular part of the tubular base part. It is noted that the direction of the cylinder of the screw cap's tubular base part is parallel to the vertical direction.

**[0058]** It is more preferred that the opening/closure assistance part is formed by a band with a width of the order of the height of the screw cap's tubular base part. The band is bent in the shape of an arc of a circle. By so doing, the opening/closure assistance part is not bulky and hence is in need only of a lesser amount of the material. In opening/closure, a surface of a broad width of the opening/closure assistance part, extending along the height of the opening/closure assistance part, is pulled as a lever to impart the force of rotation to the screw cap. The opening/closure assistance effect may be realized in stability without injuring the user's hand or finger.

**[0059]** A rotation stop is formed for protruding outwards from the outer surface of the proximal end of the opening/closure assistance part connected to the coupling part. It is preferred that the rotation stop is so formed that, when the opening/closure assistance part is rotated about the coupling part as center so as to be moved away from the annular part, the rotation of the opening/closure assistance part will be halted at a preset angle.

**[0060]** Of course, the formulation of the opening/closure assistance part is not to be limited to the above. For example, the opening/closure assistance part may be formed to a ring

shape. The vessel may then be held or hung with a user's finger, a hook or a string being placed within the ring.

#### Example 1

**[0061]** Several Examples of the screw cap opening/closure assistance mechanism **10** according to the present invention will now be described with reference to the drawings (FIGS. **1** to **4**). It is noted that the screw cap opening/closure assistance mechanism **10** of the present Example 1 is of the type formed as a member independent of a screw cap **20**. Viz., in use, the screw cap opening/closure assistance mechanism **10** is fitted to the screw cap **20** for rotation in unison therewith, as shown in FIG. **1**.

**[0062]** A vessel **30** is a PET (polyethylene terephthalate) bottle that holds a beverage, for example. This vessel is formed by blow molding a transparent resin, such as polyethylene terephthalate, to form a bottomed substantially cylindrical tubular base part, an upper portion of which is narrowed to provide an opening part **31**. The outer peripheral part of the opening part **31** is formed with flutes of an interrupted helix operating as a mating engagement part **32**. The screw cap **20** may be in threaded engagement with the opening **31**, via the mating engagement part **32**, as shown in FIG. **2A**, to permit repeated opening/closure of the opening **31**.

**[0063]** The screw cap **20** is made up of a substantially cylindrically-shaped base part **21**, a disc-shaped closure part **22**, closing an upper end of the tubular base part **21**, and a tamper evidence ring **23**. The tubular base part **21**, disc-shaped closure part **22** and the tamper evidence ring **23** are molded as one with one another from polypropylene. The tamper evidence ring **23** is coupled at a plurality of dot-like spots to the lower end of the tubular base part **21**. It is noted that, although the material of the screw cap **20** here is polypropylene, it may also be any other suitable plastics material, such as polyethylene.

**[0064]** The inner peripheral surface of the tubular base part **21** is formed with flutes of an interrupted helix operating as a mating engagement part **24**. The lower surface of the closure part **22** is formed with a hermetically sealing part **25** located along the inner peripheral surface of the opening part **31** at the time of closure to improve the hermetic sealing performance. In the present Example, this hermetically sealing part **25** is molded as one with the screw cap **20**, however, the hermetically sealing part may also be formed as a member independent of the screw cap. It is noted that, due to so-called sink or warpage resulting from the molding of resin, the tubular base part **21** of the screw cap **20** is of a substantially barrel shape extremely close to the cylindrical shape. Viz., the tubular base part **21** is shaped so as to be smaller in diameter in the vicinity of its upper end and slightly swollen at a mid part along its height, with the tubular shape becoming moderately smaller in diameter from the mid part towards its lower end.

**[0065]** The tamper evidence ring **23** of polypropylene is molded as one with the tubular base part **21** of polypropylene. It is however not essential to mold the tamper evidence ring and the tubular base part as one with each other. Viz., these may also be formed by double molding, using heterogeneous materials, instead of by integral molding. The tamper evidence ring **23** is not necessarily essential and may be dispensed with. However, it is desirably provided by way of proving the unauthorized opening or warranting virginity of the screw cap mechanism. The tamper evidence ring **23** is made up of an annular tamper evidence ring main **26** and a plurality of removal inhibiting pieces **27**. The annular tamper

evidence ring main is formed to a ring size corresponding to the diameter of the lower end of the inner peripheral surface of the screw cap 20. The removal inhibiting pieces 27 are formed as one with the lower portion of the inner peripheral surface of the tamper evidence ring main 26 and, after mounting once, dismounting may not be made with ease. However, this is not restrictive such that any suitable technique for inhibiting the removal may be used.

[0066] The screw cap opening/closure assistance mechanism 10 of the present Example is formed of hard polyethylene, and is prepared as a member independent of the screw cap 20. Referring to FIGS. 2A and 3C, the screw cap opening/closure assistance mechanism 10 includes an annular part 11 encircling the outer peripheral surface of the cylindrically-shaped tubular base part 21 of the screw cap 20, and a fitting stop 12 formed as one with the upper end of the annular part 11. The screw cap opening/closure assistance mechanism also includes a coupling part 13 formed as one with the outer peripheral surface of the annular part 11 to play the role of a hinge, and an opening/closure assistance part 14 formed as one with the coupling part 13. The screw cap opening/closure assistance mechanism further includes a rotation stop 15 formed as one with the opening/closure assistance part 14. Of course, the material of the screw cap opening/closure assistance mechanism 10 is not limited to hard polyethylene and any suitable thermoplastic resins, such as polypropylene or polyamide, or metals, may also be used. It is noted that shape stability or flexibility for size conformance is required of the annular part 11, while the characteristic of withstanding repeated flexure is required of the coupling part 13, and shape stability as well as toughness is required of the opening/closure assistance part 14. It is thus desirable to select such materials that will satisfy these requirements.

[0067] The annular part 11 is substantially cylindrically-shaped and is of a height about equal to the height of the tubular base part 21 of the screw cap 20. The inner diameter of the annular part is set so as to be about equal to the outer diameter of the tubular base part 21 of the screw cap 20. It is noted that, since the outer diameter of the tubular base part 21 of the screw cap 20 is not constant, the inner diameter of the annular part 11 is set so as to be about equal to or slightly larger than the average outer diameter of the tubular base part 21. Viz., the annular part 11 is configured to abut against the outer peripheral surface of the tubular base part 21 of the screw cap 20, without pressuring the outer peripheral surface of the screw cap 20, with the inner peripheral surface of the annular part 11 as an abutment 16, as shown in FIG. 2B. It is noted that the technique of double molding may be used for forming the abutment 16 so that inner peripheral surface of the annular part 11, formed of hard thermoplastic resin, is formed with the hard type material, and the soft material types, such as an elastomeric material or rubber is used for the soft type material. By so doing, it is possible to suppress the idle rotation of the annular part relative to the screw cap 20.

[0068] Turning to the thickness of the annular part 11, if the annular part 11 is too thick, the annular part becomes too hard so that its flexibility is lowered to deteriorate size conformance. On the other hand, if the annular part 11 is too thin, the annular part becomes short of strength to support the opening/closure assistance part 14. Hence, the thickness of the annular part 11 is set at a proper value depending on the properties of the materials. For example, if the hard thermoplastic resins,

such as polyethylene, polypropylene or polyamide, are used, the annular part 11 is preferably set to an average thickness of 0.5 to 3.0 mm.

[0069] A plurality of rib-shaped pressuring parts 17 are formed in the vicinity of the upper end of the inner peripheral surface of the annular part 11 for extending inwards from the inner peripheral surface of the annular part 11. It is noted that six of the pressuring parts 17 are equidistantly formed in the vicinity of the upper end of the inner peripheral surface of the annular part 11, as shown in FIG. 3. These pressuring parts 17 are configured for thrusting an upper portion of the lateral side of the disc-shaped closure part 22 of the screw cap 20, as indicated by arrow in FIG. 2B.

[0070] The fitting stop 12 operates to inhibit excess thrusting of the screw cap opening/closure assistance mechanism 10 at the time of fitting the screw cap 20 by thrusting the screw cap downwards. The fitting stop 12 is formed to a flat ring shape at an upper extreme end of the annular part 11. In assembling the screw cap opening/closure assistance mechanism 10 on the screw cap 20, the fitting stop 12 abuts against the rim of the upper surface of the closure part 22 of the screw cap 20. At this time, an engraving or printing 28 of a letter or a picture pattern on the upper side of the closure part 22 of the screw cap 20 may be seen from outside via a circular opening 18 provided in the fitting stop 12, as shown in FIG. 1.

[0071] The coupling part 13 operates for interconnecting the annular part 11 and the opening/closure assistance part 14 by hinge-like connection. Specifically, the coupling part 13 is a hinge-like portion extending vertically from an upper end point to a lower end point of the outer peripheral surface of the annular part 11, with one end of the coupling part being connected to the annular part 11. The other end of the coupling part 13 is connected to the opening/closure assistance part 14.

[0072] The opening/closure assistance part 14 operates for amplifying the force of rotation for opening/closing the screw cap 20 externally applied and for transmitting the so amplified force of rotation to the screw cap 20, as shown in FIG. 3. The opening/closure assistance part 14 is a band-shaped portion of reduced thickness having its one end connected to the coupling part 13 and having its other end operating as a free end. The opening/closure assistance part is used as a lever. This band-shaped portion is of a height about equal to that of the annular part 11 and is of an optional length. The band-shaped portion is arcuately shaped so as to be positioned in proximity to the outer peripheral side of the annular part 11, that is, in proximity to the outer peripheral side of the tubular base part 21 of the screw cap 20. In the present Example, the length of the opening/closure assistance part 14 is set to about one half of the outer perimeter of the annular part 11. This length, however, is not restrictive. It is noted that the length of the opening/closure assistance part not larger than about one half of the outer perimeter of the annular part 11 is desirable in view of compactness of the size of the screw cap opening/closure assistance mechanism when the latter is still fresh from the plant or is not in use. It is also noted that, if the opening/closure assistance part is too long during use, a higher strength is needed, whereas, if the opening/closure assistance part is too short, the opening/closure force may not be amplified as desired. The opening/closure assistance part 14 is thus set to a proper length to take account of the above described variable requirements.

[0073] When the opening/closure assistance mechanism 10 is still fresh from the plant, is not currently used or is in the

state of closure, it is positioned in proximity to the outer peripheral surface of the annular part 11, as shown in FIG. 3A. When the opening/closure assistance part 14 is in the opened state, the free end of the opening/closure assistance part is rotated counterclockwise, about the coupling part 13 as the center of rotation, as shown in FIG. 3B. The opening/closure assistance part 14 may thus be moved away from the outer peripheral surface of the annular part 11.

[0074] Referring to FIG. 4A showing the closed state of the opening/closure assistance part, the distance from the center of rotation O of the screw cap 20 to a root P1 of the coupling part 13, that is, the outer radius of the annular part 11, is assumed to be  $r$ . Also, the distance from the root P1 to a foremost part P2 of the rotation stop 15, extended radially outwards from the root P1, is assumed to be  $d$ , and the force required to rotate the screw cap 20 clockwise as only the outer peripheral surface of the annular part 11 is gripped is assumed to be  $f$ . The moment of force needed to cause clockwise rotation of the screw cap 20 as only the outer peripheral surface of the annular part 11 is gripped is simply expressed by  $f \times r$ . If now the screw cap 20 is rotated clockwise with the same force  $f$  as the foremost part P2 of the rotation stop 15 is gripped, the moment of the force at this time is expressed by  $n = f \times (r + d) = f \times r + f \times d$ . The moment of force is thus greater by  $f \times d$  than if the screw cap is rotated as only the annular part 11 is gripped.

[0075] Thus, if the force of the lower limit, with which the screw cap 20 is rotated clockwise, as only the annular part 11 is gripped, is  $g$ , the force of the lower limit with which the screw cap 20 may be rotated clockwise, as only the foremost part P2 of the rotation stop 15 is gripped, is expressed as  $g \times (r + d)$ . Hence, the screw cap may be rotated clockwise, that is, set to the closed position, with a force one  $(1 + d/r)$ th of a force required to cause clockwise rotation as only the annular part 11 is gripped.

[0076] Conversely, during the operation for opening, the opening/closure assistance part 14 is rotated counterclockwise, about the coupling part 13 as the center of rotation, until the rotation stop 15 abuts against the outer peripheral surface of the annular part 11. This separates the free end side of the opening/closure assistance part 14 apart from the screw cap, as shown in FIG. 4B. The free end of the opening/closure assistance part is located at a point P3 on a line of extension of a line interconnecting the center O of the screw cap 20 and the root P1 of the coupling part 13, thereby creating a large diameter moving part rotatable in unison with the screw cap 20. At this time, the distance  $r'$  from the center O to the point P3 is about equal to  $3r$  because the distance from the end P1 of the opening/closure assistance part 14 to the point P3 is about equal to the diameter of the annular part 11.

[0077] Thus, if the force of rotation required in rotating the screw cap 20 counterclockwise as only the annular part 11 is gripped is  $F$ , the moment of the force is expressed by  $N = F \times r$ . If the screw cap 20 is rotated counterclockwise with the same force  $F$ , as the foremost part P3 of the opening/closure assistance part 14 is gripped, the moment of the force is expressed by  $F \times 3r = 3N$ . Viz., in this case, the screw cap 20 may be opened with a force equal to one-third of that in case of rotating the screw cap 20 as only the annular part 11 is gripped.

[0078] Inherently, the force of rotation needed for opening, in particular for unsealing, is greater than that needed for closure. With the above described arrangement of the screw cap opening/closure assistance mechanism 10, a greater

moment of the force may desirably be obtained at the time of the opening operation, by virtue of the formulation of the opening/closure assistance part 14. In the present Example, the screw cap 20 and the screw cap opening/closure assistance mechanism 10 are formed as entities distinct from each other. Of course, the coupling part 13 may be formed as one with the outer peripheral surface of the tubular base part 21 of the screw cap 20, and the opening/closure assistance part 14 may then be connected to the other end of the coupling part 13. By so doing, the screw cap opening/closure assistance mechanism 10 may be unified to the screw cap 20 without the interposition of the annular part 11.

#### Example 2

[0079] An Example 2 of the present invention, as a modification of the screw cap opening/closure assistance mechanism according to the present invention, will now be described in detail with reference to the accompanying drawings (FIGS. 5 and 6). In the following explanation, the explanation of the formulation similar to that of Example 1 is dispensed with. Similarly to the screw cap opening/closure assistance mechanism 10 of Example 1, a screw cap opening/closure assistance mechanism 110 is formed as a member independent of a screw cap 120.

[0080] Referring to FIGS. 5 and 6, the screw cap opening/closure assistance mechanism 110 of the present Example, formed of polypropylene, includes an annular part 111, encircling the outer peripheral surface of the tubular base part 21 of the screw cap 20, and a disc-shaped fitting stop 112 formed as one with the upper end of the annular part 111. The screw cap opening/closure assistance mechanism also includes coupling parts 113, 113 formed as one with the outer peripheral surface of the annular part 111 to play the role of a hinge, and opening/closure assistance parts 114, 114 formed as one with the coupling parts 113, 113. The screw cap opening/closure assistance mechanism further includes rotation stops 115, 115 formed as one with the opening/closure assistance parts 114, 114.

[0081] The annular part 111 is substantially cylindrically-shaped and is of a height about equal to the height of the tubular base part 21 of the screw cap 20. The inner diameter of the annular part is set so as to be about equal to the outer diameter of the tubular base part 21 of the screw cap 20. It is noted that, since the outer diameter of the tubular base part 21 of the screw cap 20 is not constant, the inner diameter of the annular part 111 is set so as to be about equal to or slightly larger than the average outer diameter of the tubular base part 21 of the screw cap 20. Viz., the annular part 111 is configured to abut against the outer peripheral surface of the tubular base part 21 of the screw cap 20 without pressuring the outer peripheral surface of the screw cap 20, with the inner peripheral surface of the annular part 111, not shown, as an abutment. A plurality of rib-shaped pressuring parts, not shown, is formed in the vicinity of the upper end of the inner peripheral surface of the annular part 111 for extending inwards from the inner peripheral surface of the annular part 111. It is noted that six of the pressuring parts are equidistantly formed in the vicinity of an upper end of the inner peripheral surface of the annular part 111. These pressuring parts are configured for thrusting the lateral side of the closure part 22 of the screw cap 20 towards the center.

[0082] The fitting stop 112 operates to inhibit excess thrusting of the screw cap opening/closure assistance mechanism 110 at the time of fitting the screw cap 20 by thrusting the

screw cap downwards. The fitting stop 112 is formed substantially to a disc shape at an upper extreme end of the annular part to stop up substantially the entire region of the upper portion of the annular part 111. In assembling the screw cap opening/closure assistance mechanism 110 on the screw cap 20, the lower side of the fitting stop 112 abuts substantially against the upper surface of the closure part 22 of the screw pad 20.

[0083] The coupling parts 113, 113 operate for interconnecting the annular part 111 and the opening/closure assistance parts 114, 114 by hinge-like connection. Specifically, the coupling parts are hinge-like portions provided at diametrically opposite positions of the annular part 111 and vertically extend from an upper end to a lower end of the outer peripheral surface of the annular part 111. The one ends of the coupling parts 113, 113 are connected to the annular part 111, while the other ends thereof are connected to the opening/closure assistance parts 114, 114.

[0084] The opening/closure assistance parts 114, 114 operate as levers for amplifying the force of rotation externally applied to open/close the screw cap 20 and for transmitting the so amplified force of rotation to the screw cap 20. The opening/closure assistance parts 114, 114 are band-shaped portions of reduced thickness having one ends connected to the coupling parts 113, 113 and having the other ends as free ends. This band-shaped portion is of a height about equal to that of the annular part 111 and is of an optional length. The band-shaped portion is arcuately shaped so as to be positioned in proximity to the outer peripheral side of the annular part 111. In the present Example, the length of the opening/closure assistance parts 114, 114 is set to about one-fourth of the outer perimeter of the annular part 111.

[0085] When the opening/closure assistance mechanism 110 is still fresh from the plant, not currently used or is in the state of closure, the opening/closure assistance parts 114, 114 are positioned in proximity to the outer peripheral surface of the annular part 111, as shown in FIG. 5A. When the opening/closure assistance parts are in the opened state, the free ends of the opening/closure assistance parts are rotated counterclockwise, about the coupling parts 113, 113 as the centers of rotation, as shown in FIG. 5B. The opening/closure assistance parts are thus moved away from the outer peripheral surface of the annular part 111.

[0086] Meanwhile, during the operation for closure, with the outer radius  $r_0$  of the annular part 111 and with the distance  $r_1$  from the center O of the screw cap 20 to the foremost part of each of the rotation stops 115, 115,  $r_1$ ,  $r_0$  are set so that  $r_1 > r_0$ , as shown in FIG. 6A. The screw cap may thus be rotated clockwise with more ease than if the screw cap is rotated clockwise as only the outer peripheral surface of the annular part 111 is gripped.

[0087] Conversely, during the operation for opening, the opening/closure assistance parts 114, 114 are rotated counterclockwise, about the coupling parts 113, 113 as the centers of rotation, until the rotation stops 115, 115 abut against the outer peripheral surface of the annular part 111, as shown in FIG. 6B. This separates the free end sides of the opening/closure assistance parts 114, 114 from the screw cap, as shown in FIG. 6B. The free ends of the opening/closure assistance parts are located on the lines of extension of lines extending from the center O of the screw cap 20 to the roots of the coupling parts 113, 113, thereby creating large diameter moving parts rotatable in unison with the screw cap 20.

[0088] If, at this time, the distances from the center O to the opening/closure assistance parts 114, 114 are set so that  $r_2 > r_1 > r_0$ , the screw cap may be rotated with more ease than if the screw cap 20 is rotated counterclockwise as only the outer peripheral surface of the annular part 111 is gripped.

[0089] Inherently, the force of rotation needed for opening, in particular for unsealing, is greater than that needed for closure. In the above mentioned arrangement of the screw cap opening/closure assistance mechanism 110, a greater moment of force may be obtained at the time of the opening operation because of the configuration of the opening/closure assistance parts 114, 114. Although handling may be more complex than if only one opening/closure assistance part 14 is used, it is possible to improve the stability in strength or in rotation. Of course, there may be provided three or more opening/closure assistance parts. In the present Example, the screw cap 20 and the screw cap opening/closure assistance mechanism 110 are formed as entities distinct from each other. However, the coupling parts 113 may be formed as one with the outer peripheral surface of the tubular base part 21 of the screw cap 20, and the opening/closure assistance part 14 may then be connected to the other end of the coupling part 113. By so doing, the screw cap opening/closure assistance mechanism 10 may be unified to the screw cap 20 without the interposition of the annular part 11.

### Example 3

[0090] An Example 3 of the present invention, as a modification of the screw cap opening/closure assistance mechanism 210 according to the present invention, will now be described in detail with reference to the accompanying drawings (FIGS. 7 to 9). In the following explanation, the explanation of the formulation similar to that of Examples 1 and 2 is dispensed with. In the present Example, the screw cap opening/closure assistance mechanism 210 is of such a type in which a screw cap opening/closure assistance mechanism is molded as one with the screw cap.

[0091] The screw cap opening/closure assistance mechanism 210 of the present Example, is formed of polypropylene and, as shown in FIGS. 7A and 7B, is formed as one with a screw cap 220 on its outer surface. The screw cap 220 includes a substantially cylindrically-shaped tubular base part 221 and a substantially disc-shaped closure part 222 that stops up the upper end of the tubular base part 221. The inner peripheral surface of the tubular base part 221 is formed with flutes of a non-interrupted helix operating as an engagement part. A hermetically sealing part 225 for improving the hermetic sealing characteristic is provided on a lower surface of the tubular base part 221. A half-groove part 211 in the form of an inverted lower case letter R is formed along the overall rim of the upper surface of the closure part 222. A ring-shaped opening/closure assistance part 214 is removably fitted into the half-groove part 211.

[0092] The opening/closure assistance part 214 is provided via a coupling part 213 on an upper portion of the screw cap 220. This coupling part 213 is a hinge-like portion having one end unified to a lower extreme end of the half-groove part 211 of the screw cap 220 and having its opposite end unified to the opening/closure assistance part 214. The opening/closure assistance part 214 has a circular cross-section and is formed in its entirety by a circular ring shape. The foremost part of the coupling part 213 is unified to one end of the ring shape.

[0093] When the screw cap opening/closure assistance mechanism 210 is still fresh from the plant, or is not currently

used, the opening/closure assistance part **214** is fitted into the half-groove part **211** of the screw cap **220** and hence is positioned in proximity to the screw cap **220**, as shown in FIG. 7. In the opening/closure operation, the opening/closure assistance part **214** is uplifted from the half-groove part **211** and rotated through approximately  $180^\circ$  within a vertical plane, about the coupling part **213** as the axis of rotation, and hence is moved away from the screw cap **220**, as shown in FIG. 8.

[0094] The inner diameter of the ring-shaped opening/closure assistance part **214** is approximately equal to the inner diameter of the half-groove part **211** formed extending on the entire rim of the closure part **222**. An outer diameter  $\Phi 1$  of the opening/closure assistance part **214** is set so as to be approximately equal to the outer diameter  $D$  of the tubular base part **221** of the screw cap **220**. Thus, when the opening/closure assistance part **214** is uplifted  $180^\circ$  about the coupling part **213** as the center of rotation, the distance from the center of the so rotated opening/closure assistance part **214** to the center of the closure part **222** is approximately equal to the outer diameter  $D$  of the tubular base part **221**. The radius of rotation of the screw cap **220** becomes larger an amount corresponding to the outer diameter  $\Phi 1$  of the opening/closure assistance part **214**, thus creating a large diameter portion turned in unison with the screw cap **220**.

[0095] Since the opening/closure assistance part **214** is formed to a ring shape, a user's finger may be placed within the ring-shaped opening/closure assistance part **214**. Hence, the user may carry the vessel with his/her finger placed within the ring, or may open/close the screw cap **220**.

[0096] In the above explanation, the half-groove part **211** is formed along the rim on the upper portion of the closure part **222**. However, it is not essential that the half-groove part **211** is formed along the upper portion of the closure part **222**. For example, the half-groove part **211** may be formed so that one end of the half-groove part **211** is at the upper rim of the closure part **222a** or **222b** and so that its other end is at the lower end of the tubular base part **221a** or **221b** which is on the diametrically opposite site of the above mentioned one end of the half-groove part, as shown for example in FIG. 9. In this case, the half-groove part **211a** or **211b** inclined from the upper end portion to the diametrically opposite lower end portion and which has its upper portion removed is formed in the tubular base part **221a** or **221b**.

[0097] The coupling part **213a** may then be formed as one at its one end with a lower portion of an upper end of the half-groove part **211a** and at its other end with an end of an elliptically-shaped opening/closure assistance part **214a**, as shown in FIG. 9A. Or, the coupling part **213b** may be formed as one at its one end with a lower portion of a lower end of the half-groove part **211b** and at its other end with an end of an elliptically-shaped opening/closure assistance part **214b**, as shown in FIG. 9B. In these cases, the opening/closure assistance parts **214a**, **214b** are both elliptically-shaped. With the diameters  $D$  of the closure parts **222a**, **222b** and with the outer longer diameters  $\Phi 2$  of the ellipses,  $\Phi 2 > D = \Phi 1$ , thus creating a moving part of a diameter larger than that of the screw caps **220a** or **220b**.

#### Example 4

[0098] An Example 4 for a screw cap opening/closure assistance mechanism **310**, an alteration of the previous Examples of the present invention, will now be described in detail with reference to the drawings (FIGS. 10 to 13). It is noted that the formulation which is the same as that of the

previous Examples 1 to 3 is dispensed with. It is also noted that the screw cap opening/closure assistance mechanism **310** of the present Example is of the type in which the screw cap opening/closure assistance mechanism is formed as one with the screw cap.

[0099] The screw cap opening/closure assistance mechanism **310** of the present Example is formed of polypropylene and, as shown in FIGS. 10A and B, is formed on the outer surface of the screw cap **320** as one with the screw cap **320**. This screw cap **320** includes a substantially cylindrically-shaped tubular base part **321** and a substantially disc-shaped closure part **322** that stops up an upper end of the tubular base part **321**. An outer peripheral surface of the tubular base part **321** of the closure part **322** is provided with coupling parts **313**, **313** at two sites which are located at mid portions along the height-wise direction of the tubular base part and which are spaced apart from each other in the horizontal direction on the outer peripheral surface of the tubular base part **321** of the closure part **320**. Each of the coupling parts **313**, **313** has one end formed as one with the tubular base part **321** and has its other end globally formed as a root portion of a substantially inverted upper-case letter Y whose two branched portions are formed as one with each other by the sole root portion.

[0100] A opening/closure assistance part **314** is provided at an optional mid portion in the height-wise direction of the screw cap **320** via the coupling parts **313**, **313**. Each of the coupling parts **313**, **313** is a hinge-shaped member whose one end is formed as one with the outer peripheral surface of the screw cap **320** and whose other end is formed as one with the opening/closure assistance part **314**. This opening/closure assistance part is globally formed as a substantially inverted upper-case letter Y whose two upper branched portions are coupled to the coupling parts **313**, **313**. The opening/closure assistance part is placed so that its upper half portion is substantially in close contact with the screw cap **320** and with an opening part **331** and so that its lower half portion droops substantially in close contact with a vessel **330**. An elliptically-shaped through-hole **319** is formed in a lower end of the opening/closure assistance part **314** to form a ring. The length from the upper end to the lower end of the opening/closure assistance part **314** is set so as to be a few times as long as the diameter of the closure part **322**. The shape of a reentrant section between two upper ends of the opening/closure assistance part **314** is arcuate so as to follow the arc of a circle delimited between the two coupling parts **313**, **313** of the tubular base part **321**.

[0101] When the screw cap opening/closure assistance mechanism is still fresh from the plant or is not currently used, the opening/closure assistance part **314** is placed substantially in close contact with the screw cap **320**, opening part of the vessel **331** and with the vessel **330**, as shown in FIG. 10. In the opening/closure operation, the opening/closure assistance part **314** is uplifted from the vessel **330**, opening part **331** and from the screw cap **320**, as shown in FIG. 11. The opening/closure assistance part **314** is turned in a vertical plane through approximately  $90^\circ$  so as to be separated away from the screw cap **320**, thereby creating a moving part of a larger diameter rotatable in unison with the screw cap **320**.

[0102] At this time, the arcuate portion delimited between the two upper ends of the opening/closure assistance part **314** is positioned for snugly abutting against the outer peripheral surface of the tubular base part **321** of the screw cap **320** in a manner optimum for opening/closing the screw cap **320**. Since the elliptically shaped opening **319** is provided to form

a ring at the free end side of the opening/closure assistance part 314, a user may have his/her finger placed within the opening 319. Thus, he/she may carry the vessel as his/her finger is placed within the opening, or open/close the screw cap 320.

[0103] In the above explanation, the opening/closure assistance part 314 is provided at a mid portion along the height of the tubular base part 321. However, it is not essential that the opening/closure assistance part 314 in the present Example is provided at a mid portion along the height of the tubular base part 321. For example, an opening/closure assistance part 314a may have its one end formed as one with one end of a coupling part 313a whose other end is formed as one with the lower end of the tubular base part 321a. When the screw cap opening/closure assistance mechanism is still fresh from the plant or is not currently used, the opening/closure assistance part 314a droops from the lower end of the tubular base part 321a of the screw cap 320a into close contact with the opening part 331 and with the vessel 330.

[0104] In the opening/closure operation, the opening/closure assistance part 314a is uplifted away from the vessel 330 and from the opening part 331, as shown in FIGS. 13A and 13B. The opening/closure assistance part is then turned through approximately 90° in a vertical plane, with the coupling part 313 as the center of rotation, thereby creating a moving part of a larger diameter rotatable in unison with a screw cap 320a.

#### Example 5

[0105] An Example 5 for a screw cap opening/closure assistance mechanism 410, an alteration of the previous Examples of the present invention, will now be described in detail with reference to the drawings (FIGS. 14 to 16). It is noted that the formulation which is the same as that of any of the previous Examples 1 to 4 is dispensed with. It is also noted that the screw cap opening/closure assistance mechanism 410 of the present Example is of the type in which the screw cap opening/closure assistance mechanism 410 is formed as an entity distinct from the screw cap 20.

[0106] The screw cap opening/closure assistance mechanism 410 of the present Example is again formed of polypropylene. Referring to FIGS. 14 and 15, the screw cap opening/closure assistance mechanism includes an annular part 411 encircling the outer peripheral surface of the tubular base part 21 of the screw cap 20, and a fitting stop 412 formed as one with the upper end of the annular part 411. The screw cap opening/closure assistance mechanism includes a coupling part 413 that plays the role of a hinge formed as one with the annular part 411, and an opening/closure assistance part 414, formed as one with the coupling part 413. The screw cap opening/closure assistance mechanism further includes a rotation stop 415 formed as one with the opening/closure assistance part 414, and a rotation stop receiver 433 formed as one with the annular part 411 and adapted for receiving the rotation stop 415.

[0107] The annular part 411 is substantially cylindrically-shaped and has a height approximately equal to the height of the tubular base part 21 of the screw cap 20. The annular part 411 has an inner diameter slightly larger than the outer diameter of the tubular base part 21 of the screw cap 20. It is noted that, since the outer diameter of the tubular base part 21 of the screw cap 20 is not constant, the inner diameter of the annular part 411 is set so as to be slightly larger than the average outer diameter of the tubular base part 21. A plurality of vertically

extending abutment ribs 416 are formed at optional sites on the inner peripheral surface of the annular part 411 for engaging in vertical grooves formed in the outer peripheral surface of the tubular base part 21 of the screw cap 20.

[0108] The abutment ribs 416 are formed as a series of chevron-shaped strands formed extending from an upper end to a lower end of the inner peripheral surface of the annular part 411, as shown in FIG. 15B. These abutment ribs are of increasing heights towards the upper ends to form abutment parts 417 configured for pressuring the upper part of the outer peripheral surface of the screw cap. The chevron shape of the abutment ribs 416 is such that the cross-section of each chevron is a non-isosceles triangle, as shown in FIG. 14B. During the opening operation, an acutely inclined side 416a of the chevron shape is abutted against the vertically extending groove, not shown, formed in the outer peripheral surface of the screw cap 20. During the closure operation, a moderately inclined side 416b of the chevron shape is abutted against the vertically extending groove. Viz., the annular part 411 idles in rotation relative to the screw cap 20 with a smaller force of rotation during the operation for closure than during the operation for opening. In this formulation, the annular part 411 idles on application of a force of rotation greater than a preset value during the operation for closing. During the operation for opening, the idling of the annular part 411 relative to the screw cap 20 is inhibited. Moreover, since the abutment parts 417 are vertically elongated, the frictional resistance increases to suppress inadvertent dropout of the annular part 411 from the screw cap 20. The abutment ribs 416 may be formed by a train of a plurality of circumferentially concatenated chevron-shaped strands at three or more places on the inner peripheral surface of the annular part 411.

[0109] The fitting stop 412 operates to inhibit an excessive thrusting operation of the screw cap opening/closure assistance mechanism 410 at the time of thrusting thereof onto the screw cap 20 downwards for fitting it onto the screw cap. The fitting stop 412 is formed to a flat ring shape at an upper extreme end of the annular part 411. In assembling the screw cap opening/closure assistance mechanism 410 on the screw cap 20, the fitting stop 412 abuts against the rim of the upper side of the closure part 22 of the screw cap 20. An arrangement is made so that the engraving or printing of a letter or a picture pattern on the upper side of the closure part 422 of the screw cap 20 may be seen from outside via a center opening 418 provided in the fitting stop 412.

[0110] A mating retention portion 434 is formed at a portion of the annular part 411 for slightly protruding outwards. When the opening/closure assistance part 414 is moved near to the annular part 411, a mating retention part 435 provided on the assistance part 414 is detachably engaged with the mating retention part 434 to keep the opening/closure assistance part 414 engaged with the annular part 411. Of course, in the operation for opening the screw cap 20, the state of engagement may readily be released to allow for the operation of the opening/closure assistance part 414.

[0111] A rotation stop receiver 433, protruded slightly outwards, is provided on the annular part 411 in the vicinity of the coupling part 413, as shown in FIGS. 14 and 16. An arrangement is so made for regulating the angle of the rotation operation attendant on the operation of opening the opening/closure assistance part 414.

[0112] The coupling part 413 operates for interconnecting the annular part 411 and the opening/closure assistance part 414 by a hinge action. Specifically, the coupling part 413, a

hinge-like portion vertically extending from an upper end to a lower end of the outer peripheral surface of the annular part 411, has its one end connected to a suitable site on the outer peripheral surface of the annular part 111 along a vertically extending linear portion. The other end of the coupling part 413 is connected to the opening/closure assistance part 414, again along a vertically extending linear portion, to impart a hinge action. The length and the thickness from one end to the opposite end of the coupling part 413 are both set to be 0.5 mm or larger. The shape of the connecting part 413 is globally a band shape when seen from an upper side. Both lateral contour lines of a planar shape of the band shape when seen from above are each a hyperbola. With such shape of the coupling part 413a, a mid portion along the length of the band shape of the coupling part 413 may be reduced in thickness to impart durability against flexure. On the other hand, the portions towards both ends of the band shape may be increased in thickness to impart strength.

[0113] The opening/closure assistance part 414 is a lever-shaped moving part for amplifying the force of rotation for opening/closing the screw cap 20 externally applied and for transmitting the so amplified rotational power to the screw cap 20. The opening/closure assistance part 414 is a plate piece member having one end connected to the coupling part 413 and having the other end as a free end. This plate piece member is of a height slightly lower than the height of the annular part 411, as shown in FIG. 15A. The opening/closure assistance part 414 has a curved portion 436 that is set to a length about one-fourth of the circumferential length of the annular part 411 and that may be positioned in proximity to the outer peripheral surface of the annular part 411. A finger support 437 is provided in the vicinity of the curved portion and is bent in a direction of deviating from the outer peripheral surface of the annular part 411. The opening/closure assistance part in its entirety is in an arch shape.

[0114] A retention part 435, recessed for engagement by a mating retention portion 434, protuberantly formed on the annular part 41, is formed on an optional site at the lower end near the free end of the opening/closure assistance part 414. Thus, the retention part 435 and the mating retention part 434 may be engaged with or disengaged from each other. A small-sized opening, piercing the opening/closure assistance part 414, may be provided so as to be traversed by a strap, not shown.

[0115] A rotation stop 415 that restricts the angle of rotation of the opening/closure assistance part 414 about the coupling part 413 as the center of rotation is provided in the vicinity of the proximal end of the opening/closure assistance part 414, the coupling part 413 is connected to. The rotation stop 415 is provided extending from the proximal end in the direction of the moving radius. In the position of the maximum rotation, the rotation stop 415 and the rotation stop receiver 433, provided on the annular part, abut against each other, as shown in FIG. 16.

[0116] In the above described screw cap opening/closure assistance mechanism 410, the opening/closure assistance part 414 is moved to close to the annular part 411 during the non-use time, with the retention part 435 and the mating retention part 434 being thus engaged with each other. During the time of use, the retention part 435 is disengaged from the mating retention part 434 to release the state of engagement, with the opening/closure assistance part 414 being rotated to create a large diameter moving part.

[0117] In the present Example, the screw cap 20 and the screw cap opening/closure assistance mechanism 410 are fabricated as separate entities. As a matter of course, the coupling part 413 may be formed as one with the outer peripheral surface of the tubular base part 21 of the screw cap 20 and the screw cap opening/closure assistance part 414 may then be connected to the other end of the coupling part 413. The screw cap opening/closure assistance mechanism 410 may thus be formed as one with the screw cap 20 without the interposition of the annular part 411.

#### Example 6

[0118] An Example 6 for a screw cap opening/closure assistance mechanism 510, an alteration of the previous Examples of the present invention, will now be described in detail with reference to the drawings (FIG. 17). It is noted that explanation of the formulation which is the same as that of any of the previous Examples 1 to 5 is dispensed with. It is also noted that, similarly to the screw cap opening/closure assistance mechanism 10 of Example 1, a screw cap opening/closure assistance mechanism 510 of the present Example is of the type in which the screw cap opening/closure assistance mechanism 510 is formed as an entity distinct from a screw cap 520.

[0119] The screw cap opening/closure assistance mechanism 510 of the present Example is again formed of polypropylene. The screw cap opening/closure assistance mechanism includes an annular part 511 encircling the outer peripheral surface of the tubular base part 21 of the screw cap 20, and a substantially disc-shaped fitting stop 512 formed as one with an upper end of the annular part 511. The screw cap opening/closure assistance mechanism also includes a coupling part 513 that plays the role of a hinge, formed as one with the upper end of the annular part 511, and an opening/closure assistance part 514 formed as one with the coupling part 513. The screw cap opening/closure assistance mechanism further includes a rotation stop 515 formed as one with the opening/closure assistance part 514, and a cover-shaped coupling part 538 interconnecting the foremost part of the rotation stop 515 and an optional position of the annular part 511.

[0120] The fitting stop 512 performs the role of preventing excess thrusting in case of thrusting the screw cap opening/closure assistance mechanism 510 onto the screw cap 20 downwards for fitting it onto the screw cap. The fitting stop 512 is formed to substantially a disc shape at an extreme upper end of the annular part 511 to stop up an upper portion of the annular part 511 substantially in its entirety. A larger number of through-holes 518, piercing through front and reverse sides of the fitting stop 512, are formed in the rim portion of the substantially disc-shaped fitting stop 512 along the entire circumference at a preset distance from one another. A larger number of bridging parts 518a are thus formed between the fitting stop and an upper extreme end of the annular part 511. In the screw cap opening/closure assistance mechanism 510 of the present Example, the larger numbers of the bridging parts 518a are created as the fitting stop 512 is provided to cover the upper extreme end of the annular part 511, thereby imparting flexibility to the annular part 511 and the aesthetic sense. It is also possible to cope with variations in the outer diameter or the outer shape of the screw cap 20.

[0121] The opening/closure assistance part 514 is a lever-shaped moving part for amplifying the force of rotation externally applied for opening/closing the screw cap 20. The lever also transmits the so amplified rotational power to the screw

cap 20. The opening/closure assistance part 514 includes a finger support 537 in the vicinity of its free end, and a temporary bridging part 539, connected to the annular part 511, is provided on an inner side in the vicinity of the proximal end of the finger support 537. This temporary bridging part 539 interconnects the opening/closure assistance part 514 and the annular part 511. If a force larger than is necessary is applied to the temporary bridging part 539, the temporary bridging part is readily ruptured, indicating that the vessel is fresh from the plant. The temporary bridging part thus keeps the sable connection state of opening/closure assistance part 514 to the annular part 511 as long as the vessel has not been in use.

[0122] The rotation stop 515, extended along the moving radius, is formed at the proximal end of the opening/closure assistance part 514, as shown in FIG. 17. One end of the cover-shaped coupling part 538 having two hinge-shaped joints 538a, 538b is connected to the distal end of the rotation stop 515. This cover-shaped coupling part 538 includes a plate spring shaped part 538c of a longer length extended from an optional point of the annular part 511 substantially tangentially and a relay part 538d of a shorter length hinged to the plate spring shaped part 538c. This relay part is hinged to the rotation stop 515.

[0123] When the screw cap opening/closure assistance mechanism 510 of the present Example is in use, a moderate thrust force for opening is initially applied to the finger support 537 to rupture the temporary bridging part 539 interconnecting the annular part 511 and the opening/closure assistance part 514. The free end side of the opening/closure assistance part 514 is then turned with the coupling part 513 as a fulcrum point. When the rotational position of the rotation stop 515 has passed a dead point, the opening/closure assistance part 514 is automatically turned to its maximum rotational position under the action of the cover-shaped coupling part 538, thereby creating a large diameter moving part. After use, the opening/closure assistance part 514 is moved to close to the annular part 511 until the rotational position of the opening/closure assistance part 514 has passed the dead point. The opening/closure assistance part 514 then is automatically restored to its original position. With the screw cap opening/closure assistance mechanism 510 of the present Example, provided with the cover-shaped coupling part 538, it is possible to protect the user from having his/her finger, hand or skin caught between the annular part 511 and the rotation stop 515.

[0124] The screw cap opening/closure assistance mechanism of the present invention, described above, assists in opening/closing a screw cap in the screw cap opening/closure mechanism, and includes a coupling part and an opening/closure assistance part. The coupling part is mounted as one with or as an entity distinct from the screw cap, and may be turned at its one end in unison with the screw cap. The opening/closure assistance part is connected to the coupling part and, during the non-opening/closure time, is positioned in proximity to the outer surface of the screw cap. During the opening/closure time, the opening/closure assistance part is moved away from the screw cap to create a larger diameter moving part that is turned in unison with the screw cap. According to screw cap opening/closure assistance mechanism of the present invention, the force of rotation necessary for relative rotation between the opening part of the vessel and the screw cap may be made smaller. It is to be noted that the

present invention may be worked out in a variety of modes without departing from the scope of the invention.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0125] FIG. 1 is a perspective view showing the state in which a screw cap opening/closure assistance mechanism of Example 1 is mounted on a screw cap in a screw cap mechanism.

[0126] FIG. 2A is a cross-sectional view showing the state of cross-section before mounting a screw cap opening/closure assistance mechanism on the screw cap of FIG. 1.

[0127] FIG. 2B is a cross-sectional view showing the state of cross-section after mounting the screw cap opening/closure assistance mechanism on the screw cap of FIG. 1.

[0128] FIG. 3A is a perspective view showing a state in which an opening/closure assistance part of the screw cap opening/closure assistance mechanism has not as yet been rotated.

[0129] FIG. 3B is a perspective view showing a state in which the opening/closure assistance part of the screw cap opening/closure assistance mechanism has been rotated.

[0130] FIG. 3C is a bottom view showing the bottom side of FIG. 3A.

[0131] FIG. 4A is a schematic view for illustrating the relationship between the moment of the force and the state of the opening/closure assistance part in case the screw cap opening/closure assistance mechanism is to be turned clockwise.

[0132] FIG. 4B is a schematic view for illustrating the relationship between the moment of the force and the state of the opening/closure assistance part in case the screw cap opening/closure assistance mechanism is to be turned counterclockwise.

[0133] FIG. 5A is a perspective view showing the state of the screw cap opening/closure assistance mechanism of FIG. 2 in the unused state.

[0134] FIG. 5B is a perspective view showing the state in which the opening/closure assistance part has been moved away from the tubular base part by rotation of the opening/closure assistance part.

[0135] FIG. 6A is a plan view of FIG. 5A.

[0136] FIG. 6B is a plan view of FIG. 5B.

[0137] FIG. 7A is a perspective view showing the unused state of the screw cap opening/closure assistance mechanism which is in an unused state.

[0138] FIG. 7B is a cross-sectional view showing a longitudinal cross section of a diametrical part of the screw cap opening/closure assistance mechanism shown in FIG. 7A.

[0139] FIG. 8A is a perspective view showing an opening/closure assistance part of the screw cap opening/closure assistance mechanism shown in FIG. 7A after rotating the assistance part through 180° in a vertical plane.

[0140] FIG. 8B is a cross-sectional view showing a longitudinal cross section of a diametrical part of the screw cap opening/closure assistance mechanism shown in FIG. 7A.

[0141] FIG. 9A is a perspective view showing a modification of the screw cap opening/closure assistance mechanism of Example 3.

[0142] FIG. 9B is a perspective view showing another modification of the screw cap opening/closure assistance mechanism.

[0143] FIG. 10A is a perspective view showing the screw cap opening/closure assistance mechanism of Example 4 provided as one with a screw cap.

[0144] FIG. 10B is a plan view of FIG. 10A.  
 [0145] FIG. 11A is a perspective view showing the state in which the opening/closure assistance part of the screw cap opening/closure assistance mechanism of FIG. 10 has been rotated through 90° in a vertical plane.  
 [0146] FIG. 11B is a plan view of FIG. 11A.  
 [0147] FIG. 12A is a perspective view showing a modification of a screw cap opening/closure assistance mechanism of Example 4 and illustrating an unused state of the screw cap mechanism.  
 [0148] FIG. 12B is a plan view of FIG. 12A.  
 [0149] FIG. 13A is a perspective view showing the state in which the opening/closure assistance part of the screw cap opening/closure assistance mechanism of FIG. 12 has been rotated through 90° in a vertical plane.  
 [0150] FIG. 13B is a plan view of FIG. 13B.  
 [0151] FIG. 14A is a plan view showing the formulation of the screw cap opening/closure assistance mechanism of Example 5.  
 [0152] FIG. 14B is a bottom side view of FIG. 14A.  
 [0153] FIG. 15A is a side view showing a lateral side of the screw cap opening/closure assistance mechanism shown in FIG. 14.  
 [0154] FIG. 15B is a cross-sectional view showing a cross section of the screw cap opening/closure assistance mechanism shown in FIG. 14.  
 [0155] FIG. 16 is a plan view showing the state of operation of full opening and full closure of the opening/closure assistance part of the screw cap opening/closure assistance mechanism shown in FIG. 14.  
 [0156] FIG. 17A is a plan view showing the unused state for illustrating the formulation of the screw cap opening/closure assistance mechanism of Example 6.  
 [0157] FIG. 17B is a plan view showing the state of full opening of the opening/closure assistance part of FIG. 17A.

EXPLANATION OF REFERENCE NUMERALS

[0158] 10 screw cap opening/closure assistance mechanism  
 [0159] 11 annular part  
 [0160] 12 fitting stop  
 [0161] 13 coupling part  
 [0162] 14 opening/closure assistance part  
 [0163] 15 rotation stop  
 [0164] 16 abutment  
 [0165] 17 pressuring part  
 [0166] 18 circular opening  
 [0167] 20 screw cap  
 [0168] 21 tubular base part  
 [0169] 22 closure part  
 [0170] 23 tamper evidence ring  
 [0171] 24 engagement part  
 [0172] 25 hermetically sealing part  
 [0173] 26 tamper evidence ring main  
 [0174] 27 removal inhibiting pieces  
 [0175] 28 engraving or printing such as letter or picture pattern  
 [0176] 30 vessel  
 [0177] 31 opening part of vessel  
 [0178] 32 mating engagement part  
 [0179] 110 screw cap opening/closure assistance mechanism  
 [0180] 111 annular part  
 [0181] 112 fitting stop

[0182] 113 coupling part  
 [0183] 114 opening/closure assistance part  
 [0184] 115 rotation stop  
 [0185] 210 screw cap opening/closure assistance mechanism  
 [0186] 211 half-groove part  
 [0187] 211a half-groove part  
 [0188] 211b half-groove part  
 [0189] 213 coupling part  
 [0190] 213a coupling part  
 [0191] 213b coupling part  
 [0192] 214 opening/closure assistance part  
 [0193] 214a opening/closure assistance part  
 [0194] 214b opening/closure assistance part  
 [0195] 220 screw cap  
 [0196] 220a screw cap  
 [0197] 220b screw cap  
 [0198] 221 tubular base part  
 [0199] 221a tubular base part  
 [0200] 221b tubular base part  
 [0201] 222 closure  
 [0202] 222a closure part  
 [0203] 222b closure part  
 [0204] 224 engagement part  
 [0205] 225 hermetically sealing part  
 [0206] 310 screw cap opening/closure assistance mechanism  
 [0207] 313 coupling part  
 [0208] 313a coupling part  
 [0209] 314a opening/closure assistance part  
 [0210] 314b opening/closure assistance part  
 [0211] 319 elliptically-shaped opening  
 [0212] 320 screw cap  
 [0213] 320a screw cap  
 [0214] 321 tubular base part  
 [0215] 321a tubular base part  
 [0216] 322 closure part  
 [0217] 330 vessel  
 [0218] 331 opening part of vessel  
 [0219] 410 screw cap opening/closure assistance mechanism  
 [0220] 411 annular part  
 [0221] 412 fitting stop  
 [0222] 413 coupling part  
 [0223] 414 opening/closure assistance part  
 [0224] 415 rotation stop  
 [0225] 416 abutment ribs  
 [0226] 416a acutely inclined surface  
 [0227] 416b moderately inclined surface  
 [0228] 417 pressuring part  
 [0229] 433 rotation stop receiver  
 [0230] 434 mating retention part  
 [0231] 435 retention part  
 [0232] 436 curved portion  
 [0233] 437 finger support  
 [0234] 510 screw cap opening/closure assistance mechanism  
 [0235] 511 annular part  
 [0236] 512 fitting stop  
 [0237] 513 coupling part  
 [0238] 514 opening/closure assistance part  
 [0239] 515 rotation stop  
 [0240] 518 through-hole  
 [0241] 518a bridging part

[0242] 537 finger support  
 [0243] 538 cover-shaped coupling part  
 [0244] 538a joint part  
 [0245] 538b joint part  
 [0246] 538c plate spring shaped part  
 [0247] 538d relay part  
 [0248] 539 temporary bridging part  
 [0249] r outer radius of annular part  
 [0250] r' distance from center O to point P3  
 [0251] d distance from root site P1 of coupling part to foremost part P2 of radially outwardly located rotation stop  
 [0252] n moment  
 [0253] P1 root site of coupling part  
 [0254] P2 foremost part of rotation stop  
 [0255] P3 point on a line of extension from the center O to the root site P1 of coupling part  
 [0256] r0 outer radius of annular part  
 [0257] r1 distance from center O to each rotation stop  
 [0258] r2 distance from center O to foremost part of each rotation stop  
 [0259] D outer diameter of tubular base part  
 [0260]  $\Phi 1$  outer diameter of opening/closure assistance part  
 [0261]  $\Phi 2$  outer diameter of longer diameter of ellipse of opening/closure assistance part

1-38. (canceled)

39. A screw cap rotation assistance mechanism for assisting in the opening/closure of a screw cap in a screw cap mechanism including:

an opening of a vessel; said opening carrying a spirally extending mating engagement part in an outer peripheral surface thereof; and

said screw cap having a tubular base part and a closure part; said tubular base part carrying, on an inner peripheral surface thereof, a spirally extending engagement part adapted for being in threaded engagement with said mating engagement part; said closure part closing one end of said tubular base part to openably stop up said opening;

said screw cap rotation assistance mechanism including a rotation assistance section that may be turned to close to or away from said tubular base part of said screw cap; said rotation assistance section being adapted to be turned towards or away from said tubular base part by a hinge-like coupling part, operating as a fulcrum, in a state in which said rotation assistance section is as-one with said tubular base part;

said rotation assistance section having a free end and a rotation stop; said free end when said rotation assistance section is turned away from said tubular base part of said screw cap being moved away from said tubular base part about said coupling part as a fulcrum; said rotation stop approaching to and abutting against said tubular base part with said coupling part as a fulcrum;

the distance from said coupling part to said free end being longer than a distance from said coupling part to said rotation stop.

40. The screw cap rotation assistance mechanism according to claim 1, further comprising:

an annular part fitted over said tubular base part of said screw cap;

said rotation assistance section being formed as one with an outer surface of said annular part via said coupling part.

41. The screw cap rotation assistance mechanism according to claim 1, wherein

said rotation assistance section is formed as one with said tubular base part via said coupling part.

42. The screw cap rotation assistance mechanism according to claim 1, wherein

said coupling part is substantially band-shaped; the profile of both contour lines of a plan shape defined by front and back surfaces of said coupling part being hyperbolas.

43. The screw cap rotation assistance mechanism according to claim 1, further comprising:

an idle rotation inhibiting part on an inner surface of said annular part; said idle rotation inhibiting part intruding into a vertical groove formed in an outer peripheral surface of said tubular base part to inhibit idle rotation of said annular part relative to said screw cap.

44. The screw cap rotation assistance mechanism according to claim 1, wherein

said coupling part includes a temporary bridging part that temporarily bridges said rotation assistance part and said tubular base part so that said rotation assistance part and said tubular base part are in an as-one state; said temporary bridging part rupturing on application of a force greater than a preset force.

45. The screw cap rotation assistance mechanism according to claim 1, further comprising:

a retention part provided on said rotation assistance part and a mating retention part provided on an outer peripheral surface of said tubular base part or said annular part; said retention part and said mating retention part being engaged with each other to keep said annular part or said tubular base part engaged with said rotation assistance part.

46. The screw cap rotation assistance mechanism according to claim 1, wherein,

said rotation assistance part includes a curved portion extending along said outer peripheral surface of said tubular base part; said rotation assistance part also including, in the vicinity of a distal end of a free end side thereof, a finger support curved in a direction away from said outer peripheral surface of said tubular base part;

said rotation stop being provided in the vicinity of a proximal end of said rotation assistance part connected to said coupling part; said rotation stop prescribing the angle of rotation of said rotation assistance part.

47. The screw cap rotation assistance mechanism according to claim 1, wherein

said rotation assistance part includes a curved portion extending along the outer peripheral surface of said tubular base part.

48. The screw cap rotation assistance mechanism according to claim 1, wherein

said rotation assistance part includes a finger support in the vicinity of a distal end thereof as a free end; said finger support being curved in a direction away from the outer peripheral surface of said tubular base part.

49. The screw cap rotation assistance mechanism according to claim 1, wherein

said rotation stop is provided in the vicinity of a proximal end of said rotation assistance part where said coupling part is connected; said rotation stop prescribing the angle of rotation of said rotation assistance part.

**50.** The screw cap rotation assistance mechanism according to claim 1, wherein  
 a pressuring part that thrusts and abuts against a portion of said tubular base part is provided on an inner surface of said annular part.

**51.** The screw cap rotation assistance mechanism according to claim 1, wherein  
 said annular part is provided with an annular upper portion extending along said annular part and radially inwards from said annular part to form a ring.

**52.** The screw cap rotation assistance mechanism according to claim 1, wherein  
 said annular part includes an upper portion at an upper end thereof; said upper portion closing said annular part substantially globally.

**53.** The screw cap rotation assistance mechanism according to claim 1, wherein  
 said upper portion includes a plurality of through-holes traversing the front and back sides thereof and a plurality of bridging portions bridging said annular part and the upper portion; said bridging portions being delimited between said through-holes.

**54.** The screw cap rotation assistance mechanism according to claim 1, wherein  
 a plurality of rotation assistance parts are provided on said tubular base part.

**55.** A screw cap rotation assistance mechanism for assisting in the opening/closure of a screw cap in a screw cap mechanism including:  
 an opening of a vessel; said opening carrying a spirally extending mating engagement part in an outer peripheral surface thereof; and  
 said screw cap having a tubular base part and a closure part; said tubular base part carrying, on an inner peripheral surface thereof, a spirally extending engagement part adapted for being in threaded engagement with said mating engagement part; said closure part closing one end of said tubular base part to openably stop up said opening;  
 said screw cap rotation assistance mechanism including an annular part fitted over said tubular base part of said screw cap; and  
 a rotation assistance section provided on an outer peripheral surface of said annular part; said rotation assistance section being adapted to be movable to close to or away from said annular part;  
 said rotation assistance section being rotated by a hinge-like coupling part, operating as a fulcrum, so as to be movable towards and away from said tubular base part; said hinge-like coupling part being formed as one with said tubular base part;  
 said rotation assistance section having a free end and a rotation stop; said free end when said rotation assistance section is turned away from said tubular base part of said screw cap being turned about said coupling part as a

fulcrum so as to be moved away from said annular part; said rotation stop approaching to and abutting against said tubular base part with said coupling part as a fulcrum;  
 the distance from said coupling part to said free end being longer than a distance from said coupling part to said rotation stop.

**56.** The screw cap rotation assistance mechanism according to claim 17, further comprising:  
 an idle rotation inhibiting part on an inner surface of said annular part; said idle rotation inhibiting part intruding into a vertical groove formed in an outer peripheral surface of said tubular base part to inhibit idle rotation of said annular part relative to said screw cap.

**57.** A screw cap rotation assistance mechanism for assisting in the opening/closure of a screw cap in a screw cap mechanism including:  
 an opening of a vessel; said opening carrying a spirally extending mating engagement part in an outer peripheral surface thereof; and  
 said screw cap having a tubular base part and a closure part; said tubular base part carrying, on an inner peripheral surface thereof, a spirally extending engagement part adapted for being in threaded engagement with said mating engagement part; said closure part closing one end of said tubular base part to openably stop up said opening;  
 said screw cap rotation assistance mechanism including a rotation assistance section provided on an outer peripheral surface of said annular part so as to be movable to close to or away from said annular part;  
 said rotation assistance section being turned towards and away from said tubular base part about a hinge-like coupling part operating as a fulcrum; said coupling part being formed as one with said tubular base part;  
 said rotation assistance section having a free end and a rotation stop; said free end when said rotation assistance section is turned away from said tubular base part of said screw cap being turned away from said tubular base part about said coupling part as a fulcrum; said rotation stop approaching to and abutting against said tubular base part with said coupling part as a fulcrum;  
 the distance from said coupling part to said free end being longer than a distance from said coupling part to said rotation stop.

**58.** The screw cap rotation assistance mechanism according to claim 1, wherein  
 said coupling part includes a temporary bridging part that temporarily bridges said rotation assistance part and said tubular base part so that said rotation assistance part and said tubular base part are temporarily in an as-one state; said temporary bridging part rupturing on application of a force greater than a preset force.

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