CLOSURE FOR CONTAINER AND METHOD FOR OPERATING SAID CLOSURE

The invention relates to the field of packaging, more particularly to closures for containers, in particular wherein container and closure have cooperating threads. In particular, the invention relates to methods and apparatuses described in the claims. The closures may be used with containers for packaging liquids and in particular beverages, for example carbonated beverages such as carbonated softdrinks.

Beverage containers, such as bottles made of polyethylene terephthalate (PET), are frequently closed by means of closures including a lid and a tamper evident ring (also referred to as tamper evident band) for tamper detection. Such closures are frequently single-piece (integral) molded parts made of high-density polyethylene (HDPE) or single-piece (integral) molded parts, where the lid and the tamper-evident ring are made of polypropylene (PP) and an integrated gasket (in-line or in-shell molded gasket) which may be made of a different material. Also common are closures which comprise a single-piece (integral) molded part and a separately manufactured gasket (out-line or out-shell molded gasket), in particular where the lid and the tamper-evident ring are made of polypropylene (PP), while the gasket may be made of a different material. However, the lid and the tamper-evident ring and the whole closure, respectively, can alternatively be made of one or more different polymer materials.

The lid comprises an inner thread to cooperate with an outer thread formed at a neck of the container, the neck having an opening. In an initial state, the container is closed by the lid, the lid closing the opening of the container, and the lid and the tamper evident ring are interconnected with one another, e.g., a perforation is present between the lid and the tamper evident ring. Furthermore, the tamper evident ring is in a position in which it is rotatable about the container axis and encompasses the neck, wherein a retaining feature, such as a bulge, at the neck of the container inhibits an upward movement of the tamper evident ring.

For opening the initially closed container, the lid is screwed (unscrewed; rotated pursuant an unscrewing sense of rotation) so as to increase a distance between the lid and the tamper evident ring, thus separating the lid from the tamper evident ring by interrupting said interconnection. After further screwing (unscrewing), the lid is separated from the container. Thus, the lid can be lost – which can contribute to pollution.

In order to reduce pollution, it can be provided that measures are taken to ensure that a lid of the described kind remains with the container, e.g., remains connected to the tamper evident ring.

From US 5'215'204, a tamper evident closure with a hinged band is known. By screwing, lid and tamper evident band are separated, but two tethers of the hinged band are provided which continue to interconnect lid and tamper evident band. In order to clear the opening of the container, the lid is flipped, such that it is finally located beside the neck, with an outer top surface of the lid facing downwards.

In US 6'474'791, a similar closure is described. However, the lid in this case has a tongue to cooperate in the open state with the outer thread of the container by engaging therewith, such that in the open state, the lid is held in a fixed position beside the neck, the outer top surface of the lid facing downwards.

In both cases, the flipping of the lid is accomplished essentially by rotating the lid by more than 90° about an axis of rotation passing through the locations where the tethers are connected to the lid, wherein said axis of rotation is located outside the neck of the container. And the locations where the tethers are connected to the lid are very close to one another, and for each tether the location where the respective tether is connected to the tamper evident ring is neighboring the location where the respective tether is connected to the lid.

US 2018/0370701 A1 describes another closure for a container which comprises two tethers to keep the lid connected to the tamper evident ring while in an open state. In the open state, this lid can stay connected to the container by means of the tethers while the lid is rotated by more than 180° relative to the initial state. Furthermore, in contrast to the closures above, a location where a first of the two tethers is connected to the tamper evident ring and a location where a second of the two tethers is connected to the lid are neighboring one another while being located between a location where the first of the two tethers is connected to the lid and a location where the second of the two tethers is connected to the tamper evident ring. In other words, a sequence of azimuthal positions of said locations is given by Ri-Li-Ri-Li here, in contrast to Ri-Li-Li-Ri in case of the closures above; wherein Ri denotes a location where a tether is connected to the tamper evident ring, and Li denotes a location where a tether is connected to the lid.

The inventor invented a completely different way of operating a lid which shall remain connected to a container initially closed by the lid. In order to clear the opening of the container, a movement is proposed which involves a very limited tilting of the lid – in contrast to the essentially rotational movements of the flip-top closures described in prior art US 5’215’204, US 6’474’791 and US 2018/0370701 A1 discussed above. The movement can be an essentially shifting movement optionally comprising said limited tilting of the lid.

The tethers, more particularly their lengths and their positions in the initial state can be designed to make possible to clear the opening of the container by means of the proposed movement of the lid.

It is possible to clear the opening of the container in a way which involves a tilting of the lid by an angle of less than 90°, in particular by clearly less than 90°, such as by less than 80° or by less than 70° – in contrast to the flipping of the lid by more than 90° or even by more than 180° known from prior art flip top closures. There are various ways to define suitable lid movements and tether designs. Accordingly, there are various ways to define the invention and/or various aspects of the invention. Some of these ways are herein described.

Furthermore, the inventor invented a new way of storing a closure while the container is open. The lid member can be kept in a position with the inside of the lid facing or even opposing the container.

One object of the invention is to create a new way of operating closures with tethered lids. And corresponding closures and corresponding combinations comprising a container and a closure shall be provided. In addition, respective methods for operating a closure shall be provided as well as a method for manufacturing a closure.

Another object of the invention is to provide improved hygiene in handling tethered lids.

Another object of the invention is to provide a new way of holding a lid after opening or even of relatively fixedly holding a lid after opening, and in particular of bearing a lid against the container.

Another object of the invention is to provide a way of storing a lid, while still connected to the container (via a ring of the closure retained at the container), in a position which enables free access to the opening of the container, in particular in a position in which the lid is particularly remote from said opening.

Another object of the invention is to provide a way of realizing a tethered lid which can be manufactured as a single-piece molded part or as a single-piece molded part with a separately manufactured gasket.

Another object of the invention is to provide a way of realizing a tethered lid which can be used with existing containers or which does not require redesign of common containers.

Another object of the invention is to provide a way of realizing a tethered lid which can be applied to bottles with existing capping equipment.

Another object of the invention is to provide a way of realizing a tethered lid which is particularly light, in particular which has a weight amounting to the weight of a corresponding not-tethered lid or to an even lower weight.

Another object of the invention is to provide a way of realizing a tethered lid which can be used even for short neck finishes.

Another object of the invention is to provide a way of realizing a tethered lid which has a particularly good handling for a user.

Another object of the invention is to provide a way of realizing a tethered lid which can be used for various beverage contents, e.g. carbonated soft drinks, water or juices and various bottling technologies, e.g. hot-fill, aseptic cold-fill, non-aseptic cold-fill.

Further objects and various advantages emerge from the instant description and from herein disclosed embodiments.

At least one of these objects can be achieved in some implementations of devices and/or methods described in this disclosure.

Firstly, some clarifications regarding expressions and magnitudes used throughout the present disclosure shall be made.

Initial state: State as manufactured; before a first use. Referring to the closure applied to the container, the initial state is a particular closed state, i.e. a particular state in which the opening of the container is closed by the lid member. In the initial state, the container has not been opened yet. With reference to both, namely to merely a closure (not applied to a container) and to a container closure assembly, for example, a plurality of local connecting portions different from the tethers can interconnect, in particular directly interconnect, the ring member and the lid member. Said connecting portions are meant to break, e.g., be disrupted, when firstly opening the container.

Closed state: In the closed state, the opening of the container is closed by the lid member. The inner thread of the lid member and the outer thread of the neck are mutually engaged, more specifically, the lid member is screwed onto the neck of the container by virtue of the mutually corresponding inner thread of the lid member and outer thread of the neck. In particular in a closed state, a top end of the container can abut a top inner contact surface of the lid member. The top inner contact surface can be formed by a molded single-piece part, e.g., made of HDPE, or by a gasket which can be integrally formed with the lid member (like an in-shell molded gasket) or can be a part different from the lid member and optionally made of a material different from the material of the lid member (like an out-shell molded gasket).

Intermediate position: In the intermediate position, the inner thread of the lid member and the outer thread of the container are disengaged, and at least a region of a lower periphery of the lid member is located above a top end of the container.

Cleared position: Position of the lid member in which the opening is completely cleared from the lid member; more particularly: essentially a position of the lid member (relative to the opening or to the ring member, respectively) in which there is no overlap regarding x-y-coordinates between the lid member and the opening (and ring member, respectively). In the cleared position, it is expected to be possible for a user to drink directly from the container and/or to pour a beverage through the opening out of the container without the lid member interfering at least if the lid member is sufficiently far below the opening of the container.

Storage position: Particular cleared position in which the lid member is held by the tether members, in particular wherein a lid member in storage position is stabilized by forces exerted by the tethers acting on the lid member.

z-axis: Axis defined by the container, more particularly defined by the outer thread of the container. The z-axis is directed to point (along the +z-direction) centrally through the neck towards outside the container.

Container axis: Axis defined by the container, in particular defined by the outer thread of the container. Identical with the z-axis.

x-axis: Bisector (bisecting line) of angle δ, aligned perpendicular to z-axis and directed to point from the z-axis towards the middle between the first ends of the first and second tether members for $\delta < 180°$. The shifting movement is directed to point essentially in the direction of the x-axis.

y-axis: Directed axis forming a Cartesian coordinate system with the x-axis and the z-axis.

Azimuthal: Refers to angles around the z-axis, lying in a plane perpendicular to the z-axis and to corresponding angular coordinates (which are related to corresponding radial directions).

Upwards / Above: Refers to directions pointing in the same direction as the z-axis, i.e. in the +z-direction.

Downwards / Below: Refers to directions pointing in a direction opposite the direction of the z-axis, i.e. along the –z-direction.

Angles $\beta 1$, $\beta 2$: Azimuthal angles present in the initial state between the first end and the second end of the first and second tether member, respectively.

Angle β: Shorthand for azimuthal angles β1, β2, where β1 = β2 = β (e.g., in case of a symmetric design).

Angle δ: Azimuthal angle present in the initial state between the first end of the first tether member and the first end of the second tether member. More particularly wherein the bisector of angle δ is directed along the +x-direction.

Angle γ: Azimuthal angle present in the initial state between the second end of the first tether member and the second end of the second tether member. More particularly wherein the bisector of angle γ has a component pointing along the -x-direction.

The invention and its various aspects are described in more detail below, in some cases by means of examples and/or with reference to the included drawings. In the drawings, same reference numerals refer to same or analogous elements. The figures show schematically:

Fig. 1A a detail of a container closure assembly in an initial state, in a perspective view;

Fig. 1B a detail of the container closure assembly of Fig. 1 in an initial state, in another perspective view;

Fig. 2 a detail of the container closure assembly of Fig. 1 in an unscrewed state close the an intermediate state, in a perspective view;

Fig. 3 a perspective view of a detail of the container closure assembly of Fig. 1 in an open state, the lid member being in a cleared position;

Fig. 4A a perspective view of a detail of the container closure assembly of Fig. 1 in an open state, the lid member being in a storage position;

Fig. 4B another perspective view of a detail of the container closure assembly of Fig. 1 in an open state, the lid member being in a storage position;

Fig. 5 a closure in an initial state, strongly schematized;

Fig. 6 a closure in an initial state, strongly schematized;

Fig. 7 a cross-section through a details of a closure, strongly schematized;

Fig. 8 a symbolic illustration of a view (along the –z-direction) onto a closure for clarifying angles and ends of tether members;

Fig. 9 a closure in an initial state, strongly schematized;

Fig. 10 a closure with folded tether, in an initial state, strongly schematized;

Fig. 11 a strongly schematized illustration of a closure with tether members of different lengths, in a cleared position, the z-axis and the lid axis being skew axes;

Fig. 12 a lid member comprising an annular radial protrusion, in the storage position, strongly schematized.

Where embodiments are described, these are meant to illustrate and clarify specific aspects of the invention and/or they are example embodiments. In any event, they shall not limit the invention.

A first major aspect of the invention relates to closures we want to refer to as "shift-top" closures. Possible features of a shift-top closure have been described above already. Here is one way to more closely describe a shift-top, referring to the case that the closure is combined with a container:

The respective combination comprises a container and a closure, the container comprising a neck having an opening, at least one first retaining feature, and an outer thread defining a z-axis. The z-axis being directed to point in a +z-direction pointing from inside the neck through the opening towards outside the neck. The closure comprises

— a lid member;

— a ring member;

— a first tether member and a second tether member, each providing an interconnection between the lid member and the ring member.

The ring member is in a retained position in which it encompasses the neck. The at least one first retaining feature limits movement of the ring member towards the +z-direction.

The lid member has an inner thread to cooperate with the outer thread and defining a lid axis which in an initial state is identical to the z-axis.

Furthermore, the first and second tether members are designed to allow a user to move the lid member from the initial state to a cleared position in which a projection of the lid member onto an x-y-plane perpendicular to the z-axis is free from overlap with a projection of the opening onto the x-y-plane, while

— maintaining an angle α enclosed between the z-axis and the lid axis of less than 90°, in particular of less than 85°;

— maintaining the interconnections between the lid member and the ring member;

— the ring member remains in the retained position.

This way, a new way of operating a lid member is made possible. The inside of the lid member does not need to be exposed to an upwards direction when clearing the opening, such as for drinking directly from the container or for pouring a beverage through the opening out of the container. The tether members ensure that the lid member remains tethered to the container by the aid of the ring member being fastened to the neck.

The container can be a beverage container.

The container can be made of a polymer, e.g., of PET. It can be a single-piece (integral) part.

The container can comprise a container body which can be continuous with the neck. It can form a lower end of the container, while the neck can form an upper end of the container which is opposite the lower end.

A combination comprising a container and a closure can also be considered a container closure assembly.

The lid member can be applied to the container, more particularly to the neck.

The opening can have the shape of a circular disk. It can in particular be rotationally symmetric about the z-axis.

The opening typically is delimited by material of the neck.

For example, Figs. 3, 4A, 4B illustrate a possible embodiment of a container 4 comprising a container body 49 and a neck 41 as well as an outer thread 42 and an opening 40.

The at least one first retaining feature can be, e.g., one or more protrusions at the neck, such as one or more bulges (at the neck) or a bead. It can be a tamper evident bead. A first retaining feature embodied as a protrusion or bead is visible, e.g., in Figs. 2, 3, 4A, 4B, denoted 47.

The z-axis can in particular be an axis of rotation about which an item (such as the lid member) with an inner thread corresponding to the outer thread of the neck is rotatable when the inner and outer threads are mutually engaged.

The z-axis typically coincides with a central axis of the neck which in many embodiments coincides with a central axis of the body of the container. The z-axis can point along one or both of these axes directed from inside the container to outside the container.

The z-axis typically passes through a center point of the opening and is perpendicular to a plane defined by the opening.

A z-axis of exemplary embodiments is shown in Figs. 1A, 4A, 4B.

Angle α can be considered a tilt angle.

It is important to note that the angle α is defined between two (directed) axes, such that, e.g., $\alpha = 0°$ cannot be confused with $\alpha = 180°$, i.e. such that a position in which an inner face of a top plate portion of the lid member faces precisely downwards ($\alpha = 0°$; e.g., as in the initial state), distinguishes over a position in which the an inner face of a top plate portion of the lid member faces precisely upwards ($\alpha = 180°$; e.g., as is the case in some prior art flip-top closures).

It is remarked that an angle between two lines or axes is defined not only for mutually intersecting lines or axes, but also for skew lines or axes, as is known from school mathematics. The angle between skew lines or axes is identical to the angle between the lines or axes when one or both of them are shifted so that they intersect. Indeed, in the cleared position, the z-axis and the lid axis can be intersecting axes, e.g., as is the case in the examples of Figs. 3 and 4A, but can also be skew axes, e.g., in particular in case of tether members of different lengths, as described further below.

Fig. 11 illustrates in a strongly schematized fashion an example of a closure 1 with tether members T1, T2 of different lengths, in a cleared position. The z-axis and the lid axis A are skew axes. The unscrewing sense of rotation (counter-clockwise) is illustrated at the z-axis and at the lid axis A. The lid axis A and the x-axis intersect in a central point of top plate portion 25. The container is merely symbolically indicated in Fig. 11, by sketching neck 41 and pointing out opening 40.

The term “projection” can, more particularly refer to the type of projection known in mathematics as parallel projection.

The closure can be a single-piece part. It can be an integrally formed part. It can be made, e.g., of high-density polyethylene (HDPE) or of polypropylene (PP) optionally plus another (polymer) material, such as for an integrated gasket (such as an in-shell molded gasket).

The closure can be a single-piece part plus a separately manufactured gasket (such as an out-shell molded gasket), e.g., the single-piece part being made of polypropylene (PP) and the gasket being made of an optionally different material.

The closure can comprise a molded part, in particular a molded polymer part, such as an HDPE part, or a PP part, or a PP part with an integrated gasket optionally made of a different material, in particular of a different polymer material.

The gaskets are also known as "liners" or as "closure liners". They can function as a seal.

Instead of HDPE mentioned above, it is also possible to use a different polymer which is less brittle than HDPE and/or which has a lower elastic modulus (Young's modulus; at room temperature) than HDPE. This way, an increased durability of the tether members can be achievable. And/or the tether members can have an increased stretchability.

E.g., said polymer can in particular be a thermoplast.

Said polymer can have an elastic modulus of, e.g., below 0.8 GPa, more particularly of below 0.6 GPa, or even of below 0.5 GPa.

Said polymer can be, e.g., medium-density polyethylene (MDPE), or can be low-density polyethylene (LDPE); it can be linear low-density polyethylene (LLDPE).

Furthermore, the closure can comprise a polymer part containing color pigments. This way, colored caps can be obtained. E.g., the above-mentioned single-piece part or integrally formed part or said molded part can comprise (or more particularly be made of) a polymer containing color pigments.

The closure can be manufactured, e.g., involving an injection molding process or a compressing molding process. Optionally, after the molding process, a cutting process may be carried out; and optionally, a separately manufactured gasket can be applied to the molded part.

An exemplary closure is illustrated, in various positions, in Figs. 1A, 1B, 2, 3, 4A, 4B, denoted 1.

The lid member can comprise an annular side wall portion which bears, on its inner face, the inner thread. It can furthermore comprise a top plate portion which connects to an upper periphery of the side wall portion. Said side wall portion can have a wall thickness (outside the inner thread) of, e.g., between 0.3 mm and 1.3 mm. In this wall thickness range, it is usually possible to achieve sufficient stability while not spending too much material. Said top plate portion can have an average thickness of, e.g., between 0.35 mm and 2.2 mm. In this top plate thickness range, it is usually possible to achieve sufficient stability while not spending too much material.

The lid member can comprise a lower periphery of the lid member which can be situated opposite an upper periphery and which can face, in the initial state, the ring member.

Exemplary lid members are illustrated in Figs. 1A, 1B, 2, 3, 4A, 4B, denoted 2. Side wall portions are denoted 26 in the Figures, and top plate portions are denoted 25.

The side wall portion can comprise a radial protrusion at the lower periphery of the lid member. This radial protrusion can improve the positional stability of the lid member in the storage position, as will be described further below.

The side wall portion can exhibit a knurling pattern. This can facilitate opening and closing the container. In particular, the knurling pattern can comprise a number of equally distanced knurls. Said number can be an integral fraction of 360, such as when the number is, e.g., one of 120, 72, 30, 60, 90. But the number does not need to be an integral fraction of 360, such as when the number is 144.

Possible knurling geometries can (simply) exhibit equally distanced knurls, as is the case for the knurling patterns known as 120, 72, 30, 60, 90, 144. But they can exhibit different patterns, e.g., with knurls arranged differently in different axial ranges, such as in case of the 24/120 knurling pattern which comprises 120 equally distanced knurls in an upper axial range close to the lower periphery of the lid member, while in a lower axial range close to the upper periphery of the lid member, two neighboring knurls from every group of five neighboring knurls do not extend from said upper axial range into said lower axial range, so as to result in 24 radial range free from knurls which are equally spaced from one another. Various other knurling patterns are possible.

The knurling pattern can be one of the knurling patterns known as 120, 24/120, 72, 30, 60, 144, 90.

The closure can have an opening torque 1 (which can be regarded as the maximum opening torque, typically occurring at the beginning of an initial opening) of, e.g., between 0.55 Nm and 2.4 Nm.

The closure can have an opening torque 2 of, e.g., between 0.22 Nm and 2.3 Nm. The opening torque 2 can be regarded as the torque required for first-time separating the ring member from the lid member (while of course letting persist the connections provided by the tether members) and thus for breaking the connecting portions, cf. below.

The closure can be, e.g., a 1-start closure having an application angle (for initially applying the closure to a neck) of between 400° and 1000° or a 2-start closure having an application angle of between 150° and 400° or a 3-start closure having an application angle of between 120° and 300°.

The inner thread can have a thread depth (which can be regarded as the maximum radial difference within the threaded region) of between 0.4 mm and 1.3 mm.

In Fig. 3, a possible embodiment of an inner thread is illustrated, denoted 21.

Figs. 1A and 1B illustrate an initial state.

In Figs. 2 and 4A, for example, exemplary upper and lower peripheries are denoted 2a and 2b, respectively.

The lid axis can in particular be an axis of rotation about which the lid member is rotatable when it is applied to an item (such as the neck of a container) having an outer thread corresponding to the inner thread of the lid member when the inner and outer threads are mutually engaged. In the initial state, the lid axis typically is identical with an axis of the closure (closure axis).

In Figs. 1A, 1B, 3, 4A, the lid axis is denoted A.

The ring member can in particular be a tamper evident band.

The ring member is meant not to be disrupted in the context of this description.

The ring member can comprise one or more second retaining features to cooperate with the at least one first retaining feature. Such second retaining features can be, e.g., flaps or cams.

An upwards pulling of the ring, in particular to higher than the at least one first retaining feature, is inhibited, though typically not made impossible, by the at least one first retaining feature. In the presence of the one or more second retaining features, this can be accomplished by cooperation of at least one first retaining feature with the one or more second retaining features.

Figs. 3 and 4B, for example, illustrate suitable second retaining features embodied as flaps, denoted 37.

In the initial state, a plurality of local, e.g., azimutally distributed, connecting portions (different from the tether members) can interconnect, in particular directly interconnect, the ring member and the lid member, the connecting portions being disrupted when first opening the container by sufficiently screwing (unscrewing; rotating pursuant an unscrewing sense of rotation) the lid member.

The connecting portions can be produced, e.g., by creating corresponding incisions and perforations, respectively. This can be accomplished, e.g., during the molding process or in a cutting process carried out after the molding process. The same applies also for the further connecting portions described below.

Further connecting portions can optionally be provided to interconnect the ring member and the lid member, respectively, with the tether members. These are also meant to break when firstly opening the container – in contrast to said interconnections provided by the tether members.

A thickness (wall thickness, radially measured, in the initial state) of the ring member can amount to, e.g., between 0.3 mm and 1.3 mm.

An exemplary ring member is denoted 3, e.g., in Figs 1A to 6.

And, for example, Figs. 5, 6, 9, 10 illustrate in a strongly schematized fashion connecting portions as white portions of a dotted line between a lid member denoted 2 and a ring member denoted 3. One is denoted 6 in Fig. 10.

Exemplary further connecting portions are very schematically illustrated in Fig. 6 as white portions of thick dashed lines, denoted 7.

In the retained position, the ring member can be rotatable about the z-axis. By virtue of the tether members, a rotating of the lid member, and in particular also a screwing of the lid member on the outer thread, can provoke a consequential rotation of the ring.

In the retained position, the ring member typically has a limited movability along the z- axis, e.g., limited towards the +z-direction by the retaining feature, and limited towards the -z-direction by another feature, such as by a support ledge of the container.

Each of the tether members can have a first end at which it connects to the ring member and a second end at which it connects to the lid member. For each of the tether members, the respective first and second ends can be opposite ends.

An example therefor is shown, e.g., in Figs. 1B and 2, where the first and second ends of first tether member T1 are denoted T1a and T1b, respectively. In Figs. 1A and 2, the first end of second tether member T2 is denoted T2a.

The first and second tether members can be defined by incisions in the lid member.

Incisions defining the tether members can be created in a molding process for molding the lid member or can be applied in a cutting process taking place after a molding process in which a precursor closure is formed which lacks the one or more incisions to be created in the cutting process.

The incisions can provide gaps in the closure. There can be two types of incisions defining the tether members, one type effecting a gap between the lid member and the tether member, the other type effecting a gap between the ring member and the tether member.

Figs. 1B, 2, 3, 4B, for example, illustrate exemplary first and second tether members, denoted T1 and T2, respectively.

The incisions can separate edges of the tether members from the ring member and from the lid member, respectively, for example as illustrated in Fig. 1B where an upper incision 5a is visible providing a gap between an upper edge of the first tether member T1 and the lid member 2, more precisely the lower periphery 2b of lid member 2. And also a lower incision 5b is visible in Fig. 1B, providing a gap between a lower edge of the first tether member T1 and the ring member 3. In Figs. 5, 6, 9, 10 incisions are drawn as thick black lines.

The tether members can be elongated parts. They can be strip-shaped parts. In the examples of Figs. 1A to 4B and 5, 6, 9, 10, this is the case.

A thickness of a tether member (which in the initial state is the extension in radial direction of the tether member) can amount to, e.g., between 0.3 mm and 1.3 mm.

A width of a tether member (perpendicular to its elongation and perpendicular to its thickness dimension) can amount to, e.g., between 0.5 mm and 5 mm.

The "being designed" of the tether members to make possible a shift-top closure can in particular or principally refer to the lengths of the tether members and to their location, such as to the relative positions of their respective first and second ends.

It can be provided that the respective first ends of the first and second tether members are distanced from one another. And it can be provided that the respective second ends of the first and second tether members are distanced from one another. In the exemplary embodiment of Figs. 1A to 4B and 5, 6, 9, 10, both is the case.

A length of the first tether member can be identical to a length of the second tether member.

The first tether member can be shaped mirror symmetrically to the second tether member. Such tether members have the same length. And the first and second tether members can furthermore be positioned mirror symmetrically with respect to an x-z-plane (the x-z-plane contains the z-axis, and the y-axis is aligned perpendicular to the x-z-plane). Such tether members will be referred to as symmetric tether members.

Said lengths of the tether members can be considered identical if the length of the first tether member amounts to between 0.9 times and 1.1 times the length of the second tether member, more particularly to between 0.95 times and 1.05 times the length of the second tether member. In other words, small differences between the lengths, such as differences due to manufacturing tolerances, may in various regards be negligible.

The tether members T1, T2 in Figs. 1A to 4B are symmetric tether members.

It can be provided that the first and second tether members are not symmetric tether members. And it can also be provided that they have different lengths. However, handling a closure in practice seems, at least at a first glance, to be facilitated if symmetric tether members or at least tether members of the same lengths are provided. This seems to be (and in various cases is) a good choice, as both tether members are equally designed, at least regarding their respective lengths. But the inventor contrived and verified that, surprisingly, providing different lengths can be advantageous over tether members of the same length.

This effect is present, however, only if the first tether member is longer than the second tether member. The other case, i.e. of the first tether member is shorter than the second tether member, apparently is less favorable and also less favorable than having tether members of the same length.The effect achievable by providing that the length of the first tether member exceeds the length of the second tether member is that the handling of the closure by a user is improved. More particularly, after unscrewing the lid member, which usually is accomplished in a counter-clockwise sense of rotation, it apparently provides a more natural feeling for a user to continue (with our without interruption), to some extent, the rotation (of the lid member, versus the neck) in the same sense of rotation while shifting the lid member. The movement by means of which the lid member can be brought into a cleared position can be perceived by a user as a more fluent movement (relative to the case of tether members of equal length).

And furthermore, the tilting of the lid member during the movement can effect that the lid axis and the container axis (z-axis) become skew axes, such that the further rotation (after unscrewing) can itself contribute to the shifting movement of the lid member. This can contribute to producing a more natural feeling for a user accomplishing the movement.

In order to accomplish the effects, the first tether member is the tether member which can be defined as the tether member which occurs before the second tether member in a scan of azimuthal positions about the z axis pursuant the unscrewing sense of rotation of said lid member starting at an azimuthal coordinate which, relative to the z axis, is located opposite to the lid member in the cleared position (e.g., in the storage position).

In another way of defining the first tether member, the first tether member is the tether member which is located at lower y-coordinates than the other (=second) tether member when the lid member in a cleared position (e.g., in the storage position) is located at positive x-coordinates, more particularly when a central point of the top plate portion has a y-coordiate of zero.

A very helpful effect achievable by introducing the described asymmetry in tether member lengths is that a user intuitively tends to shift the lid member into the suitable direction, i.e. in that direction where the longer tether member is tether member one as defined above. By moving the lid member into this suitable direction (approximately along the +x-direction as herein described), the cleared position can be reached, whereas a cleared position usually cannot be reached (without damaging the closure such as by tearing off one or more tether members) in another, approximately oppositely directed direction (wrong direction; approximately along the -x-direction as herein described). In case $L1 = L2$ or even $L1 < L2$ (L1 and L2 denoting the length of the first and second tether member, respectively), it is readily possible that a user initially has to find out by trial and error into which direction the lid member should be shifted, or the user is even encouraged to initially move the lid member into the wrong direction.

By the choice of $L1 > L2$ as described, the user can be encouraged or can even be forced to move the lid member into the suitable direction. Handling of the closure and acceptance of the closure by the user can be much improved this way.

In the examples of, e.g., Figs. 3, 4A, 4B, the tether members are named in accordance with these definitions (T1 denoting the first tether member), and this is also the case for Fig. 8 referred to in more detail further below, considering that angle $\beta 1$ is associated with the first tether member.

The described specific way of providing different lengths of tether members can be considered a second major aspect of the invention. This aspect can be combined with the first major aspect ("shift cap" closures) and with the third third major aspect ("face-down-secured" closures) described in more detail below.

Not only shift caps and more particularly their handling can be improved by the described different lengths of tether members, but also face-down-secured closures and more particularly their handling, as will be described in more detail below.

Fig. 11 illustrates in a strongly schematized fashion an example of a closure 1 with tether members T1, T2 of different lengths, in a cleared position, wherein the closure 1 of Fig. 11 is an example for a closure according to the second major aspect of the invention. The z-axis and the lid axis A are skew axes. The length L1 of the first tether member T1 exceeds by far the length of the second tether member T2 ($L1/L2 > 3$). The unscrewing sense of rotation (counter-clockwise) is illustrated at the z-axis and at the lid axis A. The lid axis A and the x-axis intersect in a central point of top plate portion 25. The container is merely symbolically indicated in Fig. 11, by sketching neck 41 and pointing out opening 40. The y-coordinates of first tether member T1 are smaller than the y-coordinates of second tether member T2, more particularly, the y-coordinates of first tether member T1 are negative, whereas the y-coordinates of second tether member T2 are positive.

A length of a tether member can be defined, e.g., as the length of a line centrally following the respective tether member from its first end to its second end. In the exemplary schematic illustrations of Figs. 5, 6, 9 and 10, the first end of first tether member T1 is symbolized by a small open circle, and the second end of first tether member T1 is symbolized by a small filled circle. The circles would be start and end positions of said line.

With L1 denoting the length of the first tether member and L2 denoting the length of the second tether member, for the closures according to the second major aspect applies $L1 > L2$.

In order to achieve a notable effect, the length difference needs to be sufficiently large. E.g., the lengths can be selected such that $L1/L2$ amounts to at least 1.2 or to at least 1.4 or even to at least 1.6. Depending on the circumstances, $L1/L2$ amounts to at least 2 or even to at least 3.0. For example, for closures of type 1881 made of HDPE, values between 3 and 6 worked out well.

Furthermore, in absolute values, L1 may exceed L2, e.g., by at least 2 mm or by at least 3 mm or even by at least 4 mm.

As will be appreciated, the concrete values of L1 and L2 will depend on the circumstaces, such as on material properties and on various dimensions of the neck and of the closure.

Of course, the closure can comprise one or more additional tether members, e.g., it can comprise four tether members.

Moving the lid member from the initial state into a cleared position can involve screwing the lid member (relative to the neck and container, respectively) and thus increasing a distance (along the z-axis) between the lid member and the ring member. Said screwing is an unscrewing, i.e. a rotating of the lid member pursuant an unscrewing sense of rotation – which usually is a counter-clockwise sense of rotation. An intermediate position should be reached in which at least one point of the lower periphery of the lid member is positioned above the opening and above the neck, respectively. To reach such a position (without flipping) is not a requirement for known flip top closures, and therefore such flip top closures can function with relatively short tether members. However, here it is suggested to reach said intermediate position and to thus provide tether members suitable therefor and to move the lid member from the intermediate position into the cleared position, while avoiding flipping, avoiding rotating the lid member by at least 90°.

Whereas reaching an intermediate position can be accomplished by means of a movement prevailingly along the +z-direction, possibly combined with a tilting of the lid member which can be small, such as below 45° or below 30°, to reach the cleared position, a considerable shifting movement (along the x-axis) is required which may be combined with a tilting of the lid member, e.g., about an axis parallel to the y-axis. The shifting movement parallel to the x-axis involved when moving the lid member from the initial state into the cleared position typically amounts to more than 0.5 times an outer diameter at the lower periphery of the lid member and can amount more particularly to more than 0.5 times an outer diameter at the lower periphery of the lid member plus a minimum height of the lid member.

In Fig. 7, half the outer diameter at the lower periphery of an exemplary lid member is denoted D/2. And a height of the lid member is denoted H_0.

The tilting movement required to reach the cleared position depends on the circumstances, but provided the tether members are suitably designed, it can be relatively small, such as below 80° or below 75° or even smaller, such as below 70° or below 65°.

The first and second tether members have to be sufficiently long and, depending on the circumstances also their relative positions (in the initial state) have to be suitably selected.

Fig. 2 shows a lid member 3 approximately in an intermediate position, as it was reachable by a large movement along the +z-direction combined with a very small shifting perpendicular to the z-axis.

Fig. 3 illustrates a lid member 3 in a cleared position, as it was reachable from the initial state by a shifting movement (along the x-axis) perpendicular to the z-axis by a value between of 0.9 and 1.2 times the outer diameter at the lower periphery of the lid member plus a tilting of the lid member of between 40° and 50°, plus the movement along the +z-direction (composed of an initial +z-directed movement and a subsequent –z-movement).

As has been described, it is suggested to move the lid member from the initial state to a cleared position while, of course, preserving the integrity of the tether members and preserving their connections to the lid member and the ring member, respectively; in other words without tearing apart one of the tether members or tearing off one of the tether members from one or both of the lid member and the ring member. And while, of course, the ring member continues to be in its retained position, e.g., the ring member is not moved past the first retaining feature. And while the tilt angle α is low, such as below 90° or even below 75°.

While in Figs. 1A, 1B, 2, 3, 4A, 4B in which the tether members T1, T2 are of the same length, the lid axis A intersects (and is in one and the same plane with) the z-axis, this needs not be the case.

The lid axis and the z-axis can be skew axes at least at some point during the movement of the lid member towards a cleared position. This can in particular be the case when the tether members are of different lengths as described for the second major aspect of the invention, more particularly when in this case a rotation of the lid member (about the lid axis) in the unscrewing sense of rotation is carried out after the lid member has been unscrewed and the lid member has been tilted with respect to the z-axis.

Elastic deformations of one or both tether members can take place, and it can also be provided that plastic deformations of one or both tether members take place. Thus, the effective length of the tether members can exceed their initial length (in the initial state). Depending on the material and on the design of the tether members, the effective length can amount to, e.g., between 1.0 times and 1.4 times or between 1.0 times and 1.2 times the initial lengths.

It can be expected that using material having a relatively low elastic modulus, such as described above, e.g., below 0.8 GPa, or MDPE or LDPE, higher ratios of effective length to initial length of a tether member can be achievable before the tether member is torn apart.

The tether members can be torsionally deformed when moving the lid member from the initial state into a cleared position. Corresponding torsions are visible, e.g., in the example of Fig. 3.

A minimum tear-off force for the tether members (which can be regarded the minumum pulling force that has to be applied between tether member and lid member or between the tether member and the ring member, so that the tether member disconnects) can be above 5 N and/or below 50 N; it can be, e.g., between 5 N and 35 N. This way, it can be ensured that the lid member remains connected to the ring member (and thus, presumably, to the container) during the intended use stage of the product (combination of container and closure), while not spending too much material.

A shift-top closure can in analogy also be described when it is not applied to a container, for example as follows:

It is also possible to describe a shift-top closure without reference to an associated container. In analogy to the above, the shift-top closure can be described as follows:

A closure for a container, comprising

— a lid member;

— a ring member;

— a first tether member and a second tether member, each providing an interconnection between the lid member and the ring member;

the lid member having

— an inner thread defining a lid axis; and

— a top inner contact surface;

the ring member defining a z-axis, the z-axis being directed to point in a +z-direction pointing from inside the ring member into the lid member, wherein in the initial state, the z-axis is identical to the lid axis, and having, in an initial state, an initial shape and having an associated reference plane aligned perpendicular to the z-axis;

the top inner contact surface having an outer diameter of d and being spaced apart from the reference plane by a length h along the z-axis;

wherein the first and second tether members are designed to allow a user to move the lid member from the initial state to a cleared position in which a projection of the lid member onto an x-y-plane perpendicular to the z-axis is free from overlap with a projection onto the x-y-plane of the a circle centrally aligned to the z-axis and having a diameter amounting to said length d, without entering with any part of the lid member a volume of a cylinder having a diameter amounting said length d which is aligned centrally to the z-axis and extends from said reference plane into the +z-direction by a height amounting to said length h, while

— maintaining an angle α enclosed between the z-axis and the lid axis of less than 90°, in particular of less than 85°;

— maintaining the interconnections between the lid member and the ring member;

— essentially maintaining said initial shape of the ring member.

The top inner contact surface faces in the initial state towards the –z-direction. It can have an annular shape.

The top inner contact surface can be a surface providing a mechanical stop for the neck when closing the container.

In cases where the top inner contact surface would be oddly shaped and creating doubt about the definition of the length h, for the determination of the length h, it can be referred to a plane aligned perpendicular to the z-axis and passing through the highest point (in +z-direction) of the top inner contact surface.

In case the closure comprises a specific gasket such as an in-shell molded or an out-shell molded gasket, in particular the gasket being made of a more easily compressible material than the lid member, the length h should be determined while the gasket is in a compressed state, such as when the gasket is compressed in a closed state in which the lid member is firmly screwed on the neck. Considering the small thickness of typical gaskets in a compressed state, it can be a good approximation for the length h (in the presence of a gasket, in particular of a separately manufactured gasket) to refer to the corresponding surface of the lid member.

Fig. 7 illustrates in a strongly schematized way a detail of a cross-section through an exemplary closure denoted 1, wherein the top inner contact surface denoted 28 is formed by the lid member denoted 2, and the respective length h is shown, too. Fig. 7

can also be interpreted to show a closure 1 comprising a separate gasket such as an out-shell molded gasket while not showing the gasket in Fig. 7 and indicating an approximate length h. In Fig. 7, the cylindrical volume is made visible by a shading. Half the diameter d is denoted d/2 in Fig. 7.

Said reference plane is defined by the ring member. It can be, e.g. a bottom plane of ring member, such as illustrated in Fig. 7, denoted R.

The initial shape of the ring member can be its shape as manufactured.

It can be provided that in the initial state, the first and second ends of the tether members are positioned such that their respective azimuthal coordinates describe the following sequence:

- the first end of the first tether member;
- the second end of the first tether member;
- the second end of the second tether member;
- the first end of the second tether member;

wherein the term azimuthal is defined with reference to the z-axis.

In other words, a sequence of azimuthal positions of locations where a tether member connects to the ring member or to the lid member, respectively, is given by Ri-Li-Li-Ri, wherein Ri denotes a location where a tether member is connected to the ring member, and Li denotes a location where a tether member is connected to the lid member. The first and second ends can have azimuthal coordinates such that azimuthally next neighbors of the first end of the first tether member are the second end of the first tether member and the first end of the second tether member.

This can be helpful for realizing a shift-top closure.

Such a tether design turned out to be particularly useful in particular when at least one of the tether members is a "straight tether", more particularly when both, the first and the scond tether members are straight tethers.

A tether member is referred to as a "straight tether" when in the initial state, azimuthal coordinates of a path along the respective tether member from its first to its second end describes a monotonic function.

The tether members T1, T2 in the example of Figs. 1A to 4B are straight tethers, and they are also designed to have the azimuthal order Ri-Li-Li-Ri as described above.

Also in Fig. 8, the first ends symbolized by a small open circle each and the second ends symbolized by a small filled circle each of the first and second tether members are pairwise arranged (Li-Li-Ri-Ri being identical to Ri-Li-Li-Ri), as described above.

Under the assumption that the first and second tether members of a closure according to Fig. 8 are straight tethers which are in the initial state aligned parallel to the x-y-plane, Fig. 8 can be interpreted as an example of symmetric tether members and thus of tether members of the same length. And if $\beta 1$ were larger than $\beta 2$, Fig. 8 would illustrate an example for the second major aspect of the invention, with $L1 > L2$.

A straight tether can be aligned, in the initial state, substantially horizontally (describing a path in the x-y-plane), as is the case, e.g., in the examples of Figs. 1 to 6.

However, tether members can also be designed differently, such as being inclined relative to the x-y-plane and/or being curved. An example of a tether member which is both is tether member T1 in Fig. 9.

Furthermore, it is also possible to provide a tether member which is not a straight tether, but a "folded tether". A tether member is a folded tether when in the initial state, azimuthal coordinates of a path along the respective tether member from its first to its second end describes a non-monotonic function.

Depending on the way of manufacturing, producing a closure comprising a folded tether can be more complicated than manufacturing a closure with straight tethers only, e.g., because more complicated incisions have to be produced. But with one or more folded tethers, it can be simpler to produce relatively long tether members. By means of folded tethers, the close link between an azimuthal distance (cf. angles β; β1, β2) between the first and the second end of a tether member and the length of the tether member existing for straight tethers is much relaxed for folded tethers.

Fig. 10 illustrates an example of a folded tether T1.

In many embodiments, the four ends of the tether members are located in a different quadrant each. More precisely, respective azimuthal positions of

- the first end of the first tether member;
- the second end of the first tether member;
- the first end of the second tether member; and
- the second end of the second tether member;

are located in a different quadrant of an x-y-plane each. The x-, y- and z-axes form a Cartesian coordinate system. In particular, the x-axis can be the bisector of an angle δ between the azimuth of the first end of the first tether member and the first end of the second tether member.

This is illustrated in Fig. 8, for example.

Such a positioning of the tether members can facilitate realizing a shift-top closure.

The inventor also invented a different way of securing a lid member to a container initially closed by the lid member. It can make possible to store the lid member relative to the container in a way that the lid member does not or only slightly disturb a user when drinking or pouring from the container. The lid member can be secured in a position referred to as storage position. The lid member can be secured by forces keeping the lid member in the storage position. And to move the lid member out of the storage position requires the application of another force counteracting the forces keeping the lid member in the storage position. Thus, the lid member can be considered stabilized in the storage position.

Furthermore, it is possible to move back the lid member from the storage position into a closed position.

And, in contrast to lid positions known from prior art, where the inside of the lid member faces upwards, in the herein described storage position, the inside of the lid member faces the container and/or faces downwards, wherein "facing downwards" of course is not limited to the lid axis being parallel to the z-axis, but to the lid axis being parallel to the z-axis within less than 90°. This can be of advantage regarding hygiene.

Accordingly, a third major aspect of the invention relates to closures we want to refer to as "face-down-secured" closures. Such a face-down-secured closure can be described in form of a combination with a container as follows:

The respective combination comprises a container and a closure, the container comprising a neck having an opening, at least one first retaining feature, and an outer thread defining a z-axis, the z-axis being directed to point in a +z-direction pointing from inside the neck through the opening towards outside the neck. Wherein the closure comprises

— a lid member;

— a ring member;

— a first tether member and a second tether member, each providing an interconnection between the lid member and the ring member;

the ring member being in a retained position in which it encompasses the neck, the at least one first retaining feature limiting movement of the ring member towards the +z-direction;

the lid member having an inner thread to cooperate with the outer thread and defining a lid axis which in an initial state is identical to the z-axis;

the container or the ring member comprising at least one stop feature;

wherein the first and second tether members are designed to allow a user to move the lid member from the initial state to a storage position in which

— the interconnections between the lid member and the ring member are maintained;

— the lid member is pulled against the at least one stop feature by forces exerted on the lid member by the tether members;

while the ring member remains in the retained position.

The possibility to store the lid member in a storage position as described can provide good, free access to the opening of the container. And due to the forces pulling the lid member against the at least one stop feature, the lid member can be stabilized (relative to the container) in the storage position, e.g., such that the lid member remains in the storage position during normal use and movement of the container, unless the user applies forces to the lid member, such as by pulling, to move the lid member out of the storage position, e.g., to move the lid member back into a closed position.

The properties of the container and of the closure described herein for a shift-top closure can as well apply for a face-down-secured closure and for a closure according to the second major aspect of the invention and thus need not be repeated here.

Figs. 4A and 4B show an example of a lid member 2 in a storage position as described.

Further, it can be provided that (already) during moving the lid member from the initial state into the storage position,

— the interconnections between the lid member and the ring member are maintained; and

— the ring member remains in the retained position.

The at least one stop feature provides a mechanical stop for the lid member in the storage position, in particular against a movement in the +z-direction.

The at least one stop feature can comprise, e.g., a protrusion of the neck.

The at least one stop feature can be, e.g. a support ledge of the container. Many containers comprise a support ledge anyway, such that the support ledge can fulfill an additional function.

Figs. 4A and 4B illustrate an example where the at least one stop feature is a circular, rotationally symmetric protrusion of the neck denoted 41 and which furthermore is support ledge denoted 45 of the container denoted 4.

The at least one stop feature can be a portion of the ring member. For example, it can be a bottom portion or a bottom edge of the ring member. This can be of advantage, e.g., if the container comprises no support ledge.

The at least one stop feature can be, e.g., circular. It can be a rotationally symmetric about the z-axis; common support ledges and many known ring members have these properties. This way, a user does not have to find a particular rotational position for moving the lid member into the storage position.

The at least one stop feature can be located below the outer thread (with the lid member in the storage position). And it can be located below the retaining feature.

And, e.g., where the at least one stop feature is comprised in the container, it can be located below the ring member and/or below a bottom portion or a bottom edge of the ring member.

In the example of Figs. 4A, 4B, but not limited thereto, the stop feature denoted 45 is located below a lower portion of the ring member denoted 3 which is located below the retaining feature denoted 47 which is located below the outer thread denoted 42.

The at least one stop feature can be comprised in the outer thread of the neck. In particular, the at least one stop feature can comprise and more particularly be a ridge of the outer thread. This can be of advantage, e.g., if the container comprises no support ledge.

The forces mentioned above, stabilizing the lid member in the storage position, can more specifically be forces having a component directed in the +z-direction.

The forces can comprise a component directed in the –x-direction.

More particularly, they can comprise both, a component directed in the +z-direction and a component directed in the –x-direction.

The forces can comprise pulling forces.

The forces can comprise, and in particular even be, forces exerted by the tether members due to elastic deformation of the tether members. They can, in this regard, comprise elasticity forces, e.g., occurring due to stretching and/or bending, e.g., torsionally deforming the tether members.

For example, a user can elastically deform the tether members (or at least one of them) to move the lid member into the storage position, and thus store energy, more particularly deformation energy, in the tether members or more particularly in their elastic deformation. In order to move the lid member out of the storage position, force and energy have to be applied to the lid member, and the energy previously stored in the tether members or more particularly in their elastic deformation can thereby be set free again.

The elastic deformations of the tether members can be due to, e.g., stretching and/or to bending the tether members.

For example, the tether members can be torsionally deformed when moving the lid member from the initial state into the storage position.

Corresponding torsions are visible, e.g., in the example of Figs. 4A, 4B.

As has been mentioned before, it can be of advantage to combine the second and third major aspects of the invention. More particularly, it turns out to be easier to move the lid member into the storage position when L1 > L2. This may be due to rotating the lid member in the unscrewing sense of rotation after having reached a cleared position or, more particularly, while stretching one or both tether members. An increased stretchability of the first tether member (relative to the case of L1 = L2) may possibly also contribute to some extent to a simpler reaching of the storage position (with L1 > L2).

It is possible that the movement to be carried out by the user in order to move the lid member into the storage position is perceived by the user as a more natural movement, e.g., as a more fluent movement and/or as requiring less force, in particular less force for elastically deforming at least one tether member.

Also the fact that the user is intuitively encouraged by the described tether length asymmetry to vary or play with the alignment of the lid axis can contribute to a simplified reaching of the storage position, thus varying both, the tilt angle α and the distance between the lid axis and the z-axis.

As has been described above, also the provision of materials having a relatively low elastic modulus (cf. above for details) can contribute to simplifying moving the lid member into the storage position, as an increased stretchability and a decreased tendency to rupture of the tether members can be achievable.

Typically, in the storage position, the lid member is acted on at at least three contact regions:

- at a first contact region where the second end of the first tether member connects to the lid member;
- at a second contact region where the second end of the second tether member connects to the lid member; and

— at a third contact region where the lid member, such as more particularly the side wall portion, abuts agains the at least one stop feature.

The third contact region can be located essentially in the x-z-plane, particularly for symmetric tethers.

Exemplary third contact regions are visible in Figs. 4A, 4B, denoted 8.

With tether members of the same length (L1 = L2), the third contact region is located approximately at a middle position along a circumference of the lid member between the second ends of the first and second tether members.

However, with tether members according to the second major aspect of the invention and thus with L1 > L2, the third contact region is located at position along a circumference of the lid member which is closer to the second end of the first tether member than to the second end of the second tether member.

There can be an additional, fourth contact region. In such a fourth contact region, the lid member can abut the container, in parcticular, the lower periphery of the lid member can abut the container in the fourth contact region.

Having a fourth contact region can provide additional stability for the lid member in the storage position.

The fourth contact region can be located essentially in the x-z-plane, particularly for symmetric tethers.

The fourth contact region can be located below the third contact region, i.e. at lower z-coordinates.

The third and fourth contact regions can be located opposite to one another in regard of the lid axis.

An exemplary fourth contact region showing these features is visible in Fig. 4B, denoted 9.

As has been mentioned above already, the side wall portion of the lid member can comprise a radial protrusion at the lower periphery of the lid member, in particular for improving the positional stability of the lid member in the storage position.

The radial protrusion can be present in a circumferential range along the circumference of the lid member which includes the circumferential range between the circumferential position of the second end of the first tether member and the circumferential position of the second end of the second tether member. Said circumferential range can be facing the container in the storage position (and in the cleared position).

For example, the radial protrusion can be an annular protrusion, thus extending along the full circumference of the lid member. It can be, in particular, rotationally symmetric or, if the radial protrusion exhibits a knurling pattern, rotationally symmetric except for the knurling pattern.

The radial protrusion can comprise an abutting surface to abut the stop feature in the storage position.

In particular, the abutting surface can be angled with respect to a normal of the lid axis.

Furthermore, the abutting surface may be angled with respect to the lid axis.

E.g., the abutting surface can generally face along the lid axis, which means that its surface normals have a component parallel to (and not anti-parallel to) the lid axis.

The abutting surface can, in the storage position, abut the stop feature at a counter-surface of the stop feature which generally faces along the -z-axis, which means that its surface normals have a component antiparallel to (and not parallel to) the z-axis.

Fig. 12 illustrates, in a strongly schematized fashion, an example of a lid member 2 comprising, at its lower periphery 2b, a radial protrusion 24 which is annular and comprises an abutting surface 24a abutting a stop feature 45 (drawn by dashed lines) while in the storage position.

The lower periphery of the lid member may furthermore lie in one plane, with the (only) exception of the locations of the second ends of the tether members. In particular, said plane can be perpendicular to the lid axis. This can effect a more agreeable handling of the lid member for a user, and it can also provide a visual impression to the user which is close to the impression gained from conventional, tether-free lid members.

Fig. 11 illustrates an example of a lid member 2 having a lower periphery 2b lying in one plane which is aligned perpendicular to the lid axis A.

Also Fig. 12 illustrates an example of a lid member 2 having a lower periphery 2b lying in one plane which is aligned perpendicular to the lid axis A.

Various geometries of the radial protrusion and of its abutting surface are possible.

In the storage position, the inside of the lid member can benefit from some degree of protection from dust and debris.

The lid member can comprise a top plate portion having an outer face facing, in the initial state into the +z –direction and opposite thereto an inner face facing, in the initial state into the -z –direction, and in the storage position, the inner face of the top plate portion can face the container, in particular be opposing the container.

It depends, among others, on the shape of the container how large the tilt angle α is in the storage position. However, typically, angle α is smaller than 90° (i.e. the inner face faces downward) or at least smaller than 85°. In many cases, angle α can be smaller than 80°. And furthermore, angle α usually is larger than 20° and more particularly larger than 30°. In many cases, angle α is larger than 40°. Tilt angles angle α thus are frequently between 30° and 80°. All this in contrast to common flip-top closures where the corresponding angle of rotation exceeds and often by far exceeds 90°.

In the inset on the bottom left side of Fig. 4A, an exemplary angle α is shown.

A closure can (but need not) be both, a shift-top closure and a face-down-secured closure. Thus, features defining the one and the other can – optionally – be combined.

Such a closure has advantages regarding hygiene, at least compared to known flip-top closures, where the inside of the lid member shows upwards, and also to losable (non-tethered) closures where the lid member and in particular its inside can easily get in contact with unsuitable material such as dust and dirt.

And a shift-top closure and a face-down-secured closure and closures being both, a shift-top closure and a face-down-secured closure, can be closures according to the second major aspect of the invention (specific way of providing different lengths of tether members), such the respective features describing them can – optionally – be combined.

Various tests have been conducted with various common closure types, such as for closure types for neck finishes known as 1881, 1810, 38 mm, 29/25. It was possible to extract some Conditions in form of formulas based thereon and on simplifying theoretical, geometrical considerations which reflect quite well the reality.

Each of the Conditions relating to shift-top closures can apply in combination with the above description of a shift-top closure regarding the movement from the initial to the cleared position or as an alternative thereto, so as to provide an independent way of describing a shift-top closure.

The Conditions involve one or more of the following magnitudes:

- t: average length of the tether members in the inial state, i.e. $t = 0.5 * (t1+t2)$ with t1 and t2, respectively, denoting the length of the first and second tether members, respectively, in the inial state;

- t': stretched average length of tether members; exceeding t because of deformations (elastic and plastic). Depending on the circumstances, t' amounts to, e.g., between t and 1.4 t or to between t and 1.3 t, or to between t and 1.2 t. And analogously $t' = t1'+t2'$, with t1' and t2' denoting a stretched lengths of the first and second tether members, respectively;

- height H: roughly the height by which the lid member (or a portion thereof) has to be lifted (moved in the +z-direction) to be above the top of the neck; more precisely: difference in z-coordinate of the top inner contact surface and the lower periphery of the lid member. In cases where the top inner contact surface would be oddly shaped and creating doubt about the definition of the height H, for the determination of the height H, it can be referred to a plane aligned perpendicular to the z-axis and passing through the highest point (in +z-direction) of the top inner contact surface (in case a gasket would form the top inner contact surface, the determination of height H should be made when the gasket is in a compressed state, as explained before, or, as a good approximation, without the gasket). And in cases where the lower periphery of the lid member would be oddly shaped and creating doubt about the definition of the height H, for the determination of the height H, it can be referred to that point at the lower periphery of the lid member which is located on the -x-axis (essentially opposite to the shifting movement). Schematic illustration Fig. 7 depicts an exemplary height H.

- D: outer diameter of the lid member at the lower periphery of the lid member. In Fig. 7 an exemplary diameter D (actually D/2) is illustrated.

- angle δ: azimuthal angle (in radiant) as defined above;

- angle γ: azimuthal angle (in radiant) as defined above;

- angle β: azimuthal angle (in radiant) as defined above;

- angles $\beta 1$, $\beta 2$: azimuthal angles (in radiant) as defined above;

In Fig. 8, an example of the angles δ, γ, $\beta 1$, and $\beta 2$ is illustrated.

A first condition (Condition 1) is related to enablement of shift-top closures and is more closely related to ensure that angle γ is large enough for letting the tether members pass the neck when or before shifting – without having to stretch the tether members too strongly.

$c1 < 3$ mm, with (Condition 1)

$$c1 = 0.5\ H * [1 - \sin(\gamma/2)]$$

c1 is a constant which depends on various properties of the closure, such as on the elastic properties of the closure material, on the geometry of the tether members such as on their widths and thicknesses.

Depending on the circumstanes, $c1 < 2.5$ mm applies or even $c1 < 2$ mm applies. With $c1 < 1.8$ mm, angle γ probably is large enough even for unusual closure geometries.

A second condition (Condition 2) is related to enablement of shift-top closures and is more closely related to ensure that the tether members are long enough for letting them pass the neck when or before shifting – without having to stretch the tether members too strongly.

$$c2 < 1.4, \quad \text{with} \qquad \text{(Condition 2)}$$

$$c2 = [H^2 / (D^2 * \sin^2(\beta/2) + 1)]^{0.5}$$

c2 is a constant which depends on various properties of the closure, such as on the elastic properties of the closure material, on the geometry of the tether members such as on their widths and thicknesses.

Depending on the circumstances, $c2 < 1.4$ applies, or $c2 < 1.3$ applies or even $c2 < 1.2$ applies. With $c2 < 1.1$, the tether members are probably long enough even for unusual closure geometries.

For $\beta1 \neq \beta2$, the formula of Condition 2 translates as follows:

$$c2 = [H^2 / (D^2 * \sin^2(0.25\beta1 + 0.25\beta2) + 1)]^{0.5}$$

as β is replaced by $0.5*(\beta1+\beta2)$.

The above versions of Condition 2 apply best for straight tethers and particularly well in cases where the tether members extend essentially in a plane perpendicular to the z-axis. In case of folded tethers, however, the tether lengths are not closely linked to the angles β and $\beta1$, $\beta2$, respectively. Therefore, another version of Condition 2 is required, namely one which applies for straight tethers as well as for folded tethers, and that version reads as follows:

$t' > [H^2 + (D * \sin(\beta/2))^2]^{0.5}$

And when a design is selected such that the tether members are long enough already without stretching them, Condition 2 reads

$t > [H^2 + (D * \sin(\beta/2))^2]^{0.5}$

If β is replaced by 0.5*(β1+β2), a version of Condition 2 is obtained which also applies for $\beta 1 \neq \beta 2$.

It can facilitate operating the closure if both, Condition 1 and Condition 2 are fulfilled.

A third condition (Condition 3) has been worked out which is related to enablement of face-down-secured closures and is more closely related to ensure (i) that the lengths of the tether members is long enough to reach the envisaged storage position and (ii) that the lengths of the tether members are short enough to effect the forces exerted by the tether members which stabilize the lid member in the storage position, such as to effect forces pulling the lid member against the at least one stop feature.

$$60 \text{ mm} < c3 < 95 \text{ mm}, \quad \text{with} \qquad \text{(Condition 3)}$$

$$c3 = D * \beta / [2 - \cos(\delta/2) - \cos(\gamma/2)]$$

c3 is a constant which depends on various properties of the closure, such as on the elastic properties of the closure material, on the geometry of the tether members such as on their widths and thicknesses, on the pulling force required for keeping the lid member in the storage position.

Depending on the circumstanes, 65 mm < c3 < 90 mm applies or even 70 mm < c3 < 88 mm applies. With c3 = 80 mm ±7 mm, likelihood is high that the lid member can be successfully held in the storage position even for somewhat unusual closure geometries.

For $\beta 1 \neq \beta 2$, β merely needs to be replaced by 0.5*(β1+β2).

The Conditions relating to face-down-secured closures can apply in combination with the above description of face-down-secured closure regarding the movement from the initial to the storage position or as an alternative thereto, so as to provide an independent way of describing a face-down-secured closure.

Each of the above Conditions can apply in combination with one another and/or with the above description of shift-top closures and face-down-secured closures regarding the respective movements.

The closure can have a T-diameter of between 15 mm and 55 mm, more particularly of between 22 mm and 49 mm. The T-diameter can be regarded as the inner diameter of the lid member in the range of the inner thread, but under the assumption that there is no inner thread, i.e. that there is no ridge of the inner thread.

The closure can be a closure for a neck of one of the following types and for one of the following neck finishes, respectively: 1881, 1810, 29/25, 33 mm, 37 mm, 43 mm, 48 mm, 30/25, 27 mm, 26/22, 25/22. These are well-known and are susceptible to application of the instant invention.

Furthermore, methods for operating a closure applied to a container are described, which of course can have any of the features described for the closure itself and/or for the combination of a closure and a container.

A first method concerns shift-top closures, a second method concerns face-down-secured closures. Of course, both methods can be extended to describe handling of closures which are both, a shift-top closure and a face-down-secured closure. And in addition, the closure may optionally be a closure according to the second major aspect of the invention.

The first method is a method for operating a closure applied to a container, wherein the container comprises a neck having an opening, at least one first retaining feature, and an outer thread defining a z-axis, the z-axis being directed to point in a +z-direction pointing from inside the neck through the opening towards outside the neck, and wherein the closure comprises

— a lid member;

— a ring member;

— a first tether member and a second tether member, each providing an interconnection between the lid member and the ring member.

The lid member has an inner thread to cooperate with the outer thread and defining a lid axis which in an initial state is identical to the z-axis.

The method comprises transferring the lid member from the initial state to a cleared position in which a projection of the lid member onto an x-y-plane perpendicular to the z-axis is free from overlap with a projection of the opening onto the x-y-plane.

And the transferring comprises

a) rotating the lid member about the z-axis to increase, by virtue of cooperation of the inner and outer threads, a distance along the z-axis between the ring member and the lid member;

b) carrying out a movement of the lid member comprising a shifting of the lid member in the +x-direction.

And during the transferring

— an angle α enclosed between the z-axis and the lid axis of less than 90°, in particular of less than 85°, is maintained;

— the interconnections between the lid member and the ring member are maintained;

— the ring member remains in a retained position in which it encompasses the neck, the at least one first retaining feature limiting movement of the ring member towards the +z-direction.

Step b) can be carried out subsequently to step a).

Step a) can effect a disrupting of connecting portions interconnecting in the initial state the ring member and the lid member. Thus, step a) can effect to open a seal between ring member and lid member.

More specifically, the rotating (cf. step a)) can be a rotating of the lid member relative to the container.

During the rotating (cf. step a)), the ring member can remain being held at the neck, typically in a rotatable fashion, rotatable about the z-axis.

The rotating (cf. step a)) can be carried out, until the inner thread of the lid member and the outer thread of the container are not mutually engaged anymore, i.e. until they are disengaged.

The method can comprise to terminate a mutual engagement of the inner and outer threads.

Step b) can comprise elastically and/or plastically deforming the first and second tether members.

Furthermore, it can be provided that the movement mentioned in step b) comprises a rotation of the lid member about the lid axis in the unscrewing sense of rotation. Said rotation can be carried out after the rotating mentioned in step a).

Said rotation can overlap in time with the shifting mentioned in step b).

Said rotation can take place while the lid axis is aligned such that the lid axis and the z-axis are skew axes (i.e. they do not intersect).

It can be provided that said rotation contributes to the shifting mentioned in step b); in particular, therein, the lid axis and the z-axis can be skew axes.

Said rotation can in particular be provided in combination with the second major aspect of the invention, i.e. with tether members having different lengths as described above.

The second method is a method for operating a closure applied to a container, wherein the container comprises a neck having an opening, at least one first retaining feature, and an outer thread defining a z-axis, the z-axis being directed to point in a +z-direction pointing from inside the neck through the opening towards outside the neck. And wherein the closure comprises

— a lid member;

— a ring member;

— a first tether member and a second tether member, each providing an interconnection between the lid member and the ring member.

And the lid member has an inner thread to cooperate with the outer thread and defining a lid axis which in an initial state is identical to the z-axis.

The container or the ring member comprises at least one stop feature.

And the method comprises transferring the lid member from the initial state to a storage position, wherein the transferring comprises

A) rotating the lid member about the z-axis to increase, by virtue of cooperation of the inner and outer threads, a distance along the z-axis between the ring member and the lid member;

B) carrying out a movement of the lid member comprising a shifting of the lid member in the +x-direction and, optionally also in the –z-direction;

C) applying a force to the lid member for enabling the lid member to reach the storage position;

D) discontinuing applying said force to enable forces exerted on the lid member by the tether members to pull the lid member against the at least one stop feature.

Wherein in the storage position

— the interconnections between the lid member and the ring member are maintained;

— the lid member is pulled against the at least one stop feature by forces exerted on the lid member by the tether members;

while the ring member remains in a retained position in which it encompasses the neck, the at least one first retaining feature limiting movement of the ring member towards the +z-direction.

And wherein during the transferring

— the interconnections between the lid member and the ring member are maintained;

— the ring member remains in the retained position.

Step B) can be carried out subsequently to step A).

Step A) can effect a disrupting of connecting portions interconnecting in the initial state the ring member and the lid member. Thus, step A) can effect to open a seal between ring member and lid member.

More specifically, the rotating (cf. step A)) can be a rotating of the lid member relative to the container.

During the rotating (cf. step A)), the ring member can remain being held at the neck, typically in a rotatable fashion, rotatable about the z-axis.

The rotating (cf. step A)) can be carried out, until the inner thread of the lid member and the outer thread of the container are not mutually engaged anymore, i.e. until they are disengaged.

The method can comprise to terminate a mutual engagement of the inner and outer threads.

Step B) can comprise elastically and/or plastically deforming the first and second tether members.

In step B), the lid member can be positioned in a cleared position. It can be positioned beside the neck.

Step B) can be carried out to effect that the lid member is thereby effectively moved further into the +x-direction and further into the –z-direction, and in particular into a position in which the lid member has a higher x-coordinate and a lower z-coordinate than it has in a position reached by and at the end of step A).

The transferring can include a tilting of the lid member, in particular a tilting about an axis essentially parallel to the y-axis.

It can be provided that during the transferring an angle α enclosed between the z-axis and the lid axis of less than 90°, in particular of less than 85°, is maintained.

Step C) can result in elastically and/or plastically deforming one or both of the first and second tether members. It can in particular result in stretching one or both of the first and second tether members.

Furthermore, it can be provided that the movement mentioned in step B) comprises a first rotation and/or a second rotation of the lid member about the lid axis in the unscrewing sense of rotation. Said first and second rotations can be carried out after the rotating mentioned in step A).

Said first and second rotations can in particular be provided in combination with the second major aspect of the invention, i.e. with tether members having different lengths as described above.

Said first rotation can overlap in time with the shifting mentioned in step B).

Said first rotation can take place while the lid axis is aligned such that the lid axis and the z-axis are skew axes (i.e. they do not intersect).

It can be provided that said first rotation contributes to the shifting mentioned in step b); in particular, therein, the lid axis and the z-axis can be skew axes.

Said second rotation can overlap in time with the applying a force mentioned in step C).

It can be provided that the applying a force mentioned in step C) is accomplished, at least in part, by carrying out said second rotation. E.g., the second rotation can contribute to a stretching of one or both of the first and second tether members.In another view, the invention relates to a method of manufacturing a closure of the herein described kind using a molding process. The molding process can be, e.g., injection molding or compression molding. The manufacturing can optionally include subsequently carrying out a cutting process, such as for incisions as described above.

Even though the above has been described referring to threaded caps (to be applied to threaded necks), it is also possible to apply the described ideas to unthreaded caps (to be usually applied to unthreaded necks), e.g., to snap-on closures comprising a snap-on lid member to be applied to a snap-on neck by snapping on the lid member on the neck.

It is evident from the above how the first major aspect applies to snap-on closures, as is the case for the third major aspect. Regarding the second major aspect, the special effect thereof may be lost, at least in part, as there is no previous unscrewing rotation of the lid member. The case $L1 = L2$ may work similarly well for a user as the case $L1 > L2$.

Further possible features and embodiments of the various methods emerge from the instant description.

Further embodiments and advantages emerge from the description and the enclosed figures and from the claims.

Patent Claims:

1. A combination comprising a container and a closure, the container comprising a neck having an opening, at least one first retaining feature, and an outer thread defining a z-axis, the z-axis being directed to point in a +z-direction pointing from inside the neck through the opening towards outside the neck, the closure comprising

— a lid member;

— a ring member;

— a first tether member and a second tether member, each providing an interconnection between the lid member and the ring member;

the ring member being in a retained position in which it encompasses the neck, the at least one first retaining feature limiting movement of the ring member towards the +z-direction;

the lid member having an inner thread to cooperate with the outer thread and defining a lid axis which in an initial state is identical to the z-axis;

wherein the first and second tether members are designed to allow a user to move the lid member from the initial state to a cleared position in which a projection of the lid member onto an x-y-plane perpendicular to the z-axis is free from overlap with a projection of the opening onto the x-y-plane, while

— maintaining an angle α enclosed between the z-axis and the lid axis of less than 90°, in particular of less than 85°;

— maintaining the interconnections between the lid member and the ring member;

— the ring member remains in the retained position;

in particular wherein the first tether member occurs before the second tether member in a scan of azimuthal positions about the z-axis pursuant an unscrewing sense of rotation of said lid member starting at an azimuthal coordinate which, relative to the z-axis, is located opposite to the lid member in the cleared position, and wherein the first tether member is at least as long as the second tether member, and more particularly is longer than the second tether member.

2. The combination according to claim 1, wherein each of the tether members has a first end at which it connects to the ring member and a second end at which it connects to the lid member, wherein in the initial state the first and second ends are positioned such that their respective azimuthal coordinates describe the following sequence:

— the first end of the first tether member;

— the second end of the first tether member;

— the second end of the second tether member;

— the first end of the second tether member;

wherein the term azimuthal is defined with reference to the z-axis.

3. The combination according to claim 1 or claim 2, wherein the first and second tether members are designed such in the initial state, azimuthal coordinates of a path along the respective tether member from its first to its second end describes a monotonic function.

4. The combination according to claim 1 or claim 2, wherein the first and second tether members are designed such in the initial state, azimuthal coordinates of a path along the respective tether member from its first to its second end describes a non-monotonic function.

5. The combination according to one of claims 1 to 4, wherein respective azimuthal positions of

— the first end of the first tether member;

— the second end of the first tether member;

— the first end of the second tether member; and

— the second end of the second tether member;

are located in a different quadrant of an x-y-plane each; an x-axis, an y-axis and the z-axis forming a cartesian coordinate system.

6. The combination according to one of claims 1 to 5, wherein the following applies:

$$c1 < 3 \text{ mm}, \quad \text{with}$$

$$c1 = 0.5\, H * [1 - \sin(\gamma/2)],$$

wherein

- H denotes a difference in z-coordinate of a top inner contact surface of the lid member and the lower periphery of the lid member; and

- γ denotes an azimuthal angle present, in the initial state, between the second end of the first tether member and the second end of the second tether member;

in particular wherein c1 < 2 mm applies.

7. The combination according to one of claims 1 to 6, wherein the following applies:

$$1.4 * t > [H^2 + (D * \sin(0.25\beta 1 + 0.25\beta 2))^2]^{0.5}$$

in particular

$$1.1 * t > [H^2 + (D * \sin(0.25\beta 1 + 0.25\beta 2))^2]^{0.5}$$

wherein

- t denotes half the sum of the length of the first tether member and the length of the second tether member in the initial state;

- H denotes a difference in z-coordinate of a top inner contact surface of the lid member and the lower periphery of the lid member;

- D denotes an outer diameter of the lid member at the lower periphery of the lid member;

- $\beta 1$ denotes an azimuthal angle present, in the initial state, between the first end and the second end of the first tether member; and

- $\beta 2$ denotes an azimuthal angle present, in the initial state, between the first end and the second end of the second tether member.

8. The combination according to one of claims 1 to 7, wherein the following applies:

$$c2 < 1.4, \quad \text{with}$$

$$c2 = [H^2 / (D^2 * \sin^2(0.25\beta 1 + 0.25\beta 2) + 1)]^{0.5}$$

wherein

- H denotes a difference in z-coordinate of a top inner contact surface of the lid member and the lower periphery of the lid member;

- D denotes an outer diameter of the lid member at the lower periphery of the lid member;

- $\beta 1$ denotes an azimuthal angle present, in the initial state, between the first end and the second end of the first tether member; and

- $\beta 2$ denotes an azimuthal angle present, in the initial state, between the first end and the second end of the second tether member;

in particular wherein $c2 < 1.2$ applies.

9. The combination according to one of claims 1 to 8, the container or the ring member comprises at least one stop feature. and wherein the first and second tether members are designed to allow a user to move the lid member from the initial state to a storage position in which

— the interconnections between the lid member and the ring member are maintained;

— the lid member is pulled against the at least one stop feature by forces exerted by the tether members on the lid member;

while the ring member remains in the retained position.

10. The combination according to one of claims 1 to 9, wherein the following applies:

$$60 \text{ mm} < c3 < 95 \text{ mm}, \quad \text{with}$$

$$c3 = 0.5 D * (\beta 1+\beta 2) / [2 - \cos(\delta/2) - \cos(\gamma/2)]$$

wherein

- D denotes an outer diameter of the lid member at a lower periphery of the lid member;

- $\beta 1$ denotes an azimuthal angle in radiant present, in the initial state, between the first end and the second end of the first tether member; and

- $\beta2$ denotes an azimuthal angle in radiant present, in the initial state, between the first end and the second end of the second tether member;

- δ denotes an azimuthal angle present, in the initial state, between the first end of the first tether member and the first end of the second tether member;

- γ denotes an azimuthal angle present, in the initial state, between the second end of the first tether member and the second end of the second tether member;

in particular wherein 70 mm < c3 < 88 mm applies.

11. A method for operating a closure applied to a container, wherein the container comprises a neck having an opening, at least one first retaining feature, and an outer thread defining a z-axis, the z-axis being directed to point in a +z-direction pointing from inside the neck through the opening towards outside the neck, and

wherein the closure comprises

— a lid member;

— a ring member;

— a first tether member and a second tether member, each providing an interconnection between the lid member and the ring member;

the lid member having an inner thread to cooperate with the outer thread and defining a lid axis which in an initial state is identical to the z-axis;

the method comprising transferring the lid member from the initial state to a cleared position in which a projection of the lid member onto an x-y-plane perpendicular to the z-axis is free from overlap with a projection of the opening onto the x-y-plane,

the transferring comprising

a) rotating the lid member about the z-axis to increase, by virtue of cooperation of the inner and outer threads, a distance along the z-axis between the ring member and the lid member;

b) carrying out a movement of the lid member comprising a shifting of the lid member in the +x-direction;

wherein during the transferring

— an angle α enclosed between the z-axis and the lid axis of less than 90°, in particular of less than 85°, is maintained;

— the interconnections between the lid member and the ring member are maintained;

— the ring member remains in a retained position in which it encompasses the neck, the at least one first retaining feature limiting movement of the ring member towards the +z-direction.

12. A closure for a container, comprising

— a lid member;

— a ring member;

— a first tether member and a second tether member, each providing an interconnection between the lid member and the ring member;

the lid member having

— an inner thread defining a lid axis; and

— a top inner contact surface;

the ring member defining a z-axis, the z-axis being directed to point in a +z-direction pointing from inside the ring member into the lid member, wherein in the initial state, the z-axis is identical to the lid axis, and having, in an initial state, an initial shape and having an associated reference plane aligned perpendicular to the z-axis;

the top inner contact surface having an outer diameter of d and being spaced apart from the reference plane by a length h along the z-axis;

wherein the first and second tether members are designed to allow a user to move the lid member from the initial state to a cleared position in which a projection of the lid member onto an x-y-plane perpendicular to the z-axis is free from overlap with a projection onto the x-y-plane of the a circle centrally aligned to the z-axis and having a diameter amounting to said length d, without entering with any part of the lid member a volume of a cylinder having a diameter amounting said length d which is aligned centrally to the z-axis and extends from said reference plane into the +z-direction by a height amounting to said length h, while

- maintaining an angle α enclosed between the z-axis and the lid axis of less than 90°, in particular of less than 85°;
- maintaining the interconnections between the lid member and the ring member;
- essentially maintaining said initial shape of the ring member;

in particular wherein the first tether member is located at lower y-coordinates than the second tether member when the lid member in the cleared position is located at positive x-coordinates, and wherein the first tether member is at least as long as the second tether member, and more particularly is longer than the second tether member.

13. The closure according to claim 12, wherein each of the tether members has a first end at which it connects to the ring member and a second end at which it connects to the lid member, wherein in the initial state the first and second ends are positioned such that their respective azimuthal coordinates describe the following sequence:

- the first end of the first tether member;

— the second end of the first tether member;

— the second end of the second tether member;

— the first end of the second tether member;

wherein the term azimuthal is defined with reference to the z-axis.

14. The closure according to claim 12 or claim 13, wherein the first and second tether members are designed such in the initial state, azimuthal coordinates of a path along the respective tether member from its first to its second end describes a monotonic function.

15. The combination according to claim 12 or claim 13, wherein the first and second tether members are designed such in the initial state, azimuthal coordinates of a path along the respective tether member from its first to its second end describes a non-monotonic function.

16. The closure according to one of claims 12 to 15, wherein respective azimuthal positions of

— the first end of the first tether member;

— the second end of the first tether member;

— the first end of the second tether member; and

— the second end of the second tether member;

are located in a different quadrant of an x-y-plane each; an x-axis, an y-axis and the z-axis forming a cartesian coordinate system.

17. The closure according to one of claims 12 to 16, wherein the following applies:

$c1 < 3$ mm, with

$c1 = 0.5 H * [1 - \sin(\gamma/2)]$,

wherein

- H denotes a difference in z-coordinate of a top inner contact surface of the lid member and the lower periphery of the lid member; and

- γ denotes an azimuthal angle present, in the initial state, between the second end of the first tether member and the second end of the second tether member;

in particular wherein $c1 < 2$ mm applies.

18. The closure according to one of claims 12 to 17, wherein the following applies:

$$1.4 * t > [H^2 + (D * \sin(0.25\beta1 + 0.25\beta2))^2]^{0.5}$$

in particular

$$1.1 * t > [H^2 + (D * \sin(0.25\beta1 + 0.25\beta2))^2]^{0.5}$$

wherein

- t denotes half the sum of the length of the first tether member and the length of the second tether member in the initial state;

- H denotes a difference in z-coordinate of a top inner contact surface of the lid member and the lower periphery of the lid member;

- D denotes an outer diameter of the lid member at the lower periphery of the lid member;

- $\beta 1$ denotes an azimuthal angle present, in the initial state, between the first end and the second end of the first tether member; and

- $\beta 2$ denotes an azimuthal angle present, in the initial state, between the first end and the second end of the second tether member.

19. The closure according to one of claims 12 to 18, wherein the following applies:

$c2 < 1.4$, with

$$c2 = [H^2 / (D^2 * \sin^2(0.25\beta 1 + 0.25\beta 2) + 1)]^{0.5}$$

wherein

- H denotes a difference in z-coordinate of a top inner contact surface of the lid member and the lower periphery of the lid member;

- D denotes an outer diameter of the lid member at the lower periphery of the lid member;

- $\beta 1$ denotes an azimuthal angle present, in the initial state, between the first end and the second end of the first tether member; and

- $\beta 2$ denotes an azimuthal angle present, in the initial state, between the first end and the second end of the second tether member;

in particular wherein $c2 < 1.2$ applies.

20. The closure according to one of claims 12 to 19, wherein the following applies:

$60\ mm < c3 < 95\ mm$, with

$$c3 = 0.5\ D * (\beta 1+\beta 2) / [2 - \cos(\delta/2) - \cos(\gamma/2)]$$

wherein

- D denotes an outer diameter of the lid member at the lower periphery of the lid member;

- $\beta 1$ denotes an azimuthal angle in radiant present, in the initial state, between the first end and the second end of the first tether member; and

- $\beta 2$ denotes an azimuthal angle in radiant present, in the initial state, between the first end and the second end of the second tether member;

- δ denotes an azimuthal angle present, in the initial state, between the first end of the first tether member and the first end of the second tether member;

- γ denotes an azimuthal angle present, in the initial state, between the second end of the first tether member and the second end of the second tether member;

in particular wherein $70 \text{ mm} < c3 < 88 \text{ mm}$ applies.

21. A combination comprising a container and a closure according to one of claims 12 to 20.

22. A method for manufacturing a closure according to one of claims 12 to 20, the method comprising producing the closure or a precursor closure in a molding process.

23. A combination comprising a container and a closure, the container comprising a neck having an opening, at least one first retaining feature, and an outer thread defining a z-axis, the z-axis being directed to point in a +z-direction pointing from inside the neck through the opening towards outside the neck, the closure comprising

— a lid member;

— a ring member;

— a first tether member and a second tether member, each providing an interconnection between the lid member and the ring member;

the ring member being in a retained position in which it encompasses the neck, the at least one first retaining feature limiting movement of the ring member towards the +z-direction;

the lid member having an inner thread to cooperate with the outer thread and defining a lid axis which in an initial state is identical to the z-axis;

the container or the ring member comprising at least one stop feature;

wherein the first and second tether members are designed to allow a user to move the lid member from the initial state to a storage position in which

— the interconnections between the lid member and the ring member are maintained;

— the lid member is pulled against the at least one stop feature by forces exerted on the lid member by the tether members;

while the ring member remains in the retained position;

in particular wherein the first tether member occurs before the second tether member in a scan of azimuthal positions about the z-axis pursuant an unscrewing sense of rotation of said lid member starting at an azimuthal coordinate which, relative to the z-axis, is located opposite to the lid member in the storage position, and wherein the first tether member is at least as long as the second tether member, and more particularly is longer than the second tether member.

24. The combination according to claim 23, the lid member comprising a top plate portion having an outer face facing, in the initial state into the +z –direction and opposite thereto an inner face facing, in the initial state into the -z –direction, wherein in

the storage position, the inner face of the top plate portion faces the container, more particularly is opposing the container.

25. The combination according to claim 23 or claim 24, the container comprising a support ledge, and wherein the at least one stop feature comprises the support ledge.

26. The combination according to one of claims 23 to 25, wherein the forces are forces comprising a component directed in the +z-direction, in particular wherein the forces are forces comprising a component directed in the +z-direction and a component directed in the –x-direction.

27. The combination according to one of claims 23 to 26, wherein in the storage position the lid member is acted on at least in

— a first region in which the second end of the first tether member connects to the lid member;

— a second region in which the second end of the second tether member connects to the lid member; and

— third region in which the lid member abuts agains the at least one stop feature.

28. The combination according to one of claims 23 to 27, wherein the following applies:

$$60 \text{ mm} < c3 < 95 \text{ mm}, \quad \text{with}$$

$$c3 = 0.5\, D * (\beta 1+\beta 2) / [2 - \cos(\delta/2) - \cos(\gamma/2)]$$

wherein

- D denotes an outer diameter of the lid member at a lower periphery of the lid member;

- β1 denotes an azimuthal angle in radiant present, in the initial state, between the first end and the second end of the first tether member; and

- β2 denotes an azimuthal angle in radiant present, in the initial state, between the first end and the second end of the second tether member;

- δ denotes an azimuthal angle present, in the initial state, between the first end of the first tether member and the first end of the second tether member;

- γ denotes an azimuthal angle present, in the initial state, between the second end of the first tether member and the second end of the second tether member;

in particular wherein 70 mm < c3 < 88 mm applies.

29. A method for operating a closure applied to a container, wherein the container comprises a neck having an opening, at least one first retaining feature, and an outer thread defining a z-axis, the z-axis being directed to point in a +z-direction pointing from inside the neck through the opening towards outside the neck, and

wherein the closure comprises

— a lid member;

— a ring member;

— a first tether member and a second tether member, each providing an interconnection between the lid member and the ring member;

the lid member having an inner thread to cooperate with the outer thread and defining a lid axis which in an initial state is identical to the z-axis;

the container or the ring member comprising at least one stop feature;

the method comprising transferring the lid member from the initial state to a storage position, the transferring comprising

A) rotating the lid member about the z-axis to increase, by virtue of cooperation of the inner and outer threads, a distance along the z-axis between the ring member and the lid member;

B) carrying out a movement of the lid member comprising a shifting of the lid member in the +x-direction;

C) applying a force to the lid member for enabling the lid member to reach the storage position;

D) discontinuing applying said force to enable forces exerted on the lid member by the tether members to pull the lid member against the at least one stop feature;

wherein in the storage position

— the interconnections between the lid member and the ring member are maintained;

— the lid member is pulled against the at least one stop feature by forces exerted on the lid member by the tether members;

while the ring member remains in a retained position in which it encompasses the neck, the at least one first retaining feature limiting movement of the ring member towards the +z-direction; and

wherein during the transferring

— the interconnections between the lid member and the ring member are maintained;

— the ring member remains in the retained position;

in particular wherein the first tether member occurs before the second tether member in a scan of azimuthal positions about the z-axis pursuant an unscrewing sense of rotation of said lid member starting at an azimuthal coordinate which, relative to the z-axis, is located opposite to the lid member in the storage position, and wherein the first tether member is at least as long as the second tether member, and more particularly is longer than the second tether member.

Abstract

The combination comprises a container (4) and a closure (1), the container comprising a neck (41) having an opening (40), at least one first retaining feature (47), and an outer thread (42) defining a z-axis. The closure (1) comprises

— a lid member (2);

— a ring member (3);

— a first tether member (T1) and a second tether member (T2), each providing an interconnection between the lid member (2) and the ring member (3).

The ring member (3) is in a retained position in which it encompasses the neck (41). The at least one first retaining feature (47) limits movement of the ring member towards the +z-direction. The lid member has an inner thread (21) to cooperate with the outer thread (42) and defining a lid axis (A) which in an initial state is identical to the z-axis. The first and second tether members are designed to allow a user to move the lid member (2) from the initial state to a cleared position in which a projection of the lid member onto an x-y-plane perpendicular to the z-axis is free from overlap with a projection of the opening (40) onto the x-y-plane, while

— maintaining an angle α enclosed between the z-axis and the lid axis of less than 90°, in particular of less than 85°;

— maintaining the interconnections between the lid member and the ring member;

— the ring member (3) remains in the retained position.

(Fig. 4A)

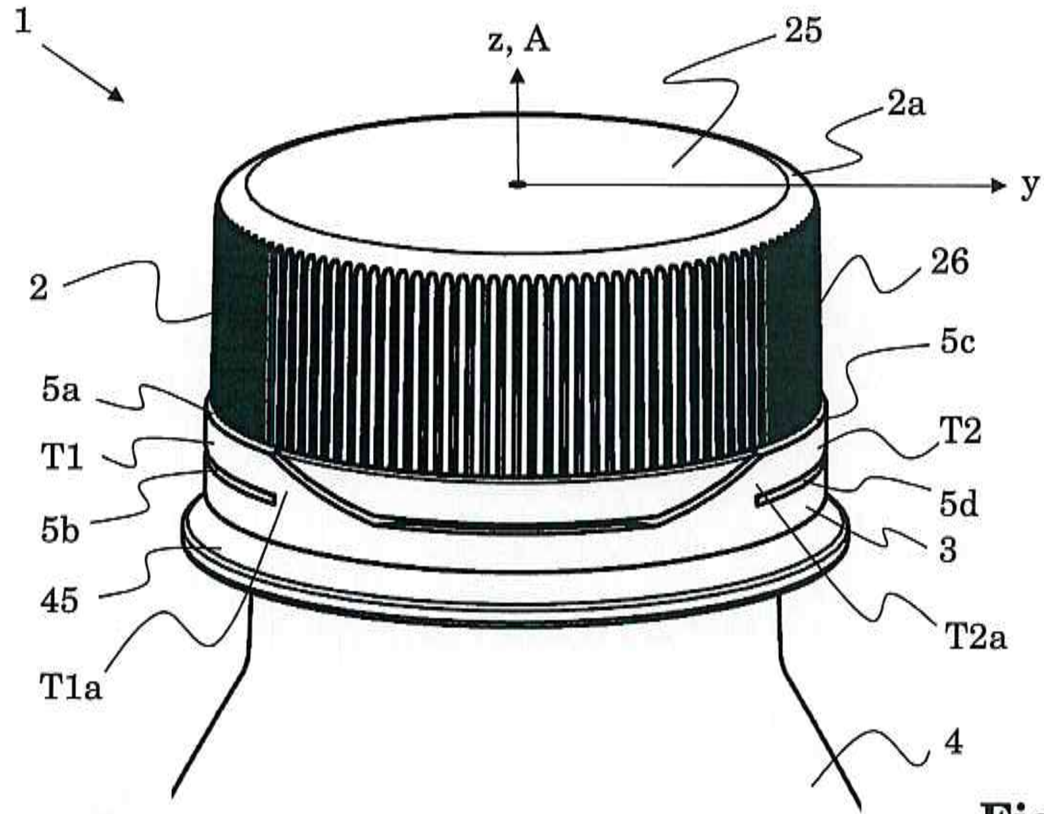
1
z, A
25
2a
y
2
26
5c
5a
T2
T1
5d
5b
3
45
T2a
T1a
4

Fig. 1A

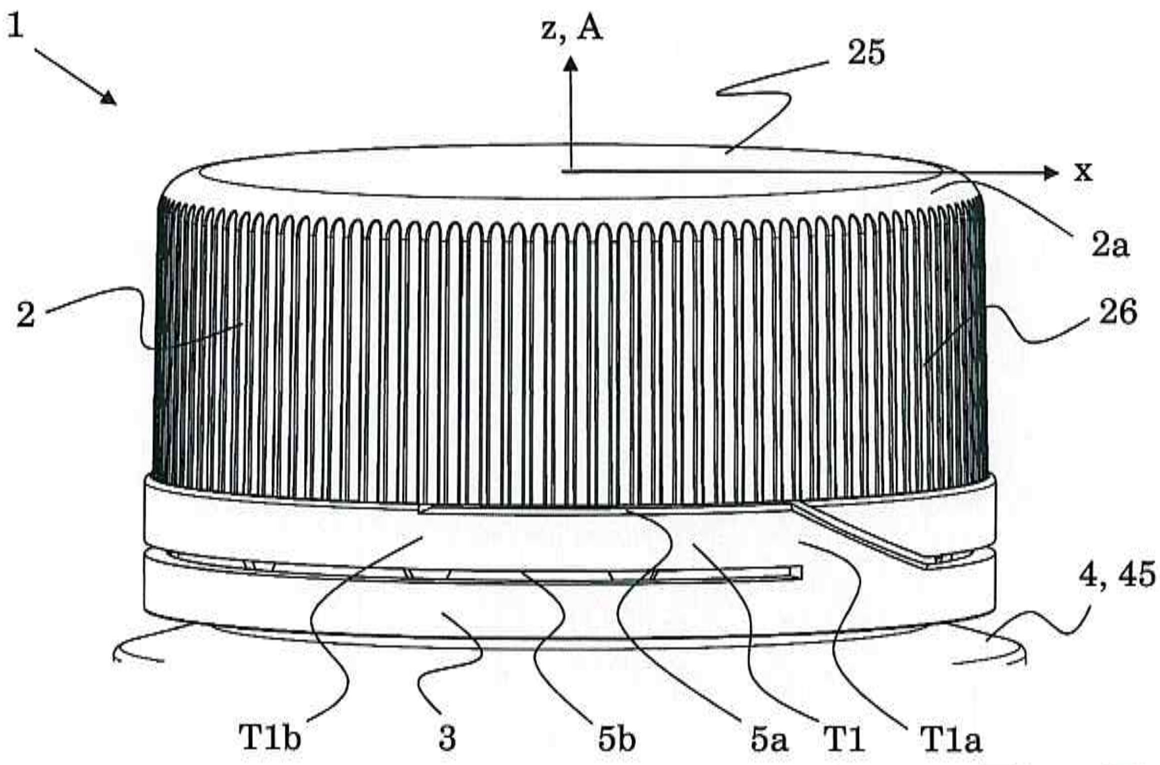
1
z, A
25
x
2a
2
26
4, 45
T1b
3
5b
5a
T1
T1a

Fig. 1B

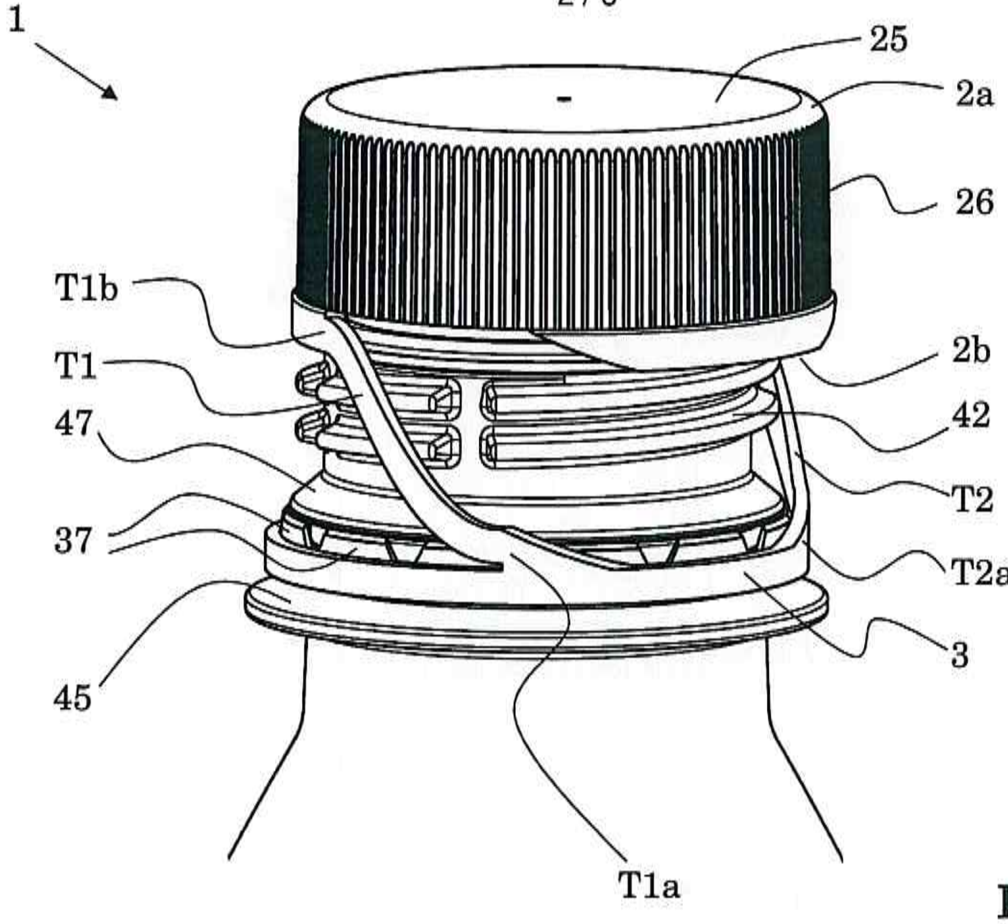
1
25
2a
26
T1b
T1
47
37
2b
42
T2
T2a
3
45
T1a

Fig. 2

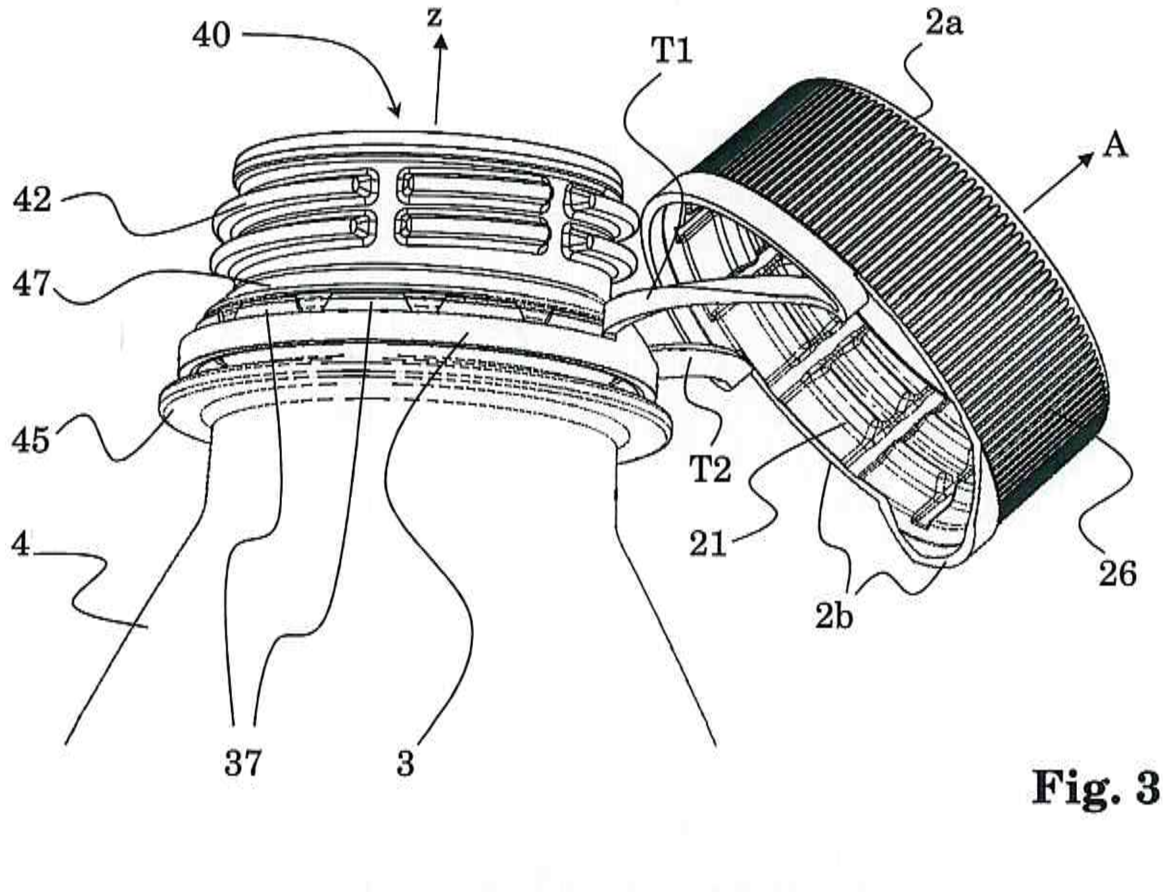
40
z
T1
2a
A
42
47
45
T2
21
26
2b
4
37
3

Fig. 3

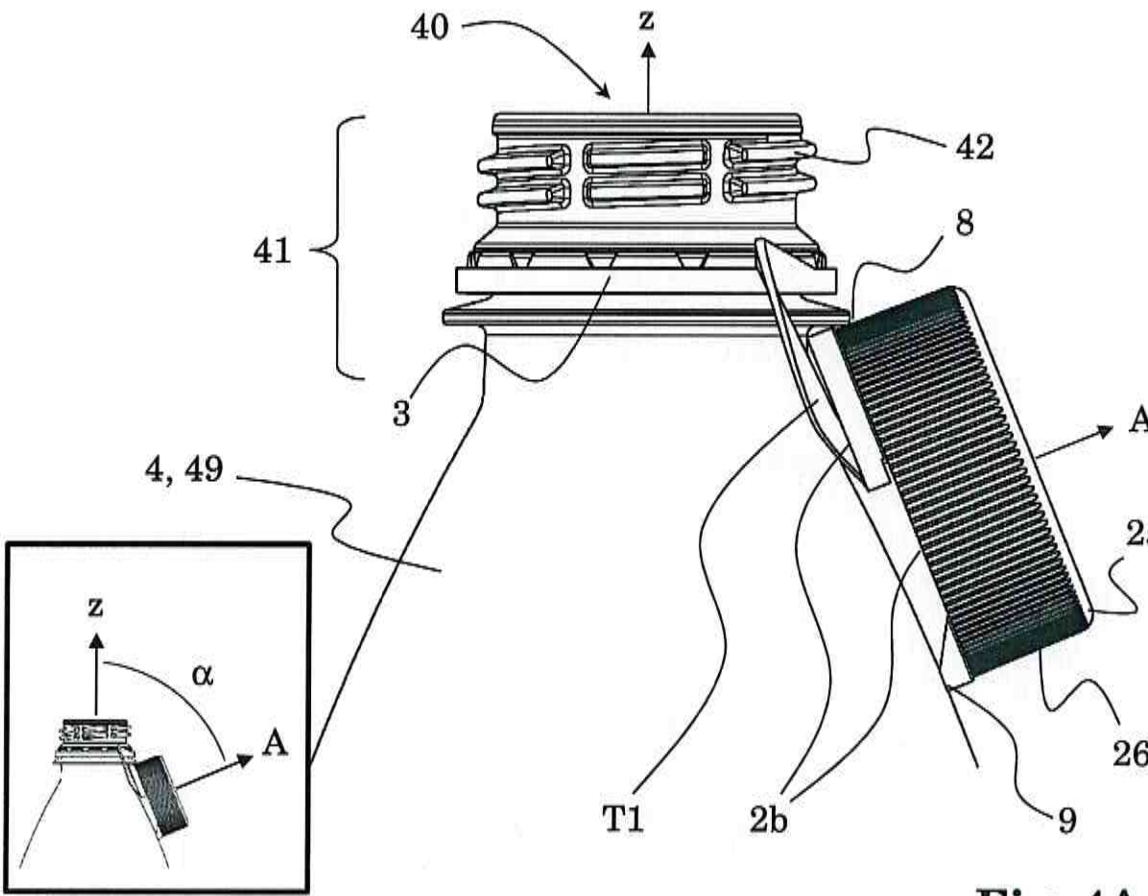

Fig. 4A

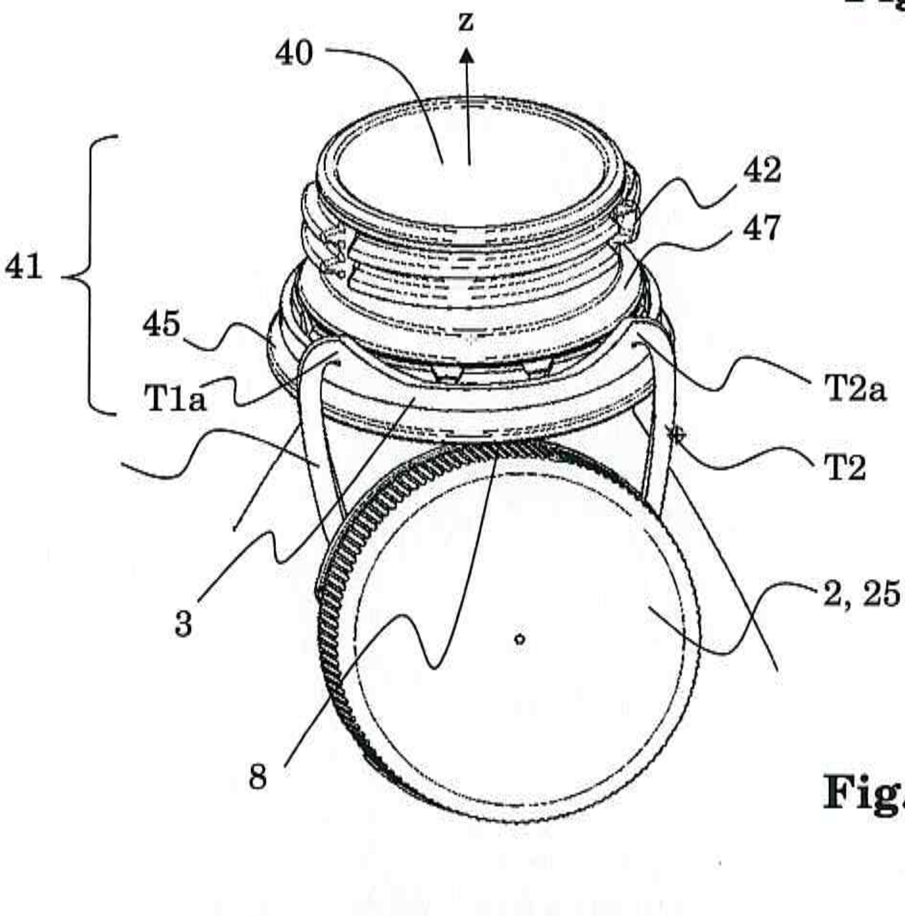

Fig. 4B

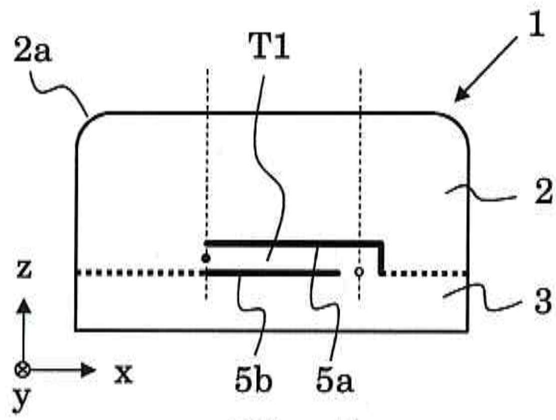

Fig. 5

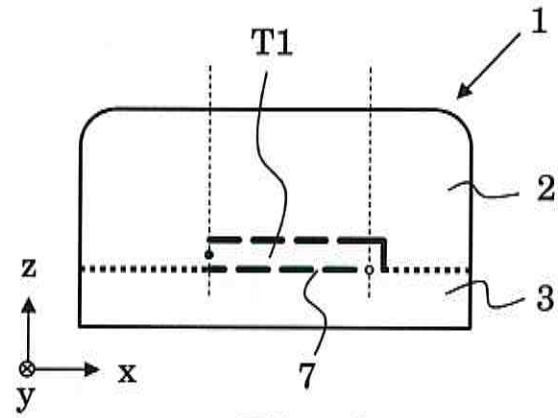

Fig. 6

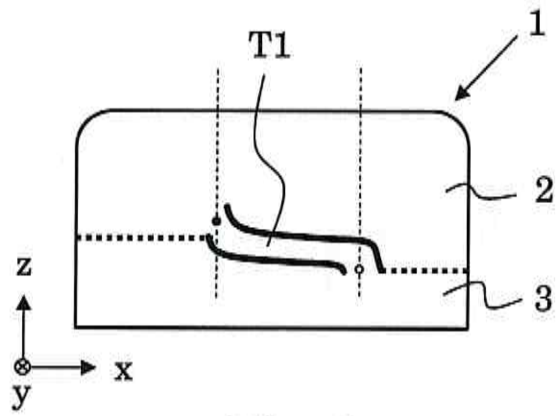

Fig. 9

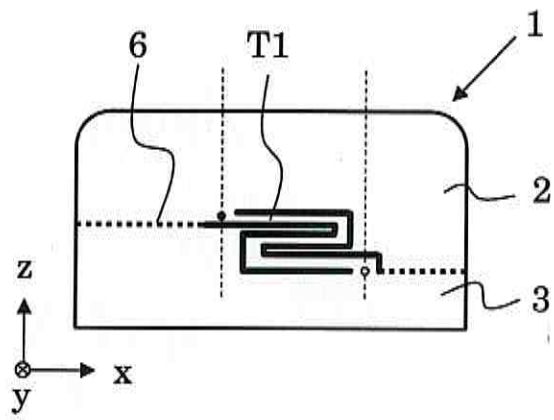

Fig. 10

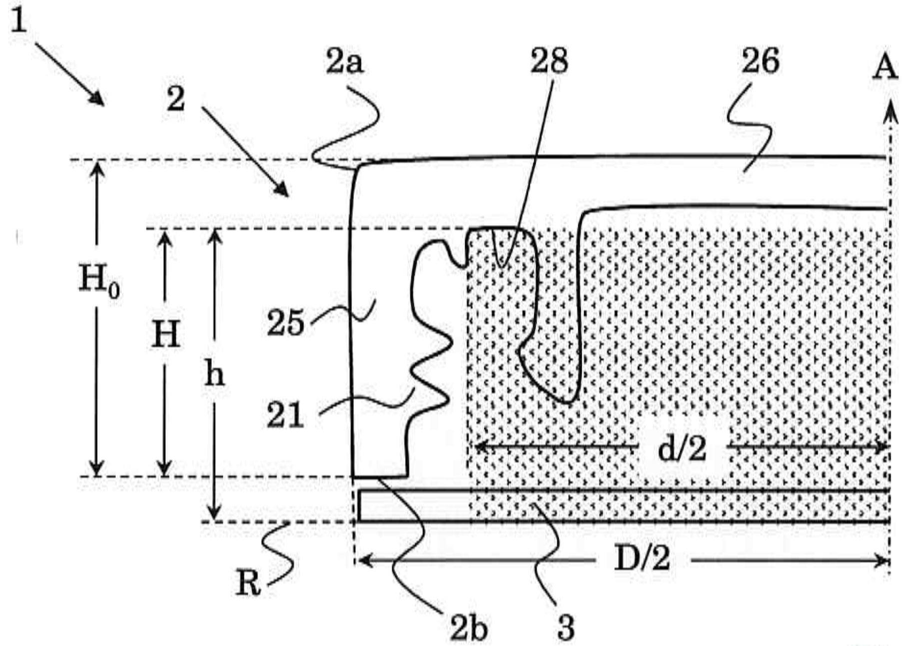

Fig. 7

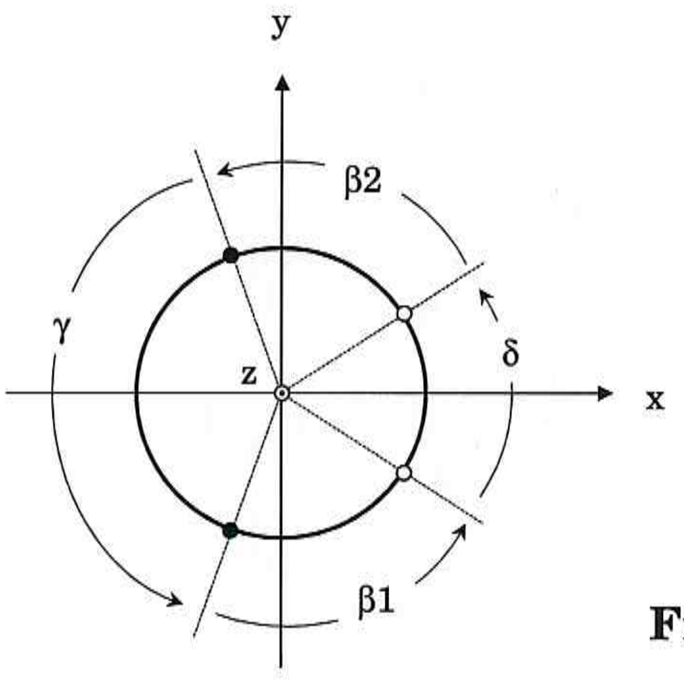

Fig. 8

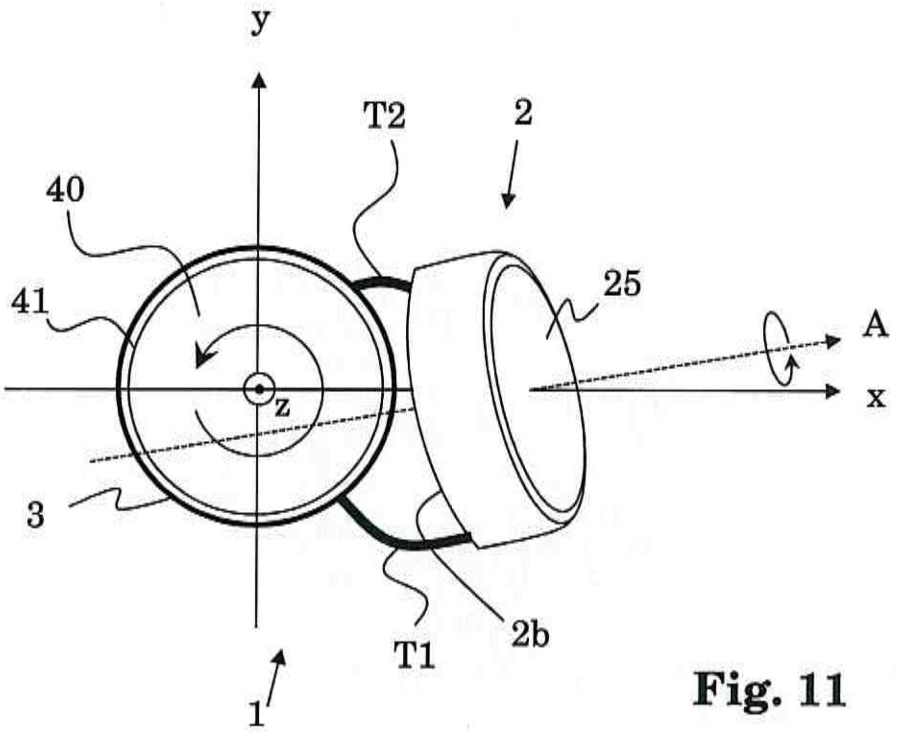

Fig. 11

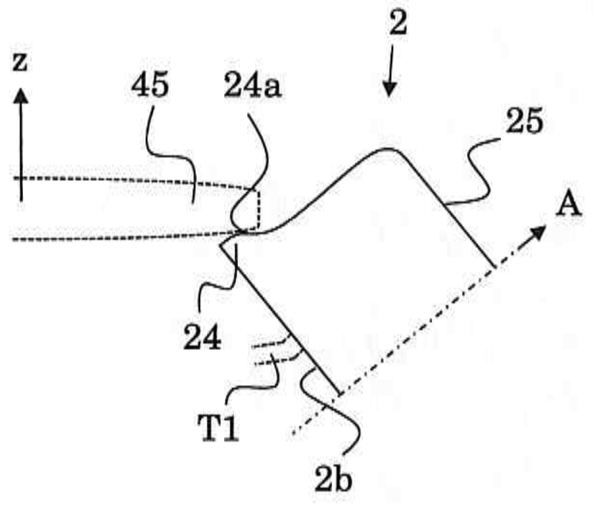

Fig. 12