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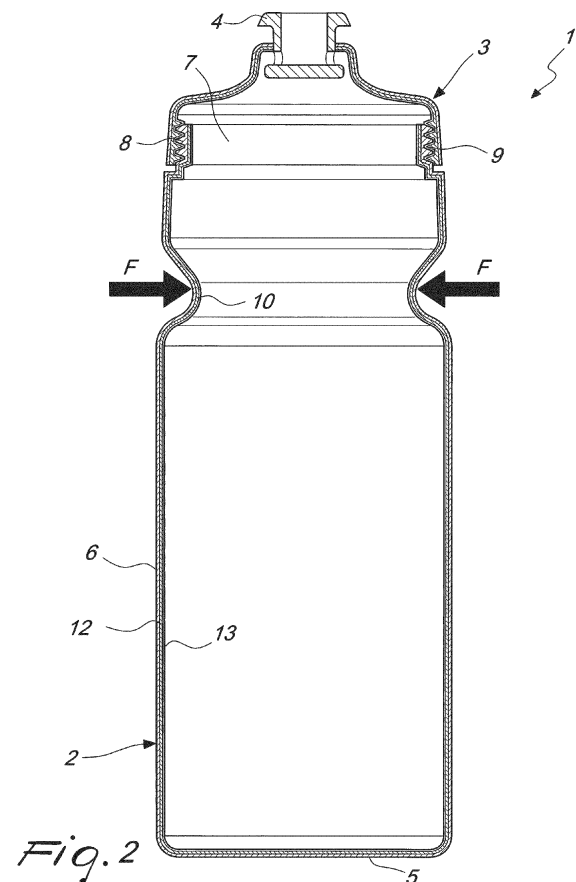
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(54) BOTTLE WITH AN INTERNAL COATING LAYER

(57) The present invention concerns a bottle (1) comprising: a squeezable plastic container (2) having a bottom (5), a lateral side (6) and an open end (7) opposite to the bottom (5), the bottom (5) and the lateral side (6) defining an inner surface of the squeezable plastic container (2), and a cap (3), wherein at least part of the inner surface of the squeezable plastic container (2) is covered with a coating layer (11) comprising a silver layer (13). The present invention also concerns a method for manufacturing a squeezable plastic container (2) for a bottle (1) with a coating layer deposited by using Physical Vapor Deposition.



Description

Technical field

[0001] The present invention is directed to a bottle comprising a squeezable plastic container with an internal coating layer and to a method of manufacturing a squeezable plastic container for a bottle with an internal coating layer.

Background of the invention

[0002] Plastic bottles with squeezable plastic containers are often used for rehydration during sports activities and are often called sports bottles. These plastic bottles are reused and not meant for single use only. Liquids are typically water, sports drinks comprising sugars and other nutrients or for instance a cold tea mix. The squeezable containers are squeezable by hand to administer the liquid more quickly. We have found that after multiple refills and despite thorough cleaning, plastic bottles typically become foul smelling over time, affecting the quality of the liquid and potentially even the user's sports achievements and health.

Summary of the invention

[0003] We have now surprisingly found that one or more of the above or other problems can be overcome with the present invention.

[0004] Accordingly, the present invention is directed to a bottle comprising a squeezable plastic container and a cap, wherein the inner surface of the squeezable plastic container is covered with a coating layer comprising a silver layer. Preferably, the coating layer has a thickness of from 10 nm to 2 micron. Preferably, the coating layer further comprises a titanium layer interposed between the silver layer and the inner surface of the squeezable plastic container. Preferably, the coating layer is made of a titanium layer interposed between the silver layer and the inner surface of the squeezable plastic container and the silver layer. In the context of the present disclosure the term layer "made of" intends to exclude other materials / layers except for the layers / materials from which the layer is disclosed as "made of". Preferably, the coating layer comprises 90% by weight of titanium and 10% by weight of silver. Preferably, the coating layer comprises 50% by weight of titanium and 50% by weight of silver. Preferably, the plastic of the squeezable container is selected from polyethylene, polypropylene, polycarbonate, bioplastics and mixtures thereof. Preferably, the inner surface of the cap of the bottle is also covered with the coating layer as above. Preferably the cap is threadable to the squeezable plastic container.

[0005] The present invention is further directed to a method of manufacturing a squeezable plastic container for a bottle, wherein a coating layer as above is applied on the inside or inner surface of the squeezable plastic

container by using Physical Vapor Deposition (PVD). Preferably, the coating layer as above is applied at a temperature of at least 60°C, preferably between 60°C and 65°C. Preferably, the squeezable plastic container is subsequently combined with a cap to produce a bottle, in particular a sports bottle.

[0006] We have found that one or more of the features of the invention offer the surprising benefits mentioned below to overcome problems associated with use of plastic in the art. Though plastic often seems to have a smooth feel, after detailed investigation we have found that plastic actually has an uneven surface providing a good breeding ground for bacteria. Also, we have found that plastic material contains additives - such as plasticizers - and, particularly after light exposure, these can diffuse into the liquid contained in the plastic bottle. These bacteria and additives can move into the liquid content of the bottle and are subsequently unintentionally consumed by the person doing sports activities.

[0007] The present invention offers multiple features that each on its own or in combination offer surprising benefits. The proposed plastic material for the squeezable plastic container for a bottle and further the proposed ingredients, thickness and/or placement of the coating layer can offer one or more surprising benefits such as chemical stability of the coating, adhesion of the coating layer to the plastic, prevention of potentially harmful and undesirable plastic additives moving into the liquid, avoidance of the formation of foul smelling biofilm on the plastic inner surface of the squeezable plastic container, and/or easy application of the coating layer on the inner plastic surface of the squeezable plastic container during manufacturing.

[0008] The invention is especially beneficial in that our bottle allows for squeezing of the squeezable plastic container thereof for quicker administration of the liquid whilst maintaining the physical integrity of the beneficial coating layer and its adherence to the inner surface of the squeezable plastic container in order to offer continued health and cleanliness benefits to the user.

[0009] For the purpose of the invention, a squeezable plastic container for a bottle (in the following also called "bottle container") is defined as a bottle container in which, when the outside of the bottle container is pressed inward, the container wall moves inwards, reducing the internal diameter of the container by at least 5%, preferably by at least 10%, and when the inwards pressure is removed, the bottle container returns to the original internal diameter. Thus, the bottle container is characterized by showing elastic deformation, i.e. after taking away externally applied pressure, the bottle container returns to its original shape. In other words, the term squeezable as used herein is an equivalent of elastically deformable. As the bottom of squeezable plastic containers for bottles is typically rigid, it will be understood that for determining squeezability, the pressure is preferably applied in the middle of the squeezable plastic container. This is in line with the purpose of squeezing the bottle container which

is to accelerate administration of the liquid such that the user can quickly refocus on the activity at hand. Bottles of the invention can be called sports bottles, or multi-use or reusable sports bottles.

[0010] For the purpose of the invention, a squeezable plastic container for a bottle is a tubular element which can preferably have the shape of a straight circular cylinder although other shapes, such as a straight cylinder with an elliptical cross section or other cylindrical shapes, are also intended. The squeezable plastic container for a bottle can also be a barrel shaped tubular element. The squeezable plastic container for a bottle can be a tubular element with depressions for facilitating its gripping by hand. In the case where a squeezable plastic container for a bottle is a tubular element which has a shape other than that of a straight circular cylinder the above definition on container squeezability applies mutatis mutandis.

[0011] The present invention will be described more in detail with reference to the non-limiting embodiments thereof discussed herein and the figures thereof, wherein:

Figure 1 is a cross-sectional presentation of a bottle according to the invention with the squeezable plastic container in a non-squeezed state;

Figure 2 is a cross-sectional presentation of a bottle of Figure 1 with the squeezable plastic container in a squeezed state; and

Figure 3 is an enlarged detail of Figure 1 showing the squeezable plastic container with a coating layer that is applied according to the invention on the inner surface of the squeezable plastic container.

Detailed description of the invention

[0012] Figures 1 and 2 represent a bottle according to the invention. The bottle 1 comprises a squeezable plastic container 2, a plastic cap 3 and a silicon mouthpiece 4. The squeezable plastic container 2 has a generally tubular shape, in particular the shape of a substantially straight cylinder although other shapes, such as a straight cylinder with an elliptical cross section or other cylindrical shapes, may also be provided. The squeezable plastic container 2 can also be a substantially barrel shaped tubular element. The squeezable plastic container 2 can be advantageously provided with depressions 10 for facilitating its gripping by hand.

[0013] The squeezable plastic container 2 has a bottom 5, a lateral side 6 and an open end 7 provided with engagement means 8 for releasably engaging corresponding engagement means 9 of the cap 3. The engagement means 8 of the squeezable plastic container 2 are preferably embodied as an external thread which is engageable with a mating thread provided on the cap 3 and embodying the engagement means 9 of the cap 3. While threads as described hereinbefore are the preferred means for engagement between the squeezable

plastic container 2 and the cap 3, other equivalent engagement means are also intended to be covered by the present disclosure.

[0014] The bottom 5 of the squeezable plastic container 2 may be made to be more rigid (thus less squeezable) than the remainder of the container 2, in particular the lateral side 6 of the container 2, for instance by providing additional plastic material at the bottom 5. Equally, the open end 7 at the engagement means 8 may be more rigid than the remainder of the container 2, in particular the lateral side 6 of the container 2, for instance by providing additional plastic material at the engagement means 8 of the open end 7 of the container 2.

[0015] Figure 1 is a schematic presentation of the bottle 1 with the squeezable plastic container 2 in a non-squeezed state. Figure 2 is a schematic presentation of the bottle 1 with the squeezable plastic container 2 in a squeezed state along a squeezing direction which is essentially parallel to the bottom 5 and thus essentially perpendicular to the axis of the tubular squeezable plastic container 2. The squeezing force F in Figure 2 is applied about halfway between the bottom 5 of the container 2 and the open end 7 of the container 2.

[0016] The squeezable plastic container 2 can be filled with liquid and is squeezable, as defined above. By squeezing the container 2, the user can more quickly extract liquids from the bottle 1. The cap 3 ensures that the liquid remains inside the bottle 1 and can be taken off for filling the container 2.

[0017] Typically, the cap 3 is more rigid than the container 2, providing rigidity to the bottle 1 for instance when placed in a bottle holder on a bike. The mouthpiece 4 is typically integrated in the cap 3. The mouthpiece 4 can typically be pushed into the cap 3 to prevent liquid from leaking out and taken out of the cap 3 to allow the user to drink the liquid.

[0018] Preferably, the plastic material of the squeezable container 2 is selected from polyethylene, polypropylene, polycarbonate, plant originated bioplastics and mixtures thereof. Bioplastics are polymers that are prepared by coupling naturally occurring and biodegradable monomers. An example of such a bioplastic monomer is sugar cane. Preferred plastic is selected from polyethylene, polypropylene, polycarbonate and mixtures thereof. Polypropylene is generally most preferred as it can generally best withstand the higher temperatures used in the Physical Vapor Deposition (PVD) coating process.

[0019] The cap 3 is typically made of plastic. Preferred plastics for the cap 3 are as outlined for the container. Preferably the cap 3 is made of the same plastic as the container 2.

[0020] The mouthpiece 4 is preferably made of silicone. Preferably, the mouthpiece 4 can be pushed into the cap 3 to prevent the liquid from leaking out of the bottle 2 and can preferably be pushed out of the cap 3 to allow for drinking of the liquid. The mouthpiece 4 can be preferably connected to the cap 3 by means of a cord (not shown) in order to avoid losing the mouthpiece 4 when it

is pushed out of the cap 3.

[0021] Figure 3 shows a cross section of Figure 1 with a coating layer 11 applied on the inside or inner surface of the squeezable plastic container 2 at the lateral side 6 thereof. According to the invention the coating layer 5 coats a substantial part of the inner surface of the squeezable plastic container 2. In particular, the coating layer 11 coats at least part, preferably at least 50% of the inner surface of the container 2, more preferably at least 80% of the inner surface of the container 2 and even more preferably at least 95% of the inner surface of the container 2. Most preferably, the whole inner surface of the squeezable plastic container 2 including the bottom 5 of the container 2 and the lateral face 6 of the container 2 up to the open end 7 thereof is coated with the coating layer 11. The coating layer 11 is continuous and non-porous. In the context of the present invention a coating layer of an element may sometimes be called a coating, internal coating or lining.

[0022] Preferably, the coating layer 11 may also be applied inside the cap 3, i.e. the side facing the container 2 in the closed state or mounted state of the cap 3, and/or inside the mouthpiece 4, i.e. the side facing the cap 3 in the closed or mounted state of the mouthpiece 4.

[0023] According to the invention the coating layer 11 comprises a silver (Ag) layer 13 which is coated directly or indirectly on the inner surface of the squeezable plastic container 2 with an extension as described hereinabove. The silver layer 13 beneficially functions as a barrier which prevents plastic additives from moving into the liquid and which prevents bacteria from forming a biofilm on the inside of the plastic bottle 1. Further, the silver layer 13 functions as an anti-bacterial agent preventing formation of a biofilm and/or emergence of foul smell inside the bottle 1. Furthermore, the silver layer 13 can be applied on the inner surface of the container 2 of the bottle 1 such that squeezing of the squeezable plastic container 2 is possible without cracking the silver layer 13.

[0024] Preferably, the silver layer 13 has a thickness of at least 10 nm, more preferably at least 20 nm, most preferably at least 50 nm, and preferably at most 1.0 micron, more preferably at most 0.5 micron, most preferably at most 200 nm, for instance around 100 nm. The silver layer 13 offers the benefits indicated yet essentially does not crack upon squeezing of the squeezable plastic container 2 of the bottle 1 with a reasonable squeezing force. A reasonable squeezing force is, in the context of the present invention, a force commonly applied by a user to squeeze out liquids from the bottle 1.

[0025] Advantageously, the coating layer 11 comprises a titanium (Ti) layer 12 which is coated directly or indirectly on the inner surface of the squeezable plastic container 2 with an extension as described hereinabove. Preferably, the titanium layer 12 is first coated on the inner surface of the squeezable plastic container 2 and the silver layer 13 is coated on the titanium layer 12.

[0026] The titanium layer 12 offers additional benefits in that it is an inert and strong metal that even in a thin

layer applied on the inner surface of the squeezable plastic container 2 of the bottle 1 reinforces the bottle 1 and offers an effective coating to prevent not only additives from leaking into the liquid but also bacteria from growing on the plastic surface on the inside of the bottle 1. Further, the titanium layer 12 advantageously facilitates a uniform coating of the silver layer 13 thereon and/or reduces the risk of cracking of the coating layer 11 upon squeezing of the container 2 of the plastic bottle 1 with a reasonable force as described above.

[0027] Preferably, the titanium layer 12 has a thickness of at least 10 nm, more preferably at least 20 nm, most preferably at least 50 nm, and preferably at most 1.0 micron, more preferably at most 0.5 micron, most preferably at most 200 nm, for instance around 100 nm.

[0028] Preferably, when the coating layer 11 is made of the titanium layer 12 and the silver layer 13 the overall thickness of the coating layer 13 may be equal to at least 20 nm, more preferably at least 40 nm, most preferably at least 100 nm, and preferably at most 2.0 micron, more preferably at most 1.0 micron, most preferably at most 0.8 micron, particularly preferred 400 nm, for instance around 200 nm.

[0029] Preferably, when the coating layer 11 is made of the titanium layer 12 and the silver layer 13, the thickness of the titanium layer 12 may be in the range of 700 to 900 nm and the thickness of the silver layer may be in the range of 700 to 900 nm. Within the above ranges preferred values are of about 800 nm for titanium and of about 800 nm for silver, the titanium being in a proportion of about 50% by weight and the silver being in a proportion of 50% by weight. The latter composition is advantageous as the anti-bacterial effect due to the silver layer is effective for the intended use as a sports bottle and the titanium layer provides for an effective adhesion of the silver layer in sports bottle applications.

[0030] In a preferred embodiment, when the coating layer 11 is made of the titanium layer 12 and the silver layer 13, the composition of the titanium layer 12 and the silver layer 13 comprises titanium in a proportion of at least 50% by weight of the composition, more preferably at least 60% by weight, most preferably at least 70% by weight, and preferably at most 98% by weight, more preferably at most 95% by weight, most preferably at most 90% by weight. Preferably, the composition comprises silver in a proportion of at least 2% by weight of the composition, more preferably at least 5% by weight, most preferably at least 10% by weight, and preferably at most 50% by weight, more preferably at most 40% by weight, most preferably at most 30% by weight. This aspect beneficially provides for an efficient manufacturing process.

[0031] In a preferred embodiment, which is applicable in general to the invention, the titanium layer 12 is first deposited on the inside or inner surface of the container 2 and the silver layer 13 is subsequently deposited on the titanium layer 13. The titanium layer 12 thus faces the plastic of the squeezable container 2 on the inside of the

bottle 1 and the silver layer faces a liquid in the interior of the bottle 1. This aspect beneficially provides for improved adhesion to the plastic of the squeezable container 2 due to the use of the titanium layer 12 which provides strength and flexibility to the coating layer 11 as well as a good adhesion of the silver layer 13, and for a more efficient use of the silver on the side exposed to the liquid providing bactericidal properties.

[0032] In a preferred embodiment, a coating layer as described above is applied on the inner surface of the cap 3 and/or the inner surface of the mouthpiece 4. Preferably, a silver layer of the coating layer faces the interior of the bottle 1 or the cap 3 and a titanium layer of the coating layer faces the inner surface of the cap 3 or the mouthpiece 4. The silver layer is preferably deposited on the titanium layer, Type, amounts and ratios of the silver and the titanium used for the cap 3 and/or the mouthpiece 4 are as indicated above for the coating layers on the inside surface of the squeezable plastic container 2 of the bottle 1.

[0033] The bottle 1 of the invention is manufactured by blow molding the squeezable plastic container 2 from plastic. Typically, injection blow molding is used for producing the squeezable plastic container 1 of the bottle 1. Depending on the bottle type and shape, a cap and/or a mouthpiece can be prepared.

[0034] The coating layer 11 is preferably applied after blow molding the squeezable plastic container 2. The coating layer 11 can be advantageously applied by a method selected from PVD, electrochemical deposition, use of electrolyte solutions, magnetron deposition, electron beam deposition or Chemical Vapor Deposition (CVD). A preferred method is PVD. PVD allows formation of a thin coating layer 11 (of for instance in the range of 1800 nm) with good adhesion to the plastic substrate, wherein the coating layer does not peel off or deform or otherwise crack when a reasonable force as defined above is applied to the bottle 1.

[0035] As has been discussed, preferably Physical Vapor Deposition (PVD) is used as a method for applying the coating layer 11 on the inside of the squeezable plastic container 2. PVD allows for deposition of a thin coating layer 11 on the inside of the squeezable plastic container 2. The PVD process results in excellent adhesion of a thin coating layer 11 to the plastic substrate. Preferably, the inner surface of the squeezable plastic container 2 is pre-treated with an acid. This step is called an activation step. Preferably, this step uses nitric and sulfuric acid (chromic acid is less preferred). The coating layer 11 is applied at a temperature of at least 60°C, more preferably at least 70°C and for instance up to a temperature of 100°C. A particularly advantageous application range for the coating layer is from 60°C to 65°C. Selection of the optimal temperature to be used for PVD of course also takes into account the type of plastic used for the squeezable plastic container 2. Polypropylene can generally better withstand higher temperature and is preferred. Preferably, the PVD process uses vacuum.

PVD allows for deposition of a thin coating layer, for instance around 100 nm (as reflected in the ranges for the thickness of the layer indicated above), on the inside surface of the squeezable plastic container 2 with good adherence such that the coating layer 13 beneficially does not peel off from the plastic or break or crack upon squeezing with a reasonable force as described hereinabove.

[0036] Preferably, if PVD is used, the diameter of the opening at the open end of the container 2 is of at least about 40 mm (or if the opening is not circular the area of the opening is at least equal to the area of a circle having the diameter of 40 mm) and/or the container 2 is held in a horizontal position and/or the depth of the container 2 does not exceed 2.5 x the diameter of the opening at the open end thereof. The area of the opening is comparable to the area of a horizontal cross section throughout the lateral side 6 of the container 2.

[0037] Preferably, the titanium layer 12 is first deposited on the inside surface of the container 2 by means of PVD. Preferably, the squeezable plastic container 2 is pre-treated with an acid as described above. Subsequently, preferably the silver layer 13 is deposited on the titanium layer 12. The PVD process for depositing the titanium layer 12 and the silver layer 13 is carried out at the temperatures described above with the selection of the optimal temperature to be used for PVD taking into account the type of plastic used for the squeezable plastic container 2. Polypropylene can generally better withstand higher temperatures and is preferred.

Example 1

[0038] A squeezable plastic polypropylene container was produced by injection blow molding. A fitting cap of polypropylene was made as well as a silicone mouthpiece. The squeezable plastic container was subjected to an acid pretreatment step (using nitric and sulfuric acid to activate the inside or inner surface of the container). Subsequently, a coating layer of titanium was formed by PVD on the whole inside or inner surface of the container including the bottom and the lateral side of the container up to the open end of the container followed by forming of a coating layer of silver on the coating layer of titanium by PVD, equally on the whole extension of the coating layer of titanium. The PVD process for forming the titanium and the silver coating layer was carried out holding the container in a horizontal position with the depth of the container not exceeding 2.5 x the diameter of the opening at the open end thereof, at a temperature of about 65°C. The diameter of the opening at the open end of the container was about 40 mm. The area of the opening was comparable to the area of a horizontal cross section throughout the lateral side of the container. The titanium layer had a thickness of about 0,8 micron (800 nm) silver layer had a thickness of about 0.8 micron (800 nm). The ratio of titanium to silver was about 50% percent by weight.

[0039] The plastic bottle with the titanium and silver coating layers on the inside of the container was compared in race cycling events to the same bottle without any such coating layers over the course of 6 months. After 170 refills of the bottle, the bottle without the coating layers as above had a foul smell while the bottle with the coating layers as above did not have a foul smell and upon inspection, the coating layers were still intact.

Example 2

[0040] The container was prepared as in example 1. In addition, the inside of the cap was separately covered with a coating layer of titanium and with a coating layer of silver in a manner similar to the container of example 1. The mouthpiece was integrated into the cap and the cap was screwed on top of the container.

[0041] The plastic bottle with the titanium and silver coating layers on the inside of the container and the cap was compared in race cycling events to the same bottle without any such coating layers over the course of 6 months. After 170 refills of the bottle, the bottle without the coating layers as above had a foul smell while the bottle with the coating layers as above did not have a foul smell and upon inspection, the coating layers were still intact. The content of bacteria was lower than in example 1.

Example 3

[0042] The container was prepared as in example 1 with the titanium layer having a larger thickness of 900 nm.

[0043] The plastic bottle with the titanium and silver coating layers on the inside of the container was compared in race cycling events to the same bottle without any such coating layers over the course of 6 months. After 200 refills of the bottle, the bottle without the coating layers as above had a foul smell while the bottle with the coating layers as above did not have a foul smell and upon inspection, the coating layers were still intact. The content of bacteria was lower than in example 1.

List of reference numbers

[0044]

- 1 bottle
- 2 squeezable plastic container
- 3 cap
- 4 mouthpiece
- 5 bottom of the container
- 6 lateral face of the container
- 7 open end of the container
- 8 engagement means of the container
- 9 engagement means of the cap
- 10 depressions of the container
- 11 coating layer

- 12 titanium layer
- 13 silver layer
- F squeezing force

5 Claims

1. Bottle (1) comprising:

a squeezable plastic container (2) having a bottom (5), a lateral side (6) and an open end (7) opposite to the bottom (5), the bottom (5) and the lateral side (6) defining an inner surface of the squeezable plastic container (2), and a cap (3), wherein at least part of the inner surface of the squeezable plastic container (2) is covered with a coating layer (11) comprising a silver layer (13).

2. Bottle (1) according to claim 1, wherein the whole inner surface of the squeezable plastic container (2) including the bottom (5) and the lateral face (6) up to the open end (7) is coated with the coating layer (11).

3. Bottle (1) according to one or more of claims 1-2, wherein the coating layer (11) has a thickness of from 10 nm to 2 micron.

4. Bottle (1) according to one or more of claims 1-3, wherein the coating layer (11) comprises a titanium layer (12) and the silver layer (13) or wherein the coating layer (11) is made of the titanium layer (12) and the silver layer (13)

5. Bottle according to claim 4, wherein the titanium layer (12) is deposited on the inner surface of the squeezable plastic container (1) and the silver layer (13) is deposited on the titanium layer (13).

6. Bottle (1) according to one or more of claims 1-5, wherein the plastic of the squeezable container (2) is selected from polyethylene, polypropylene, polycarbonate, bioplastics and mixtures thereof.

7. Bottle (1) according to one or more of claims 1-6, wherein the coating layer (11) is provided by Physical Vapor Deposition,

8. Bottle (1) according to one or more of claims 1-7, wherein the plastic of the squeezable container (2) is pre-treated with an acid, preferably with nitric and sulfuric acid.

9. Bottle (1) according to one or more of claims 1-8, wherein the diameter of the opening at the open end of the squeezable plastic container (2) is of at least about 40 mm or if the opening is not circular the area of the opening is at least equal to the area of a circle

having a diameter of 40 mm; and/or wherein the depth of the squeezable plastic container (2) does not exceed 2.5 x the diameter of the opening at the open end thereof.

10. Bottle (1) according to any one or more of claims 1-9, wherein the inner surface of the cap (3) of the bottle (1) and/or the inner surface of the mouthpiece (4) are also covered with the coating layer (11).

11. Method of manufacturing a bottle (1) comprising a squeezable plastic container (2) having a bottom (5), a lateral side (6) and an open end (7) opposite to the bottom (5), the bottom (5) and the lateral side (6) defining an inner surface of the squeezable plastic container (2), wherein at least part of the inner surface of the squeezable plastic container (2) is covered with a coating layer (11) comprising a silver layer (13) by using Physical Vapor Deposition.

12. Method according to claim 11, wherein the whole inner surface of the squeezable plastic container (2) including the bottom (5) and the lateral face (6) up to the open end (7) is coated with the coating layer (11) by using Physical Vapor Deposition.

13. Method according to one or more of claims 11-12, wherein the coating layer (11) is applied by using Physical Vapor Deposition at a temperature of at least 60°C, preferably between 60°C and 65°C.

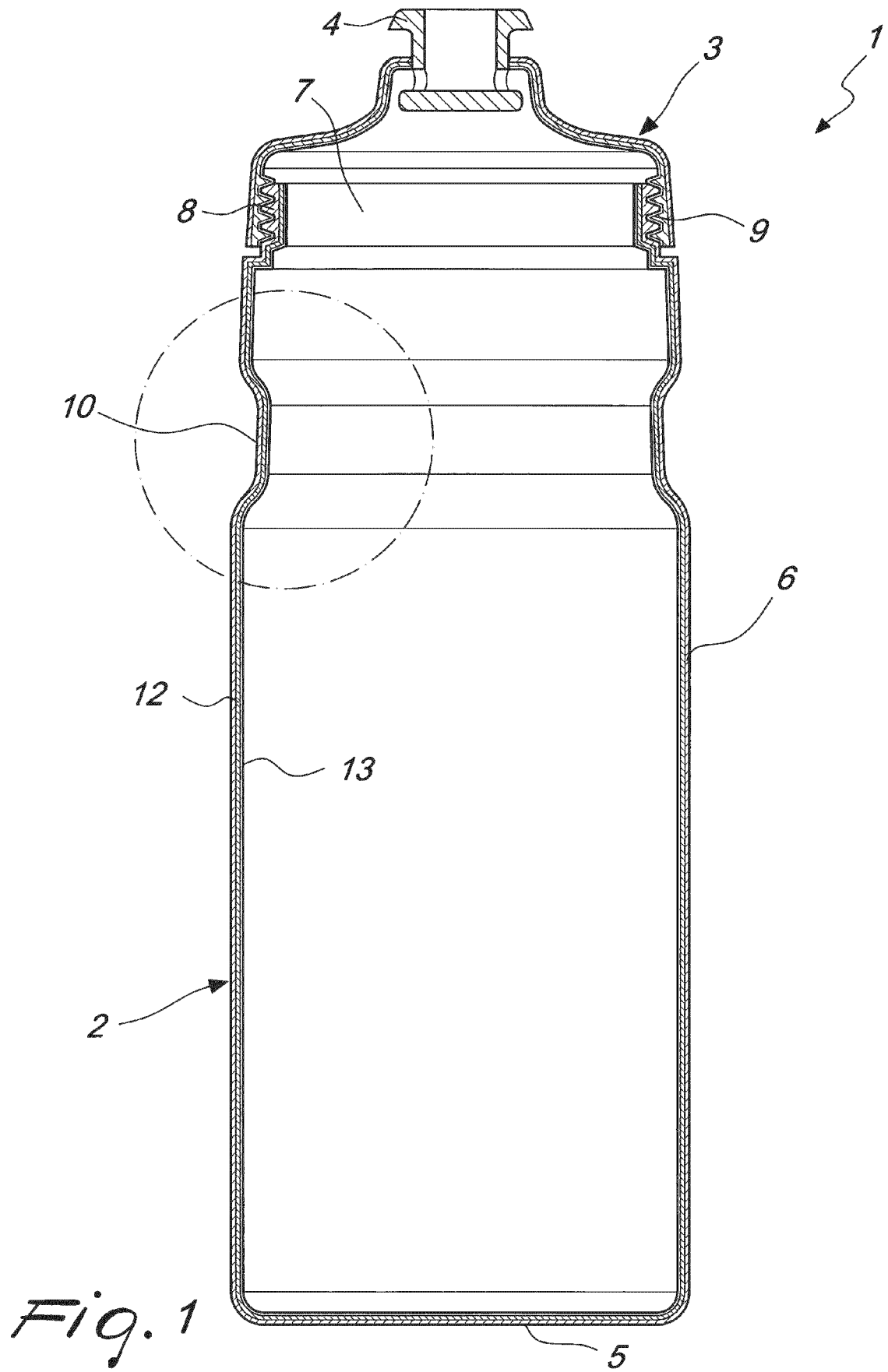
14. Method according to one or more of claims 11-13, wherein the coating layer (11) comprises a titanium layer (12) and the silver layer (13) or wherein the coating layer (11) is made of a titanium layer (12) and the silver layer (13), and wherein the titanium layer (12) is deposited on the inner surface of the plastic squeezable container (1) by using Physical Vapor Deposition and the silver layer (13) is deposited on the titanium layer (13) by using Physical Vapor Deposition.

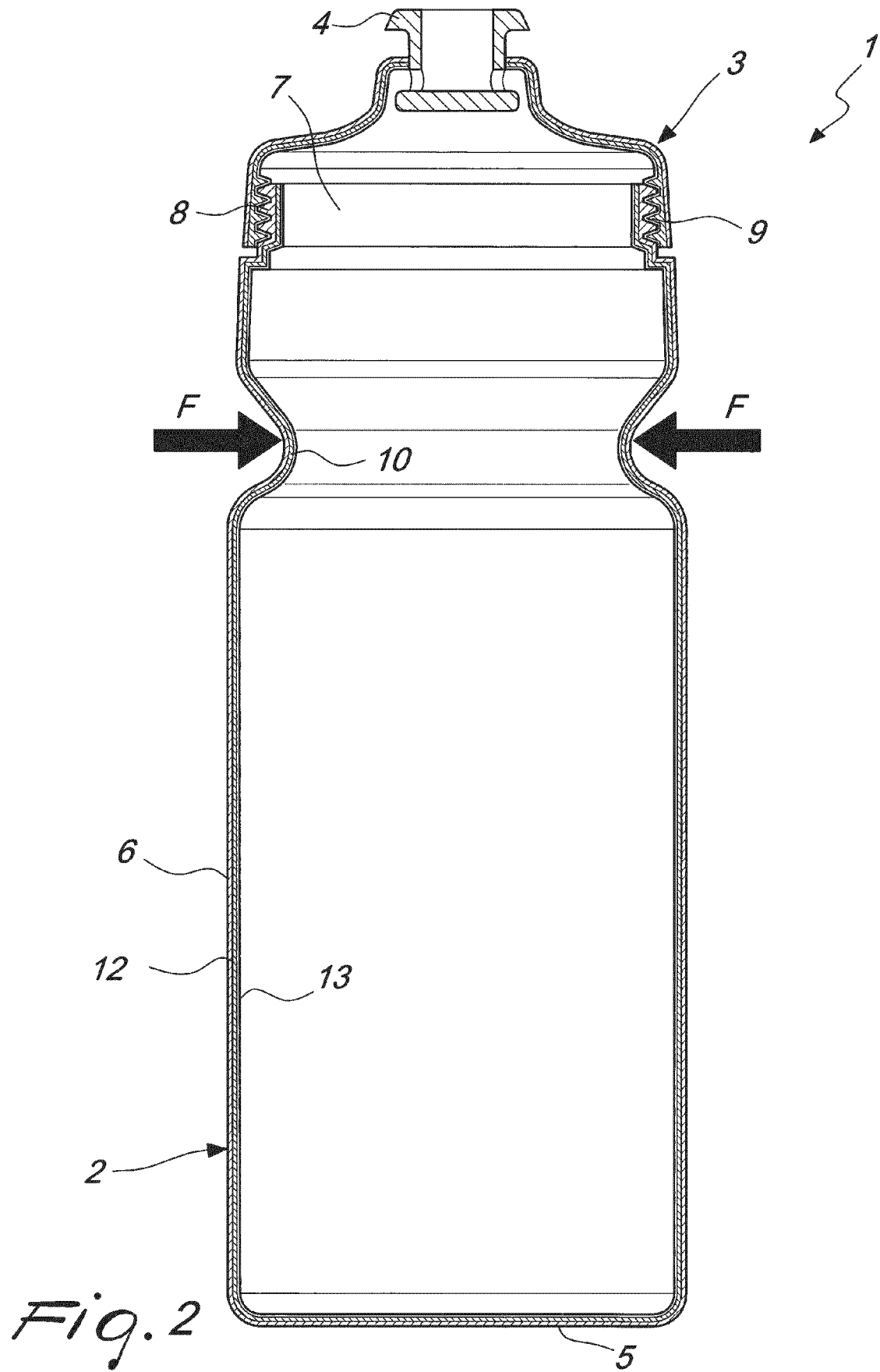
15. Method according to one or more of claims 11-14, wherein the plastic of the squeezable container (2) is selected from polyethylene, polypropylene, polycarbonate, bioplastics and mixtures thereof, further preferably comprising the step of pre-treating the plastic of the squeezable container (2) with an acid, preferably with nitric and sulfuric acid.

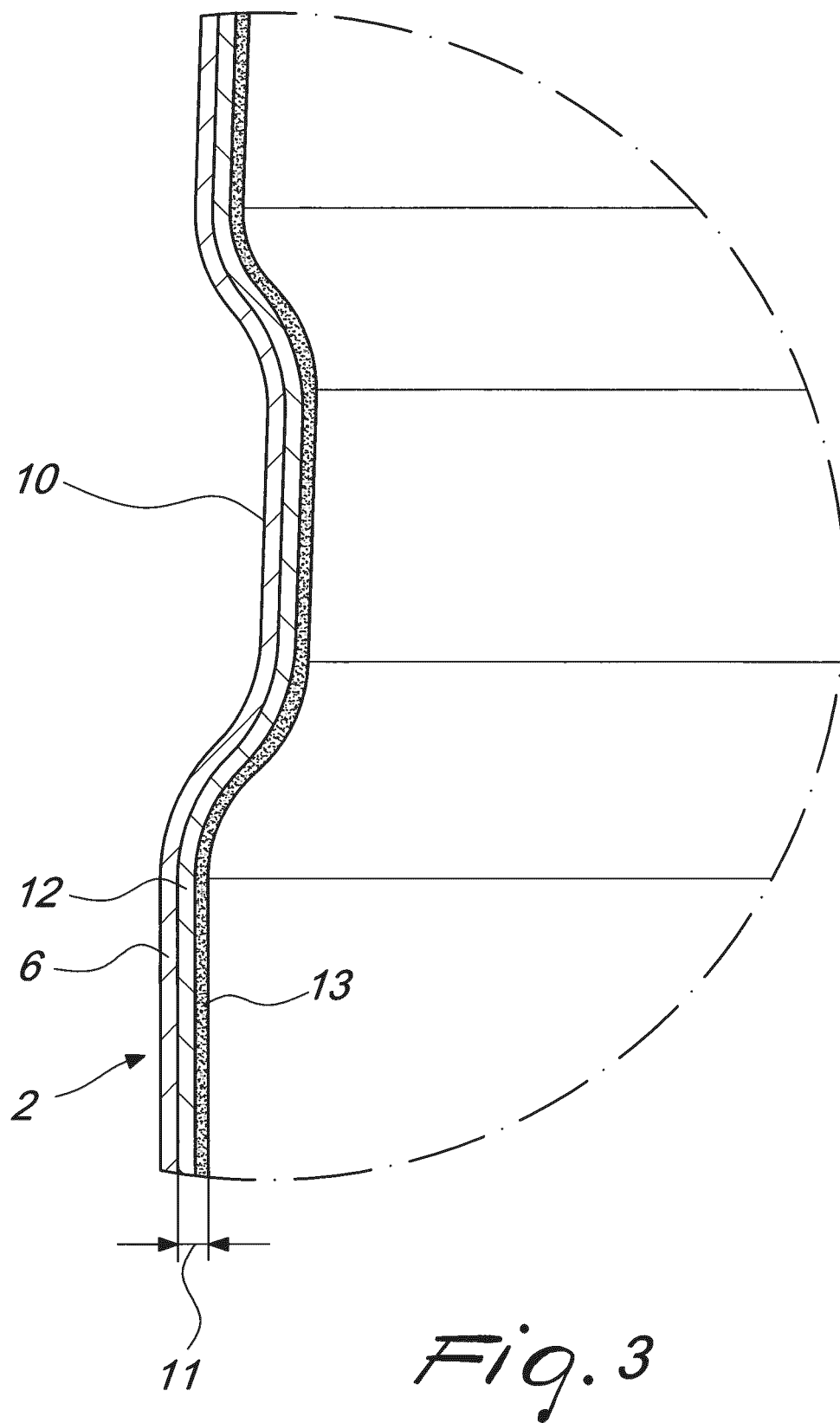
16. Method according to one or more of claims 11-15, wherein the diameter of the opening at the open end of the squeezable plastic container (2) is of at least about 40 mm or if the opening is not circular the area of the opening is at least equal to the area of a circle having a diameter of 40 mm; and/or wherein the depth of the squeezable plastic container (2) does not exceed 2.5 x the diameter of the opening at the

open end thereof.

17. Method according to one or more of claims 11-16, wherein the squeezable plastic container (2) is subsequently combined with a cap to produce a bottle (1).









EUROPEAN SEARCH REPORT

Application Number

EP 23 19 8866

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2020/153421 A1 (KYORAKU CO LTD) 30 July 2020 (2020-07-30)	1, 2, 4, 6, 8, 9	INV. B65D1/02
A	* paragraphs [0022] - [0023]; figures *	3, 5, 7, 11-17	B29C49/42 B65D1/32
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 14 February 2024	Examiner Fournier, Jacques
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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