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(54) **NON-LETHAL PROJECTILE**

(57) The present invention relates to a non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700). The non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700) comprises a front member (102) having a forward facing portion (102a), a cylindrical sidewall member (104) having an outer surface (106) and an inner surface (108), and a partition member (102b) arranged between the front member (102) and the sidewall member (104), wherein the partition member (102b) and the inner surface (108) of the sidewall member (104) forms an open cavity (124) having an open end opposing the partition member (102b), wherein the sidewall member (104) comprises a first portion (104a) abutting the partition member (102b), and a second portion (104b) away from the partition member (102b), wherein the second portion (104b) is tapered from a first end abutting the first portion (104a) of the sidewall member (104) towards an opposite second end, wherein the projectile (100, 100', 200, 300, 300', 400, 600, 700) further comprises: a plurality of rear fins (110) protruding from the outer surface (106) of the sidewall member (104), and a rotation generating member (114) arranged within the open cavity (124), the rotation generating member (114) being configured to generate a rotary motion of the projectile (100, 100', 200, 300, 300', 400, 600, 700) when subject to a forward driving force.

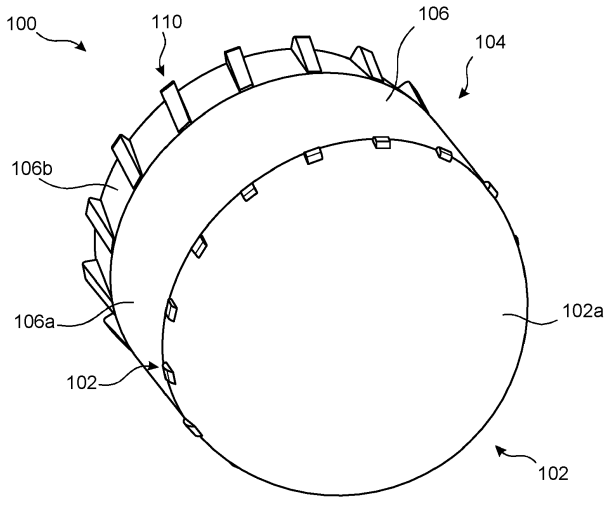

FIG. 1A

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Description

Technical field

[0001] The present invention generally relates to projectiles. More specifically, it is related to non-lethal projectiles.

Background

[0002] Aerodynamic projectiles, such as rubber bullets and paintballs, are commonly used for training, recreational play, as well as for non-lethal law enforcement purposes. These projectiles typically consist of a spherical or cylindrical shell provided with a rubber tip, or filled with a non-lethal material, such as marking liquid or irritants, and is generally propelled from a rifle by compressed gas.

[0003] One of the primary challenges in designing such aerodynamic projectiles is ensuring that they travel in a predictable and stable trajectory. Unstable flight paths can lead to inaccurate or unsafe projectile behavior, such as ricocheting, collateral damage or failing to achieve the desired effect on the target. Additionally, the impact force and range of the projectile is greatly affected by its aerodynamic properties, such as its drag coefficient and spin characteristic.

[0004] Previous attempts to improve the aerodynamic properties of projectiles have included modifying their shape, surface texture, and weight distribution. For example, some projectiles have been designed with fins or flanges to stabilize their flight path, while others have used weighted cores to increase their momentum.

[0005] However, these approaches have often been limited in their effectiveness, due to factors such as manufacturing complexity, or simply failing to achieve a desirable precision and range. Therefore, there is a need for an improved aerodynamic projectile design that can address these issues and provide enhanced accuracy, stability, predictability and range.

Summary

[0006] The herein disclosed technology seeks to at least partly mitigate, alleviate or eliminate one or more of the above-mentioned deficiencies and disadvantages in the prior art. In particular, it is an object to provide an improved non-lethal projectile having improved aerodynamic properties and flight characteristics. The inventors has realized a new way of improving the aerodynamic properties of the projectile as well as improving how the projectile interacts with the barrel of the rifle to improve both accuracy and range.

[0007] Various embodiments of the disclosed invention are defined below and in the accompanying independent and dependent claims.

[0008] According to a first aspect, there is provided a non-lethal projectile. The projectile comprises a front member having a forward facing portion. The projectile further comprises a cylindrical sidewall member having an outer surface and an inner surface. The projectile further comprises a partition member arranged between the front member and the sidewall member. The partition member and the inner surface of the sidewall member forms an open cavity having an open end opposing the partition member. The sidewall member comprises a first portion abutting the partition member, and a second portion away from the partition member. The second portion is tapered from a first end abutting the first portion of the sidewall member towards an opposite second end. The projectile further comprises a plurality of rear fins protruding from the outer surface of the sidewall member. The projectile further comprises a rotation generating member arranged within the open cavity. The rotation generating member is configured to generate a rotary motion of the projectile when subject to a forward driving force.

[0009] The wording "non-lethal projectile", herein refers to a projectile which intends to minimize a (permanent) personal damage to a target. The non-lethal projectile may for instance be used in training, in recreational play, or by law enforcement e.g. in crowd control or to temporarily immobilize a suspect. The non-lethal projectile may throughout the present disclosure also be referred to as aerodynamic projectile, or just projectile.

[0010] By relative wordings such as "forward facing" or "front", it is herein meant in relation to a direction of travel of the projectile, i.e. towards a leading edge of the projectile. In contrast, the wording "rear" herein refers to a back of the projectile, i.e. towards a trailing edge of the projectile.

[0011] The wording "open cavity", herein refers to a space having a solid sidewall, one closed end, and one open end. In contrast, the wording "closed cavity" as used herein, refers to a space entirely enclosed by solid walls.

[0012] A possible associated advantage of having the rotation generating member and the rear fins is that a rotational speed of the projectile may be increased. An effect of increased rotational speed is that the accuracy and range of the projectile is also improved, thereby increasing the probability of hitting the intended target. The plurality of rear fins may further improve the stability of the projectile during flight.

[0013] An effect of having a tapered end of the projectile is that a drag coefficient of the projectile may be reduced.

[0014] The projectile may further comprise a plurality of front fins protruding from the forward facing portion of the front member and/or from the outer surface of the sidewall member. In particular, the plurality of front fins may be arranged forward of the plurality of rear fins. For example, the plurality of front fins may be arranged at the first portion of the sidewall member while the plurality of rear fins are arranged at the second portion of the sidewall member.

[0015] A possible advantage associated with the plurality of front fins is that the rotational speed of the pro-

jectile may be even further improved. Further, the plurality of front fins together with the plurality of rear fins may interact with a rifling of the barrel used to fire the projectile to thereby promote even more rotation of the projectile. Even further, having both front and rear fins may be advantageous in that it improves the stability of the projectile as it travels through the barrel, by reducing the possibility of a pitch and yaw rotation of the projectile.

[0016] Each rear fin of the plurality of rear fins and/or each front fin of the plurality of front fins may extend at a transverse angle to a central axis of the projectile about the outer surface of the sidewall member.

[0017] By having the plurality of rear fins and/or the plurality of front fins at an angle, the fins, when travelling through the air, imparts further rotational motion of the projectile.

[0018] An outermost portion of the plurality of rear fins and/or the plurality of front fins may define an outermost circumference of the projectile.

[0019] A possible associated advantage of having the fins forming the outermost portion of the projectile is that a contact area between the barrel and the projectile can be reduced, thus reducing a friction there between. This may in turn lead to a higher exit velocity. A higher exit velocity may be utilized in increasing a range of the projectile. Alternatively, the amount of compressed gas that is to be released when firing the projectile can be reduced, while still maintaining a sufficient exit velocity. Thereby, the stored energy in the rifle can last longer before needing to be refilled.

[0020] The plurality of rear fins may be between 2 and 32 rear fins. The plurality of front fins may be between 2 and 32 front fins. Preferably, the plurality of rear fins and/or the plurality of front fins may be 8 or 16, as it forms a good match with the rifling of many barrels, which typically has 8 grooves.

[0021] The projectile may further comprise a fill nipple for providing the fill to the closed cavity of the front member. The fill nipple may be arranged at a center of the rotation generating member.

[0022] Having the fill nipple arranged at a rear of the projectile may be advantageous in that it has little to no negative effect of the aerodynamics of the projectile. Further, a risk of the projectile getting jammed in a magazine or the rifle (in particular when the projectile is moving from the magazine to the rifle) can be reduced, as compared to having a fill nipple arranged on the front member. This is because the resulting fill nipple is generally surrounded with sharp edges that can get caught against edges or other surfaces in the magazine or the rifle. It may further be advantageous in that the risk of having air bubbles formed in the closed cavity may be reduced, where air bubbles in the closed cavity can have a negative effect on the flight characteristics of the projectile.

[0023] The forward facing portion of the front member may comprise a plurality of grooves.

[0024] A possible associated advantage of having the grooves may be further improved flight characteristics, e.g. due to improved flight stability and rotational speed, caused by the grooves.

[0025] A further scope of applicability of the present disclosure will become apparent from the detailed description given below. However, it should be understood that the detailed description and specific examples, while indicating some variants of the present inventive concept, are given by way of illustration only, since various changes and modifications within the scope of the inventive concept will become apparent to those skilled in the art from this detailed description.

[0026] Hence, it is to be understood that this inventive concept is not limited to the particular steps of the methods described or component parts of the systems described as such method and system may vary. It is also to be understood that the terminology used herein is for purpose of describing particular embodiments only and is not intended to be limiting. It must be noted that, as used in the specification and the appended claim, the articles "a", "an", "the", and "said" are intended to mean that there are one or more of the elements unless the context clearly dictates otherwise. Thus, for example, reference to "a member" or "the member" may include several devices, and the like. Furthermore, the words "comprising", "including", "containing" and similar wordings do not exclude other elements or steps.

Brief description of the drawings

[0027] The above and other aspects of the present inventive concept will now be described in more detail, with reference to appended drawings showing variants of the present inventive concept. The figures should not be considered limiting the invention to the specific variant; instead, they are used for explaining and understanding the inventive concept.

[0028] As illustrated in the figures, the sizes of layers and regions are exaggerated for illustrative purposes and, thus, are provided to illustrate the general structures of variants of the present inventive concept. Like reference numerals refer to like elements throughout.

Figure 1A to 1F illustrates different views of an example of a projectile according to some embodiments of the present disclosure.

Figure 2A and 2B illustrates different views of a further example of the projectile according to some embodiments of the present disclosure.

Figure 3A and 3B illustrates different views of a further example of the projectile according to some embodiments of the present disclosure.

Figure 4A and 4B illustrates different views of a further example of the projectile according to some embodiments of the present disclosure.

Figure 5A and 5B illustrates different views of two further examples of the projectile according to some embodiments of the present disclosure.

Figure 6A and 6B illustrates different views of a fur-

ther example of the projectile according to some embodiments of the present disclosure.

Figure 7A and 7B illustrates different views of a further example of the projectile according to some embodiments of the present disclosure.

Figure 8A-8C illustrates an example of the projectile according to some embodiments prior to assembling.

Detailed description

[0029] The present inventive concept will now be described more fully hereinafter with reference to the accompanying drawings, in which some variants of the inventive concept are shown. This inventive concept may, however, be implemented in many different forms and should not be construed as limited to the variants set forth herein; rather, these variants are provided for thoroughness and completeness, and fully convey the scope of the present inventive concept to the skilled person.

[0030] It is also to be understood that the terminology used herein is for purpose of describing particular embodiments only, and is not intended to be limiting. It should be noted that, as used in the specification and the appended claim, the articles "a", "an", "the", and "said" are intended to mean that there are one or more of the elements unless the context clearly dictates otherwise. Thus, for example, reference to "a unit" or "the unit" may refer to more than one unit in some contexts, and the like. Furthermore, the words "comprising", "including", "containing" do not exclude other elements or steps. It should be emphasized that the term "comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps, or components. It does not preclude the presence or addition of one or more other features, integers, steps, components, or groups thereof. The term "and/or" is to be interpreted as meaning "both" or each as an alternative.

[0031] It will also be understood that, although the term first, second, etc. may be used herein to describe various elements or features, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first portion could be termed a second portion, and, similarly, a second portion could be termed a first portion, without departing from the scope of the embodiments. The first portion and the second portion are both portions, but they are not the same portion.

[0032] A non-lethal projectile according to the present inventive concept will now be described with reference to figure 1A to 8C. Fig. 1A to 8C illustrates, by way of example, a number of embodiments. It should however be noted that features of the disclosed embodiments may be suitably combined with each other in any manner apparent to anyone of ordinary skill in the art, such that one or more features of one embodiment may also be considered to be disclosed in relation to another embodiment. It should further be appreciated that the claimed subject matter is not limited to the disclosed examples of the figures.

[0033] Figures 1A to 1F illustrates, by way of a first example, a non-lethal projectile 100 according to some embodiments. More specifically, Fig. 1A is a first perspective view of the projectile 100 in a generally front facing direction. Fig. 1B is a second perspective view of the projectile 100 in a generally rear facing direction. Fig. 1C is a front view of the projectile 100. Fig. 1D is a rear view of the projectile 100. Fig. 1E is a side view of the projectile 100. Fig. 1F is a side view of the projectile without any fins for illustrating the tapering of a second portion 104b of a sidewall member 104 of the projectile.

[0034] Referring to Figs. 1A-1F, the projectile 100 comprises a front member 102 and a cylindrical sidewall member 104. The front member 102 constitutes the leading portion of the projectile 100 as it travels through the air. The sidewall member 104 constitutes a trailing portion of the projectile. The front member 102 and the sidewall member 104 are arranged along a central axis AC of the projectile 100. The sidewall member 104 may be seen as a cylindrical sidewall extending rearwards from a rear of the front member 102, along the central axis AC. The front member 102 and the sidewall member 104 together forms a main body of the projectile 100. The projectile 100 may be manufactured as a single piece of material. Alternatively, the front member 102 and the sidewall member 104 may be manufactured as two separate pieces which can be joined together, as will be further exemplified and described below in connection with Fig. 8A-8C.

[0035] The projectile 100 further comprises a partition member 102b. The partition member 102b is arranged between the front member 102 and the sidewall member 104. The partition member 102b should be understood as an inner wall separating the front member 102 from the sidewall member 104. The partition member 102b may also be referred to as a divider. The partition member 102b may be an integral part of the front member 102. Thus, the partition member 102b may constitute a rear facing portion or surface of the front member 102. Alternatively, the partition member 102b may be an integral part of the sidewall member 104, as illustrated in Fig. 8A. Thus, the partition member 102b may constitute a front facing portion or surface of the sidewall member 104.

[0036] The front member 102 comprises a forward facing portion 102a. The forward facing portion 102a should be seen as the surface of the front member 102 arranged towards the direction of travel. As illustrated herein, the forward facing portion 102a of the front member 102 has a hemispherical shape. In some embodiments, the forward facing potion 102a may have other shapes, such as a blunt shape, a cylindrical shape, a conical shape, or a conical shape with a blunt tip.

[0037] In some embodiments, the front member 102 comprises a protrusion (not shown) at a front/top end of the forward facing portion 102a. The protrusion may be a hemispherical protrusion that extends 0,1-2 mm from

the outer surface of the forward facing portion 102a. Thereby the projectile may be provided with a smaller contact surface when traveling through the magazine, reducing the risk of jamming within the magazine without increasing the risk of jamming when moving from the magazine to the barrel chamber since the protrusion is smooth.

[0038] The front member 102 may in some embodiments be made of a solid material. The front member 102 may for instance be made of an elastic material, such as rubber. As another example, the front member 102 may be made of a deformable material, such as a foam material.

[0039] In some embodiments, the front member encloses a closed cavity 126. In other words, the front member 102 may be hollow. The closed cavity may be formed by the walls of the front member 102 and the partition member 102b. The closed cavity 126 may be provided with a fill. The fill may be a liquid, a gas, or a solid, such as a powder. In case of having a closed cavity 126, the front member 102 is preferably made of a frangible material so as to break on impact. The fill may for instance be an irritant agent, such as pepper spray or tear gas. In another example, the fill may be an inflammatory or noxious agent such as malodorants, which induce nausea and/or vomiting. In yet another example, the fill may be a marking compound. The marking compound may mark the target in the visible, ultraviolet or infrared spectrum. Alternatively, the marking compound may be a DNA marker. In yet another example, the closed cavity may comprise a GPS tracker. In yet another example, the closed cavity may comprise an explosive device. The projectile 100 may be compatible with other suitable fills as well.

[0040] The projectile 100 may further comprise a fill nipple 128 for providing the fill to the closed cavity 126 of the front member 102. The fill nipple 128 may be arranged at a center of a rotation generating member 114 (further described below) as illustrated in Fig. 1D. The fill nipple 128 may then extend though the center of the rotation generating member 114 and the partition member 102b so that it reaches the closed cavity 126. Alternatively, the fill nipple 128 may be provided at a center of the forward facing portion 102a of the front member 102. However, having the fill nipple 128 arranged in the back may be advantageous in that the forward facing portion 102a of the front member 102 can be made to have a smooth surface, which improves the aerodynamic properties of the projectile 100 as well as minimizing the risk of jamming due to projectiles getting stuck in the rifle or magazine.

[0041] The cylindrical sidewall member 104 comprises a first portion 104a and a second portion 104b. The first portion abuts the partition member 102b (or the front member 102), and the second portion 104b is arranged away from the partition member 102b, as seen along the direction of travel, or along a central axis AC (as illustrated in Fig. 1). The first portion 104a defines a portion of the sidewall member 104 having a constant outer diameter. The second portion 104b is instead tapered from a first end abutting the first portion 104a of the sidewall member 104 towards an opposite second end. In other words, the second portion 104b may have a frustoconical shape having a larger outside diameter at the first end than at the opposite second end. The tapering of the second portion 104b of the sidewall member 104 is further described below in connection with Fig. 1F.

[0042] The cylindrical sidewall member 104 has an inner surface 108 and an outer surface 106. The inner surface 108 may comprise a first inner sub surface 108a corresponding to the inner surface of the first portion 104a of the sidewall member 104 and a second inner sub surface 108b corresponding to the inner surface of the second portion 104b of the sidewall member 104. Correspondingly, the outer surface 106 may comprise a first outer sub surface 106a corresponding to the outer surface of the first portion 104a of the sidewall member 104 and a second outer sub surface 106b corresponding to the outer surface of the second portion 104b of the sidewall member 104.

[0043] The projectile 100 further comprises a plurality of rear fins 110. The plurality of rear fins 110 protrude from the outer surface 106 of the sidewall member 104. As in the illustrated example, the plurality of rear fins may be arranged on the second portion 104b of the sidewall member 104. Alternatively, the plurality of rear fins 110 may be arranged on the first portion 104a of the sidewall member 104. Alternatively, the plurality of rear fins may extend over at least a part of both the first and second portion 104a, 104b of the sidewall member 104. For example, the rear fins may extend over the entire length of the sidewall member 104.

[0044] The wording "protruding from" a surface should when herein used in connection with the rear fins of the projectile be construed as projecting outwards in a radial direction of the sidewall member 104.

[0045] The wording "extending" when herein used in connection with fins of the projectile 100 should be construed as a lengthwise extension of the fin (i.e. mainly in an axial direction of the projectile 100), as opposed to a width extension of the fin (i.e. mainly in an angular direction around the projectile 100).

[0046] Preferably, the rear fins of the plurality of rear fins 110 are evenly distributed around the circumference of the sidewall member 104. In the illustrated example, the projectile 100 comprises 16 rear fins. It should however be appreciated that the projectile 100 may comprise any number of rear fins, such as any number between 2 and 32. Preferably, the projectile 100 comprises 8 or 16 rear fins.

[0047] The rear fins of the plurality of rear fins 110 may protrude from the outer surface 106 of the sidewall member 104 at a ramp angle, as denoted by the angle δ in Fig. 1E. Thus, the rear fin gradually protrudes more and more from the outer surface 106 of the sidewall member 104 from a first edge 118a to a second edge 118b.

[0048] In the illustrated example, the rear fins of the plurality of rear fins 110 has its outermost portion (i.e. in radial direction) at the second edge 118b. However, in some embodiments, the outermost portion may be arranged at an intermediate position between the first edge 118a and the second edge 118b. Put differently, the protrusion of the rear fins need not follow a straight line, as depicted herein. The protrusion may for instance first increase and later decrease, or be constant along the extension of the rear fin, in relation to the central axis of the projectile 100.

[0049] Having the plurality of rear fins 110 arranged on the tapered second portion 104b of the sidewall member 104 allows the rear fins to protrude to a greater extent in relation to the surface of the projectile 100 on which it is arranged, thus having a greater effect on the rotation of the projectile 100.

[0050] The projectile 100 further comprises a plurality of front fins 112. The plurality of front fins 112 may protrude from the forwards facing portion 102a of the front member 102 as illustrated herein. The plurality of front fins 112 may be evenly distributed around the circumference of the projectile 100 as shown in Fig. 1C. As shown in Fig. 1E, the plurality of front fins 112 may be arranged at a rear end of the front member 102. Alternatively, or in combination, the plurality of front fins 112 may protrude from the outer surface of the sidewall member 104 (or more specifically from the first portion 104a of the sidewall member 104). The projectile 100 may comprises the same number of rear fins as front fins, in this case 16. However, the projectile 100 may comprise any number of front fins between 2 and 32. Preferably, the projectile 100 comprises 8 or 16 front fins. Further, the projectile 100 may comprise a different number of front and rear fins, an example of which is illustrated in Fig. 3B.

[0051] The inner surface 108 together with the partition member 102b forms an open cavity 124 of the projectile 100. The open cavity 124 has an open end opposing the partition member 102b, i.e. towards a rear of the projectile 100. The sidewall member 104 may thus be seen as a hollow skirt portion of the projectile 100.

[0052] As shown in fig. 1B, the projectile 100 further comprises a rotation generating member 114. The rotation generating member 114 is arranged within the open cavity 124. More specifically, the rotation generating member may be arranged on the partition member 102b. The rotation generating member 114 (or means for generating a rotational motion of the projectile 100) is configured to generate a rotary motion of the projectile 100 around its central axis, AC, when subject to a forward driving force. The forward driving force (also referred to as a propulsive force) may be caused by a compressed gas, such as air, being released to fire the projectile. As in the illustrated example, the rotation generating member 114 may be a propeller-like structure as illustrated herein. However, as is readily understood by the skilled person, other types of structures which drives a rotation of the projectile 100 in response to a propulsive force may be used as well. The skirt-like structure of the sidewall member 104 that surrounds the rotation generating member 114 may serve the purpose of concentrating the forward driving force of the compressed air when the projectile 100 travels through the rifle, and, once the projectile 100 travels through the air, preventing the oncoming airflow from engaging the rotation generating member 114 to inhibit the rotary motion of the projectile 100.

[0053] In the illustrated example, the rotation generating member 114 comprises a plurality of rotor blades 120. Herein, the rotation generating member 114 comprises 8 rotor blades 120. However, any number of rotor blades between 2 and 32 may be used. An angle of attack of the rotor blades of the plurality of rotor blades may be between 5 and 75 degrees, preferably 10 and 50 degrees, or more preferably 30 to 45 degrees.

[0054] Turning again to Fig. 1D, and in particular to the zoomed-in portion of a rear fin. Each rear fin of the plurality of rear fins 110 comprises a first flank surface 116a and a second flank surface 116b. The first and second flank surfaces 116a, 116b may also be referred to as a first and second sidewall of the fins. The first and second flank surfaces 116a, 116b may form a respective angle (herein denoted α and β) to the outer surface 106 of the sidewall member 104. In the illustrated example, the first flank surface 116a is perpendicular to the outer surface 106 of the sidewall member 104. In other words, the angle $\alpha = 90$ degrees. The angle β of the second flank surface 116b is different from the angle of the first flank surface 116a. For example, the angle β is smaller than 90 degrees. More specifically, the angle β may be between 75 and 90 degrees. Similarly to the rear fins, the plurality of front fins 112 may also have a first and second flank surface formed at angles to the outer surface 106 the same way as described above.

[0055] With reference to Fig. 1E, each rear fin of the plurality of rear fins 110 extend at a transverse angle to the central axis AC of the projectile 100 about the outer surface 106 of the sidewall member 104. In other words, the rear fins are angled in relation to a direction of travel of the projectile 100. Thus, a first edge 118a of a rear fin of the plurality of rear fins 110 is offset, in a circumferential direction of the projectile 100, from a second edge 118b of the rear fin. The plurality of front fins 112 (if present) may also extend at a transverse angle to the central axis AC of the projectile 100. The transverse angle of the plurality of front fins 112 may be the same or different from the transverse angle of the plurality of rear fins 110. Having the plurality of rear fins 110 (and/or the plurality of front fins 112) provided at a transverse angle assist in promoting the rotary motion of the projectile 100 as it travels through the air. In some embodiments, the plurality of rear fins 110 (and/or the plurality of front fins 112) may have a curvature as they traverse the length of the sidewall member 104 (as compared to extending along a straight line as herein illustrated).

[0056] As further illustrated in Fig. 1E, the plurality of rear fins 110 may be offset in the circumferential direction

from the plurality of front fins 112 such that they extend along different lines. Put differently, a rear fin of the plurality of rear fins 110 may extend along a first axis denoted A1. A corresponding front fin of the plurality of front fins 112 may extend along a second axis denoted A2. The first and second axis A1, A2 may be parallel, but different axes. In other words, the first and second axis A1, A2, is in this case not coincident. In some embodiments, the first and second axis A1, A2, may be coincident, as will be further described below in connection with Fig. 4B. Having the front wings offset from each other may have an advantageous effect of an improved interaction with the rifling of the barrel.

[0057] Turning to Fig. 1F, the projectile 100 is shown without any front and rear fins for the purpose of illustrating certain aspects of the main body of the projectile 100.

[0058] As described above, the second portion 104b of the sidewall member 104 is tapered. The tapering of the second portion 104b may be defined by an angle, herein denoted by γ, which the tapered portion deviates from cylindrical first portion 104a of the sidewall member 104. The angle γ may be 5 to 15 degrees, or more preferably 10 degrees. Put differently, the second portion 104b of the sidewall member 104 has a first diameter D1 at the end abutting the second portion 104b and a second diameter D2 at the opposite end, where the second diameter D2 is smaller than the first diameter D1. It goes without saying that the illustrated angle γ, (and thus also the illustrated relationship between the first and second diameters D1, D2) are to be seen merely as an illustrative example. Other relative dimensions of the projectile 100 may be possible as well within the scope of the present inventive concept. It should also be appreciated that the tapering of the second portion 104b need not to be constant. For instance, the tapering may gradually increase or decrease towards the distal end of the second portion 104b.

[0059] The first diameter D1 should be seen as the largest diameter of the main body of the projectile 100. The first diameter D1 may thus be set based on a caliber of the rifle used to fire the projectile 100. The projectile 100 described herein may for instance be designed for .43cal or .68cal. However, an outermost portion (i.e. in the radial direction) of the plurality of rear fins 110 and (if present also) the plurality of front fins 112 may define an outermost circumference of the projectile 100. This is illustrated in Fig. 1E, by the diameter denoted D0 being larger than the first diameter D1. The diameter D0 may for instance be 0.6 to 2.0 mm larger than D1. In other words, the outermost portion of the plurality of rear fins 110 (and plurality of front fins 112) may protrude 0.3 to 1.0 mm out from the outermost portion of the main body of the projectile 100.

[0060] Fig. 1F further illustrates that the front member 102 has a first height H1, the first portion 104a of the sidewall portion 104 has a second height H2 and the second portion 104b of the sidewall portion 104 has a third height H3. It goes without saying that the different heights H1, H2, H3 of the projectile 100 may be selected differently without departing from the present inventive concept. For example, even though in the illustrated example the second height H2 is larger than the third height H3, in some embodiments, the third height may be made equal to or larger than the second height. Thus a larger portion of the projectile 100 may be tapered. In some embodiments, the combined height of the first and second portion 104a, 104b, should be larger than, or equal to the first height H1. This may have an advantageous effect of the stability of the projectile 100.

[0061] In the following, with reference to Fig. 2A to Fig. 8C, different variants of the projectile 100 will be described. As is readily understood by the skilled person, any principles, aspects or features described in connection with one example embodiment are applicable also to the other example embodiments if not stated otherwise.

[0062] Figure 2A and 2B illustrates, by way of a second example, a projectile 200 according to some embodiments. More specifically, Fig. 2A is a perspective view of the projectile 200 in a generally rear facing direction and Fig. 2B is a side view of the projectile 200. In comparison to the projectile 100 as described above in connection with Fig. 1A to 1F, the projectile 200 as presently described has no plurality of front fins. Such an projectile 200 may be advantageous in that it to some extent allows for a simpler manufacturing process, while still achieving improved flight characteristics due to the rotation generating member 114, the plurality of rear fins 110 and the tapered second portion 104b of the sidewall member 104.

[0063] In the illustrated example of Fig. 2A and 2B, the plurality of rear fins 110 defines the outermost circumference of the projectile 200, as in the example of Figs. 1A to 1F. However, in some embodiments, an outer surface of the plurality of rear fins 110 may coincide with the outer surface 106 of the first portion 104a of the sidewall member 104. Put differently, the outermost circumference of the projectile 200 may be defined by the first portion 104a of the sidewall member 104 and the outer surface of the plurality of rear fins 110.

[0064] Figure 3A and 3B illustrates, by way of a third example, a projectile 300 according to some embodiments. More specifically, Fig. 3A is a perspective view of the projectile 300 in a generally rear facing direction and Fig. 3B is a side view of the projectile 300. In comparison to the projectile 100 as described above in connection with Fig. 1A to 1F, the projectile 300 as presently described shows a case where the projectile 300 has a different number of front fins compared to the number of rear fins. In the present example, the projectile 300 has eight front fins 112 and sixteen rear fins 110. This combination of front and rear fins has proven to achieve especially good results in terms of accuracy. However, as is readily understood by the skilled person, other combinations of front and rear fins may be applicable as well.

[0065] Figure 4A and 4B illustrates, by way of a fourth example, a projectile 400 according to some embodi-

ments. More specifically, Fig. 4A is a perspective view of the projectile 400 in a generally rear facing direction and Fig. 4B is a side view of the projectile 400. In comparison to the projectile 100 as described above in connection with Fig. 1A to 1F, the projectile 400 as presently described illustrates a case where the plurality of rear fins 110 are aligned with the plurality of front fins 112 so as to extend along a common axis.

[0066] More specifically, a rear fin of the plurality of rear fins 110 and a corresponding front fin of the plurality of front fins 112 may extend along common third axis A3. The front and rear fin may in such case be seen as a single fin being interrupted at an intermediate portion, so as to form two separate fins with a lengthwise offset there between.

[0067] Fig. 5A illustrates, by way of example, a variant of the projectile 300 as described above in connection with Fig. 3A and 3B. The projectile 300' illustrated herein shows an example where the plurality of front fins 112 are arranged on the first portion 104a of the sidewall member 104, instead of on the front member 102. Preferably, the plurality of front fins 112 are arranged towards the end of the first portion 104a abutting the front member 102 so as to provide a distance between the plurality of front fins 112 and the plurality of rear fins 110.

[0068] Similarly, Fig. 5B illustrates, by way of example, a variant of the projectile 100 as described above in connection with Fig. 1A to 1F. The plurality of front fins 112 of the projectile 100' illustrated herein, are also arranged on the first portion 104a of the sidewall member 104.

[0069] Figure 6A and B illustrates, by way of a sixth example, a projectile 600 according to some embodiments. More specifically, Fig. 6A is a perspective view of the projectile 600 and Fig. 6B is a front view of the projectile 600.

[0070] The plurality of front fins 112 of the projectile 600, as compared to the projectile 300 of Fig. 3A and 3B, extends over a greater portion of the front member 102. Having the longer front fins, as illustrated herein, may promote even further rotary motion of the projectile 600.

[0071] Figure 7A and 7B illustrates, by way of a seventh example, a projectile 700 according to some embodiments. More specifically, Fig. 7A is a perspective view of the projectile 700 and Fig. 7B is a front view of the projectile 700.

[0072] The projectile 700 further comprises a plurality of grooves 130. The plurality of grooves 130 are arranged on the forward facing portion 102a of the front member 102. The plurality of grooves 130 may be understood as a plurality of depressions in the surface of the front member 102.

[0073] Each groove of the plurality of grooves 130 may be provided at a transverse angle to the central axis of the projectile 700. Put differently, a forward end of a groove of the plurality of grooves 130 may be offset in a circumferential direction from a rear end of the groove, as can be seen in the front view of Fig. 7B.

[0074] The projectile 700 comprises 16 grooves. However, the projectile 700 may comprise 8 grooves, or any number of grooves between 2 and 32.

[0075] The projectile 700 as illustrated herein comprises both a plurality of front fins 112 and the plurality of grooves 130. However, in some embodiments, the projectile 700 comprises only the plurality of grooves 130 (and no front fins 112).

[0076] However, in some embodiments, the plurality of grooves 130 are in the form of indentations or dimples (not shown), such as e.g., hemispherical indentations or dimples, provided on at least portion of the outer surface of the front member 102. Thus, only a portion of the outer surface of the front member 102 may be covered with the plurality of indentations or dimples, or the entire surface of the front member 102 may be covered by the plurality of indentations or dimples. The plurality of indentations or dimples may accordingly be evenly distributed on the outer surface of the front member 102.

[0077] Fig. 8A-C illustrates an example of the projectile 100', according to some embodiments, prior to assembling. As described above, the front member 102 and the sidewall member 104 may be provided as two separate parts (as illustrated herein) which may be joined together. The sidewall member 104 is shown in Fig. 8A. Fig. 8B and 8C illustrates two different examples of the front member 102.

[0078] The front member 102 may be a hollow shell for forming the closed cavity 126 as shown in Fig. 8B. In the illustrated example, the partition member 102b is provided as an integral part of the sidewall member 104. Thus, the closed cavity is formed by the front member 102 and the partition member 102b once the front member 102 is attached to the sidewall member 104.

[0079] The front member 102 and the sidewall member 104 is provided with a respective mating interface for joining them together in a secure and reliable way. As realized by the skilled person, the mating interface may to some extend be designed based on the manner in which the front member 102 and the sidewall member 104 are to be joined together, e.g. by solvent welding, ultrasonic welding, or use of adhesive. As an example, the front member 102 may comprise a rim 134 extending around an inside of the front member 102 for forming a closed seal against the partition member 102b. Further, the sidewall member 104 may be provided with a notch 132 around an outer edge of the sidewall member 104 for allowing the front member 102 to partly overlap the sidewall member 104 when attached together.

[0080] In the presently disclosed configuration, the closed cavity 126 of the projectile 100' is filled from the rear of the projectile 100', after the front member 102 and the sidewall member 104 has been joined together. Thus, the fill nipple 128 extends through the partition member 102b as illustrated herein. Alternatively, the closed cavity 126 may be filled after joining of the front member 102 and the sidewall member 104 though a fill nipple provided on the front member 102. In yet another alternative, the front member 102 may be filled prior to being joined with

the sidewall member 104. In such case (as illustrated in Fig. 8C), the front member 102 may be sealed by a partition member 102b attached to the front member 102 for forming the closed cavity. The rim 134 may form part of the partition member 102b or be attached thereto. It should however be appreciated that the partition member 102b may constitute two or more elements. For instance, a first part of the partition member 102b may be arranged on the sidewall member 104, e.g. as illustrated in Fig. 8A, and a second part of the partition member 102b may be arranged on the front member 102, e.g. as illustrated in Fig. 8C. When assembling, the two parts of the partition member 102 may be joined together.

[0081] The sidewall member 104 may be made of a rigid plastic which do not break by the pressure used when firing the projectile 100'. Accordingly, the sidewall member 104 may be made from a suitable polymeric material or composite material.

[0082] The front member 102, or at least the forward facing portion 102a of the front member 102 may be made of a frangible material so as to break on impact, but not break or dissolve during storage or handling. Accordingly, the front member 102, or at least the forward facing portion 102a, may be made from a suitable polymeric material or composite material.

[0083] Preferably, the materials of the projectile are biodegradable.

[0084] Additionally, variations to the disclosed variants can be understood and effected by the skilled person in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims.

Claims

1. A non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700) comprising a front member (102) having a forward facing portion (102a), a cylindrical sidewall member (104) having an outer surface (106) and an inner surface (108), and a partition member (102b) arranged between the front member (102) and the sidewall member (104),

   wherein the partition member (102b) and the inner surface (108) of the sidewall member (104) forms an open cavity (124) having an open end opposing the partition member (102b),
   wherein the sidewall member (104) comprises a first portion (104a) abutting the partition member (102b), and a second portion (104b) away from the partition member (102b),
   wherein the second portion (104b) is tapered from a first end abutting the first portion (104a) of the sidewall member (104) towards an opposite second end,
   wherein the projectile (100, 100', 200, 300, 300', 400, 600, 700) further comprises:
   a plurality of rear fins (110) protruding from the outer surface (106) of the sidewall member (104), and
   a rotation generating member (114) arranged within the open cavity (124), the rotation generating member (114) being configured to generate a rotary motion of the projectile (100, 100', 200, 300, 300', 400, 600, 700) when subject to a forward driving force.

2. The non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700) according to claim 1, wherein the projectile (100, 100', 200, 300, 300', 400, 600, 700) further comprises a plurality of front fins (112) protruding from the forward facing portion (102a) of the front member (102) and/or from the outer surface (106) of the sidewall member (104).

3. The non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700) according to claim 2, wherein each rear fin (110) of the plurality of rear fins and/or each front fin (112) of the plurality of front fins has a first flank surface (116a) and a second flank surface (116b),

   wherein the first flank surface (116a) is perpendicular to the outer surface (106) of the sidewall member (104), and
   wherein the second flank surface (116b) is at an angle to the outer surface (106) of the sidewall member (104) different from the first flank surface (116a).

4. The non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700) according to claim 2 or 3, wherein each rear fin (110) of the plurality of rear fins and/or each front fin (112) of the plurality of front fins extend at a transverse angle to a central axis (AC) of the projectile (100, 100', 200, 300, 300', 400, 600, 700) about the outer surface (106) of the sidewall member (104).

5. The non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700) according to claim 4, wherein a front fin (112) of the plurality of front fins extend along a first axis (A1), and a rear fin (110) of the plurality of rear fins extend along a second axis (A2), wherein the first axis (A1) and the second axis (A2) are parallel.

6. The non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700) according to claim 4, wherein a front fin (112) of the plurality of front fins and a rear fin (110) of the plurality of rear fins extend along a common third axis (A3).

7. The non-lethal projectile (100, 100', 200, 300, 300',

400, 600, 700) according to any one of the claims 2 to 6, wherein an outermost portion of the plurality of rear fins (110) and/or the plurality of front fins (112) defines an outermost circumference of the projectile (100, 100', 200, 300, 300', 400, 600, 700).

8. The non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700) according to any one of the claims 2 to 7, wherein the plurality of rear fins (110) is between 2 and 32 rear fins, and/or
wherein the plurality of front fins (112) is between 2 and 32 front fins.

9. The non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700) according to any one of the claims 1 to 8, wherein the plurality of rear fins (110) protrude from the outer surface (106) of the sidewall member (104) at a ramp angle.

10. The non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700) according to any one of the claims 1 to 9, wherein the rotation generating member (114) comprises a plurality of rotor blades (120).

11. The non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700) according to any one of the claims 1 to 10, wherein the forward facing portion (102a) of the front member (102) has a hemispherical shape.

12. The non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700) according to any one of the claims 1 to 11, wherein the front member (102) is solid and made of an elastic material.

13. The non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700) according to any one of the claims 1 to 12, wherein the front member (102) encloses a closed cavity (126) comprising a fill.

14. The non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700) according to claim 13, further comprising a fill nipple (128) for providing the fill to the closed cavity (126) of the front member (102), the fill nipple (128) being arranged at a center of the rotation generating member (114).

15. The non-lethal projectile (100, 100', 200, 300, 300', 400, 600, 700) according to any of the claims 1 to 14, wherein the forward facing portion (102a) of the front member (102) comprises a plurality of grooves (130).

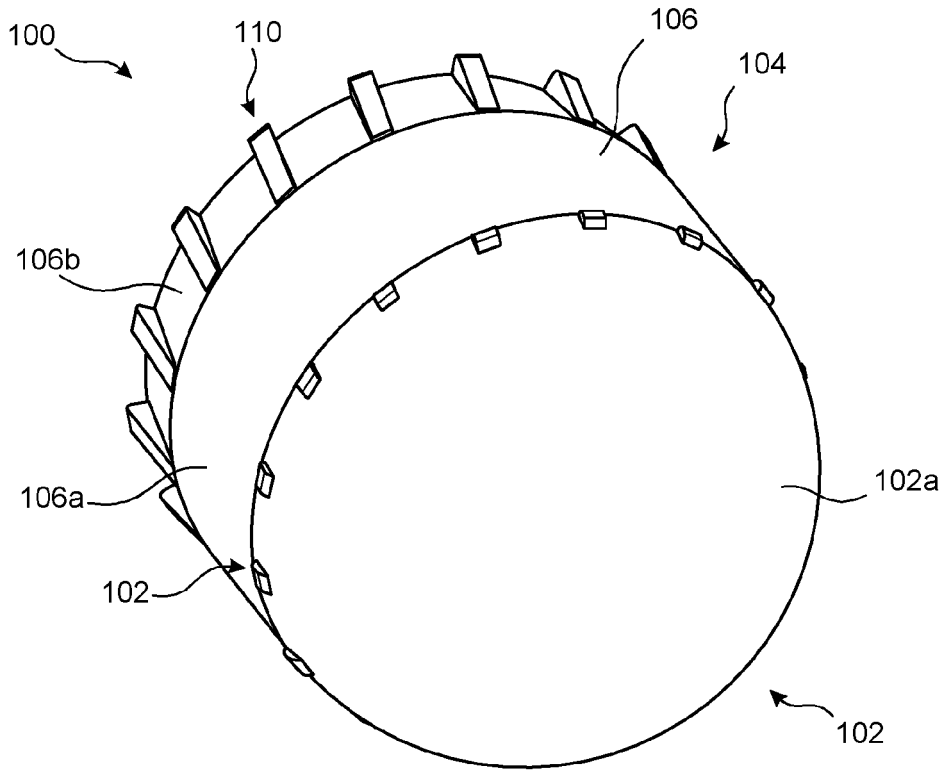
100
110
106
104
106b
106a
102a
102
102

FIG. 1A

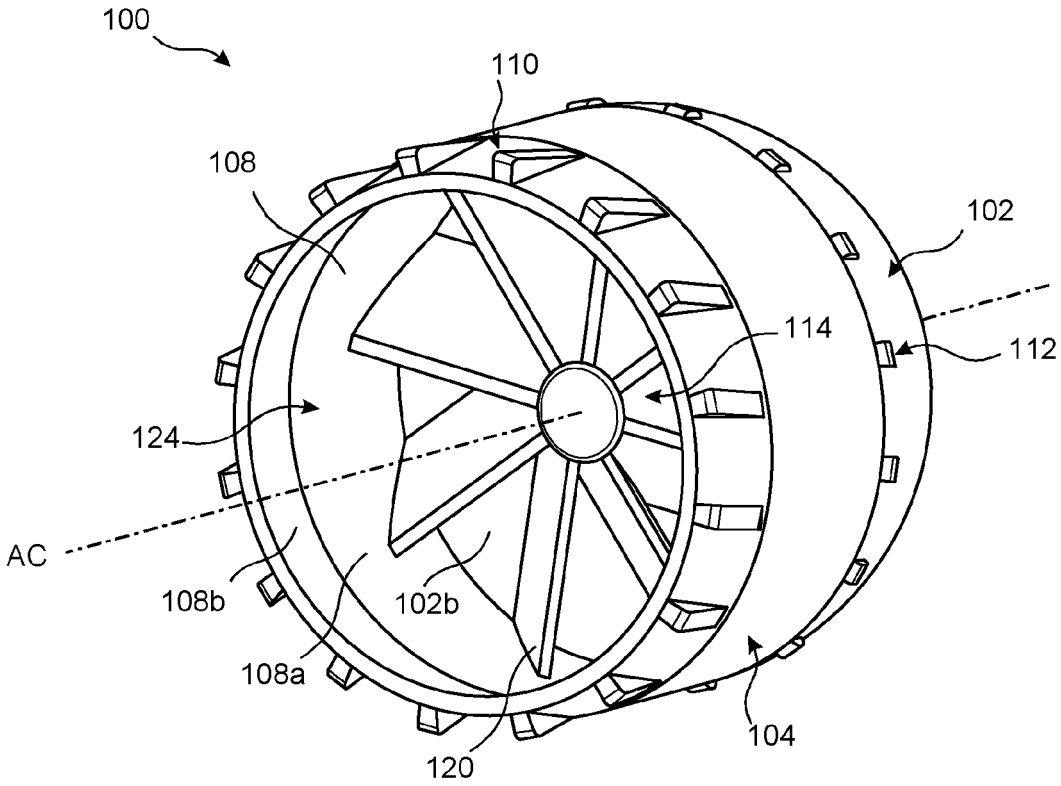
100
110
108
102
114
112
124
AC
108b
102b
108a
104
120

FIG. 1B

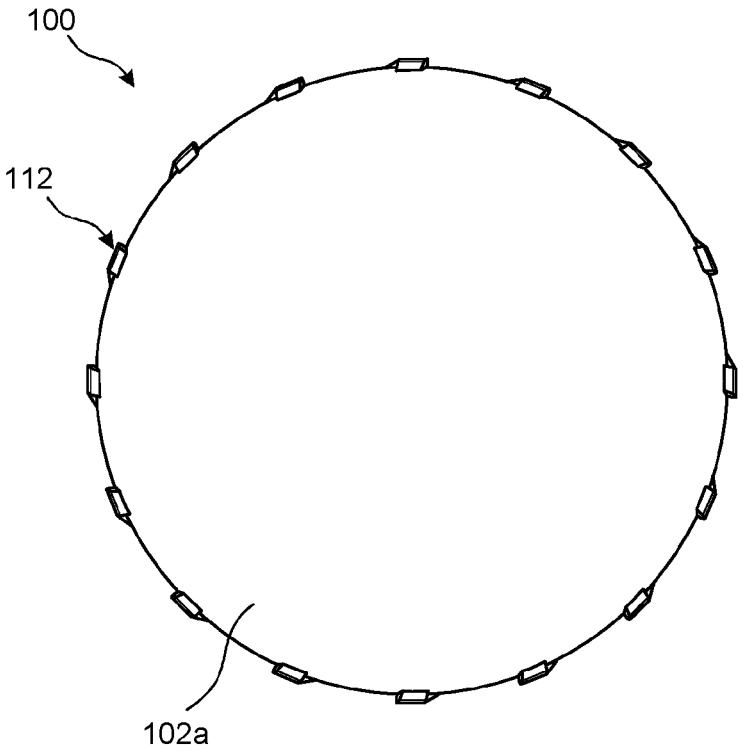

FIG. 1C

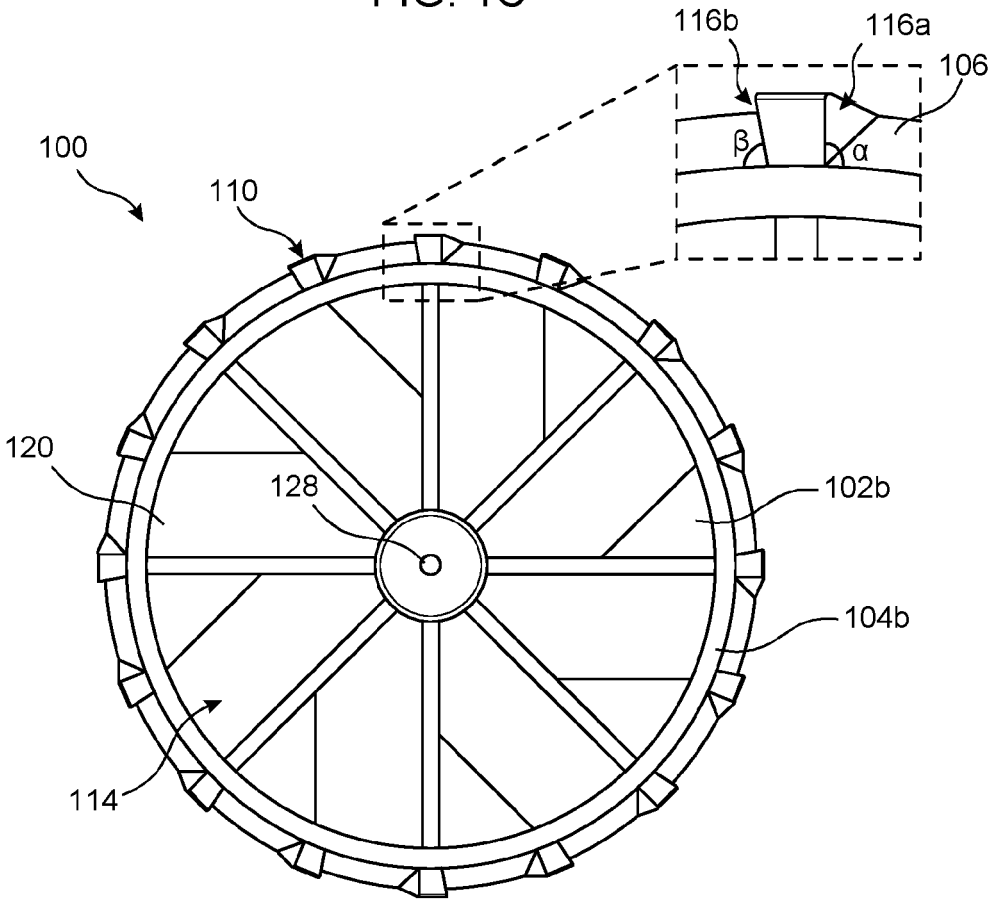

FIG. 1D

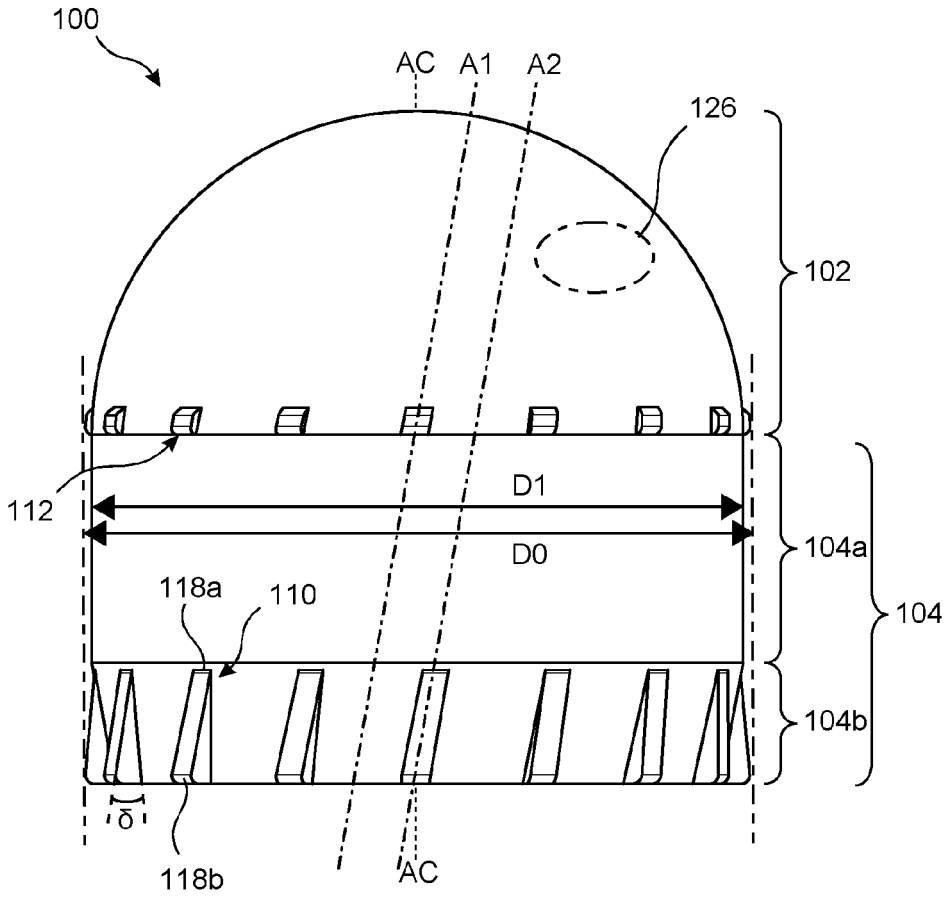
100
AC
A1
A2
126
102
112
D1
D0
104a
104
118a
110
104b
δ
118b
AC

FIG. 1E

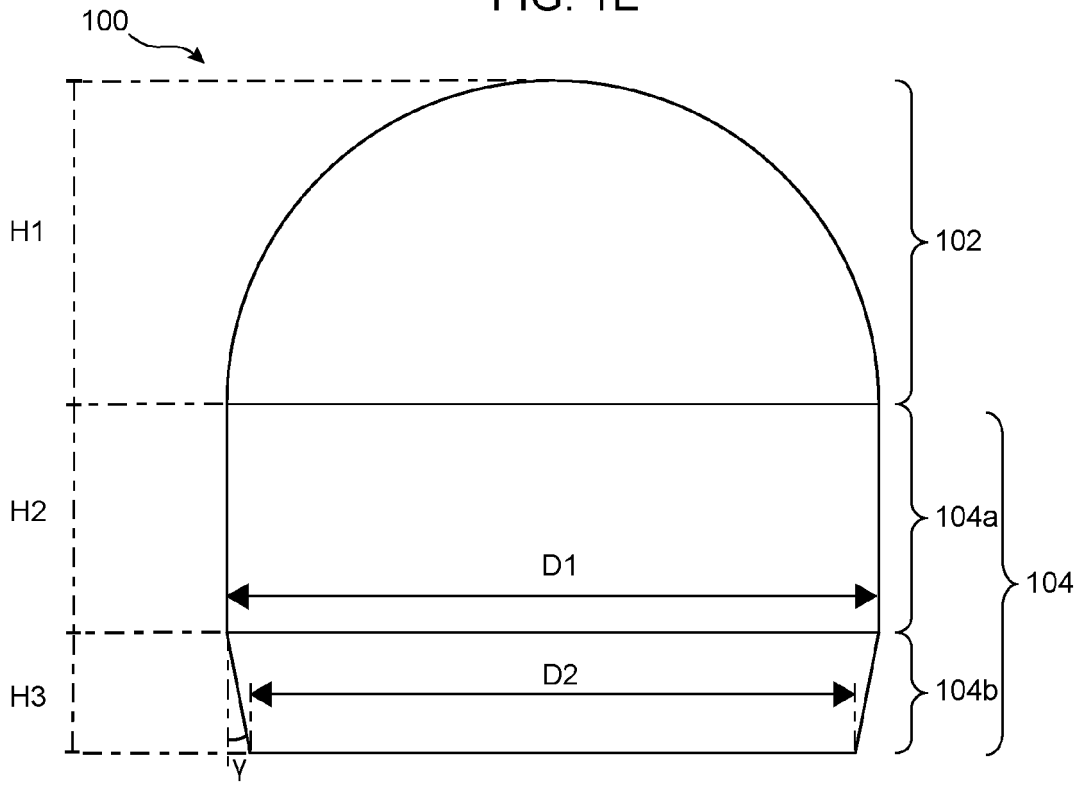
100
H1
102
H2
104a
D1
104
H3
D2
104b
γ

FIG. 1F

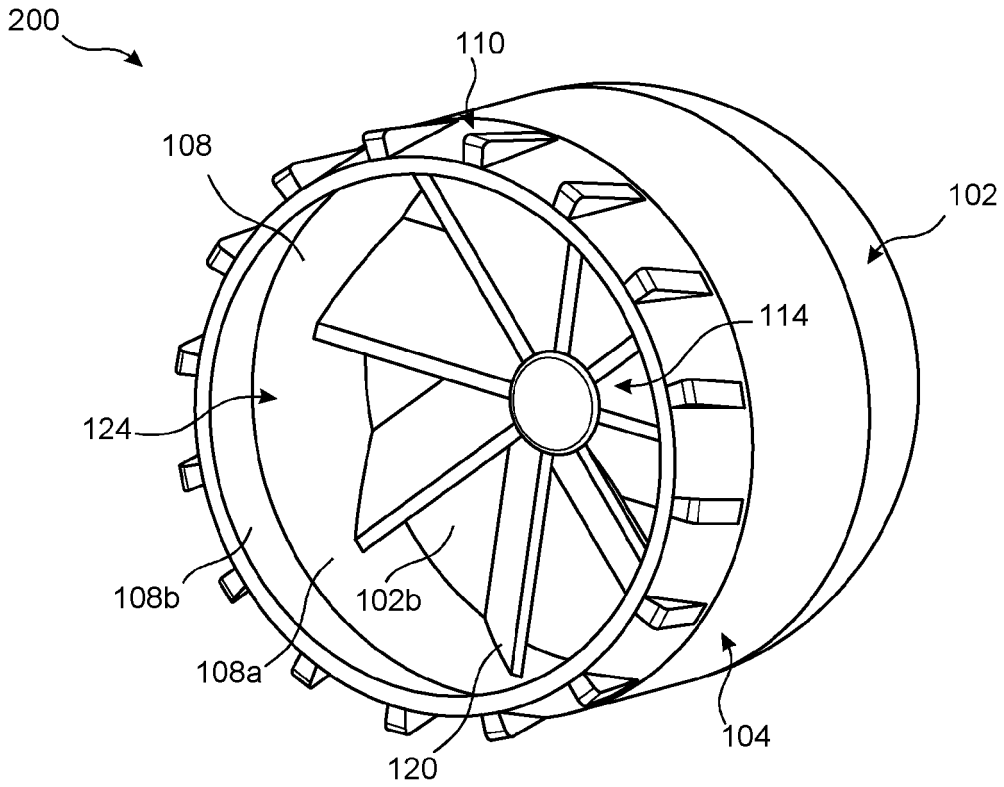
200
110
108
102
114
124
108b
102b
108a
104
120

FIG. 2A

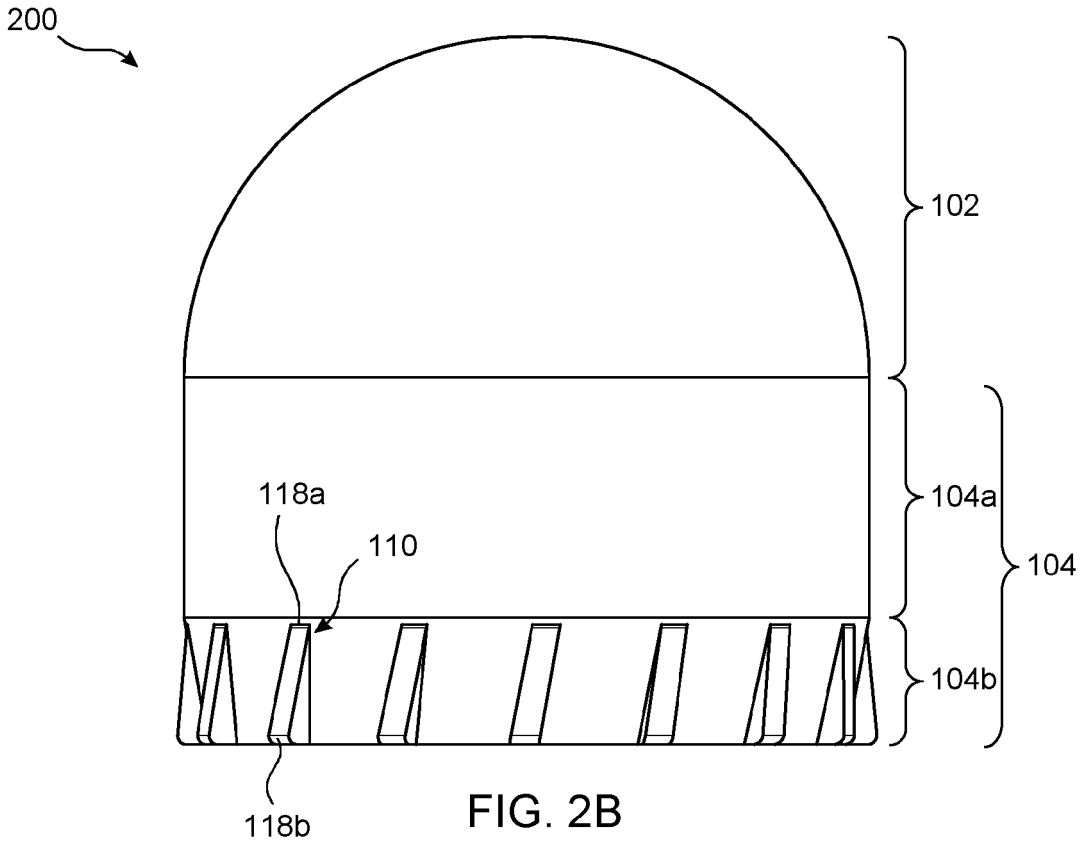
200
102
104a
104
118a
110
104b
118b

FIG. 2B

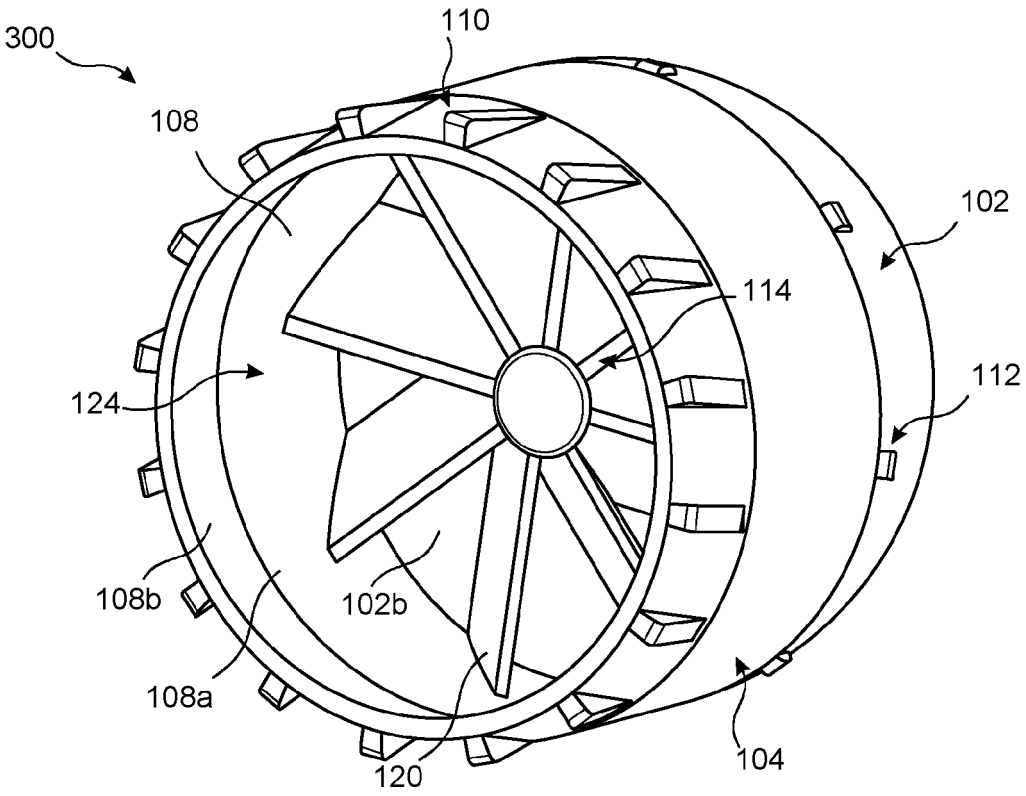
300
110
108
102
114
112
124
108b
102b
108a
120
104

FIG. 3A

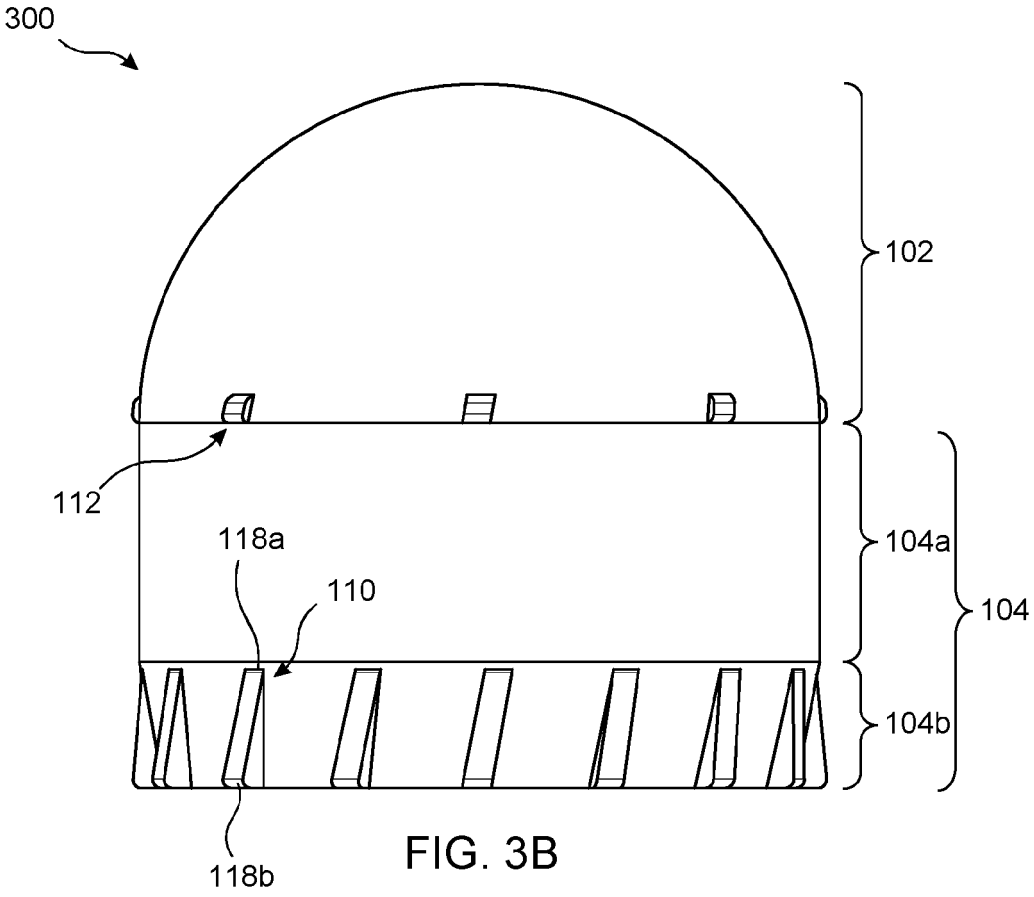
300
102
112
118a
110
104a
104
104b
118b

FIG. 3B

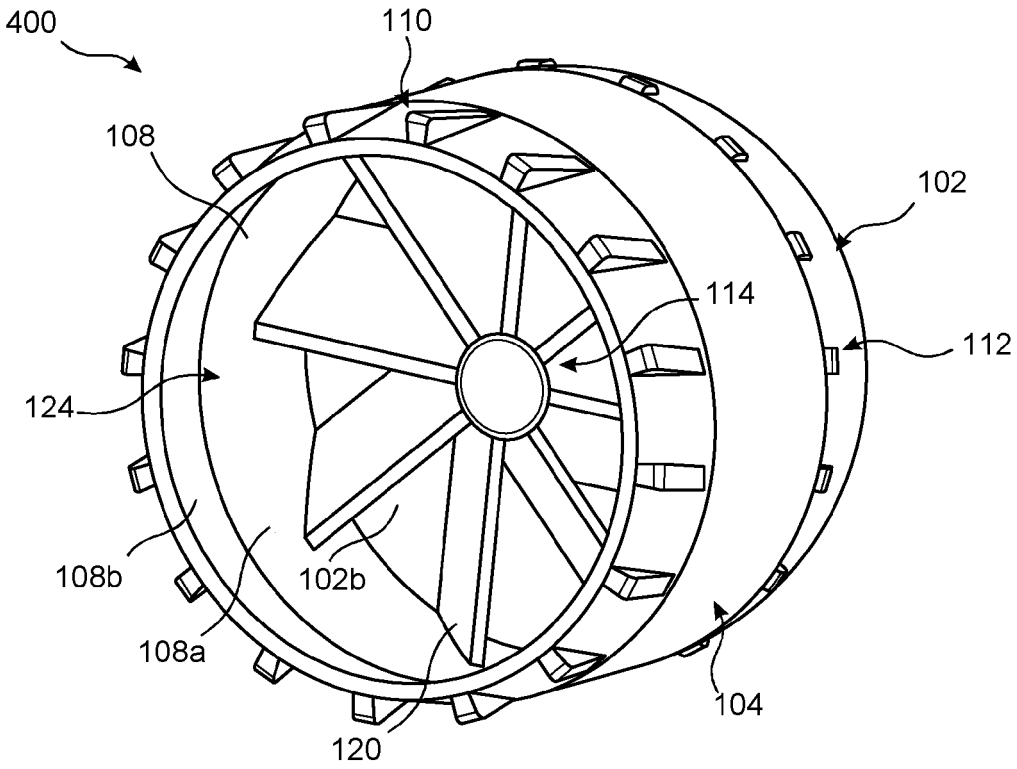
400
110
108
102
114
112
124
108b
102b
108a
104
120

FIG. 4A

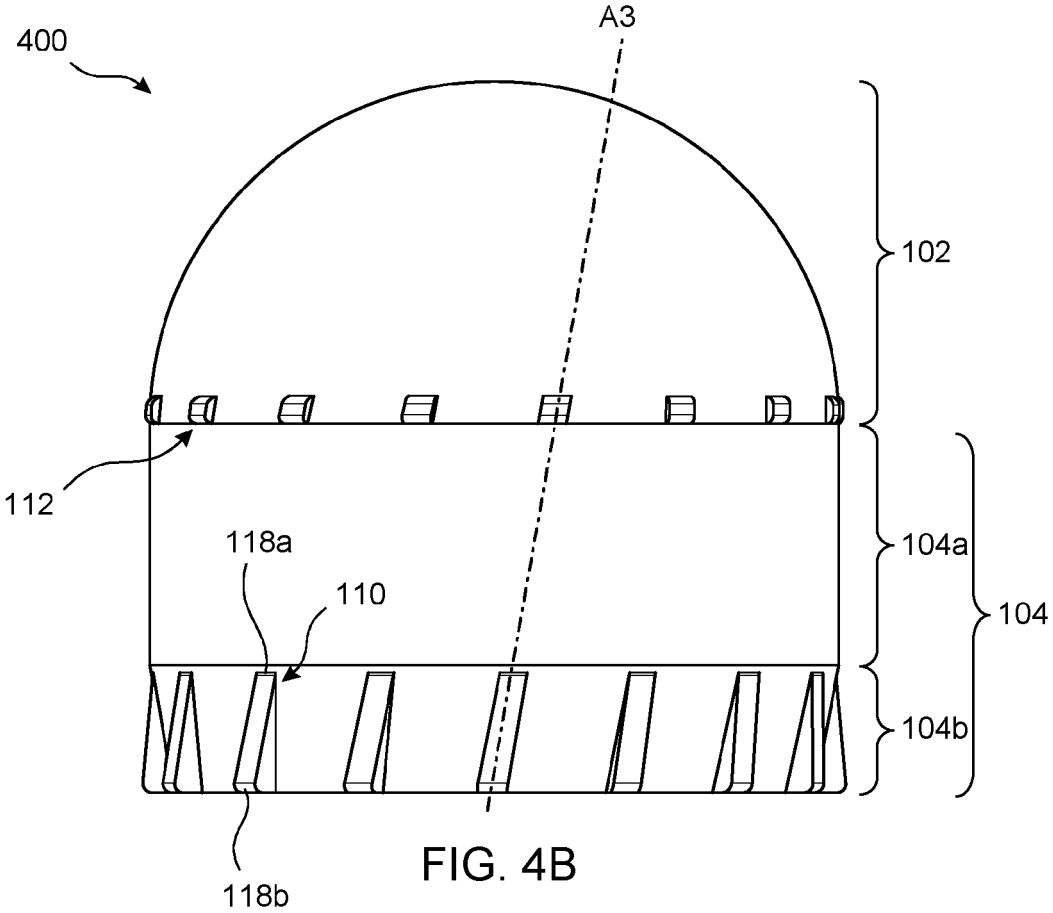
400
A3
102
112
104a
118a
110
104
104b
118b

FIG. 4B

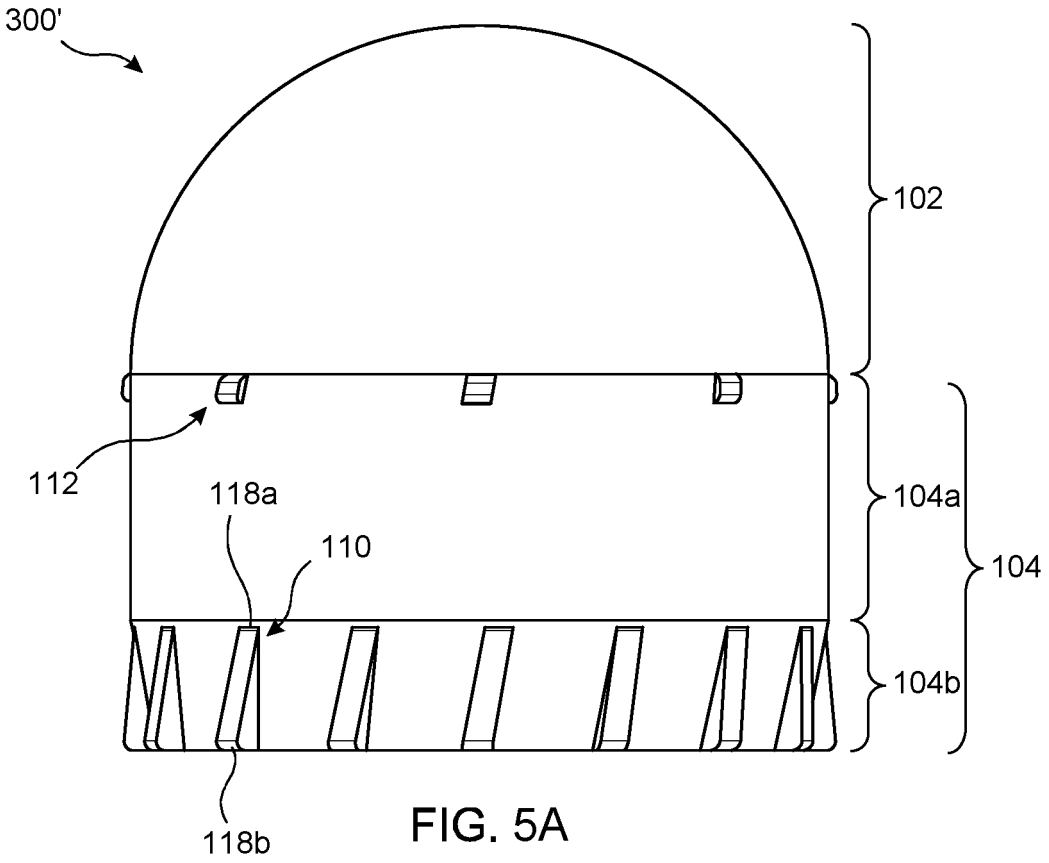
300'
102
112
118a
110
104a
104
104b
118b

FIG. 5A

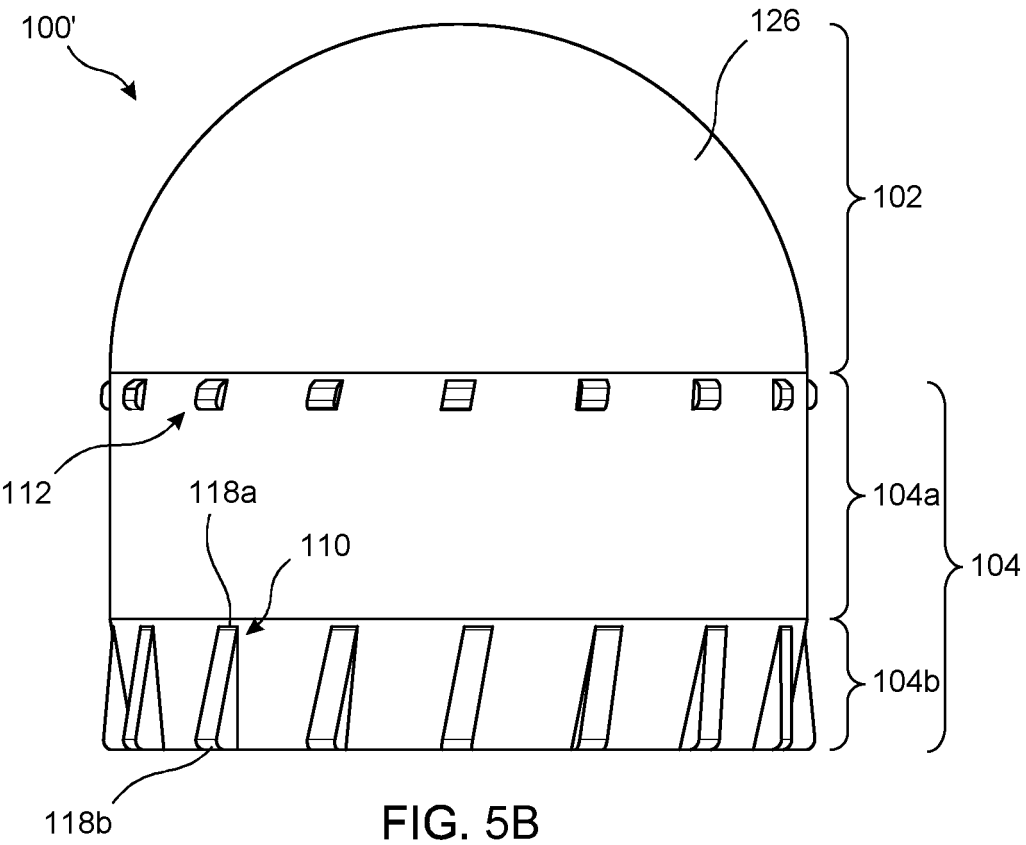
100'
126
102
112
118a
110
104a
104
104b
118b

FIG. 5B

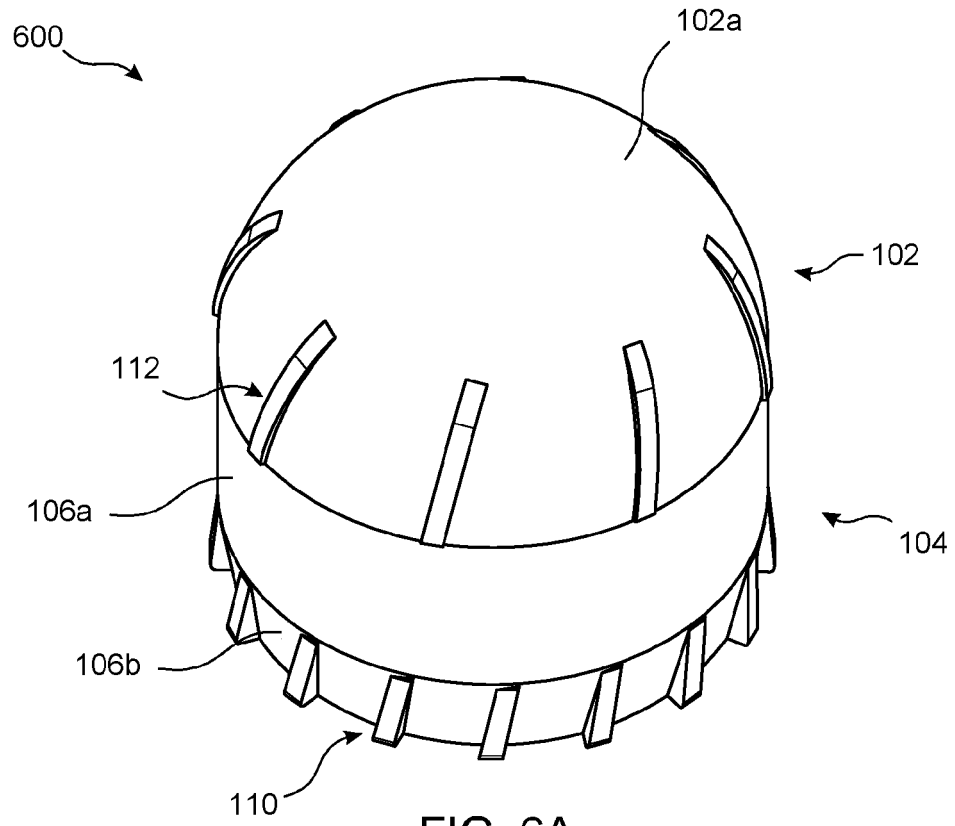

FIG. 6A

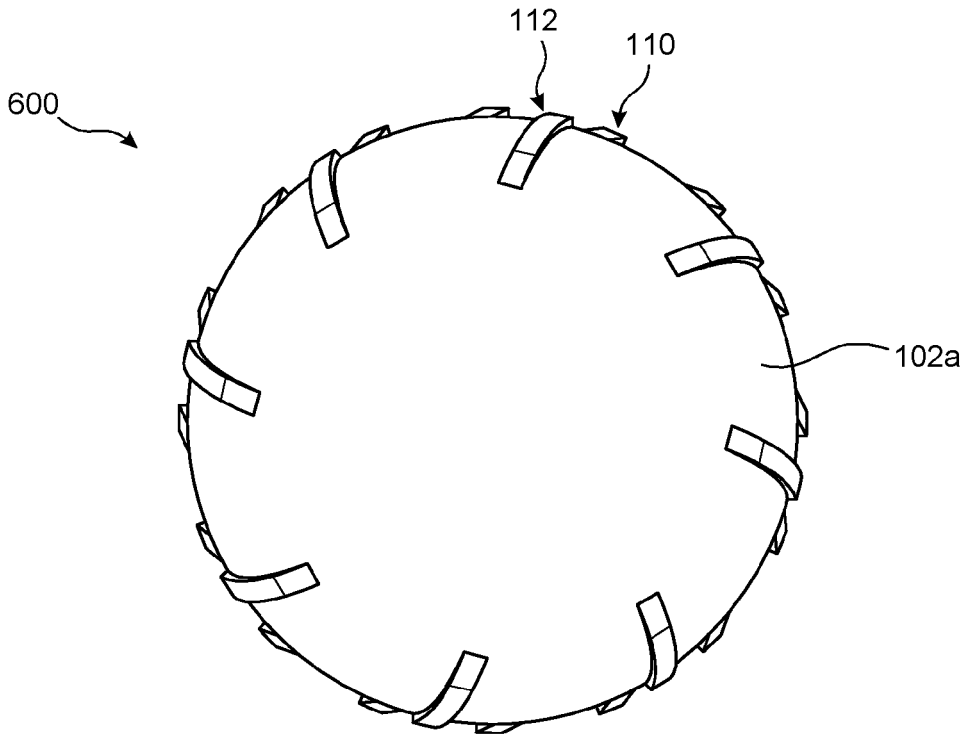

FIG. 6B

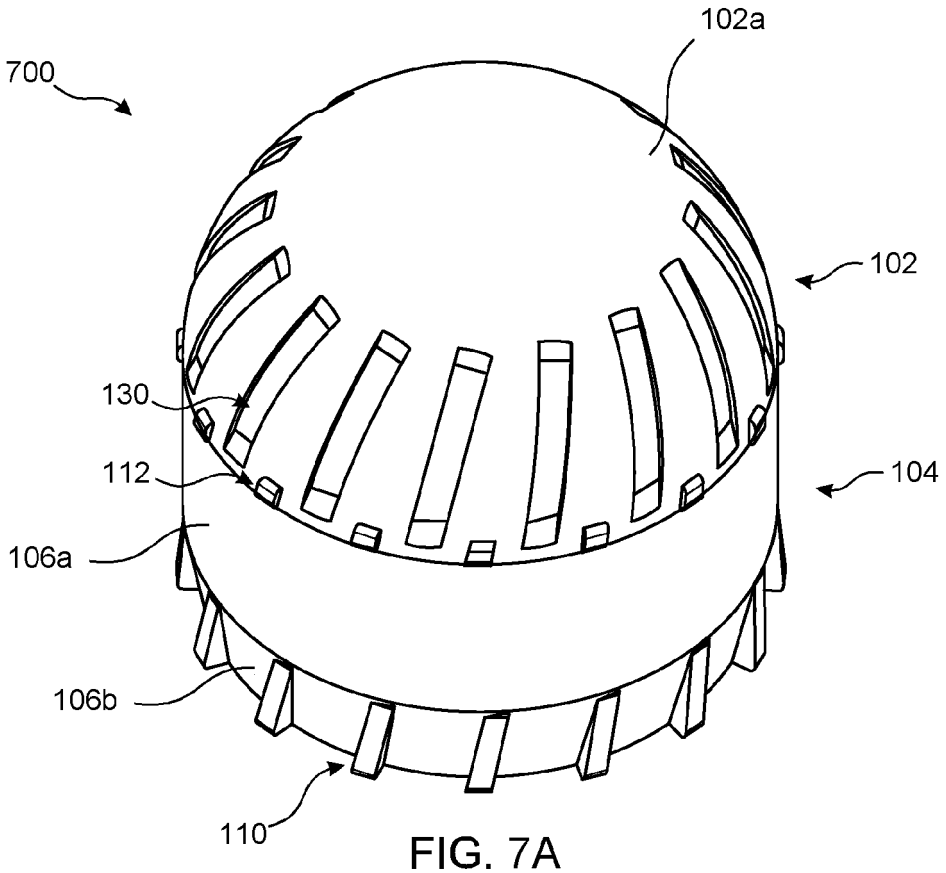

FIG. 7A

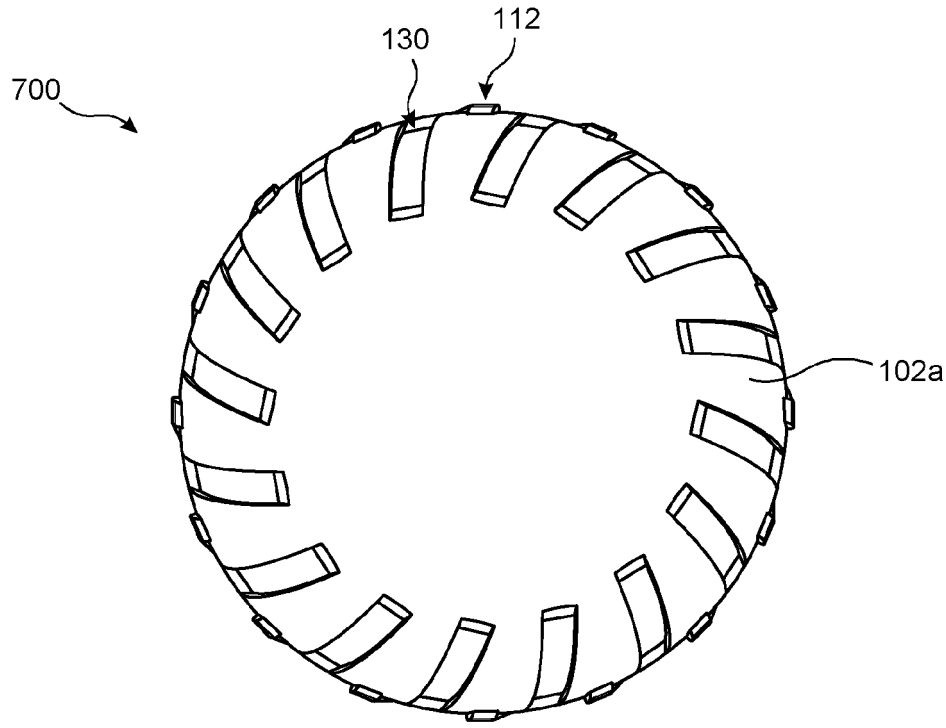

FIG. 7B

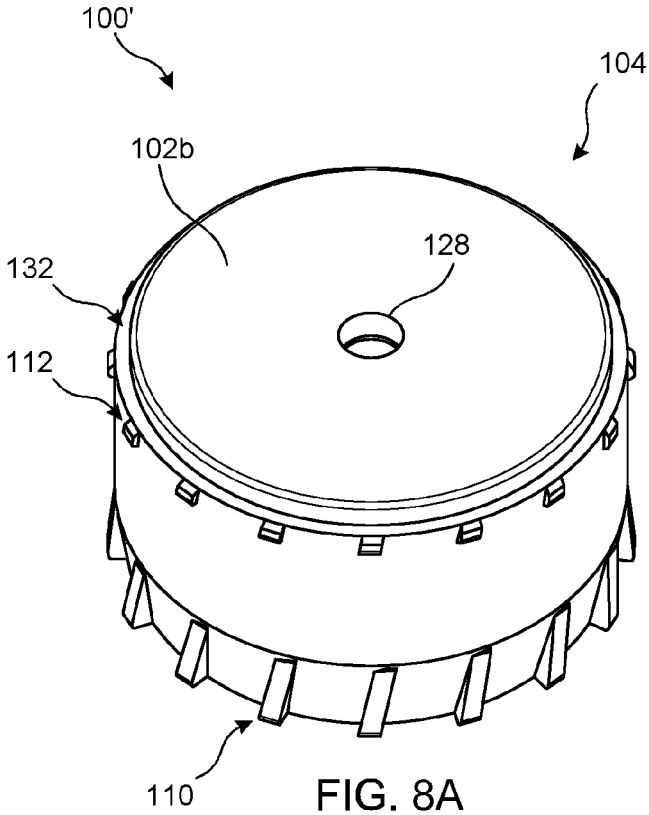

FIG. 8A

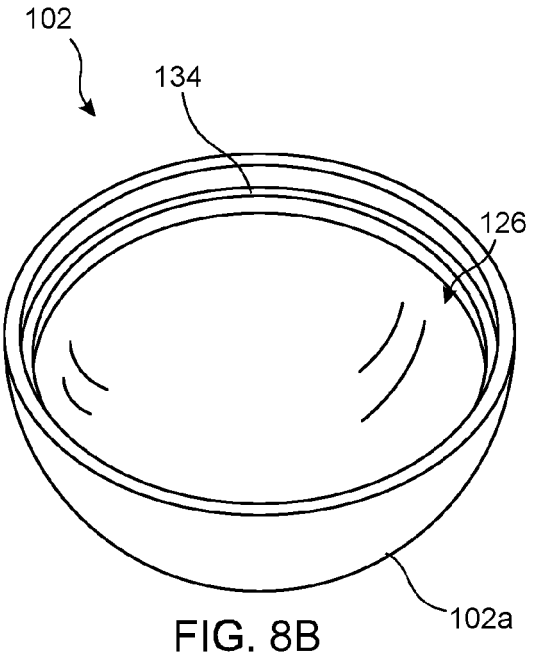

FIG. 8B

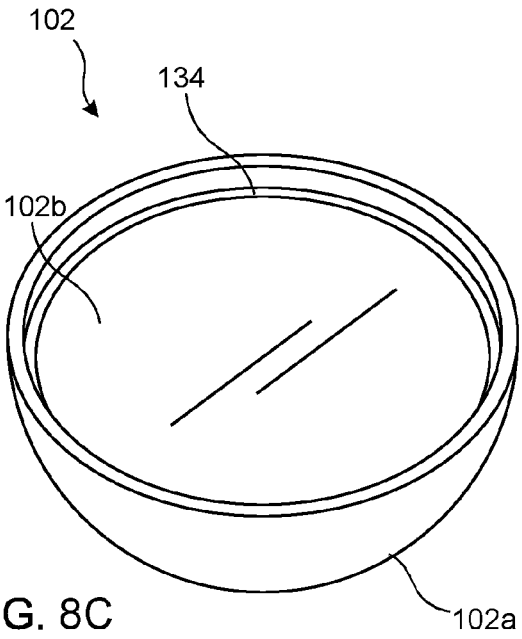

FIG. 8C

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EUROPEAN SEARCH REPORT

Application Number
EP 23 16 1497

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2012/199034 A1 (GIBSON GARY E [US] ET AL) 9 August 2012 (2012-08-09) * paragraphs [0028] - [0050]; figures 1-8 * -----	1-15	INV. F42B12/40 F42B6/10 F42B8/14 F42B10/04
A	WO 2023/017497 A1 (A T COBRA [IL]) 16 February 2023 (2023-02-16) * paragraphs [0016] - [0048]; figures 1-8 * -----	1-15	F42B10/06 F42B10/26

TECHNICAL FIELDS SEARCHED (IPC)

F42B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 July 2023	Kasten, Klaus

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 16 1497

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27-07-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012199034 A1	09-08-2012	NONE	
WO 2023017497 A1	16-02-2023	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82