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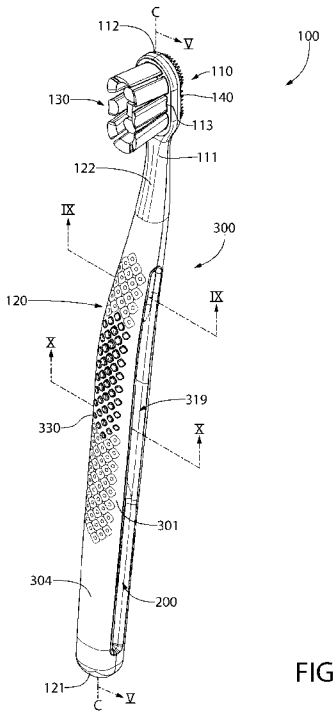

FIG. 1

(57) Abstract: A personal care implement having a head portion configured to perform a personal care treatment function, and a handle portion configured to be gripped by a user. The handle portion has a core component and an exterior body portion, both formed from a hard plastic material. The core component has a top surface, a bottom surface, a first lateral side, a second lateral side, and an aperture extending from the first lateral side to the second lateral side. The exterior body portion covers the top and bottom surfaces of the core component while leaving the first and second lateral sides of the core component exposed.

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PERSONAL CARE IMPLEMENT

BACKGROUND

[0001] Many personal care products, including toothbrushes, are typically manufactured out of plastic and are only intended to be used for a short period of time, after which they are discarded and replaced. Many plastics are not recyclable, are more difficult to recycle, or are not accepted in standard local recycling streams. There is a current trend in many industries to move away from plastic as a material for product manufacture or to reduce the amount of plastic that is used to manufacture a product in order to address environmental concerns. Thus, there is a continuing need to find alternative techniques for reducing the amount of plastic used in the manufacture of toothbrushes and other personal care implements.

BRIEF SUMMARY

[0002] The present invention may be directed to a personal care implement having a head and a handle. The handle may have a core component, an exterior body portion, and an aperture extending through the lateral sides of the implement.

[0003] In one aspect, the invention may be a personal care implement comprising: a head portion configured to perform a personal care treatment function; a handle portion configured to be gripped by a user, the handle portion comprising: a core component comprising a top surface, a bottom surface, a first lateral side, a second lateral side, and an aperture extending from the first lateral side to the second lateral side; an exterior body portion covering the top and bottom surfaces of the core component while leaving the first and second lateral sides of the core component exposed; and wherein the core component and the exterior body portion are both formed from a hard plastic material.

[0004] In another aspect, the invention may be a personal care implement comprising: a head portion configured to perform a personal care treatment function; a handle portion configured to be gripped by a user, the handle portion comprising: a core component comprising a top surface, a bottom surface, a first lateral side, a second lateral side, and an aperture extending from the first lateral side to the second lateral side; an exterior body portion covering the top and bottom surfaces of the core component while leaving the first and second lateral sides of the core

component exposed; and wherein the core component is transparent and the exterior body portion is opaque.

[0005] In yet another aspect, the invention may be a personal care implement comprising: a main structural body that extends along a longitudinal axis, the main structural body comprising an exterior body portion of a handle portion, the exterior body portion comprising a top surface that forms a top exterior surface of the handle portion, a bottom surface that forms a bottom exterior surface of the handle portion, a first lateral side, a second lateral side, and a cavity that extends from a first opening in the first lateral side to a second opening in the second lateral side; and a core component positioned within the cavity of the exterior body portion, the core component comprising a first lateral side, a second lateral side, a first axial portion that defines an aperture that extends from the first lateral side to the second lateral side, and a second axial portion having an I-beam shaped transverse cross-sectional area.

[0006] In yet another aspect, the invention may be a personal care implement comprising: a head portion configured to perform a personal care treatment function; and a handle portion configured to be gripped by a user during performance of the oral care treatment function, the handle portion extending along a handle axis and comprising a top surface, a bottom surface, a first lateral surface, a second lateral surface, a first axial portion comprising an aperture that extends from the first lateral surface to the second lateral surface and is elongated in a direction of the handle axis, and a second axial portion comprising an I-beam shaped transverse cross-sectional area.

[0007] In another aspect, the invention may be a personal care implement comprising: a handle portion configured to be gripped by a user during performance of a personal care treatment function; and a head extending along a head axis and comprising a head portion having a front surface and a plurality of tooth cleaning elements extending from the front surface, the plurality of tooth cleaning elements comprising: a plurality of central bristle tufts positioned along a central portion of the front surface of the head portion, the plurality of central bristle tufts comprising a first bristle tuft extending along a first bristle axis and having a first transverse cross-sectional shape, a second bristle tuft extending along a second bristle axis and having a second transverse cross-sectional shape that is the same as the first transverse cross-sectional shape, and a third bristle tuft extending along a third bristle axis and having a third transverse cross-sectional shape that is different than the first and second transverse cross-sectional shapes,

the third bristle tuft being located between the first and second bristle tufts in a direction of the head axis; and a plurality of peripheral bristle tufts positioned along a peripheral portion of the front surface of the head portion, the plurality of peripheral bristle tufts collectively surrounding the plurality of central bristle tufts.

[0008] In one aspect, the invention may be a personal care implement comprising: a handle portion configured to be gripped by a user during performance of a personal care treatment function; and a head extending along a head axis and comprising a head portion having a front surface and a plurality of tooth cleaning elements extending from the front surface, the plurality of tooth cleaning elements comprising: one or more central bristle tufts positioned along a central portion of the front surface of the head portion, the one or more central bristle tufts defining a central cleaning element arrangement having an hourglass shape; and a plurality of peripheral bristle tufts positioned along a peripheral portion of the front surface of the head portion, the plurality of peripheral bristle tufts collectively surrounding the central cleaning element arrangement.

[0009] In another aspect, the invention may be a method of manufacturing a personal care implement, the method comprising: injection molding a core component from a first hard plastic material, the core component comprising an aperture that extends from a first lateral side of the core component to a second lateral side of the core component, the core component comprising at least one through-hole extending from a front surface of the core component to a rear surface of the core component; and injection molding an exterior body portion of a main structural body onto the top and bottom surfaces of the core component without covering the first and second lateral sides of the core component, the main structural body formed from a second hard plastic material, the exterior body portion extending through and filling the at least one through-hole in the core component.

[0010] Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0012] FIG. 1 is a perspective view of a personal care implement in accordance with an embodiment of the present invention;

[0013] FIG. 2 is a partially exploded perspective view of the personal care implement of FIG. 1;

[0014] FIG. 3 is a rear perspective view of the personal care implement of FIG. 1;

[0015] FIG. 4 is a front view of the personal care implement of FIG. 1;

[0016] FIG. 5 is a side view of the personal care implement of FIG. 1;

[0017] FIG. 6A is a perspective view of a core component in accordance with an embodiment of the present invention;

[0018] FIG. 6B is a front view of the core component of FIG. 6A;

[0019] FIG. 6C is a side view of the core component of FIG. 6A;

[0020] FIG. 6D is a cross-sectional view taken along line VIID-VIID of FIG. 6A;

[0021] FIG. 6E is a cross-sectional view taken along line VIIE-VIIE of FIG. 6A;

[0022] FIG. 7A is a perspective view of an external body component in accordance with an embodiment of the present invention;

[0023] FIG. 7B is a front view of the core component of FIG. 7A;

[0024] FIG. 7C is a side view of the core component of FIG. 7A;

[0025] FIG. 7D is a cross-sectional view taken along line VIID-VIID of FIG. 7A;

[0026] FIG. 8 is a cross-sectional view taken along line V-V of FIG. 1;

[0027] FIG. 9 is a cross-sectional view taken along line IX-IX of FIG. 1;

[0028] FIG. 10 is a cross-sectional view taken along line X-X of FIG. 1;

[0029] FIG. 11 is a close-up front view of a head of a personal care implement in accordance with an embodiment of the present invention; and

[0030] FIG. 12 is a close-up rear view of a head of a personal care implement in accordance with an alternative embodiment of the present invention.

DETAILED DESCRIPTION

[0031] The following description of the preferred embodiment(s) is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

[0032] The description of illustrative embodiments according to principles of the present invention is intended to be read in connection with the accompanying drawings, which are to be considered part of the entire written description. In the description of embodiments of the invention disclosed herein, any reference to direction or orientation is merely intended for convenience of description and is not intended in any way to limit the scope of the present invention. Relative terms such as "lower," "upper," "horizontal," "vertical," "above," "below," "up," "down," "top" and "bottom" as well as derivatives thereof (e.g., "horizontally," "downwardly," "upwardly," etc.) should be construed to refer to the orientation as then described or as shown in the drawing under discussion. These relative terms are for convenience of description only and do not require that the apparatus be constructed or operated in a particular orientation unless explicitly indicated as such. Terms such as "attached," "affixed," "connected," "coupled," "interconnected," and similar refer to a relationship wherein structures are secured or attached to one another either directly or indirectly through intervening structures, as well as both movable or rigid attachments or relationships, unless expressly described otherwise. Moreover, the features and benefits of the invention are illustrated by reference to the exemplified embodiments. Accordingly, the invention expressly should not be limited to such exemplary embodiments illustrating some possible non-limiting combination of features that may exist alone or in other combinations of features; the scope of the invention being defined by the claims appended hereto.

[0033] Referring first to FIGS. 1 and 2, a personal care implement 100 will be described in accordance with an embodiment of the present invention. In the exemplified embodiment, the personal care implement 100 is a manual toothbrush. However, the invention is not to be so limited in all embodiments and the personal care implement 100 can take on other structural forms, including being a powered toothbrush, a tongue scraper, a gum and soft tissue cleanser, a water pick, an interdental device, a tooth polisher, a specially designed ansate implement having tooth engaging elements, or any other type of implement that is commonly used for oral care. Furthermore, in still other embodiments the implement may not be specifically used for oral care but could instead be a personal care implement which includes the various types of personal care implements noted herein and also includes hairbrushes, razors, body scrubbers, skin treatment devices, or the like. Thus, it is to be understood that the inventive concepts discussed herein can

be applied to any type of personal care implement or oral care implement unless a specific type of implement is specified in the claims.

[0034] Referring first to FIGS. 1-5, the personal care implement 100 will be described in accordance with an embodiment of the present invention. The personal care implement 100 may comprise a head portion 110 extending along a head axis A-A from a proximal end 111 to a distal end 112, and a handle portion 120 extending along a handle axis B-B from a proximal end 121 to a distal end 122. The head portion 110 of the personal care implement 100 may be configured to perform a personal care treatment function during a personal care treatment session. In an embodiment, the head portion 110 may be configured to perform an oral treatment function, such as teeth cleaning, gum scraping, flossing, or the like. The handle portion 120 of the oral care implement 100 may be held by a user to manipulate the head portion 110 during performance of a personal care treatment session. The head portion 110 and the handle portion 120 may be coupled together to form a singular unitary structure. In some embodiments, the head portion 110 may be permanently attached to the handle portion 120. In other embodiments, the head portion 110 may be detachable from the handle portion 120.

[0035] The head portion 110 may comprise a front surface 113 and a rear surface 116. A plurality of tooth cleaning elements 130 may extend from the front surface 113 of the head portion 110. The tooth cleaning elements 130 may be coupled to the head 110 in any manner known in the art, including staples, in-mold tufting (IMT), anchor-free tufting (AFT), or a modified AFT known as AMR. While a specific pattern of the tooth cleaning elements 130 is shown in the exemplified embodiment, the invention is not to be so limited in all embodiments and various different tooth cleaning element patterns may be used in other embodiments. The details of the tooth cleaning element pattern for the exemplified embodiment will be described below with reference to FIG. 11. A soft tissue cleanser 140 may be coupled to or positioned on the rear surface 116 of the head portion 110. The soft tissue cleanser 140 may be formed from an elastomeric material, such as a thermoplastic elastomer, a thermoplastic polyurethane, or the like. In certain other embodiments, the soft tissue cleanser 140 may include protuberances, which can take the form of elongated ridges, nubs, or combinations thereof. Of course, the invention is not to be so limited and in certain embodiments and the personal care implement 100 may not include any soft tissue cleaner.

[0036] Where it does not conflict with the other disclosure provided herein or the claims, it should be appreciated that the term "tooth cleaning elements" may be used in a generic sense to refer to any structure that can be used to clean, polish, or wipe the teeth and/or soft oral tissue (e.g. tongue, cheek, gums, etc.) through relative surface contact. Common examples of "tooth cleaning elements" include, without limitation, bristle tufts, filament bristles, fiber bristles, nylon bristles, polybutylene terephthalate (PBT) bristles, spiral bristles, rubber bristles, elastomeric protrusions, flexible polymer protrusions, combinations thereof, and/or structures containing such materials or combinations. Thus, any combination of these tooth-cleaning elements may be used within the tooth cleaning element field in some embodiments. Furthermore, where bristles are used for one or more of the tooth cleaning elements 105, such bristles can be tapered, end-rounded, spiral, or the like.

[0037] In embodiments that use elastomeric materials to form the tooth cleaning elements 130 or soft tissue cleaner 140, suitable elastomeric materials may include any biocompatible resilient material suitable for uses in an oral hygiene apparatus. To provide optimum comfort as well as cleaning benefits, the elastomeric material of any such tooth-cleaning element may have a hardness property in the range of A10 to A70 Shore hardness in one embodiment, or A8 to A25 Shore hardness in another embodiment. One suitable elastomeric material is styrene-ethylene/butylene-styrene block copolymer (SEBS) manufactured by GLS Corporation. Nevertheless, SEBS material from other manufacturers or other materials within and outside the noted hardness range could be used.

[0038] The handle portion 120 of the personal care implement 100 may have a specific design that results in a reduction in plastic material used to form the personal care implement 100 to address environmental concerns related to the use of plastic. Thus, the handle portion 120 may have voids or recesses or slots, described in detail below, to, among other purposes, facilitate this reduction in plastic material while having a design that ensures that the structural integrity of the personal care implement 100 is maintained. These features may also provide additional functional benefits to the user, such as pressure control, grip enhancements, and various pivoting actions of the head portion 110 relative to the handle portion 120 to gain better access to areas deeper within the oral cavity.

[0039] As best shown in FIG. 2, the personal care implement 100 may comprise a core component 200 and a main structural body 300. The main structural body 300 may comprise the

head portion 110 of the personal care implement 100 and an exterior body portion 301 of the handle portion 120. Thus, the handle portion 120 may be formed by the exterior body portion 301 of the main structural body 300 and the core component 200. The main structural body 300 may be a monolithic structure that comprises the exterior body portion 301 of the handle portion 120 and the head portion 110. The core component 200 may be a separate component that is affixed to the main structural body 300, or more specifically to the exterior body portion 301 of the main structural body 300, in the finished and assembled personal care implement 100. In alternative embodiments, the entire personal care implement 100 (with the exception of the tooth cleaning elements 130 and the soft tissue cleanser 140) may be formed as an integral, monolithic structure.

[0040] The handle portion 120 may be an elongated structure that extends along the handle axis B-B from a proximal end 122 to a distal end 121. As noted above, the handle portion 120 is the portion of the personal care implement that is gripped by a user during use of the personal care implement 100. Specifically, a user may wrap his/her hand around the handle 120 to manipulate the personal care implement 100 during use in order to brush teeth or perform other operations with the personal care implement 100. The handle portion 120 may be formed from a hard plastic. In the exemplified embodiment, the core component 200 and the main structural body 300 are both formed from a hard plastic. The handle portion 120 may be formed from a transparent material, an opaque material, or a mix of both transparent and opaque materials. In some embodiments, the core component 200 may be transparent or translucent and the main structural body 300 may be opaque. In some embodiment, the care component 200 and the main structural body 300 may have a different light transmissivity. Thus, in some embodiments the core component 200 and the main structural body 300 may have differing degrees of transparency, translucency, and/or opacity.

[0041] Examples of hard plastic materials that could be used to form the core component 200 and the main structural body 300 may include, for example without limitation, polypropylene, polyethylene terephthalate, polyethylene, polystyrene, polyvinyl chloride, or the like in various different embodiments. In some embodiments, a grip formed from an elastomeric material may be located along portions of an exterior surface of the exterior body portion 301 of the main structural body 300. In such embodiments, the elastomeric material may be formed from a

thermoplastic elastomer, a thermoplastic polyurethane, rubber, silicone, or the like. Such an elastomeric grip component is not included in the exemplified embodiment.

[0042] In the exemplified embodiment, and as described in more detail below, the exterior body portion 301 of the main structural body 300 may comprise a cavity 319, and the core component 200 may be positioned within the cavity 319 of the exterior body portion 301. The main structural body 300 may be injection molded over top of the core component 200 to manufacture the structure as described. The exterior body portion 301 may form an exterior or outer surface of the handle portion 120 and the core component 200 may form an interior structure within the exterior body portion 301 of the handle portion 120. The exterior body portion 301 may comprise an outer exterior surface 304 that forms an exterior surface or outer surface of the handle portion 120 of the personal care implement 100. The outer exterior surface 304 of the exterior body portion 301 may comprise gripping features 330 thereon to aid a user in gripping the handle portion 120 of the personal care implement 100. The gripping features 330 will be described in greater detail below, with specific reference to FIGS. 7A-7C.

[0043] Referring to FIGS. 6A through 6E, the core component 200 of the handle portion 120 of the personal care implement 100 will be described in detail. The core component 200 may extend along a longitudinal axis C-C from a proximal end 201 to a distal end 202. As mentioned above, the core component 200 may be configured to fit inside the cavity 319 formed by the exterior body portion 301. The core component 200 may be fixed within the cavity 319 of the exterior body portion 301 such that the core component 200 may be unable to be removed from the cavity 319. That is, while the exterior body portion 301 and the core component 200 may be separate components, they may be fixed together in a non-separable manner (other than by breaking) to form the end product which is intended to be used by consumers.

[0044] The core component 200 may comprise a top surface 203, a bottom surface 204, a first lateral side 205, and a second lateral side 206. The first and second lateral sides 205, 206 may extend between the top surface 203 and the bottom surface 204. An aperture 219 may extend through the core component 200 from the first lateral side 205 to the second lateral side 206. The aperture be elongated along the longitudinal axis C-C. The aperture 219 may extend through the core component 200 in a direction transverse to the longitudinal axis C-C. The aperture 219 may be open along at least a portion of the first lateral side 205 and at least a portion of the second lateral side 206. While in the exemplified embodiment the core component 200 has a singular

aperture 219, alternative embodiments of the core component 200 may comprise a plurality of apertures 219 of similar or varying sizes.

[0045] The core component 200 may generally comprise an upper portion 210 having an inner surface 211 and an outer surface 212, a lower portion 213 having an inner surface 214 and an outer surface 215, and at least one beam portion 216 that extends from the inner surface 211 of the upper portion 210 to the inner surface 214 of the lower portion 213. The upper and lower portions 210, 213 may have a greater width, measured in a direction transverse to the handle axis B-B, than the beam portion 216. In some embodiments, the beam portion 215 may extend along a portion of the length of the core component 200, but not the entirety of the core component 200 due to the core component 200 comprising the aperture 219. The aperture 219 may be formed through the beam portion 216 only and not also through the upper and lower portions 210, 213.

[0046] The beam portion 216 may have a first side surface 217 and a second side surface 218 that is opposite the first side surface. Specifically, the first lateral side 205 of the core component 200 may comprise the first side surface 217 of the beam portion 215 and the second lateral side 206 of the core component 200 may comprise the second side surface 218 of the beam portion 215. The top surface 203 of the core component 200 may be formed from the outer surface 212 of the upper portion 210 and the bottom surface 204 of the core component 200 may be formed from the outer surface 215 of the lower portion 213. In the exemplified embodiment, the aperture 219 may extend through the core component 200 so that the roof of the aperture 219 is formed from the inner surface 211 of the upper portion 210 and the floor of the aperture 219 is formed from the inner surface 214 of the lower portion 213. That is, the aperture 219 may be bounded by the inner surfaces 211, 214 of the upper and lower portions 210, 213 while being open along the lateral sides of the core component 200.

[0047] In the exemplified embodiment, the beam portion 216 may be conceptually divided into a first beam portion 216A that is located on a first side of the aperture 219 and a second beam portion 216B that is located on a second side of the aperture 219. Thus, in the exemplified embodiment the aperture 219 may be located between the first and second beam portions 216A, 216B. Thus, the first and second beam portions 216A, 216B may be separated from one another by the aperture 219. The first beam portion 216A may extend from a first end 238 of the aperture 219 towards the proximal end 201 of the core component 200 and the second beam portion 216B may extend from a second end 239 of the aperture 219 towards the distal end 202 of the core

component 200. While the beam portion 216 is divided into two beam portions 216A, 216B in the exemplified embodiment, the beam portion 216 may be divided into any number of portions in various other embodiments, including having a singular beam portion or more than two beam portions. For example, the core component 200 may comprise one beam portion 216 and one aperture 219, or the core component 200 may comprise three beam portions 216 and two apertures 219 such that each aperture 219 separates two of the beam portions 216 from one another.

[0048] As mentioned above, the beam portion 216 may extend from the inner surface 214 of the lower portion 213 to the inner surface 211 of the upper portion 210. That is, the beam portion 216 may be coupled to the inner surface 214 of the lower portion 213 and to the inner surface 211 of the upper portion 210. The first and second side surfaces 217, 218 of the beam portion 216 may be recessed relative to the side edges of the upper and lower portions 210, 213 of the core component 200. The beam portion 216 may be elongated along the longitudinal axis C-C from the proximal end 201 of the core component 200 to the distal end 202 of the core component 200.

[0049] As best seen in FIG. 6E, in some embodiments, the core component 200 may comprise a first recess 207 and a second recess 208, both of which may be elongated along the longitudinal axis C-C. Thus, the first side surface 217 of the beam portion 216 may be recessed relative to first side surfaces 206, 207 of the upper and lower portions 210, 213 of the core component 200 and the second side surface 218 of the beam portion 216 may recessed relative to second side surfaces 228, 229 of the upper and lower portions 210, 213 of the core component 200. The first recess 207 may be defined by the first side surface 217 of the beam portion 216, a portion of the inner surface 211 of the upper portion 210, and a portion of the inner surface 214 of the lower portion 213. The second recess 208 may be defined by the second side surface 218 of the beam portion 216, a portion of the inner surface 211 of the upper portion 210, and a portion of the inner surface 214 of the lower portion 213. In the exemplified embodiment the first and second recesses 207, 208 may form a U-shape. However, it should be understood that the first and second recesses 207, 208 could have other shapes.

[0050] The core component 200, or portions thereof, may comprise an I-beam shaped transverse cross-sectional area. Specifically, for any transverse cross-section taken through the core component 200 that intersects one of the beam portions 216, the core component 200 may have

an I-beam shaped transverse cross-sectional area. This is due to the fact that the lateral sides of the beam portions 216 are recessed relative to the lateral sides of the upper and lower portions 210, 213, thereby forming the I-beam like shape.

[0051] The aperture 219 may divide the core component 200 into different segments. In some embodiments, the core component 200 may have at least a first axial portion 232 comprising the aperture 219, and a second axial portion comprising the beam portion 216. The division of the core component 200 is generally created by the location of the aperture 219. In the exemplified embodiment, the aperture 219 divides the core component 200 into a first axial portion 232 containing the aperture 219, a second axial portion 231 that extends from the first axial portion 232 to the distal end 202, and a third axial portion 230 that extends from the first axial portion 232 to the proximal end 201. The core component 200 may be configured so that the first axial portion 232 is located axially between the second and third axial portions 230, 231. In the exemplified embodiment, the first axial portion 232 comprises the aperture 219, the second axial portion 231 comprises the second beam portion 216B, and the third axial portion comprises the first beam portion 216A.

[0052] In embodiments, the second and third axial portions 230, 231 may comprise an I-beam structure. In some embodiments, the first axial portion 232 may also have an I-beam structure, albeit with the aperture 219 extending through at least a portion of a vertical wall portion of the I-beam structure. In other embodiments the first axial portion 232 may have planar top and bottom surfaces, but no vertical wall portion and therefore no I-beam structure.

[0053] While the segmented portions of the personal care implement 100 are referred to as the first, second, and third axial portions, it should be understood that the portions could be referenced by their position such that the first axial portion 232 may be referred to as the central axial portion, the second axial portion 231 may be referred to as the distal axial portion, and the third axial portion 230 may be referred to as the proximal axial portion.

[0054] The second and third axial portions 230, 231 may comprise additional features such as additional cleaning elements, or elements to aid in assembling the personal care implement 100. In the exemplified embodiment, the second and third axial portions 230, 231 comprise a through-hole 221 and a connection feature 222. The through-hole 221 may extend from the top surface 203 of the core component 200 to the bottom surface 204 of the core component 200. The through-hole 221 may be configured to allow material from the exterior body portion 301 to pass

through the core component 200 during manufacture to facilitate the fixed attachment between the exterior body portion 301 and the core component 200. In some embodiments, the second axial portion 231 may comprise a first through-hole 221A located adjacent to the second end 239 of the aperture 219 and a first connection feature 222A located at the proximal end 201 of the core component 200. The third axial portion 230 may comprise a second through-hole 221B located adjacent to the first end 238 of the aperture 219 and a second connection feature 222B located at the distal end 202 of the core component 200. The first and second connection features 222A, 222B may be protrusions or the like that extend from a main body of the core component 200 in an axial direction. The first and second connection features 222A, 222B may function to enhance the attachment between the core component 200 and the main structural body 300. The connection feature 222 may be any feature known in the art. In some embodiments, the connection feature 222 is a structural feature having a shape that is configured to mate with or nest within a corresponding feature located on the interior of the main structural body 300.

[0055] The core component 200 may comprise a rib 220 that is elongated along the longitudinal axis C-C. The rib 220 may protrude from the top surface 203 of the core component 200, the bottom surface 204 of the core component 200, or both of the top and bottom surfaces 203, 204 of the core component 200. The rib 220 may be configured to nest within a channel in the exterior body portion 301, as described further below. In the exemplified embodiment, the core component 200 comprises two ribs 220A, 220B with one rib 220A being located on and protruding from the top surface 203 and one rib 220B being located on and protruding from the bottom surface 204. While in some embodiments the rib 220 may protrude from any portion of the top or bottom surface 203, 204 of the core component 200, in the exemplified embodiment, the ribs 220 are located along the first (or central) axial portion 232. The ribs 220 may be located between the through-holes 221A, 221B in an embodiment, although this is not required and other locations for the ribs 220 could be used in other embodiments.

[0056] The first axial portion 232 of the core component 200 may comprise a first length L1. The second axial portion 231 of the core component 200 may comprise a second length L2. The third axial portion 230 of the core component 200 may comprise a third length L3. The third length L3 may be greater than the second length L2. The first length L1 may be greater than the second length L2.

[0057] As noted above, in some embodiments the core component 200 may be formed from a hard plastic material, such as polypropylene, polyethylene, or other materials with similar characteristics and hardness. In some embodiments, the core component 200 may be formed from a transparent material. In other embodiments, the core component 200 may be formed from a transparent or translucent material. In still other embodiments, the core component 200 may be formed from an opaque material. This may be dictated based on the desired aesthetics for the end product, material costs, or the like.

[0058] Referring to FIGS. 7A through 7D, the main structural body 300 will be described in detail. As noted above, the main structural body 300 comprises the exterior body portion 301 of the handle 120 and also the head portion 110 of the personal care implement 100 in a single, integral, monolithic structure. The exterior body portion 301 is coupled to the head portion 110 via a neck portion 316 of the main structural body 300. Thus, the main structural body 300 is a singular monolithic elongated structure that comprises the exterior body portion 301 of the handle portion 120, the neck portion 316, and the head portion 110. The main structural body 300 may be formed from a hard plastic material, such as polyethylene, polypropylene, or other hard plastic materials with similar hardness values. The main structural body 300 may be opaque and may have one or more colors to create a desired aesthetic.

[0059] The main structural body 300 may extend along a longitudinal axis D-D from a proximal end 302 that forms a bottommost end of the exterior body portion 301 to a distal end 303 that forms a top-most end of the head portion 110. The exterior body portion 301 may comprise the outer exterior surface 304, an inner surface 305 (that defines/bounds the cavity 319), a first lateral side 323 and a second lateral side 324. As noted, the exterior body portion 301 comprises the cavity 319 that extends transversely through the exterior body portion 301 from the first lateral side 323 to the second lateral side 324. Specifically, the cavity 319 extends from a first opening 321 (not shown in FIGS. 7A-7D, but called out in FIGS. 9 and 10) in the first lateral side 323 to a second opening 322 in the second lateral side 324. The core component 200 may be visible through the first and/or second openings 321, 322.

[0060] The exterior body portion 301 may comprise an upper strip portion 310 and a lower strip portion 313. The upper strip portion 310 may comprise an outer surface 311 and an inner surface 312, and the lower strip portion 313 may comprise an outer surface 314 and a lower surface 315. The inner surfaces 312, 315 of the upper and lower strip portions 310, 313 may collectively form

the inner surface 305 of the exterior body portion 301. The inner surfaces 312, 315 of the upper and lower strip portions 310, 313 may comprise one or more channels 307 that are configured to receive the ribs 220A, 220B of the core component 200 to further facilitate the attachment between the core component 200 and the main structural body 300. The nesting of the ribs 220A, 220B within the channels 307 may further lock the core component 200 to the exterior body portion 301 of the main structural body 300. The outer exterior surface 304 of the exterior body portion 301 is generally formed from the outer surfaces 311, 314 of the upper and lower strip portion 310, 313. The inner surface 305 of the exterior body portion is generally formed from the inner surfaces 312, 315 of the upper and lower strip portions 310, 313. In some embodiments, the outer surface 311 of the upper portion 210 forms a top exterior surface 308 of the personal care implement 100 and the outer surface 314 of the lower strip portion 313 forms a bottom exterior surface 309 of the personal care implement 100.

[0061] The inner surfaces 312, 315 of the upper and lower strip portion 310, 313 may be spaced apart from one another by the cavity 319. In some embodiments, the cavity 319 may be exposed through the first and second openings 321, 322 of the exterior body portion 301. When the personal care implement 100 is in its finished state, the first and second lateral sides 205, 206 of the core component 200 may be exposed through the first and second openings 321, 322. In alternative embodiments, the cavity 319 may be only partially exposed, or only exposed on one lateral side 323, 324.

[0062] As mentioned above, the exterior body portion 301 may comprise gripping features 330 located on the outer exterior surface 304. The gripping features 330 may comprise raised features 331, recessed features 332, or any mixture thereof. The gripping features 330 may be located on any portion of the exterior body portion 310. In the exemplified embodiment, the gripping features 330 comprise a central region with raised features 331 and peripheral regions with recessed features 332. Specifically, in the exemplified embodiment the gripping features 330 comprise a first grouping of recessed features 332a, a second grouping of recessed features 332b, and a grouping of raised features 331 located axially in between the first and second groupings of recessed features 332a, 332b. The gripping features 330 thereby provide by an aesthetic enhancement as well as a gripping enhancement. In the exemplified embodiment, the gripping features 330 are all diamond-shaped, although the invention is not to be so limited and the

gripping features 330 may take on other shapes including, for example without limitation, star-shaped, circular, squared, diamond-shaped, etc.

[0063] The exterior body portion 301 may comprise one or more filler portions 306 that extend through the cavity 319 from the inner surface 312 of the upper strip portion 310 to the inner surface 315 of the lower strip portion 313. The filler portions 306 may be cylindrical or otherwise shaped. As shown below with reference to FIG. 8, the filler portions 306 may fill the through-holes 221 of the core component 200 to further enhance the connection between the core component 200 and the main structural body 300.

[0064] The head portion 110 is part of the main structural body 300, as described. The head portion 110 may comprise a recess for receiving a head plate that has the cleaning elements/bristles attached thereto, as best shown in FIGS. 7D and 8.

[0065] Referring to FIGS. 8-10, various cross-sections of the personal care implement 100 are provided to facilitate a description of the relationship between the exterior body portion 301 of the main structural body 300 and the core component 200. As described above, as best seen in FIG. 9, at least a portion of the core component 200 may comprise an I-beam shaped transverse cross-sectional area formed from the upper portion 210, the lower portion 213, and the beam portion 216 of the core component 200. In the exemplified embodiment, the second and third axial portions 230, 231 of the core component 200 comprise an I-beam shaped transverse cross-sectional area. It should be understood that when the exterior body portion 301 is overlaid on top of the core component 200, the personal care implement 100 may continue to comprise an I-beam shaped transverse cross-sectional area. Thus, in an embodiment, portions of the handle portion 120 of the personal care implement 100 may comprise an I-beam shaped transverse cross-sectional area. In an embodiment the main structural body 300 and the core component 200 may be formed as a singular, integral, monolithic structure having the shape as shown in FIGS. 8-10.

[0066] The exterior body portion 301 may cover a portion of the top and bottom surfaces 203, 204 of the core component 200. In an embodiment, the exterior body portion 301 may cover the entirety of the top and bottom surfaces 203, 204 of the core component 200 so that the top and bottom surfaces 203, 204 of the core component 200 are concealed in the final assembled product. In the exemplified embodiment, the exterior body portion 301 covers the top and bottom surfaces 203, 204 of the core component 200, and the proximal and distal ends 201, 202 of the

core component 200. However, in the exemplified embodiment, the first and second lateral sides 205, 206 of the core component are left exposed, through the first and second openings 321, 322 so that the first and second recesses 207, 208 are visible to the user. The first and second connection features 222A, 222B of the core component 200 may be covered by the exterior body portion 301.

[0067] The inner surface 305 of the exterior body portion 301 may be configured to be in contact with at least a portion of the top and bottom surfaces 203, 204 of the core component 200. In the exemplified embodiment, the inner surface 312 of the upper strip portion 310 is configured to be in contact with the top surface 203 of the core component 200, and the inner surface 315 of the lower strip portion 313 is configured to be in contact with the bottom surface 204 of the core component. As noted above, the ribs 220A, 220B of the core component 200 may nest within the channels 307 in the upper and lower strip portions 310, 313

[0068] As noted above, the core component 200 may comprise first and second through-holes 221A, 221B each of which extends from the top surface 203 of the core component to the bottom surface 204 of the core component 200. The through-holes 221A, 221B may be in spatial or fluid communication with the aperture 219 of the core component 200. The filler portions 306 of the exterior body portion 301 of the main structural body 300 may extend into and through the first and second through-holes 221A, 221B so that the first and second through-holes 221A, 221B are filled by the filler portions 306 of the exterior body portion 301. As such, portions of the filler portion 306 of the exterior body portion 301 may be exposed to the aperture 219 which may make the portions of the filler portion 306 visible to a user who is peering into the aperture 219.

[0069] When the personal care implement 100 is in an assembled state, the core component 200 and the exterior body portion 301 may be configured to deflect into the aperture 219 of the core component 200 in response to forces being applied to the handle and head portions 110, 120 of the personal care implement 100. In some embodiments, the force being applied is an excessive downward force applied to the head portion 110 while the handle portion 120 is held in a fixed position. That is, if an excessive downward force is applied onto the head portion 110, the personal care implement 100 may bend at a position along the aperture 219, which can be used to indicate to a user of the excessive pressuring being applied.

[0070] Referring to FIG. 11, the tooth cleaning elements 130 on the head portion 110 of the personal care implement 100 will be described. In the exemplified embodiment, the plurality of

tooth cleaning elements 130 are bristles. The invention is not to be so limited in all embodiments and in some alternative embodiments one or more of the tooth cleaning elements or "tufts" of cleaning elements may be formed as a lamella from an elastomeric material. The front surface 113 of the head portion 110 may comprise a peripheral portion 150 that is adjacent to a peripheral edge of the head portion 110 and a central portion 151 that is surrounded by the peripheral portion 150. The plurality of tooth cleaning elements 130 may comprise a plurality of peripheral bristle tufts 150 positioned on the peripheral portion 114 of the front surface 113 of the head portion 110 and a plurality of central bristle tufts 151 positioned on the central portion 115 of the front surface 113 of the head portion 110. The plurality of peripheral bristle tufts 150 may be arranged in a loop-like manner so that the peripheral bristle tufts 150 collectively surround the central bristle tufts 151.

[0071] The plurality of peripheral bristle tufts 150 may comprise one or more distal bristle tufts 152 that are positioned adjacent to the distal end 112 of the head portion 110 and one or more proximal bristle tufts 153 that are adjacent to the proximal end 111 of the head portion 110. The one or more proximal bristle tufts 153 may collectively form a U-shape. The one or more distal bristle tufts 152 may collectively form a U-shape.

[0072] In the exemplified embodiment, the one or more distal bristle tufts 152 may comprise a central distal bristle tuft 160 located adjacent to the distal end 112 of the head portion 110, a first distal lateral tuft 161 positioned on one side of the central distal bristle tuft 160, and a second distal lateral tuft 162 positioned on the opposite side of the central distal bristle tuft 160. Each of the central distal bristle tuft 160 and the first and second distal lateral tufts 161, 162 may be arcuate having concave interior surfaces that face the central portion 115 of the front surface 113 of the head portion 110 and convex exterior surfaces that face the peripheral edge of the head portion 110.

[0073] In the exemplified embodiment, the one or more proximal bristle tufts 153 may comprise a central proximal bristle tuft 163 located adjacent to the proximal end 111 of the head portion 110, a first proximal lateral tuft 164 positioned on one side of the central proximal bristle tuft 163, and a second proximal lateral tuft 165 positioned on the opposite side of the central proximal bristle tuft 163. Each of the central proximal bristle tuft 163 and the first and second proximal lateral tufts 164, 165 may be arcuate having concave interior surfaces that face the

central portion 115 of the front surface 113 of the head portion 110 and convex exterior surfaces that face the peripheral edge of the head portion 110.

[0074] The plurality of peripheral bristle tufts 150 may further comprise a first central peripheral bristle tuft 166 and a second central peripheral bristle tuft 167. The first central peripheral bristle tuft 166 may be located on a first side of the head axis A-A and the second central peripheral bristle tuft 167 may be located on a second side of the head axis A-A. The first central peripheral bristle tuft 166 may be located between the first distal lateral tuft 161 and the first proximal lateral tuft 164. The second central peripheral bristle tuft 167 may be located between the second distal lateral tuft 162 and the second proximal lateral tuft 165. The first and second central peripheral bristle tufts 166, 167 may comprise convex inner surfaces that face the head axis A-A and concave outer surfaces that face the peripheral edge of the head portion 110.

[0075] Thus, the bristle tufts 160-167 of the peripheral bristle tufts 150 may collectively form a loop structure that surrounds the central bristle tufts 151 and the central portion 115 of the front surface 113 of the head portion 110.

[0076] The plurality of central bristle tufts 151 may comprise a first bristle tuft 170, a second bristle tuft 171, and a third bristle tuft 172. The first bristle tuft 170 may have a first transverse cross-sectional shape, the second bristle tuft 171 may have a second transverse cross-sectional shape, and the third bristle tuft 172 may have a third transverse cross-sectional shape. The first, second, and third transverse cross-sectional shapes may be the shapes that are visible in FIG. 11, such as the shape when viewed in a top plan view. The third bristle tuft 172 may be located axially in between the first and second bristle tufts 171, 172 such that the third bristle tuft 172 is located centrally on the front surface 113 of the head portion 110. The first bristle tuft 170 may be partially surrounded by the distal bristle tufts 152 and the second bristle tuft 171 may be partially surrounded by the proximal bristle tufts 153. In some embodiments, the first bristle tuft 170 may extend along a first bristle axis, the second bristle tuft 171 may extend along a second bristle axis, and the third bristle tuft 172 may extend along a third bristle axis.

[0077] The first and second transverse cross-sectional shapes may be the same as one another, although rotated relative to one another. The first, second, and third cross-sectional shapes may be any known shape in the art including a circle, rectangle, star, ring, hourglass, pear, etc. In the exemplified embodiment, the first and second transverse cross-sectional shapes are circles or circular segments, and the third transverse cross-sectional shape is rectangular and elongated in

the direction of the head axis A-A. Specifically, the first and second transverse cross-sectional shapes may be circles or circular segments. The first and second transverse cross-sectional shapes may be circular segments such that each comprises a linear portion 180 and an arcuate portion 181. The linear portions of the first and second transverse cross-sectional shapes may face one another, and may face the third bristle tuft 172. The third transverse cross-sectional shape of the third bristle tuft 172 may be different than the first and second transverse cross-sectional shapes of the first and second bristle tufts 170, 171. The third transverse cross-sectional shape may be an hourglass shape in an embodiment. The third bristle tuft 172 may comprise first and second side surfaces 182, 183 that are concave.

[0078] The first central bristle tuft 166 of the plurality of peripheral bristle tufts 150 may be positioned adjacent to the first side surface 182 of the third bristle tuft 172 of the plurality of central bristle tufts 151. The convex inner surface of the first central bristle tuft 166 may face the concave first side surface 182 of the third bristle tuft 172. The second central bristle tuft 167 of the plurality of peripheral bristle tufts 150 may be positioned adjacent to the second side surface 183 of the third bristle tuft 172 of the plurality of central bristle tufts 151. The convex inner surface of the second central bristle tuft 167 may face the concave second side surface 183 of the third bristle tuft 172.

[0079] The plurality of central bristle tufts 151 may collectively define a central cleaning element arrangement. The central cleaning element arrangement may collectively have an hourglass shape. The invention is not to be so limited in all embodiments and in other embodiments the central cleaning element arrangement may have different shapes, such as pear, ring, star, or oval shaped arrangements, to name a few. The central cleaning element arrangement may comprise a bulbous distal portion (formed by the arcuate portion 181 of the first bristle tuft 170 of the plurality of central bristle tufts 151), a bulbous proximal portion (formed by the arcuate portion 181 of the second bristle tuft 171 of the plurality of central bristle tufts 151), and a non-bulbous central portion (formed by the third bristle tuft 172 of the plurality of central bristle tufts 151) located between the bulbous proximal and distal portions. In the exemplified embodiment, the outermost lateral surface portions of the bulbous proximal and distal portions of the central cleaning element arrangement are located further from the head axis A-A than the outermost lateral surface portions of the non-bulbous central portion of the central cleaning element arrangement.

[0080] As used herein, it should be understood that a bristle tuft is a collection of bristles or cleaning elements that are disposed within a single tuft hole in the head portion 110 of the personal care implement 100.

[0081] Referring to FIG. 12, the head portion 110 may comprise a soft tissue cleaner 140 located on the rear surface 116 of the head portion 110. In certain embodiments, the soft tissue cleaner 140 may comprise a plurality of protrusions. In the exemplified embodiment, the soft tissue cleaner 140 is a tongue-cleaning element comprising a plurality of nubs 141 and at least one ridge 142. The plurality of nubs 141 may be arranged in circular groups and the at least one ridge 142 may be arranged in a central region on the rear surface 116 of the head portion 110. However, the particular arrangement and style of the protrusions is not to be limiting of the invention in all embodiments. Thus, in other embodiments, the soft tissue cleaner 140 could comprise nubs 141 but no ridges 142, or ridges 142 but no nubs 141, or some other combination of elements protruding from the rear surface 116 of the head portion 110 designed to clean the papillae of the tongue. In some embodiments, the soft tissue cleaner 140 may be formed from the same material as the exterior body portion. In the exemplified embodiment, the soft tissue cleaner 140 may be formed from an elastomeric material.

[0082] In certain embodiments, the personal care implement 100 of the present invention may be manufactured by injection molding. The method of injection molding may comprise the steps of (1): injection molding the core component 200 from a first hard plastic material, which may be transparent, and (2) injection molding the main structural body 300 so that the exterior body portion 301 of the main structural body 300 is formed onto the top and bottom surfaces 203, 204 of the core component 200 without covering the first and second lateral sides 205, 206 of the core component 200; and (3) allowing the exterior body portion 301 to extend through and fill at least one through-hole 221 in the core component 200. The main structural body 300 may be formed from a second hard plastic material or from a generally opaque material.

[0083] As used throughout, ranges are used as shorthand for describing each and every value that is within the range. Any value within the range can be selected as the terminus of the range. In addition, all references cited herein are hereby incorporated by reference in their entireties. In the event of a conflict in a definition in the present disclosure and that of a cited reference, the present disclosure controls.

[0084] While the invention has been described with respect to specific examples including presently preferred modes of carrying out the invention, those skilled in the art will appreciate that there are numerous variations and permutations of the above described systems and techniques. It is to be understood that other embodiments may be utilized and structural and functional modifications may be made without departing from the scope of the present invention. Thus, the spirit and scope of the invention should be construed broadly as set forth in the appended claims.

[0085] EXEMPLARY CLAIM SET

[0086] Exemplary Claim 1. A personal care implement comprising: a head portion configured to perform a personal care treatment function; a handle portion configured to be gripped by a user, the handle portion comprising: a core component comprising a top surface, a bottom surface, a first lateral side, a second lateral side, and an aperture extending from the first lateral side to the second lateral side; an exterior body portion covering the top and bottom surfaces of the core component while leaving the first and second lateral sides of the core component exposed; and wherein the core component and the exterior body portion are both formed from a hard plastic material.

[0087] Exemplary Claim 2. The personal care implement according to Exemplary Claim 1 wherein the handle portion extends along a longitudinal axis, and wherein at least a portion of the core component comprises an I-beam shaped transverse cross-sectional area.

[0088] Exemplary Claim 3. The personal care implement according to Exemplary Claim 1 or Exemplary Claim 2 wherein the handle portion extends along a longitudinal axis, and wherein the core component comprises a distal axial portion, a proximal axial portion, and a central axial portion located between the distal and proximal axial portions, and wherein the central axial portion of the core component comprises the aperture.

[0089] Exemplary Claim 4. The personal care implement according to Exemplary Claim 3 wherein the distal axial portion and the proximal axial portion of the core component have an I-beam shape.

[0090] Exemplary Claim 5. The personal care implement according to Exemplary Claim 3 or Exemplary Claim 4 wherein the central axial portion of the core component comprises: a lower portion having an inner surface that forms a floor of the aperture and an outer surface that forms the bottom surface of the core component; and an upper portion having an inner surface that

forms a roof of the aperture and an outer surface that forms the top surface of the core component; and wherein the exterior body portion covers the outer surfaces of the lower and upper portions of the core component.

[0091] Exemplary Claim 6. The personal care implement according to Exemplary Claim 5 wherein the exterior body portion covers an entirety of the outer surfaces of the lower and upper portions of the core component so that no part of the outer surfaces of the lower and upper portions of the core component is exposed.

[0092] Exemplary Claim 7. The personal care implement according to any one of Exemplary Claims 1 to 6 wherein the core component is transparent or translucent and the exterior body portion is opaque.

[0093] Exemplary Claim 8. The personal care implement according to any one of Exemplary Claims 1 to 7 wherein the core component comprises at least one through-hole extending from the top surface of the core component to the bottom surface of the core component, and wherein the exterior body comprises a filler portion that fills the at least one through-hole of the core component.

[0094] Exemplary Claim 9. The personal care implement according to Exemplary Claim 8 wherein the through-hole is spatially coupled to the aperture so that the filler portion of the exterior body is exposed to the aperture.

[0095] Exemplary Claim 10. The personal care implement according to any one of Exemplary Claims 1 to 9 wherein the core component comprises a distal end and a proximal end, and wherein the exterior body portion wraps around and covers an entirety of the distal and proximal ends of the core component.

[0096] Exemplary Claim 11. The personal care implement according to any one of Exemplary Claims 1 to 10 wherein the handle portion extends along a longitudinal axis and the core component comprises a rib that protrudes from the top surface of the core component, the rib being elongated along the longitudinal axis and nesting within a channel in the exterior body portion.

[0097] Exemplary Claim 12. The personal care implement according to any one of Exemplary Claims 1 to 11 wherein the aperture is elongated in a direction of a longitudinal axis of the personal care implement.

[0098] Exemplary Claim 13. The personal care implement according to any one of Exemplary Claims 1 to 12 wherein the exterior body portion comprises an upper strip portion comprising an outer surface that forms a top exterior surface of the handle portion and an inner surface opposite the outer surface, a lower strip portion comprising an outer surface that forms a bottom exterior surface of the handle portion and an inner surface opposite the outer surface, the inner surfaces of the upper and lower strip portions being spaced apart from one another to define a cavity that is open on opposing lateral sides of the exterior body portion, and wherein the core component is positioned within the cavity of the exterior body portion.

[0099] Exemplary Claim 14. The personal care implement according to any one of Exemplary Claims 1 to 13 wherein the exterior body portion comprises a top surface that forms a top exterior surface of the handle portion and a bottom surface that forms a bottom exterior surface of the handle portion, the exterior body portion comprising gripping features protruding from at least one of the top and bottom surfaces.

[0100] Exemplary Claim 15. The personal care implement according to any one of Exemplary Claims 1 to 14 further comprising a main structural body, the main structural body being a monolithic component that that forms the exterior body portion of the handle portion and the head portion.

[0101] Exemplary Claim 16. The personal care implement according to any one of Exemplary Claims 1 to 15 wherein the head portion comprises a front surface and a rear surface, and further comprising a plurality of bristles extending from the head portion.

[0102] Exemplary Claim 17. The personal care implement according to Exemplary Claim 16 wherein the head portion extends along a head axis, wherein the plurality of bristles comprises a plurality of peripheral bristle tufts positioned along a peripheral portion of the front surface of the head portion and a plurality of central bristle tufts positioned along a central portion of the front surface of the head portion, the plurality of peripheral bristle tufts surrounding the plurality of central bristle tufts, and wherein the plurality of central bristle tufts comprises a first bristle tuft extending along a first bristle axis and having a first transverse cross-sectional shape, a second bristle tuft extending along a second bristle axis and having a second transverse cross-sectional shape that is the same as the first transverse cross-sectional shape, and a third bristle tuft extending along a third bristle axis and having a third transverse cross-sectional shape that is

different than the first and second transverse cross-sectional shapes, the third bristle tuft being located between the first and second bristle tufts in a direction of the head axis.

[0103] Exemplary Claim 18. The personal care implement according to Exemplary Claim 17 wherein the first and second transverse cross-sectional shapes are circles or circular segments and wherein the third transverse cross-sectional shape is rectangular, the third bristle tuft being elongated in the direction of the head axis.

[0104] Exemplary Claim 19. The personal care implement according to Exemplary Claim 18 wherein the third transverse cross-sectional shape comprises a top side that faces the first bristle tuft, a bottom side that faces the second bristle tuft, and first and second lateral sides extending between the top and bottom sides, wherein the first and second lateral sides are concave.

[0105] Exemplary Claim 20. The personal care implement according to Exemplary Claim 19 wherein the plurality of peripheral bristle tufts comprises a first peripheral bristle tuft located on a first side of the head axis and being aligned with the first lateral side of the third transverse cross-sectional shape of the third bristle tuft and a second peripheral bristle tuft located on a second side of the head axis and being aligned with the second lateral side of the third transverse cross-sectional shape of the third bristle tuft, the first and second peripheral bristle tufts comprising convex inner surfaces that face the concave first and second sides of the third transverse cross-sectional shape of the third bristle tuft.

[0106] Exemplary Claim 21. The personal care implement according to Exemplary Claim 20 wherein the plurality of peripheral bristle tufts further comprise one or more proximal bristle tufts that form a U-shape adjacent to a proximal end of the head portion and one or more distal bristle tufts that form a U-shape adjacent to a distal end of the head portion.

[0107] Exemplary Claim 22. The personal care implement according to any one of Exemplary Claims 1 to 21 wherein the core component and the exterior body portion are configured to deflect into the aperture in response to forces being applied onto the handle and head portions of the personal care implement.

[0108] Exemplary Claim 23. The personal care implement according to any one of Exemplary Claims 1 to 22 wherein the handle portion extends along a handle axis and wherein the core component comprises a first recess in the first lateral side and second recess in the second lateral side, the first and second recesses being elongated in a direction of the handle axis.

[0109] Exemplary Claim 24. The personal care implement according to any one of Exemplary Claims 1 to 23 wherein the core component comprises a lower portion having an inner surface, an upper portion having an inner surface, and at least one beam portion that extends from the inner surface of the lower portion to the inner surface of the upper portion, the at least one beam portion comprising a first side surface that is recessed relative to first side edges of the upper and lower portions and a second side surface that is recessed relative to second side edges of the upper and lower portions.

[0110] Exemplary Claim 25. The personal care implement according to Exemplary Claim 24 wherein the handle portion extends along a handle axis, and wherein the at least one beam portion comprises a first beam portion and a second beam portion, the aperture being located axially in between the first and second beam portions.

[0111] Exemplary Claim 26. A personal care implement comprising: a head portion configured to perform a personal care treatment function; a handle portion configured to be gripped by a user, the handle portion comprising: a core component comprising a top surface, a bottom surface, a first lateral side, a second lateral side, and an aperture extending from the first lateral side to the second lateral side; an exterior body portion covering the top and bottom surfaces of the core component while leaving the first and second lateral sides of the core component exposed; and wherein the core component and the exterior body component have a different light transmissivity.

[0112] Exemplary Claim 27. A personal care implement comprising: a main structural body that extends along a longitudinal axis, the main structural body comprising an exterior body portion of a handle portion, the exterior body portion comprising a top surface that forms a top exterior surface of the handle portion, a bottom surface that forms a bottom exterior surface of the handle portion, a first lateral side, a second lateral side, and a cavity that extends from a first opening in the first lateral side to a second opening in the second lateral side; a core component positioned within the cavity of the exterior body portion, the core component comprising a first lateral side, a second lateral side, a first axial portion comprising an aperture that extends from the first lateral side to the second lateral side, and a second axial portion having an I-beam shaped transverse cross-sectional area.

[0113] Exemplary Claim 28. The personal care implement according to Exemplary Claim 27 wherein the main structural body and the core component have a different light transmissivity.

[0114] Exemplary Claim 29. The personal care implement according to Exemplary Claim 27 or Exemplary Claim 28 wherein the main structural body and the core component are both formed from a hard plastic material.

[0115] Exemplary Claim 30. The personal care implement according to any one of Exemplary Claims 27 to 29 wherein the cavity, the first opening, the second opening, and the aperture are elongated in a direction of the longitudinal axis.

[0116] Exemplary Claim 31. The personal care implement according to any one of Exemplary Claims 27 to 30 wherein the main structural body comprises a head portion that is integrally formed with the exterior body portion of the handle portion.

[0117] Exemplary Claim 32. The personal care implement according to any one of Exemplary Claims 27 to 31 wherein the core component comprises a third axial portion having an I-beam shaped transverse cross-sectional area, the first axial portion located axially between the second and third axial portions.

[0118] Exemplary Claim 33. The personal care implement according to Exemplary Claim 32 wherein the second axial portion is located adjacent to a distal end of the handle portion and has a first length and the third axial portion is located adjacent to a proximal end of the handle portion and has a second length, the first length being greater than the second length.

[0119] Exemplary Claim 34. The personal care implement according to Exemplary Claim 33 wherein the first axial portion has a third length that is greater than the second length.

[0120] Exemplary Claim 35. A personal care implement comprising: a head portion configured to perform a personal care treatment function; and a handle portion configured to be gripped by a user during performance of the oral care treatment function, the handle portion extending along a handle axis and comprising a top surface, a bottom surface, a first lateral surface, a second lateral surface, a first axial portion comprising an aperture that extends from the first lateral surface to the second lateral surface and is elongated in a direction of the handle axis, and a second axial portion comprising an I-beam shaped transverse cross-sectional area.

[0121] Exemplary Claim 36. The personal care implement according to Exemplary Claim 35 further comprising a main structural body that forms the head portion and an exterior body portion of the handle portion, the handle portion further comprising a core component positioned within a cavity of the exterior body portion, and wherein the core component is transparent or translucent and the exterior body portion is opaque.

[0122] Exemplary Claim 37. The personal care implement according to Exemplary Claim 36 wherein the core component and the exterior body portion are both formed from a hard plastic material.

[0123] Exemplary Claim 38. The personal care implement according to any one of Exemplary Claims 35 to 37 wherein the handle portion further comprises a third axial portion comprising an I-beam shaped transverse cross-sectional area, the first axial portion being located between the second and third axial portions.

[0124] Exemplary Claim 39. The personal care implement according to any one of Exemplary Claims 35 to 38 wherein the handle portion further comprises an upper portion that forms an upper boundary of the aperture and a lower portion that forms a lower boundary of the aperture, the lower portion being configured to deflect into the aperture in response to an excessive downward force being applied onto the head portion while the handle portion is held in a fixed position.

[0125] Exemplary Claim 40. A personal care implement comprising: a handle portion configured to be gripped by a user during performance of a personal care treatment function; and a head extending along a head axis and comprising a head portion having a front surface and a plurality of tooth cleaning elements extending from the front surface, the plurality of tooth cleaning elements comprising: a plurality of central bristle tufts positioned along a central portion of the front surface of the head portion, the plurality of central bristle tufts comprising a first bristle tuft extending along a first bristle axis and having a first transverse cross-sectional shape, a second bristle tuft extending along a second bristle axis and having a second transverse cross-sectional shape that is the same as the first transverse cross-sectional shape, and a third bristle tuft extending along a third bristle axis and having a third transverse cross-sectional shape that is different than the first and second transverse cross-sectional shapes, the third bristle tuft being located between the first and second bristle tufts in a direction of the head axis; and a plurality of peripheral bristle tufts positioned along a peripheral portion of the front surface of the head portion, the plurality of peripheral bristle tufts collectively surrounding the plurality of central bristle tufts.

[0126] Exemplary Claim 41. The personal care implement according to Exemplary Claim 40 wherein the first and second transverse cross-sectional shapes are circles or circular segments.

[0127] Exemplary Claim 42. The personal care implement according to Exemplary Claim 41 wherein the first and second transverse cross-sectional shapes are circular segments so that each of the first and second transverse cross-sectional shapes comprises a linear portion and an arcuate portion, the linear portions of the first and second transverse cross-sectional shapes facing the third bristle tuft.

[0128] Exemplary Claim 43. The personal care implement according to any one of claims 40 to 42 wherein the third transverse cross-sectional shape comprises a top end that faces the first bristle tuft, a bottom end that faces the second bristle tuft, and first and second sides extending between the top and bottom ends, wherein the first and second sides are concave.

[0129] Exemplary Claim 44. The personal care implement according to Exemplary Claim 43 wherein the plurality of peripheral bristle tufts comprises a first peripheral bristle tuft located on a first side of the head axis and being aligned with the first lateral side of the third transverse cross-sectional shape of the third bristle tuft and a second peripheral bristle tuft located on a second side of the head axis and being aligned with the second lateral side of the third transverse cross-sectional shape of the third bristle tuft, the first and second peripheral bristle tufts comprising convex inner surfaces that face the concave first and second sides of the third transverse cross-sectional shape of the third bristle tuft.

[0130] Exemplary Claim 45. The personal care implement according to any one of Exemplary Claims 40 to 44 wherein the plurality of peripheral bristle tufts comprise one or more proximal bristle tufts that form a U-shape adjacent to a proximal end of the head portion and one or more distal bristle tufts that form a U-shape adjacent to a distal end of the head portion, the one or more proximal bristle tufts at least partially surrounding the first bristle tuft and the at least one distal bristle tuft at least partially surrounding the second bristle tuft.

[0131] Exemplary Claim 46. A personal care implement comprising: a handle portion configured to be gripped by a user during performance of a personal care treatment function; and a head extending along a head axis and comprising a head portion having a front surface and a plurality of tooth cleaning elements extending from the front surface, the plurality of tooth cleaning elements comprising: one or more central bristle tufts positioned along a central portion of the front surface of the head portion, the one or more central bristle tufts defining a central cleaning element arrangement having an hourglass shape; and a plurality of peripheral bristle tufts

positioned along a peripheral portion of the front surface of the head portion, the plurality of peripheral bristle tufts collectively surrounding the central cleaning element arrangement.

[0132] Exemplary Claim 47. The personal care implement according to Exemplary Claim 46 wherein the central cleaning element arrangement comprises a bulbous distal portion, a bulbous proximal portion, and a non-bulbous central portion located between the bulbous distal and proximal portions.

[0133] Exemplary Claim 48. The personal care implement according to Exemplary Claim 47 wherein outermost lateral surface portions of the bulbous proximal and distal portions of the central cleaning element arrangement are located further from the head axis than outermost lateral surface portions of the non-bulbous central portion of the central cleaning element arrangement.

[0134] Exemplary Claim 49. A method of manufacturing a personal care implement, the method comprising: injection molding a core component from a first hard plastic material, the core component comprising an aperture that extends from a first lateral side of the core component to a second lateral side of the core component, the core component comprising at least one through-hole extending from a front surface of the core component to a rear surface of the core component; and injection molding an exterior body portion of a main structural body onto the top and bottom surfaces of the core component without covering the first and second lateral sides of the core component, the main structural body formed from a second hard plastic material, the exterior body portion extending through and filling the at least one through-hole in the core component.

[0135] Exemplary Claim 50. The method according to Exemplary Claim 49 wherein the first hard plastic material is transparent or translucent and the second hard plastic material is opaque.

[0136] Exemplary Claim 51. The method according to Exemplary Claim 49 wherein at least a portion of the core component comprises an I-beam shape.

CLAIMS

WHAT IS CLAIMED IS:

1. A personal care implement comprising:

a head portion configured to perform a personal care treatment function;

a handle portion configured to be gripped by a user, the handle portion comprising:

a core component comprising a top surface, a bottom surface, a first lateral side, a second lateral side, and an aperture extending from the first lateral side to the second lateral side;

an exterior body portion covering the top and bottom surfaces of the core component while leaving the first and second lateral sides of the core component exposed; and

wherein the core component and the exterior body portion are both formed from a hard plastic material.

2. The personal care implement according to claim 1 wherein the handle portion extends along a longitudinal axis, and wherein at least a portion of the core component comprises an I-beam shaped transverse cross-sectional area.

3. The personal care implement according to claim 1 or claim 2 wherein the handle portion extends along a longitudinal axis, and wherein the core component comprises a distal axial portion, a proximal axial portion, and a central axial portion located between the distal and proximal axial portions, and wherein the central axial portion of the core component comprises the aperture.

4. The personal care implement according to claim 3 wherein the distal axial portion and the proximal axial portion of the core component have an I-beam shape.

5. The personal care implement according to claim 3 or claim 4 wherein the central axial portion of the core component comprises:

a lower portion having an inner surface that forms a floor of the aperture and an outer surface that forms the bottom surface of the core component; and

an upper portion having an inner surface that forms a roof of the aperture and an outer surface that forms the top surface of the core component; and

wherein the exterior body portion covers the outer surfaces of the lower and upper portions of the core component.

6. The personal care implement according to any one of claims 1 to 5 wherein the core component is transparent or translucent and the exterior body portion is opaque.

7. The personal care implement according to any one of claims 1 to 67 wherein the core component comprises at least one through-hole extending from the top surface of the core component to the bottom surface of the core component, and wherein the exterior body comprises a filler portion that fills the at least one through-hole of the core component.

8. The personal care implement according to any one of claims 1 to 7 wherein the aperture is elongated in a direction of a longitudinal axis of the personal care implement.

9. The personal care implement according to any one of claims 1 to 8 wherein the exterior body portion comprises an upper strip portion comprising an outer surface that forms a top exterior surface of the handle portion and an inner surface opposite the outer surface, a lower strip portion comprising an outer surface that forms a bottom exterior surface of the handle portion and an inner surface opposite the outer surface, the inner surfaces of the upper and lower strip portions being spaced apart from one another to define a cavity that is open on opposing lateral sides of the exterior body portion, and wherein the core component is positioned within the cavity of the exterior body portion.

10. The personal care implement according to any one of claims 1 to 9 further comprising a main structural body, the main structural body being a monolithic component that that forms the exterior body portion of the handle portion and the head portion.

11. The personal care implement according to any one of claims 1 to 10 wherein the head portion comprises a front surface and a rear surface, and further comprising a plurality of bristles extending from the head portion, the head portion extends along a head axis, wherein the plurality of bristles comprises a plurality of peripheral bristle tufts positioned along a peripheral portion of the front surface of the head portion and a plurality of central bristle tufts positioned along a central portion of the front surface of the head portion, the plurality of peripheral bristle tufts surrounding the plurality of central bristle tufts, and wherein the plurality of central bristle tufts comprises a first bristle tuft extending along a first bristle axis and having a first transverse cross-sectional shape, a second bristle tuft extending along a second bristle axis and having a second transverse cross-sectional shape that is the same as the first transverse cross-sectional shape, and a third bristle tuft extending along a third bristle axis and having a third transverse cross-sectional shape that is different than the first and second transverse cross-sectional shapes, the third bristle tuft being located between the first and second bristle tufts in a direction of the head axis.

12. The personal care implement according to claim 11 wherein the first and second transverse cross-sectional shapes are circles or circular segments and wherein the third transverse cross-sectional shape is rectangular, the third bristle tuft being elongated in the direction of the head axis, wherein the third transverse cross-sectional shape comprises a top side that faces the first bristle tuft, a bottom side that faces the second bristle tuft, and first and second lateral sides extending between the top and bottom sides, wherein the first and second lateral sides are concave.

13. The personal care implement according to claim 12 wherein the plurality of peripheral bristle tufts comprises a first peripheral bristle tuft located on a first side of the head axis and being aligned with the first lateral side of the third transverse cross-sectional shape of the third bristle tuft and a second peripheral bristle tuft located on a second side of the head axis and being aligned with the second lateral side of the third transverse cross-sectional shape of the third bristle tuft, the first and second peripheral bristle tufts comprising convex inner surfaces that face the concave first and second sides of the third transverse cross-sectional shape of the third bristle tuft.

14. The personal care implement according to any one of claims 1 to 13 wherein the core component and the exterior body portion are configured to deflect into the aperture in response to forces being applied onto the handle and head portions of the personal care implement.

15. The personal care implement according to any one of claims 1 to 14 wherein the handle portion extends along a handle axis and wherein the core component comprises a first recess in the first lateral side and second recess in the second lateral side, the first and second recesses being elongated in a direction of the handle axis.

16. The personal care implement according to any one of claims 1 to 15 wherein the core component comprises a lower portion having an inner surface, an upper portion having an inner surface, and at least one beam portion that extends from the inner surface of the lower portion to the inner surface of the upper portion, the at least one beam portion comprising a first side surface that is recessed relative to first side edges of the upper and lower portions and a second side surface that is recessed relative to second side edges of the upper and lower portions.

17. A personal care implement comprising:

a head portion configured to perform a personal care treatment function;

a handle portion configured to be gripped by a user, the handle portion comprising:

a core component comprising a top surface, a bottom surface, a first lateral side, a second lateral side, and an aperture extending from the first lateral side to the second lateral side;

an exterior body portion covering the top and bottom surfaces of the core component while leaving the first and second lateral sides of the core component exposed; and

wherein the core component and the exterior body component have a different light transmissivity.

18. A personal care implement comprising:

a main structural body that extends along a longitudinal axis, the main structural body comprising an exterior body portion of a handle portion, the exterior body portion comprising a top surface that forms a top exterior surface of the handle portion, a bottom surface that forms a bottom exterior surface of the handle portion, a first lateral side, a second lateral side, and a cavity that extends from a first opening in the first lateral side to a second opening in the second lateral side;

a core component positioned within the cavity of the exterior body portion, the core component comprising a first lateral side, a second lateral side, a first axial portion comprising an aperture that extends from the first lateral side to the second lateral side, and a second axial portion having an I-beam shaped transverse cross-sectional area.

19. The personal care implement according to claim 18 wherein at least one of:

the main structural body and the core component have a different light transmissivity; and

the main structural body and the core component are both formed from a hard plastic material.

20. The personal care implement according to any one of claims 18 to 19 wherein the cavity, the first opening, the second opening, and the aperture are elongated in a direction of the longitudinal axis.

21. The personal care implement according to any one of claims 18 to 20 wherein the core component comprises a third axial portion having an I-beam shaped transverse cross-sectional area, the first axial portion located axially between the second and third axial portions.

22. The personal care implement according to claim 21 wherein the second axial portion is located adjacent to a distal end of the handle portion and has a first length and the third axial portion is located adjacent to a proximal end of the handle portion and has a second length, the first length being greater than the second length, and wherein the first axial portion has a third length that is greater than the second length.

23. A personal care implement comprising:

a head portion configured to perform a personal care treatment function; and

a handle portion configured to be gripped by a user during performance of the oral care treatment function, the handle portion extending along a handle axis and comprising a top surface, a bottom surface, a first lateral surface, a second lateral surface, a first axial portion comprising an aperture that extends from the first lateral surface to the second lateral surface and is elongated in a direction of the handle axis, and a second axial portion comprising an I-beam shaped transverse cross-sectional area.

24. A method of manufacturing a personal care implement, the method comprising:

injection molding a core component from a first hard plastic material, the core component comprising an aperture that extends from a first lateral side of the core component to a second lateral side of the core component, the core component comprising at least one through-hole extending from a front surface of the core component to a rear surface of the core component; and

injection molding an exterior body portion of a main structural body onto the top and bottom surfaces of the core component without covering the first and second lateral sides of the core component, the main structural body formed from a second hard plastic material, the exterior body portion extending through and filling the at least one through-hole in the core component.

25. The method according to claim 24 wherein at least a portion of the core component comprises an I-beam shape.

26. A personal care implement comprising:

a handle portion configured to be gripped by a user during performance of a personal care treatment function; and

a head extending along a head axis and comprising a head portion having a front surface and a plurality of tooth cleaning elements extending from the front surface, the plurality of tooth cleaning elements comprising: a plurality of central bristle tufts positioned along a central portion of the front surface of the head portion, the plurality of central bristle tufts comprising a

first bristle tuft extending along a first bristle axis and having a first transverse cross-sectional shape, a second bristle tuft extending along a second bristle axis and having a second transverse cross-sectional shape that is the same as the first transverse cross-sectional shape, and a third bristle tuft extending along a third bristle axis and having a third transverse cross-sectional shape that is different than the first and second transverse cross-sectional shapes, the third bristle tuft being located between the first and second bristle tufts in a direction of the head axis; and

a plurality of peripheral bristle tufts positioned along a peripheral portion of the front surface of the head portion, the plurality of peripheral bristle tufts collectively surrounding the plurality of central bristle tufts.

27. A personal care implement comprising:

a handle portion configured to be gripped by a user during performance of a personal care treatment function; and

a head extending along a head axis and comprising a head portion having a front surface and a plurality of tooth cleaning elements extending from the front surface, the plurality of tooth cleaning elements comprising: o

ne or more central bristle tufts positioned along a central portion of the front surface of the head portion, the one or more central bristle tufts defining a central cleaning element arrangement having an hourglass shape; and

a plurality of peripheral bristle tufts positioned along a peripheral portion of the front surface of the head portion, the plurality of peripheral bristle tufts collectively surrounding the central cleaning element arrangement.

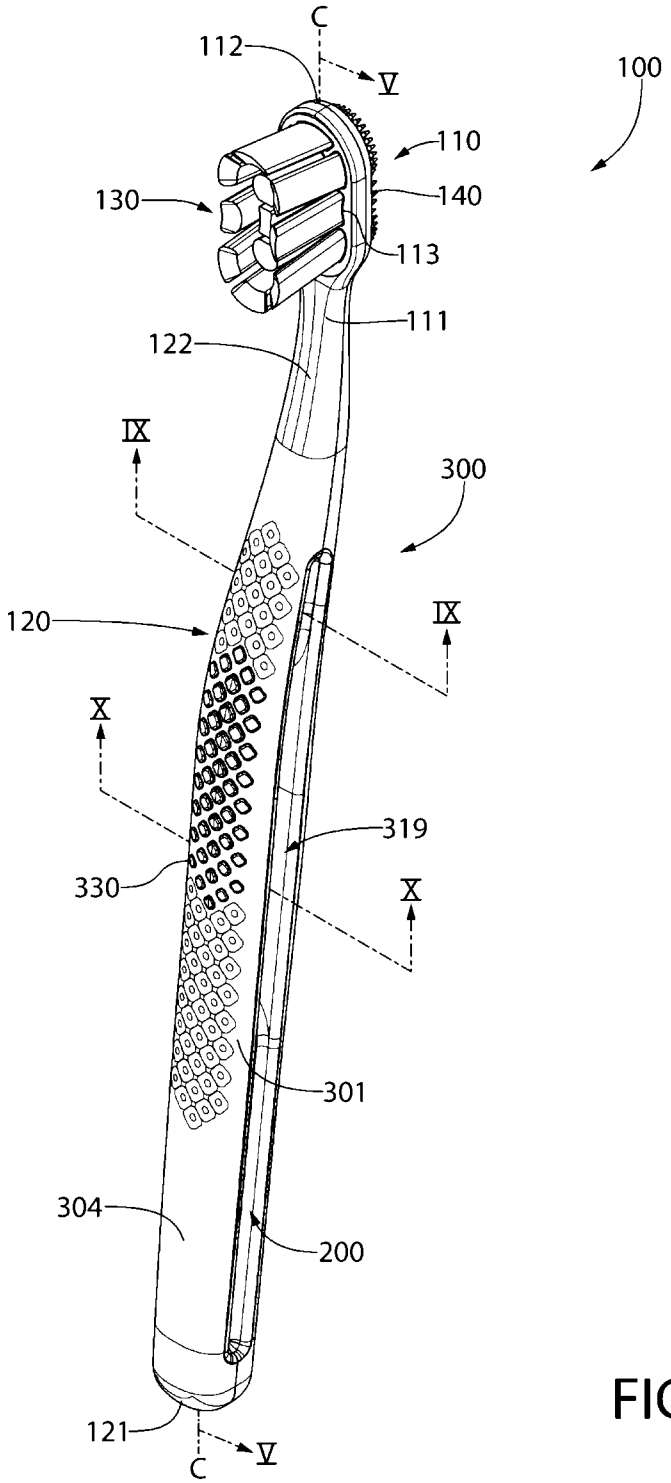
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FIG. 1

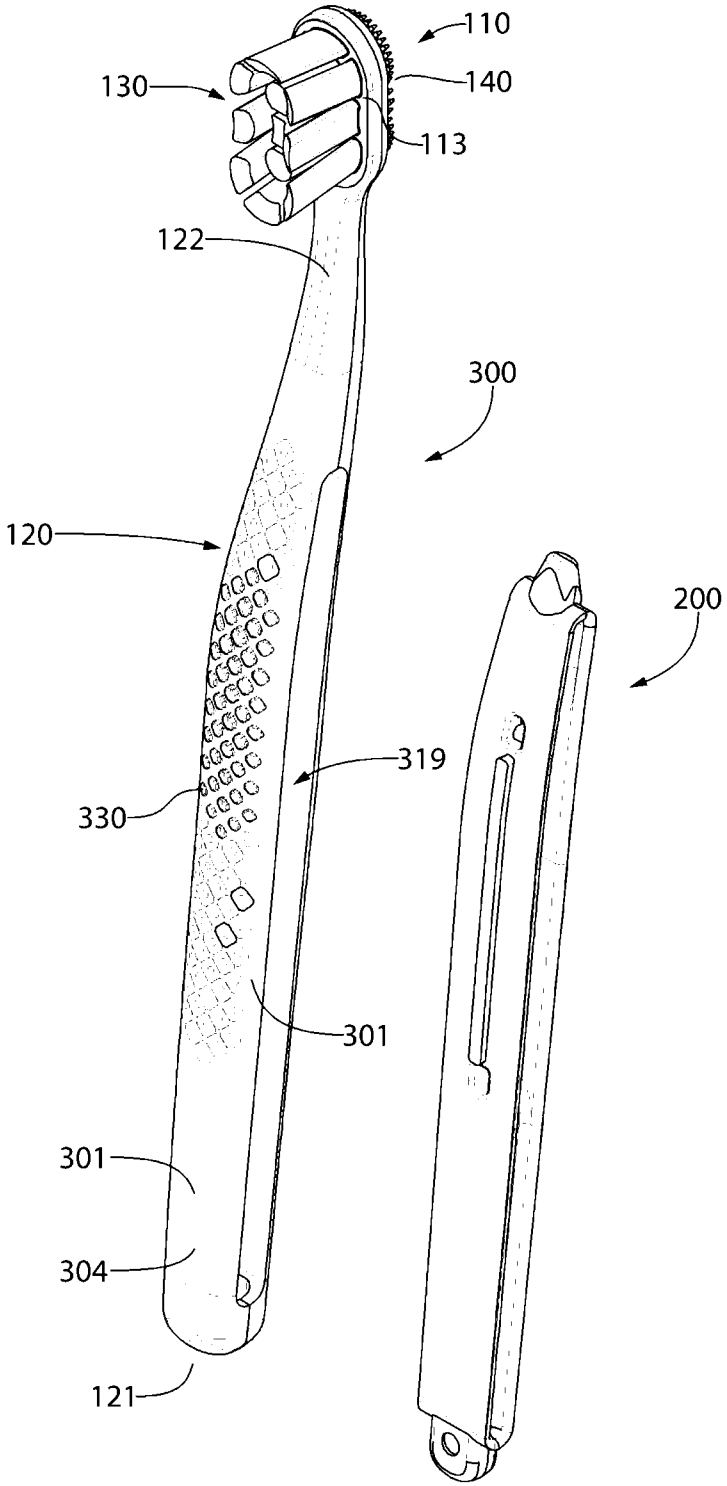

FIG. 2

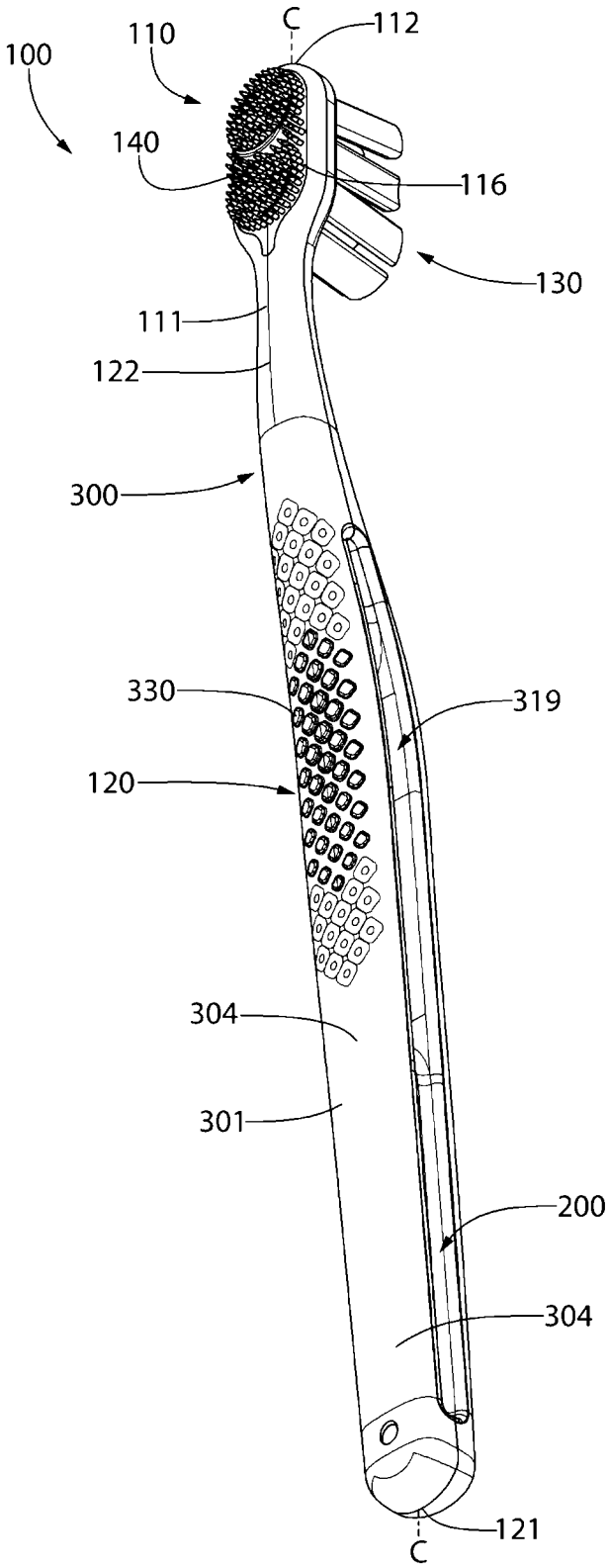
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FIG. 3

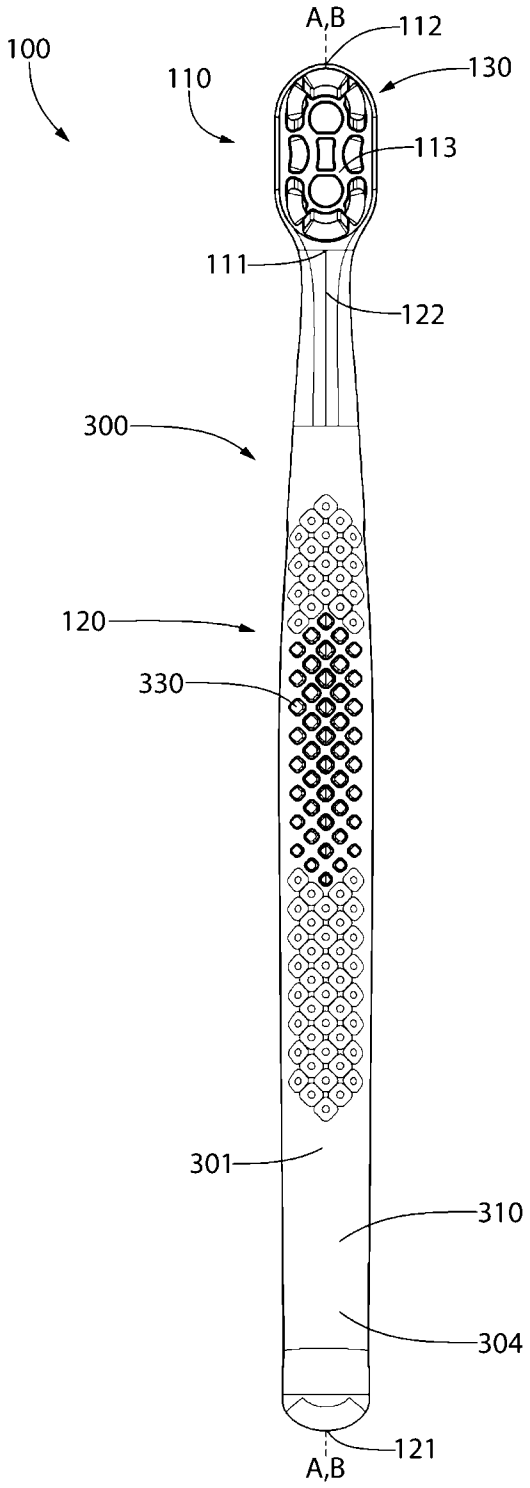

FIG. 4

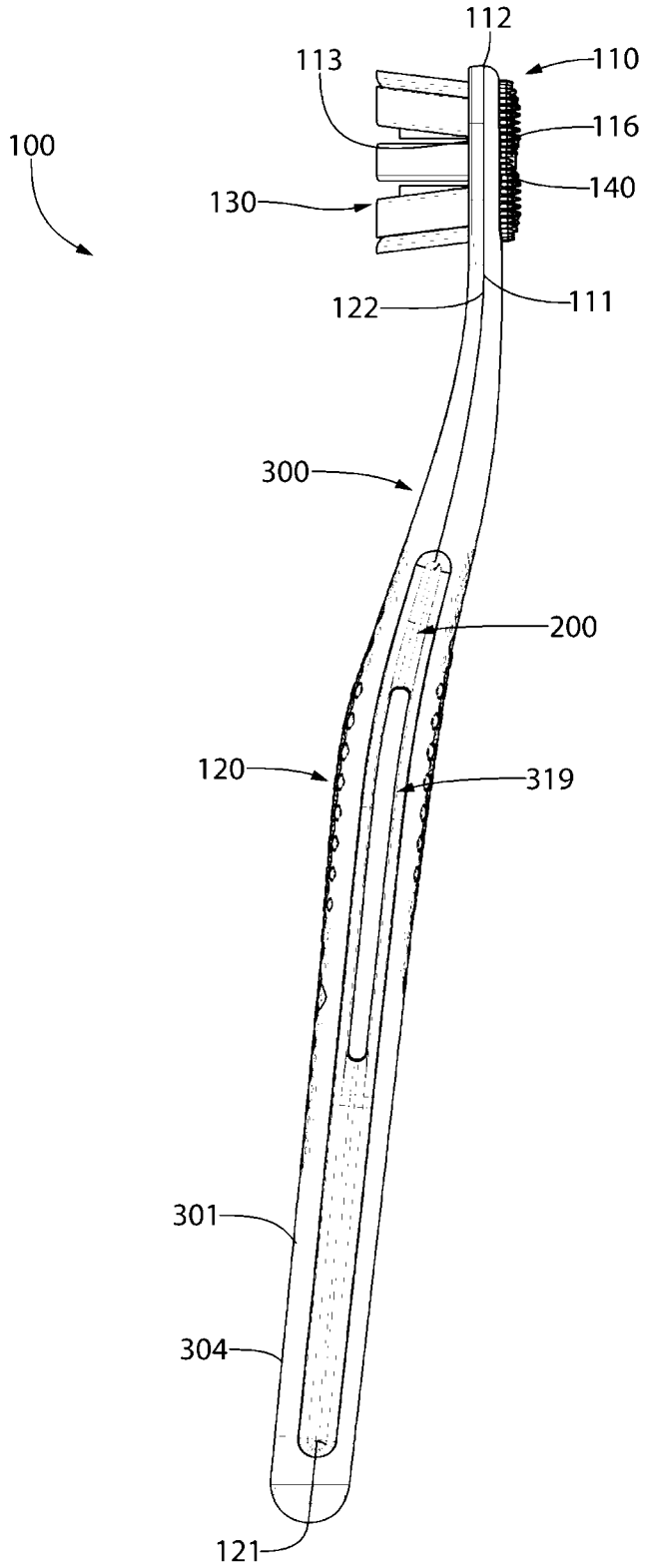

FIG. 5

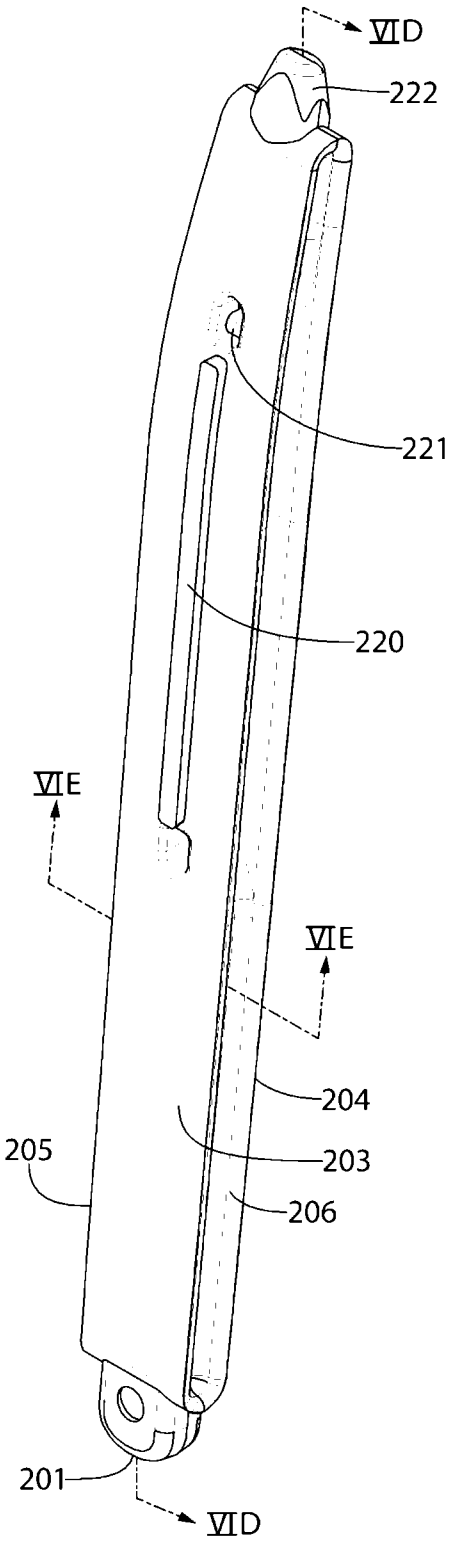

FIG. 6A

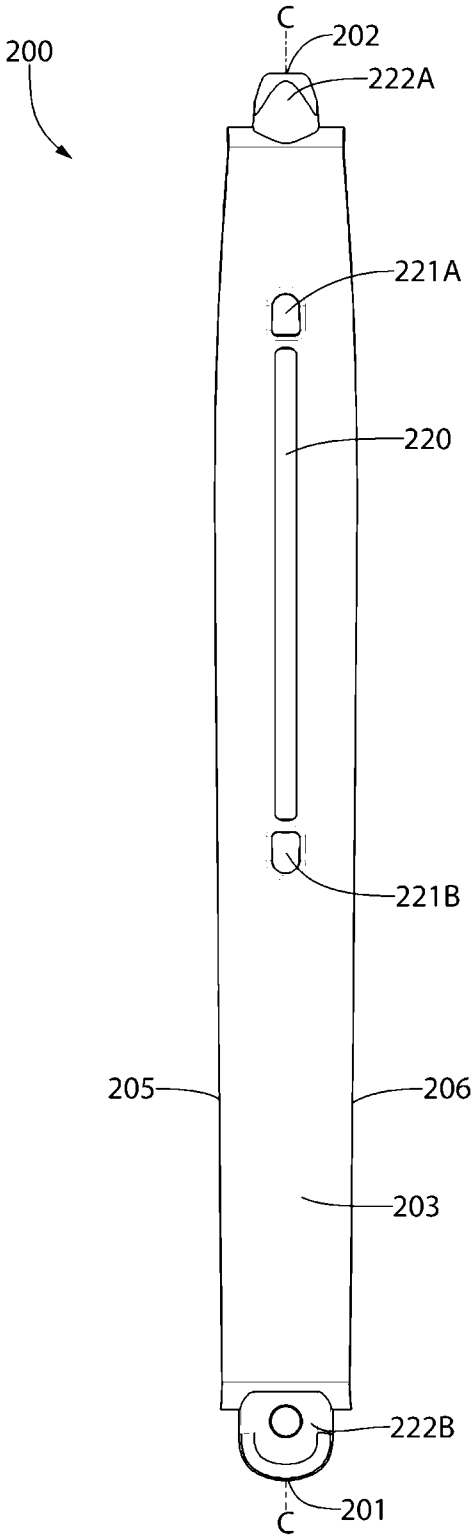

FIG. 6B

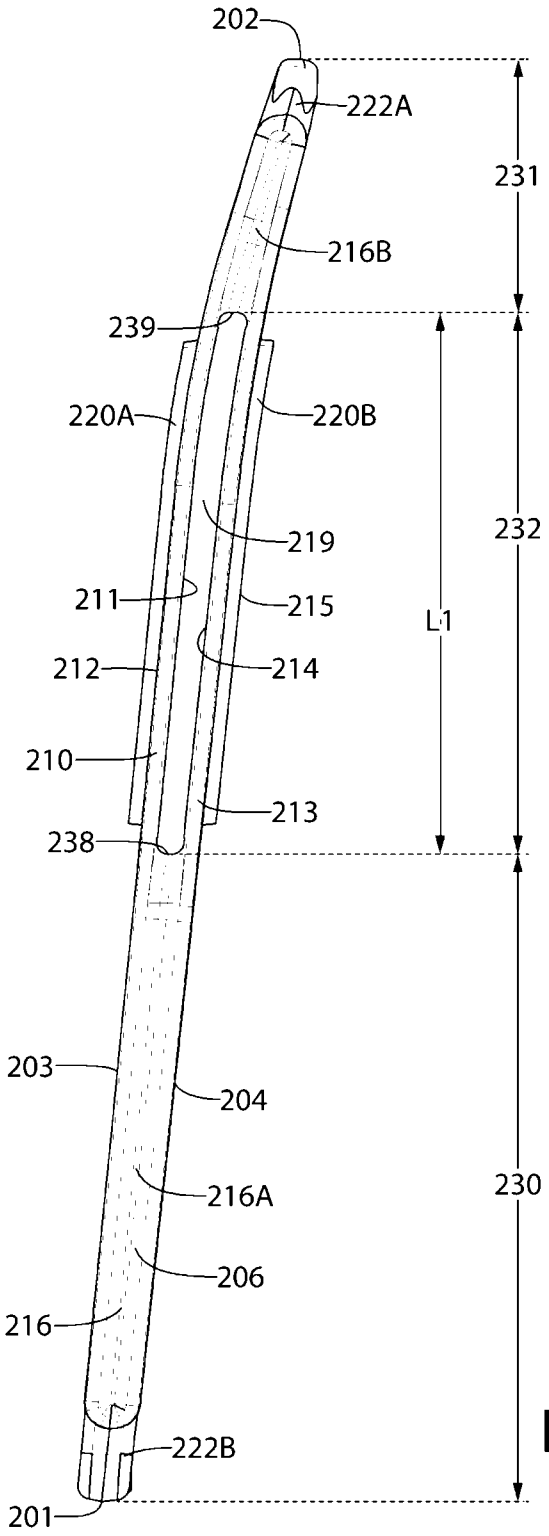
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FIG. 6C

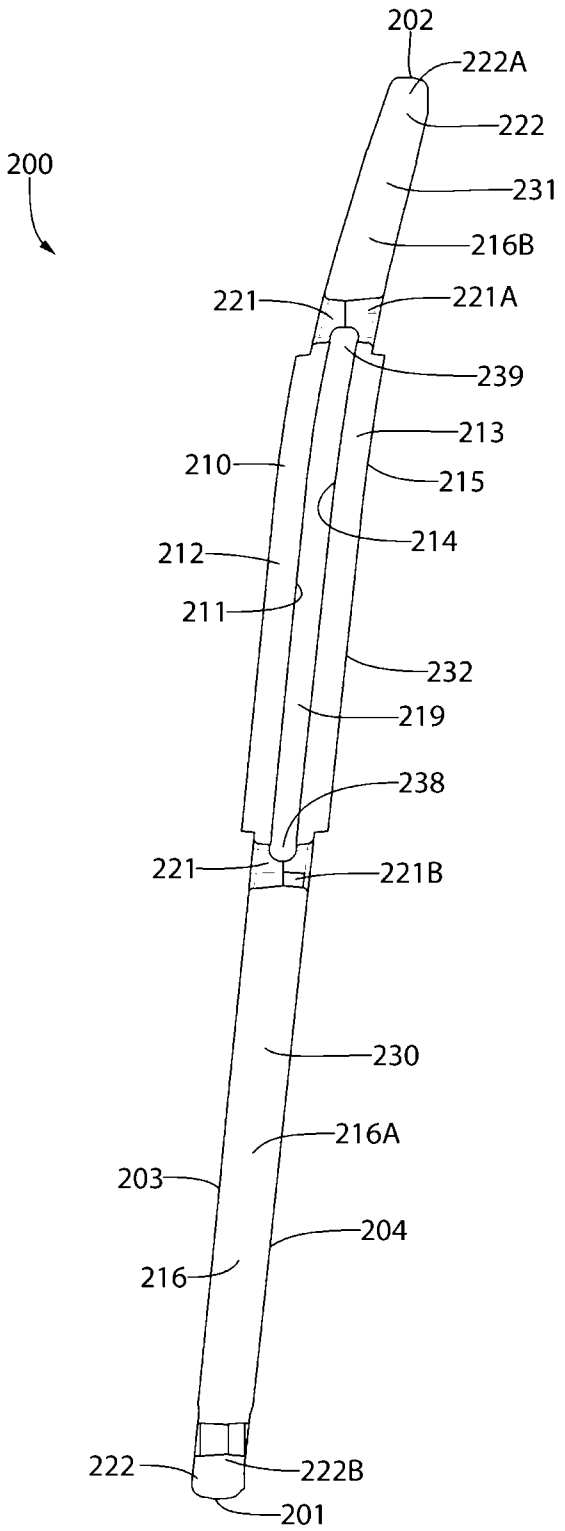
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FIG. 6D

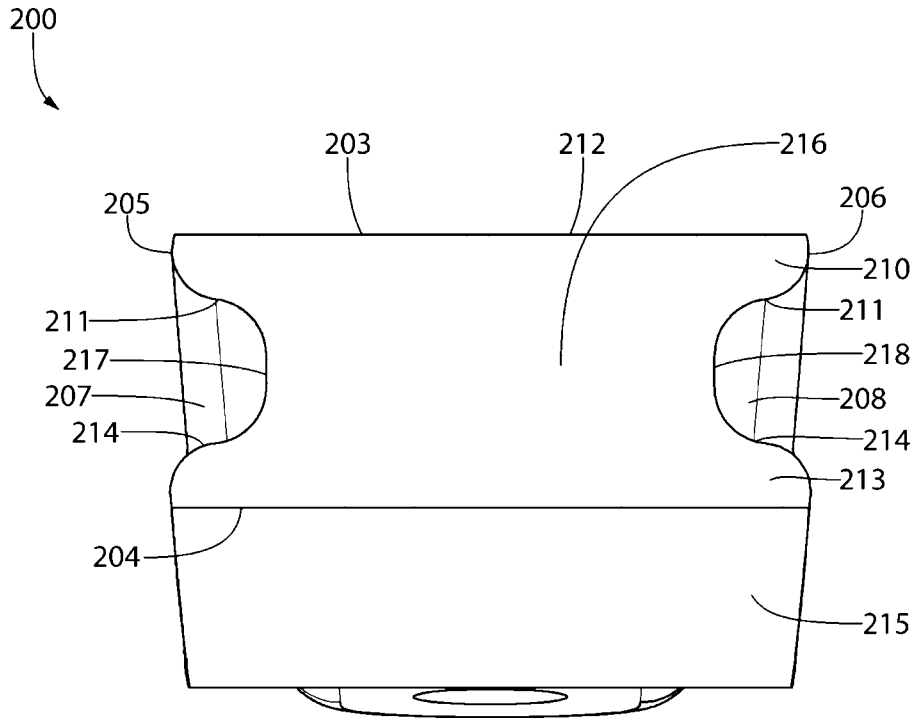
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FIG. 6E

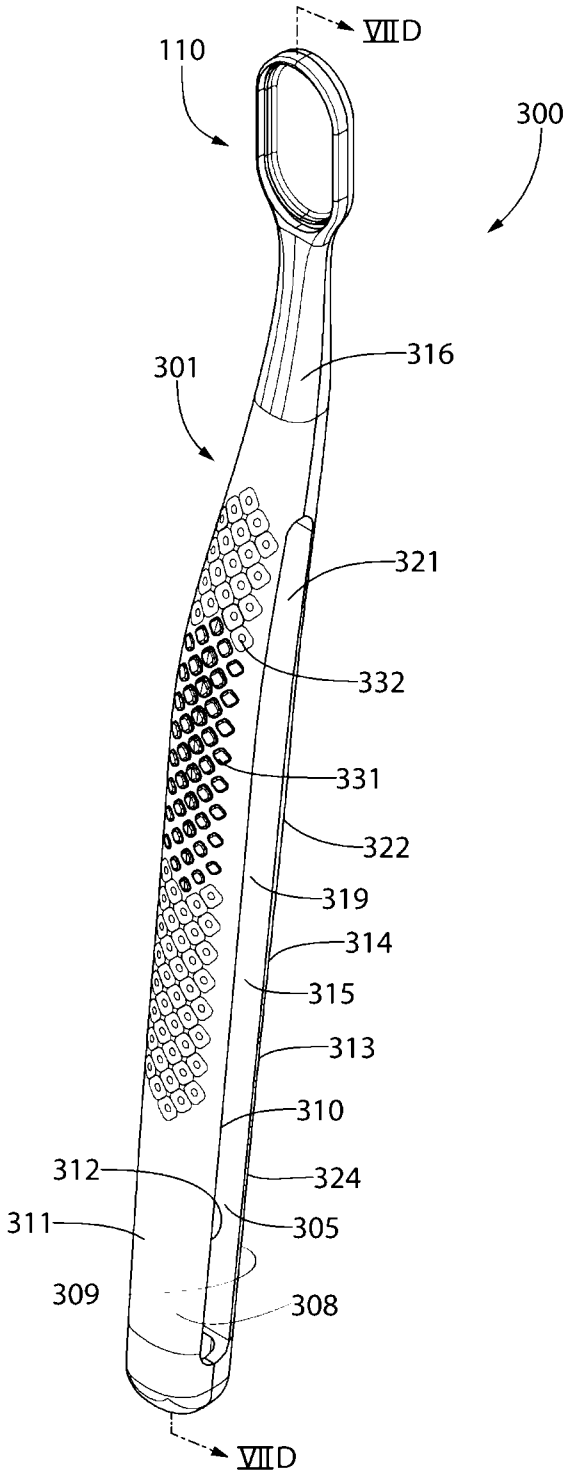
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FIG. 7A

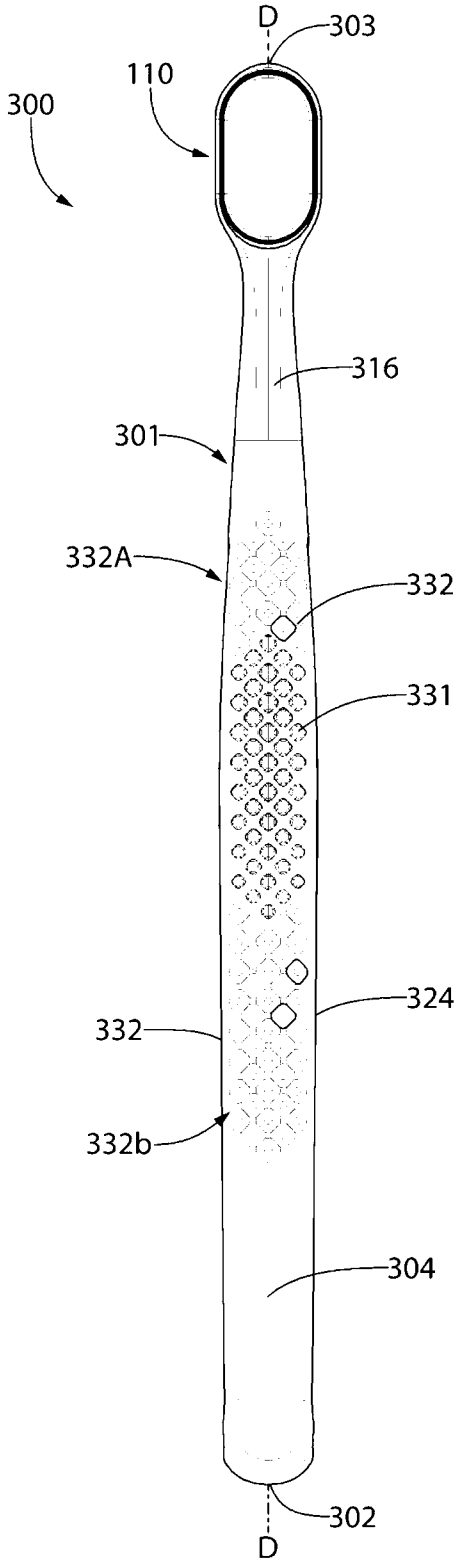

FIG. 7B

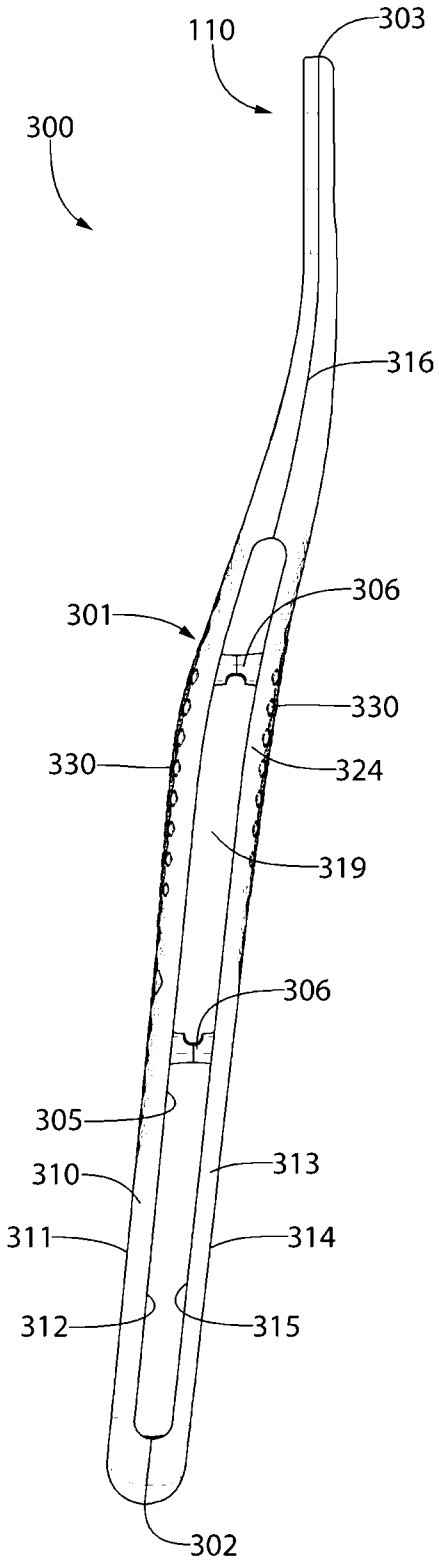
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FIG. 7C

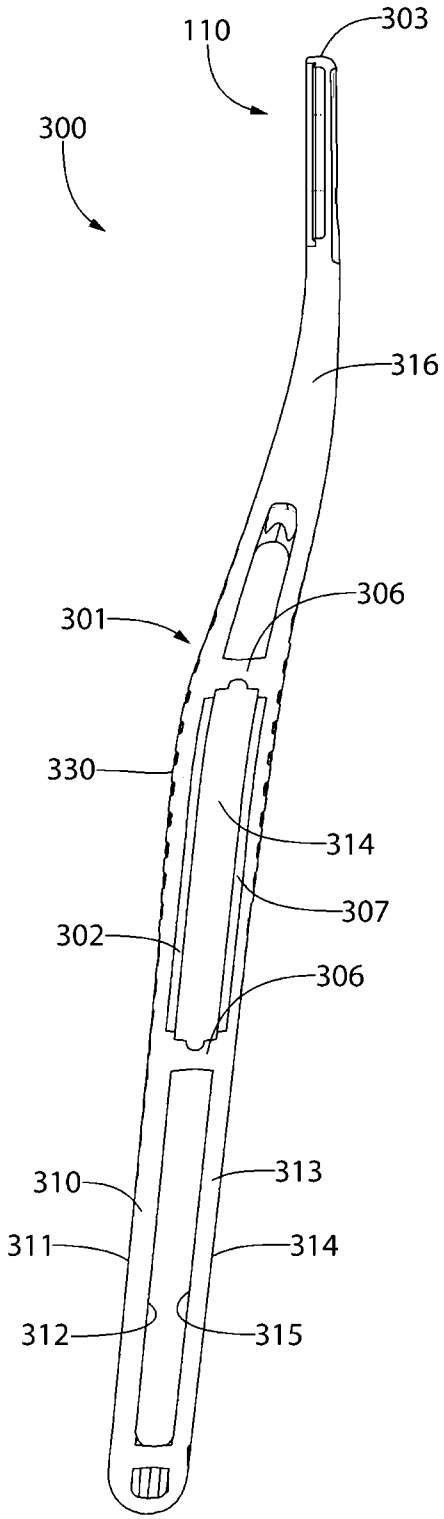
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FIG. 7D

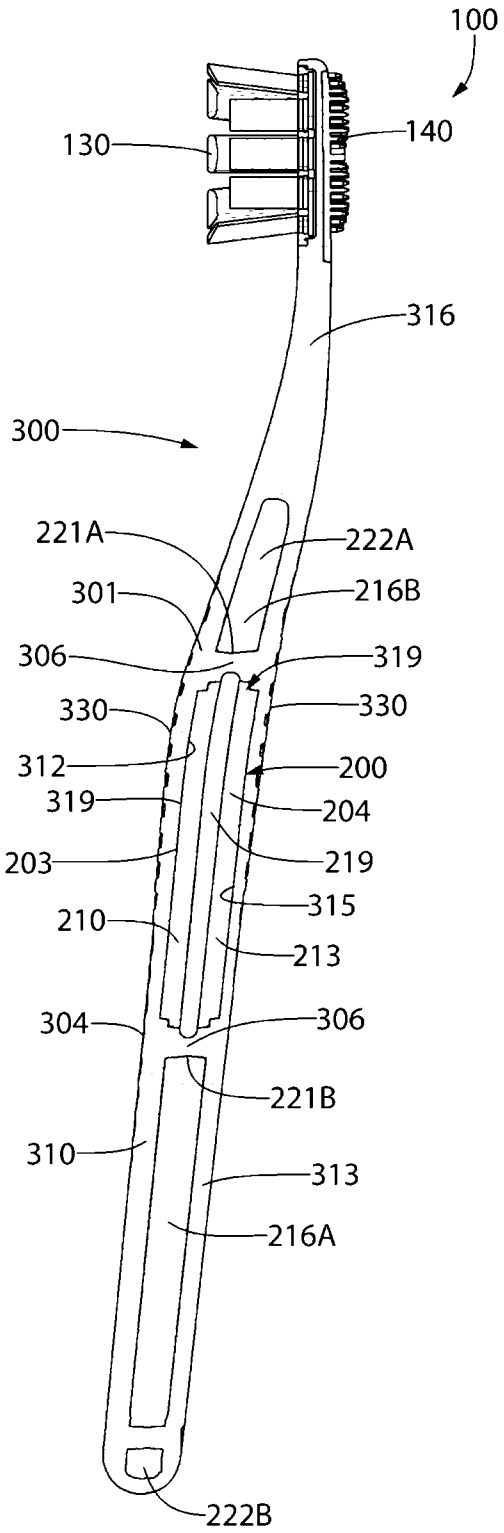
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FIG. 8

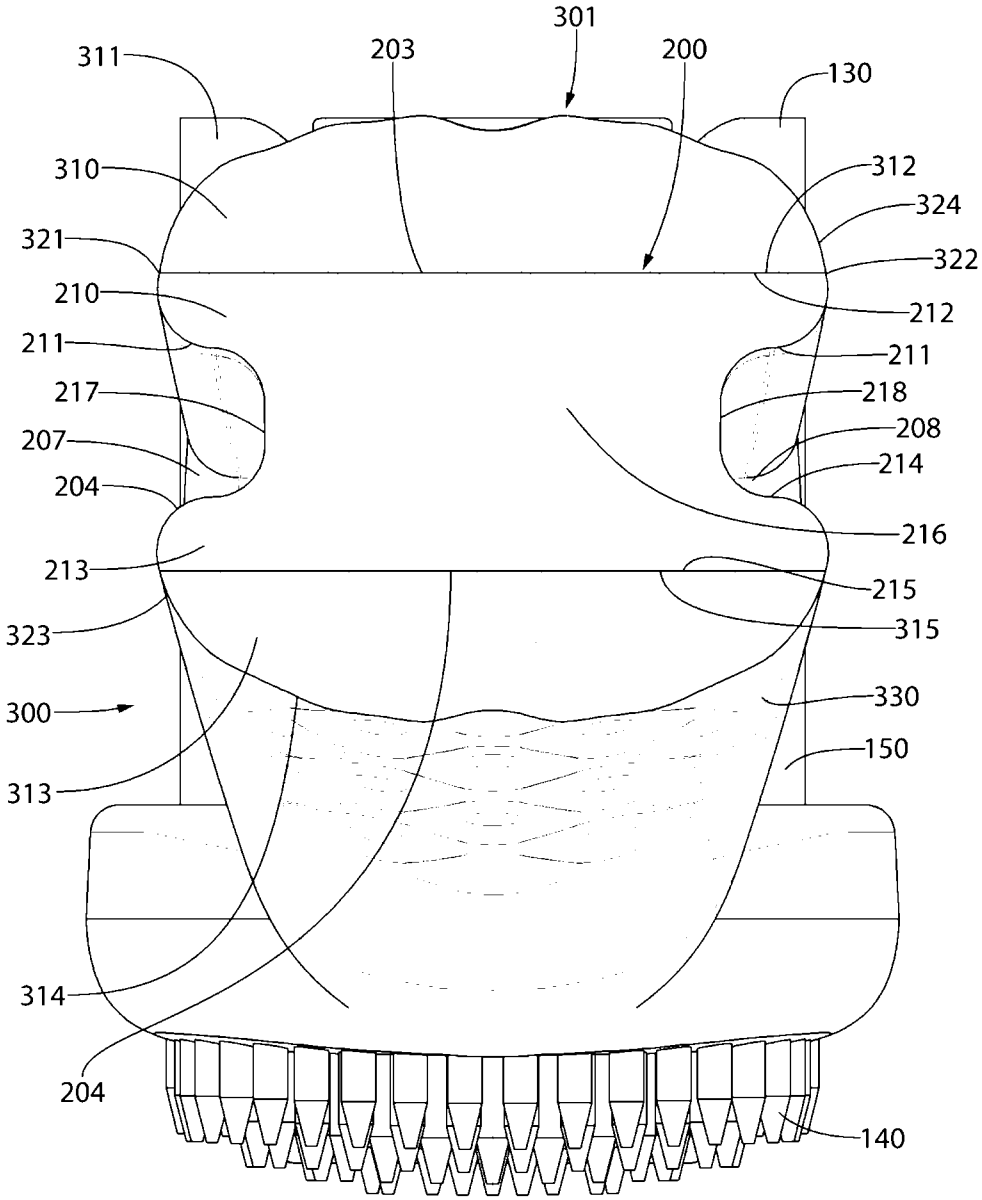
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FIG. 9

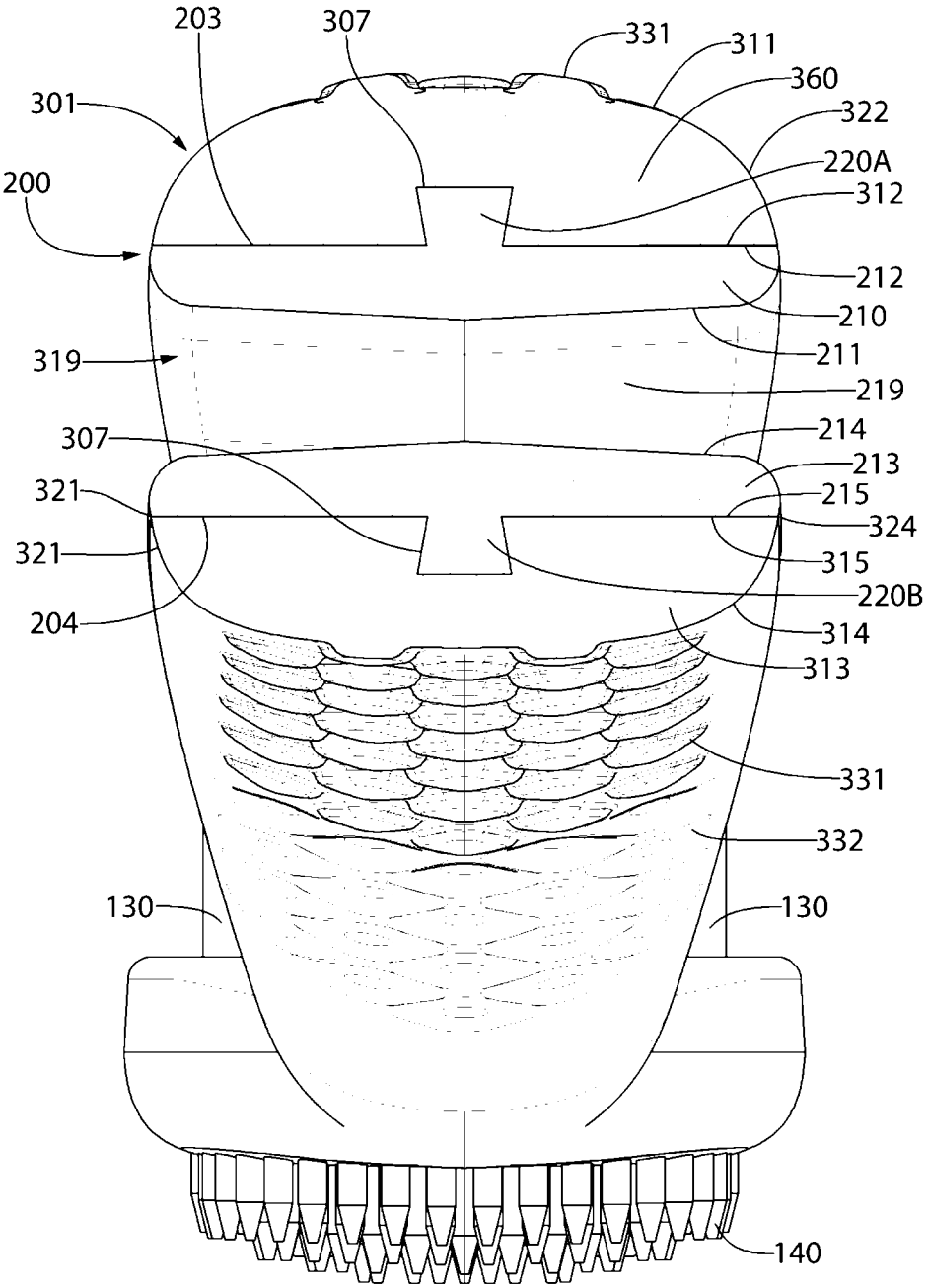
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FIG. 10

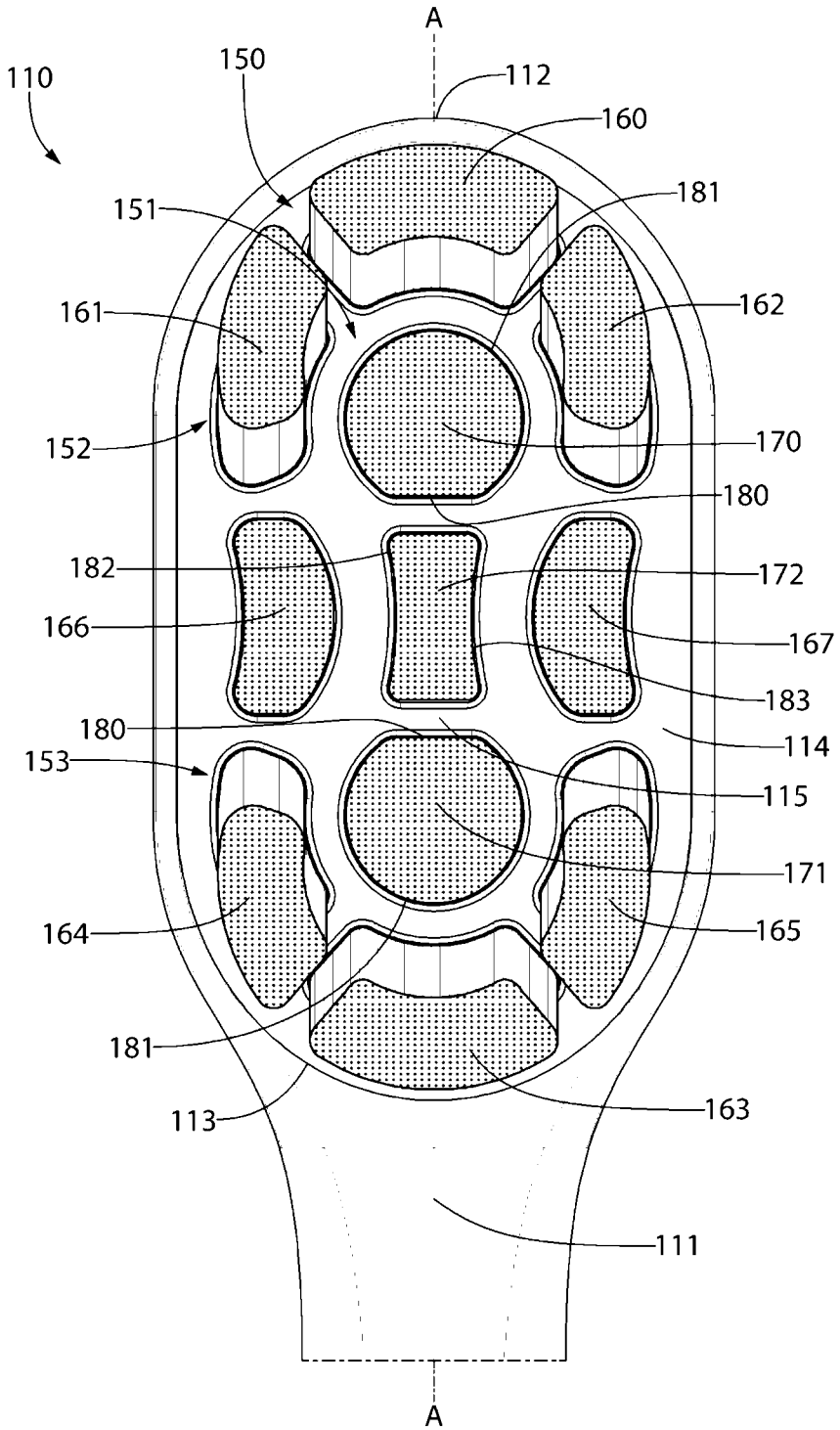
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FIG. 11

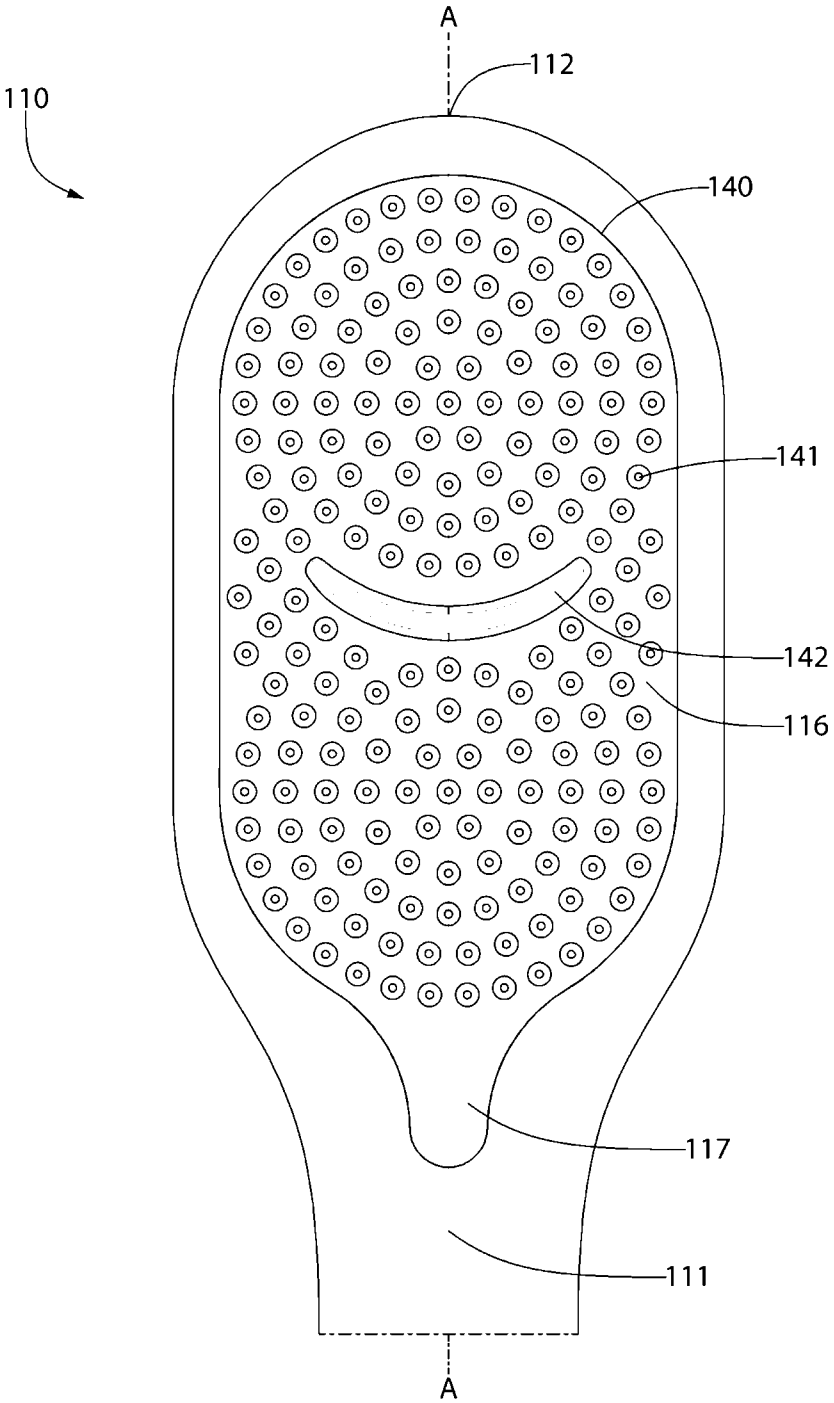

FIG. 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/CN2023/112422

A. CLASSIFICATION OF SUBJECT MATTER
INV. A46B5/00 A46B5/02
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A46B

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009/158540 A1 (BAERTSCHI ARMIN [CH] ET AL) 25 June 2009 (2009-06-25) paragraphs [0082] - [0085], [0087], [0090], [0118] - [0122], [0125] - [0128], [0131], [0133] figures 4-10,26-32	1-16,24, 25
X	US 2021/161282 A1 (HOHLBEIN DOUGLAS [US] ET AL) 3 June 2021 (2021-06-03) paragraphs [0057] - [0069] claims 1,20; figures 10-14	1-16,24, 25

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 December 2023	22/12/2023

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Raybould, Bruce

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/112422

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

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

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 17-23, 26, 27
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

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

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

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims;; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 17-23, 26, 27

PCT CLARIFICATION REQUEST

On account of the applicant's not having replied indicating which of the independent claims 1, 17, 18, 23, 26, 27 is to be searched, then only the first system claim 1 and its dependent claims 2-16 will be treated by the ISO, and related method claims 24,25. The remaining claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT
The unsearched subject matter must be entirely excised from the application.
Divisional applications comprising said unsearched subject matter may be filed in any subsequent regional phase.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) PCT declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/CN2023/112422

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009158540 A1	25-06-2009	EP 1924167 A1	28-05-2008
		US 2009158540 A1	25-06-2009
		WO 2007030958 A1	22-03-2007
US 2021161282 A1	03-06-2021	EP 4069032 A2	12-10-2022
		US 2021161282 A1	03-06-2021
		WO 2021113855 A2	10-06-2021