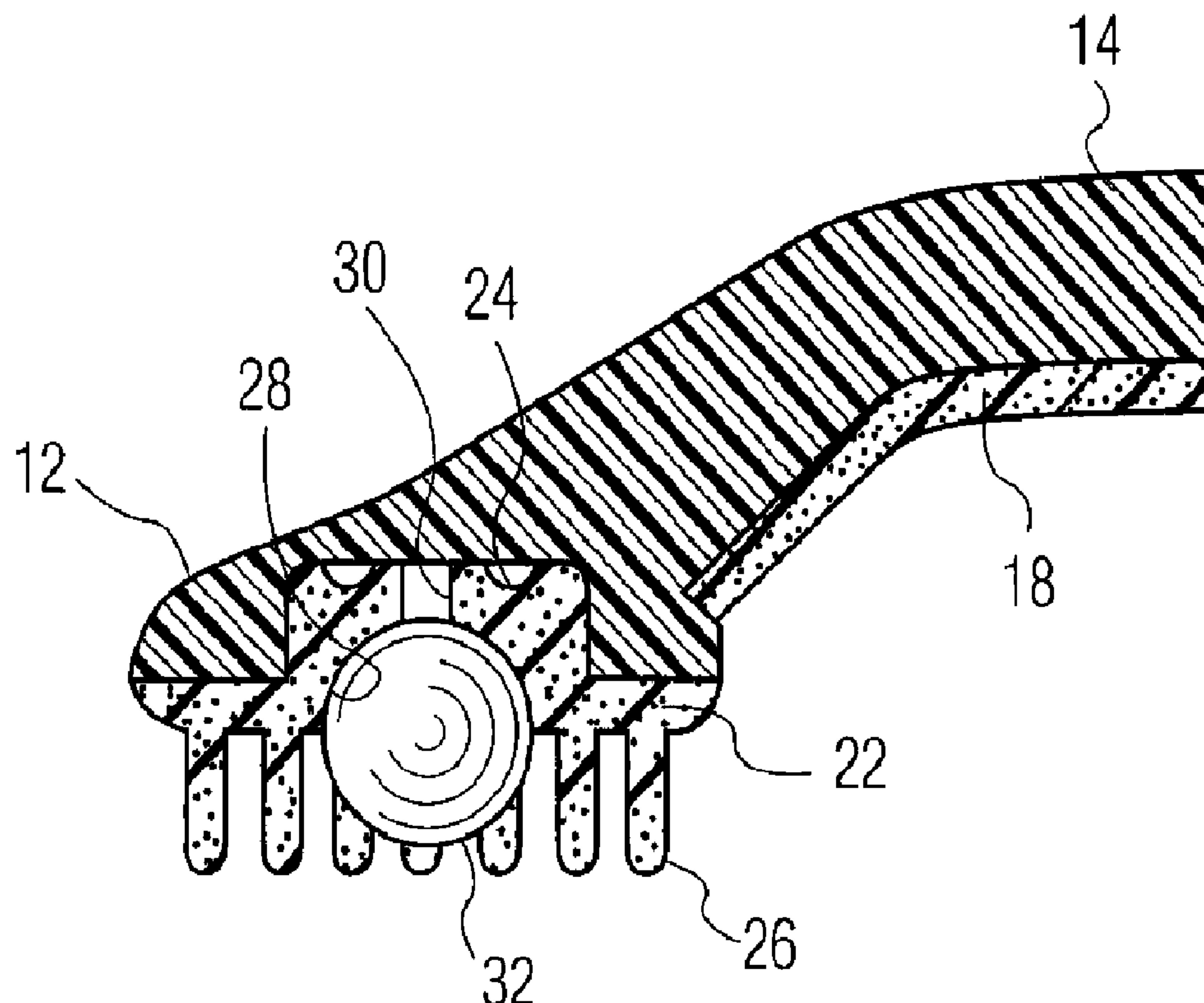




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(72) Inventeurs/Inventors:
SORRENTINO, ALAN, US;
HOHLBEIN, DOUGLAS J., US;
SPROSTA, AL, US
(73) Propriétaire/Owner:
COLGATE-PALMOLIVE COMPANY, US
(74) Agent: SMART & BIGGAR

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(54) Title: ORAL CARE IMPLEMENT WITH BEAD RETENTION



(57) Abrégé/Abstract:

An oral care toothbrush (10) includes a head (12) mounted to one end of the handle (14) containing a plurality of oral care elements (26). An oral care accessory is mounted to the opposite end of the handle. An oral care dispenser (32) is mounted in the head within the cleaning field defined by the oral care elements. The oral care dispenser may be held in place by a plurality of prongs (81) located in the field defined by the oral care elements. The toothbrush may be made of small size and of lightweight so as to be readily portable for use away from the home.



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(74) Agent: **TRAUT, Donald**; Colgate-Palmolive Company,
909 River Road, PO Box 1343, Piscataway, NJ 08854 (US).

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(71) Applicant (for all designated States except US): **COLGATE-PALMOLIVE COMPANY** [US/US]; 300 Park Avenue, New York, NY 10022 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **SORRENTINO, Alan** [US/US]; 17 Adams Drive, Cranbury, NJ 08512 (US). **HOHLBEIN, Douglas, J.** [US/US]; 45 Diverty Road, Pennington, NJ 08534 (US). **SPROSTA, Al** [US/US]; 200 Burnett Avenue, Maplewood, NJ 07040 (US).

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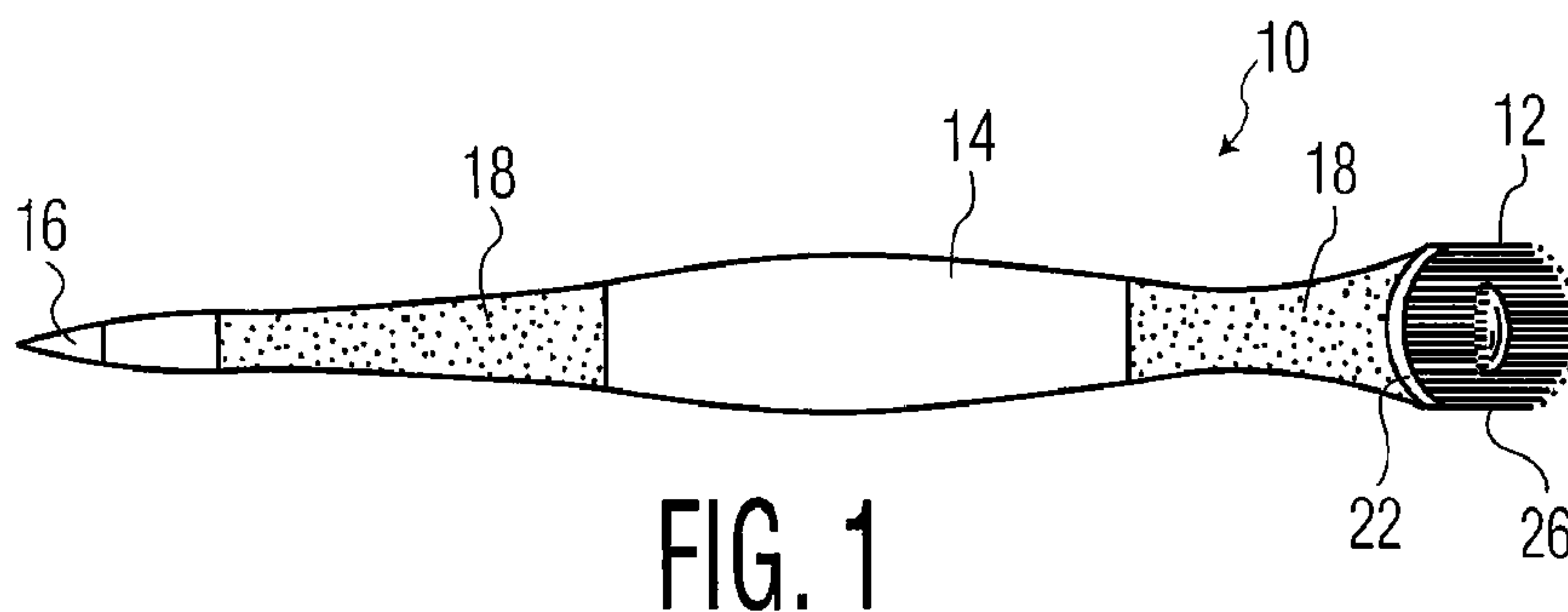


FIG. 1

(57) Abstract: An oral care toothbrush (10) includes a head (12) mounted to one end of the handle (14) containing a plurality of oral care elements (26). An oral care accessory is mounted to the opposite end of the handle. An oral care dispenser (32) is mounted in the head within the cleaning field defined by the oral care elements. The oral care dispenser may be held in place by a plurality of prongs (81) located in the field defined by

the oral care elements. The toothbrush may be made of small size and of lightweight so as to be readily portable for use away from the home.

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TITLE OF THE INVENTION

ORAL CARE IMPLEMENT WITH BEAD RETENTION

BACKGROUND OF THE INVENTION

[02] The present application relates generally to toothbrushes, and, more particularly, to a toothbrush which may have an oral care dispenser, such as a breath freshening, teeth cleaning gel capsule, and an oral care accessory, such as a toothpick.

[03] The advantages of good dental hygiene are well known. Often, however, toothbrushes are forgotten when one is travelling or away from home. Hotels, health care facilities, nursing homes, hospitals, daycare facilities, schools, airlines, etc. have a need for single use disposable or limited multiple use toothbrushes that may be economically supplied to and discarded by individuals without a toothbrush and/or a water supply. Such toothbrushes could be used in vending machines, or distributed in large quantities for simple, portable use from anywhere.

[04] Various types of disposable, limited use, or portable toothbrushes are known in the art. For example, some toothbrush systems have attempted to meet some of these needs by providing toothpaste within the toothbrush itself, through an integrated channel, for distribution through the toothbrush and around the bristles. This approach can be less economical due to the added manufacturing costs of toothbrushes with integrated channels. In addition, the toothpaste in some of these integrated channel toothbrushes, not being properly sealed, has a tendency to become dry, hard and stale.

[05] U.S. Pat. No. 6,135,274 shows an apparatus for brushing teeth that includes an outer bag, a toothbrush sealed within the outer bag, and a dispenser sealed within the outer bag and containing a mouth care solution. In use, the rupturable dispenser is squeezed or otherwise subjected to pressure while the toothbrush remains sealed within the outer bag. Unfortunately, the apparatus for brushing teeth requires an outer bag, increasing the cost of the apparatus, and fails to provide the rupturable dispenser and toothbrush as one complete, connected unit. The reference also fails to provide a toothpick mechanism for cleaning in between teeth, and which is also connected to the toothbrush.

[06] U.S. Pat. No. 6,397,860 discloses a disposable, waterless tooth brushing assembly that includes a toothbrush, a non-foaming, saliva-activated, teeth-cleaning agent pre-applied to the bristles of the toothbrush, a small moistened disposable towel for user after teeth cleaning, and a compact, lightweight, two-layer heat-sealed packaging container for pre-use sanitary storage of the toothbrush and towel. Like U.S. Pat. No. 6,135,274, the assembly of U.S. Pat. No. 6,397,860 requires a packaging container, increasing the cost of the assembly, and fails to provide a rupturable dispenser and toothbrush as one complete, connected unit. The reference also fails to provide a toothpick mechanism for cleaning in between teeth, and which is also connected to the toothbrush.

[07] Published U.S. application 2002/0106234 discloses a chewable toothbrush made of a flexible shell with bristles coupled to the shell and a chewable centerpiece disposed within the shell interior. A burstable capsule is disposed adjacent to the chewable centerpiece within the shell interior and maintains a digestible fluid.

BRIEF SUMMARY OF THE INVENTION

[08] The present application solves one or more of the problems of the related art by providing in one embodiment a waterless toothbrush having a toothpick connected thereto to enable cleaning in between teeth, and a rupturable dispenser containing a dentifrice and being connected in the bristle portion of the toothbrush for dispensing the dentifrice to the teeth to provide teeth cleaning and breath freshening, to deliver a cleaning, polishing, whitening, between teeth cleaning, and breath freshening action in addition to enhancing the cleaning efficiency of a typical disposable or limited use toothbrush.

[09] In one embodiment, a toothbrush may have (1) tooth surface cleaning provided by the toothbrush bristles or other cleaning elements and the dentifrice in the rupturable dispenser; (2) between teeth cleaning provided by the toothpick; and (3) breath freshening provided by the dentifrice in the rupturable dispenser.

[10] As embodied and broadly described herein, an oral care toothbrush may comprise a handle having an oral care head mounted to one end of the handle with an oral care accessory mounted to an opposite end of the handle. A plurality of oral care elements such as cleaning/massage elements, which could be bristles, extending outwardly from the outer surface of the head. The head may also include one or more structures for dispensing oral care material in the oral care field of the head.

[11] The oral care toothbrush may be characterized by its small size and light weight so that it is readily adaptable for travel use. The oral care toothbrush may be capable of having multiple functions by including an accessory as part of the toothbrush such as a toothpick, dental floss or tongue cleaner.

[12] The oral care toothbrush may include a toothpick formed at one end of the handle; and a head connected at another end of said handle, said head having a bristle block that includes a plurality of bristles and retains a gel capsule therein, the gel capsule containing a mouth care solution. In further embodiments, the gel capsule can be replaced by a quantity of toothpowder, toothpaste or a tooth cleaning gel dentifrice, to provide the cleaning benefits of the dentifrice within the rupturable dispenser.

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[13] In some embodiments, a subset of bristles in the toothbrush head may include retaining members that hold the capsule in place. The retaining members may extend out of the head's bristle block, and may be curved inward to hold the capsule. The retaining members may be made of the same material as the other bristles, and may be shorter and
5 wider than the bristles to provide greater support and rigidity.

[14] Further features will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the scope of the invention
10 will become apparent to those skilled in the art from this detailed description. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only.

[15] Among the advantages of some embodiments of the toothbrushes disclosed herein are that the size and configuration of the toothbrush allows discreet hygienic
15 use, such as no fingers in the mouth, adapting it to be readily used in public areas. Such uses could be done without the need for a sink or fountain or other source of water.

[15a] According to one aspect of the present invention, there is provided an oral care implement, comprising: a handle; a carrier at an end of the handle; a cleaning block on the carrier; a plurality of retaining members extending outwardly from the cleaning block;
20 and oral care elements extending from the cleaning block, wherein the retaining members have an arcuate shape and provide an inward bias force for retaining an oral care dispenser therebetween.

[15b] According to another aspect of the present invention, there is provided an oral care implement, comprising: a handle having a carrier; a cleaning block on the
25 carriers; oral care elements extending from the cleaning block and a plurality of members extending outwardly from the cleaning block adjacent to the oral care elements, and the members are curved inward toward the oral care dispenser; wherein the members are for holding an oral care dispenser in the carrier.

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[15c] According to still another aspect of the present invention, there is provided an oral care implement, comprising: a handle with a carrier; a cleaning block on the carrier; a field of bristles extending from the cleaning block; a plurality of prongs located within the field; and an oral care dispenser retained in the field by the plurality of prongs.

5 [15d] According to still another aspect of the present invention, there is provided an oral care implement, comprising: a handle; a carrier at an end of the handle, the carrier comprising a front surface and a back surface; a cleaning block on the carrier, the cleaning block extending through the carrier and comprising a portion exposed on the front surface of the carrier and a portion exposed on the back surface of the carrier; a gel on the
10 cleaning block; a plurality of retaining members extending outwardly from the cleaning block; wherein the retaining members are in contact with the gel; and oral care elements extending from the cleaning block and surrounding the retaining members, wherein the oral care elements extend outwardly from the cleaning block for a first distance, the retaining members extend from the cleaning block a second distance that is less than the first distance.

15 [15e] According to still another aspect of the present invention, there is provided an oral care implement, comprising: a handle having a carrier comprising a front surface and a back surface; a cleaning block on the carrier, the cleaning block extending through the carrier and comprising a portion exposed on the front surface of the carrier and a portion exposed on the back surface of the carrier; oral care elements extending from the
20 cleaning block; and a plurality of members extending outwardly from the cleaning block; wherein the members contact an oral care

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material in the carrier, the cleaning block and the oral care elements are formed of the same material.

BRIEF DESCRIPTION OF THE DRAWINGS

5 **[16]** The features herein will become more fully understood from the detailed description given herein below and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

[17] FIG. 1 is a front elevational view of an oral care toothbrush with a toothpick and a breath freshening, teeth cleaning gel capsule connected thereto;

10 **[18]** FIG. 2 is a side elevational view of the toothbrush shown in FIG. 1;

[19] FIG. 3 is a rear elevational view of the toothbrush shown in FIGS. 1-2;

[20] FIG. 4 is a fragmental, cross-sectional view of the head of an oral care toothbrush;

15 **[21]** FIGS. 5-6 are side elevational views of other forms of heads for an oral care toothbrush;

[22] FIG. 7 is a fragmental side elevational view showing a head detachably mounted to the handle for an alternate embodiment;

[23] FIG. 8 is a fragmental cross-sectional elevational view showing a vibrating toothbrush head for an alternate embodiment;

[24] FIGS. 9-10 are fragmental front elevational views partly broken away of portions of a handle for an alternate embodiment;

[25] FIG. 11 is a side elevational view partly in section of yet another embodiment;

[26] FIGS. 12-13 are front elevational views showing various forms of toothbrushes in a packaged or display condition;

[27] FIG. 14 is a side view of a head of an embodiment with only portions of the cleaning elements shown in solid lines for purposes of focus and clarity;

[28] FIG. 15 is a perspective view of one embodiment of a toothbrush head;

[29] FIG. 16 is an enlarged perspective front view of the head of FIG. 15;

[30] FIG. 17 is a perspective view of an alternate toothbrush head embodiment;

[31] FIG. 18 is an enlarged perspective front view of the head of FIG. 17;

[32] FIG. 19 is an enlarged cross-sectional side view of the head of FIG. 17; and

[33] FIG. 20 is a cross-sectional side view of an alternate embodiment toothbrush having the head shown in FIG. 17.

DETAILED DESCRIPTION OF THE INVENTION

[34] The following detailed description refers to the accompanying drawings. The same reference numbers in different figures identify the same or similar elements.

[35] FIGS. 1-4 illustrate an oral care toothbrush 10 that includes a head 12 and a handle 14. Head 12 may be a refill head and thus be removably connected to handle 14, or head 12 may be permanently connected to head 12.

[36] The majority of handle 14 and a portion of head 12 may be molded from a variety of rigid materials, including plastics, resins, etc., such as, for example, polypropylene. An end portion of handle 14, opposite the end head 12 is attached to an accessory, preferably a toothpick 16 formed of a resilient and soft thermoplastic

elastomer. Toothpick 16 may be a refill and thus be removably connected to handle 14, or toothpick 16 may be permanently connected to handle 14. Toothpick 16 provides a mechanism for spot cleaning between teeth. Forming toothpick 16 of a soft elastomer provides more comfortable interproximal cleaning between teeth. Toothpick 16 could, however, be made of a stiff rigid material similar to the main portion of handle 14, or could simply be a rubber or elastomeric pick adhered or otherwise mounted to the end of handle 14.

[37] Portions 18 of handle 14 may also be formed of a resilient and soft thermoplastic elastomer. The thermoplastic elastomer which forms toothpick 16 and handle portions 18 may be a thermoplastic vulcanate (TPV) consisting of a mixture of polypropylene and EPDM (ethylene propylene diene monomers) which is available as SANTOPRENE (brand), described in U.S. Pat. No. 5,393,796, or VYRAM (brand), another TPV consisting of a mixture of polypropylene and natural rubber. Both SANTOPRENE and VYRAM (brands) are elastomers marketed by Advanced Elastomer Systems. Other suitable elastomers include KRATON, a brand of styrene block copolymer (SBC) marketed by Shell, and DYNAFLEX G 2706 (brand), a thermoplastic elastomer marketed by GLS Corporation and which is made with KRATON (brand) polymer.

[38] Handle 14 may further include dimples, bumps, or ridges protruding from portions of its surface, and providing a decorative appearance to handle 14 and enhanced gripping of handle 14 during use of toothbrush 10. The dimples may be formed from the same material as soft elastomer portions 18 of handle 14 or from the same material as the majority of handle 14 (e.g., a rigid material such as polypropylene). All or part of handle 14 could be made of any suitable material, such as plastic, wood, metal or various natural materials which are biodegradable. Preferably handle 14 is made of a generally flat or oval shape rather than cylindrical in its gripping portion which would be between the spaced elastomer portions 18 to facilitate the gripping of the handle.

[39] As shown in FIG. 4 another portion of head 12, defining a bristle or cleaning element block 22 of head 12, may also be formed of a resilient and soft thermoplastic elastomer, such as the thermoplastic elastomer used to form handle portions 18. Cleaning block 22 may include one or more depressions 24 provided in

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a surface 30 thereof with an opening 30 therein that provides a cushioning effect to a rupturable dispenser, preferably a gel capsule 32, contained therein, as described more fully below. Cleaning block 22 further includes a multitude of cleaning elements which could be conventional filament, preferably nylon, or elastomeric bristles or fingers 26 extending integrally outwardly from the outer surface of head 12. In the illustrated embodiment as best shown in FIG. 4, all of the cleaning elements 26 extend outwardly from the outer surface of block 22 the same distance so as to create a generally flat surface. Alternatively, however, some elements 26 may be shorter or longer than other elements 26. The variable length of the cleaning elements 26 is illustrated by the dotted out tips 26a in FIG. 14, with only body portions 26b of the cleaning elements 26 shown in solid lines for purposes of clarity and to focus on the variable nature of such elements.

[40] The term "cleaning elements" as used herein is intended to be used in a generic sense as cleaning elements or massage elements arranged in a circular cross-section shape or any type of desired shape, including straight portions or sinusoidal portions. It is to be understood that the specific illustration of the cleaning elements is merely for exemplary purposes. The features herein can, however, be practiced with various combinations of the same or different configurations (such as stapled, in-mold tufting (IMT) bristle technology as disclosed in U.S. Pat. Nos. 5,609,890, 5,390,984, and 5,533,791) and/or with the same or different bristle materials (such

as nylon bristles, spiral bristles, rubber bristles, etc.). Similarly, while FIGS. 1-4 illustrate the cleaning elements 26 to be generally perpendicular to the outer surface of head 12, some or all of the cleaning elements 26 may be angled at various angles with respect to the outer surface of head 12. It is thereby possible to select the combination of configurations, materials and orientations to achieve specific intended results, such as enhanced cleaning, tooth polishing, breath freshening, tooth whitening and/or massaging of the gums.

[41] As stated above, the cleaning block 22 may include one or more depressions 24 which are designed to receive and retain an oral care dispenser, such as a rupturable gel capsule 32 therein. The one or more depressions 24 can be varied in size so as to accommodate not only varying size dispensers 32, but varying

quantities of toothpowder, a toothpaste or tooth cleaning gel dentifrice or other oral care material, for delivery to the dentiture as the elements 26 extending from the block 22 are applied thereto, during use of the present invention such that the oral care material enhances the cleaning of the dentiture by the cleaning elements. While the present invention can be manufactured containing a packed toothpowder, toothpaste or tooth cleaning gel dentifrice and used repeatedly by the user refilling the dispenser with toothpowder, toothpaste or tooth cleaning gel dentifrice, it is preferably used with one or more gel capsules 32 contained therein. Most preferably the present invention is used with a single gel capsule 32, supplied therewith, so as to be most easily transported, used, and subsequently disposed of; however, it may also be used repeatedly with replaceable gel capsules 32, and then disposed of.

[42] It is preferred that the depression is in the form of a cushioned socket 28 sized and shaped to receive and retain the gel capsule 32, without premature rupture of the gel capsule 32 prior to use thereof during application of the bristle block 22 to the dentiture and brushing thereof. Cushioning socket 28 opening 30, and the material making up bristle block 22 provide a cushioning effect for gel capsule 32 to prevent gel capsule 32 from rupturing prior to use.

[43] Gel capsule 32 holds and applies a mouth care solution onto bristles 26 of toothbrush head 12. The mouth care solution may be a toothpaste, a gel, a mouthwash, or similar dentifrice or oral hygiene product, or a combination of the same contained in the rupturable capsule 32. Preferably gel capsule 32 is a liquid-filled gel capsule having frangible, thin walls that easily rupture or burst when rubbed against the teeth, or dissolve when mixed with the saliva of a user. The materials making up gel capsule 32 and the oral or mouth care solution contained therein preferably are consumable by the user of toothbrush 10, eliminating the need for water, a sink, or a waste receptacle to expectorate the gel capsule 32 or its contents. The mouth care solution remains in gel capsule 32 until toothbrush 10 is ready for use. Gel capsule 32 may be fully sealed, helping the mouth care solution to remain fresh until use.

[44] The capsule or dispenser 32 may include an active agent. Non-limiting examples of active agents which can be used include antibacterial agents, whitening agents, anti-sensitivity agents, anti-inflammatory agents, anti-attachment agents,

plaque indicator agents, flavorants, sensates, breath freshening agents, gum health agents and colorants. Examples of these agents include metal ion agents (e.g., stannous ion agents, copper ion agents, zinc ion agents, silver ion agents) triclosan; triclosan monophosphate, chlorhexidine, alexidine, hexetidine, sanguinarine, benzalkonium chloride, salicylanilide, domiphen bromide, cetylpyridinium chloride, tetradecylpyridinium chloride, N-tetradecyl-4-ethylpyridinium chloride (TDEPC), octenidine, delmopinol, octapinol, nisin, essential oils, furanones, bacteriocins, flavans, flavinoids, folic acids, vitamins, minerals, hydrogen peroxide, urea peroxide, sodium percarbonate, PVP-H₂O₂, polymer-bound peroxides, potassium nitrates, occluding agents, bioactive glass, arginine salts, arginine bicarbonate, bacalin, polyphenols, ethyl pyruvate, guanidinoethyl disulfide, tartar control agents, anti-stain ingredients, phosphate salts, polyvinylphosphonic acid, PVM/MA copolymers; enzymes, glucose oxidase, papain, ficin, ethyl lauroyl arginate, menthol, carvone, and anethole, various flavoring aldehydes, esters, and alcohols, spearmint oils, peppermint oil, wintergreen oil, sassafras oil, clove oil, sage oil, eucalyptus oil, marjoram oil, cinnamon oil, lemon oil, lime oil, grapefruit oil, and/or orange oil.

[45] The active agent may be compatible with toothpaste, or may be unstable and/or reactive with typical toothpaste ingredients. The active agent also may be a tooth cleaning agent to boost the overall efficacy of brushing.

[46] The active agent can be provided in any suitable vehicle, such as in aqueous solution or in the form of gel or paste. The vehicle can have a variety of different visual aesthetics including clear solution or gel or opaque solution or gel. Non-limiting examples of vehicles include water, monohydric alcohols such as ethanol, poly(ethylene oxides) such as polyethylene glycols such as PEG 2M, 5M, 7M, 14M, 23M, 45M, and 90M available from Union Carbide, carboxymethylene polymers such as Carbopol® 934 and 974 available from B.F. Goodrich, and combinations thereof. The selection of a suitable vehicle will be apparent to persons skilled in the art depending on such factors as the properties of the active agent and the desired properties of the medium, such as viscosity.

[47] In use, gel capsule 32 would be pressed against the teeth and burst or rupture or dissolve, applying the mouth care solution over cleaning elements 26. The

user then may brush their teeth with toothbrush 10. The user may also use toothpick 16 to clean between teeth, either before or after brushing. After the user has used toothbrush 10, one may, but not necessarily, then easily and economically dispose of toothbrush 10.

[48] In some embodiments, the entire structure of toothbrush 10, including head 12, handle 14, and toothpick 16, may be molded as one integral structure, using a conventional two-component injection molding operation typically used in the manufacture of toothbrushes. This enables toothbrush 10 to be economically and quickly manufactured. Although toothbrush 10 may have a variety of sizes and dimensions, it is preferred that toothbrush 10 have a small profile, with head 12 being small enough to cover one tooth at a time and handle being thinner than conventional, everyday toothbrush handles. Toothbrush 10 is thus readily portable or space saving.

[49] The toothbrush 10 may provide many benefits, including the cosmetic benefits of brushing one's teeth in a form that can be used when one is away from home, and away from a water supply. The cosmetic benefits achieved by the toothbrush 10 include the cleaning of debris between teeth with toothpick 16, broad tooth surface cleaning (particularly the front teeth) with cleaning elements 26 and the mouth care solution of gel capsule 32, and breath freshening with the mouth care solution of gel capsule 32.

[50] In addition to the cosmetic benefits, the toothbrush 10 may also provide economic benefits in the form of an inexpensive toothbrush that is both quickly and economically manufactured. Toothbrush 10 also provides a mechanism for maintaining oral health, without the need for toothpaste, water, mouth wash, and containers to hold the same. Thus, toothbrush 10 is also very convenient to use.

[51] Furthermore, the toothbrush 10 provides at least one benefit of preventing the spread of waterborne diseases. For example, the toothbrush 10 eliminates the conventional practice of using local water to mix with toothpaste. This feature is useful for military applications where there is a limited source of potable water or a need to conserve water or maintain the oral health of troops, such as in desert fighting environments. In another situation, the toothbrush is useful in

outdoor camping environments to prevent disease or sickness from waterborne bacteria.

[52] Although FIGS. 1-4 illustrate a manually-operated, disposable toothbrush, the features herein may also be practiced where the head includes one or more power or electrically operated movable sections carrying cleaning elements. Such movable section may oscillate in a rotational manner or may oscillate linearly in a longitudinal direction with respect to the longitudinal axis of the head or may oscillate linearly in a lateral or transverse direction with respect to the longitudinal axis of the head. The movable section may oscillate in and out in a direction toward and away from the outer surface of the head. The movable section may rock back and forth with respect to the outer surface of the head. The movable section may rotate continuously in the same direction, rather than oscillate. Any suitable drive mechanism may be used for imparting the desired motion to the movable section. Where plural movable sections are used, all of the movable sections may have the same type and direction of movement, or combinations of different movements may be used.

[53] In some embodiments, the cleaning elements may be in the form of bristles made from conventional materials, such as nylon, as well as from a combination of materials so as to provide the proper stiffness in an economical manner. For example, the cleaning elements could be made of a flexible resilient material, such as TPE and a lesser expensive material such as LLDPE (linear low density polyethylene) or EVA (ethylene vinyl acetate) or a TPE. The cleaning elements could be made of a blend of TPE and either LLDPE, EVA, or polypropylene. Preferably, the two materials are combined to provide a stiffness of less than 600 MPa. The blend of materials would give the properties of conventional nylon bristles, while offering reduced costs. For example, there would be lower manufacturing costs by injection molding instead of conventional bristle tufting. Alternatively the resilient material could be a single material, such as hard TPE (i.e. Shore A 80 hardness), straight LLDPE or straight EVA.

[54] The cleaning elements may be of any desired shape. For example, the cleaning elements could be of cylindrical shape having a uniform diameter throughout their length. Alternatively, the cleaning elements could taper from the

root of each cleaning element where it extends from head 22 to its outer cleaning end. Since a preferred practice of the invention is to provide a small lightweight toothbrush the dimensions of the various components of toothbrush 10 are preferably small. Thus, for example, each cleaning elements may extend outwardly from the outer surface of cleaning block 12 a distance no greater than 10 mm and preferably no greater than 8 mm and most preferably no greater than 6 mm. Where tapered cleaning elements are used the root diameter should be no greater than 1.5 mm, preferably no greater than 1 mm, most preferably no greater than 0.7 mm or no greater than 0.5 mm or no greater than 0.3 mm. The diameter could then decrease in size to no greater than 0.2 mm at a distance of no greater than 6 mm from the base of the cleaning element. The taper relationship of diameter at a distance location above the root diameter could be a range of no greater than 1 mm at a distance of no greater than 10 mm, preferably no greater than 0.6 mm at a distance of no greater than 8 mm, most preferably no greater than 0.2 mm at a distance of no greater than 6 mm. Preferably, the length of the entire toothbrush 10 is no greater than 5 inches, preferably no greater than 4 inches, and more preferably no greater than 3.75 or 3 or 2.50 inches, and may be in the range of 2 to 4 inches.

[55] As illustrated in FIGS. 1 and 4 the cleaning elements define a cleaning field in the head and the dispenser 32 is mounted within this cleaning field. The cleaning elements 26 preferably extend outwardly from the cleaning block 22 to be approximately flush with the outer surface of the gel bead or capsule 32, as shown in FIG. 4. The features herein, however, can also be practiced where the cleaning elements extend either a greater distance or a lesser distance than the dispenser 32 as shown in FIG. 14. Since toothbrush 10 is intended to be both small and lightweight, it is preferred that toothbrush 10 weigh no more than 3 grams. The small size is such that it can be held completely within the palm of an adult user. Head 12 is of a size that it would correspond to the size of an individual tooth or an individual tooth and the interproximal areas. Head 12 could be made of any suitable shape and is preferably of circular or oval shape having a maximum lateral dimension or diameter of no greater than 13 mm, preferably no greater than 12 mm and most preferably no greater than 11 mm. Where head 12 is of non-circular shape its maximum lateral dimension is 14 mm.

[56] As shown in FIG. 2 head 12 may be at an angle between 0° and 90° to the longitudinal axis of handle 14. The preferred angle is from 20° to 70° and more preferably from 30° to 60°. The cleaning elements could be perpendicular to the outer surface of head 12 or could also be at an angle to the outer surface such as in the range of 60° to 90° or in the range of 75° to 90°.

[57] In one embodiment, the cleaning elements could be hollow, such as hollow bristles, which are capable of absorbing a medicament by capillary action. Such a feature would be particularly useful for children where a medicament or some form of flavor could be dispensed from the hollow cleaning elements. It is also possible to leach antibacterial material from the cleaning elements. In one embodiment where the cleaning elements are used to dispense oral care materials the cleaning elements themselves may be considered as the oral care dispensers without requiring additional dispensers such as capsule 32.

[58] Where specific parameters and characteristics have been given for cleaning elements, the features herein could be practiced where other cleaning elements do not include those parameters and characteristics.

[59] FIGS. 5-6 show other variations wherein the cleaning elements are in the form of a single mass having an irregular outer surface. As shown in FIG. 5 the mass 34 is similar to that of "steel wool" as used in household cleaning or could be part of VELCRO, formations, such as hooks or loops.

[60] FIG. 6 shows a variation where the cleaning element 36 is of a single mass of foam for cotton which could be used as a swab for oral care material. The outer surface of the swab could be generally planar or could have surface irregularities. In such practice of the invention the cleaning element 36 could be impregnated with the oral care material or could be dipped into oral care material so as to absorb the material and thereby the cleaning element 36 would also function as the oral care dispenser. Such swab type cleaning elements are gentle for children, particularly infants.

[61] The features herein could be practiced where the various components of the toothbrush 10 are segmented for manufacturing and assembly purposes. Such segmented components could also be detachably connected together so as to permit the interchangeability of the components thereby providing the possibility for the

substitution of different components in the combination. Thus, the head 12 could be detachably connected to the handle 14. FIG. 7, for example, illustrates head 12 to be detachably mounted to handle 14 by a snap fitting 38 which may be of any suitable construction as is known to those of ordinary skill in the art.

[62] The concept of a detachable interconnection may also be used wherein the dispenser 32 is detachably mounted in the head 12 or wherein the oral care accessory, such as toothpick 16, is detachably mounted to handle 14. Thus, as later described with respect to FIGS. 12 and 13 the toothbrush and its various components could be packaged wherein the same package includes a plurality of toothbrushes and/or a plurality of different components such as heads, dispensers or accessories.

[63] FIG. 8 shows a further embodiment wherein a piezoelectric crystal 40 is provided in the handle 14 at the junction with head 12 so as to cause the head 12 to vibrate during use. Alternatively the head 12 could be mounted to a rotatable shaft extending from the handle and having an eccentric weight on the shaft to cause the head to vibrate.

[64] Although FIGS. 1-3 illustrate an oral care accessory 16 in the form of a toothpick, other types of accessories 42 could be used as schematically shown in FIG. 9. As illustrated therein such accessory 42 would be mounted to the end of handle 14 similar to the mounting of toothpick 16. Such mounting could be detachable or of a permanent nature. Examples of such oral care accessories include tongue cleaners, floss holders or an interproximal brush. Similarly, the accessory could be of a swab or foam type similar to the cleaning element 36 of FIG. 6 or could be of the single mass of roughened material such as the cleaning element 34 of FIG. 5.

[65] FIG. 10 shows another variation wherein the toothbrush is particularly adapted for use by children. Such use is enhanced by providing any suitable ornament or caricature 44 on the toothbrush, such as on the handle or on any other suitable location including the backside of the head. Such ornament 44 could be detachably mounted so that it could be kept by the child after the rest of the toothbrush is thrown away. Other aspects of the invention which make it desirable for use by children include the possibilities of dispensing various types of oral care materials including materials having special flavors, tooth numbing materials, anti-sensitive materials or various medicaments.

[66] The toothbrush could also be made of various colors for different parts of the toothbrush. For example, soft elastomer 18 could be made of a different, such as a contrasting, color with respect to the remainder of handle 14 which would be made of a rigid material. Similarly, the head 12 could be made of a different color than the rigid portion of the handle and/or the soft elastomer portions 18. The cleaning elements 26 could be made of distinct colors and the dispenser 32 could also be made of a distinct color. Along the same lines the accessory such as toothpick 16 or other accessory 42 could be made of a distinct color. These various colors could be contrasting or complementary with each other. Thus, for example, the various colors could differ only slightly in color or shade.

[67] FIG. 11 illustrates another embodiment wherein the handle 14 has a hollow chamber 46 in which the oral care material could be contained. Chamber 46 leads to a passageway 48 which extends to the head 12 such as terminating in a plurality of branches 49 at the outer surface of head 12 within the cleaning field. In order to dispense the oral care material located in the chamber or reservoir 46 handle 14 would have sufficient resiliency so that it can be squeezed thereby forcing the material from the handle to the head into a dispensing cavity or one or more dispensing openings.

[68] FIGS. 15 and 16 illustrate a head 60 according to another embodiment, the head 60 having an outer surface 62, a plurality of cleaning elements 64 extending from a portion of the outer surface 62, and a raised socket 68 extending from another portion of the outer surface 62. The socket 68 may be formed from the same material as the outer surface 62, and can be integrally formed with the outer surface such as by molding or the like. The socket 68 extends outwardly relative to the outer surface 62 by an upstanding wall 69, and includes a seat to accommodate an oral care dispenser such as a bead or capsule 70 as discussed herein. The raised socket 68 positions the dispenser 70 closer to the edges of the cleaning elements 64 to facilitate contact between the dispenser 70 and the user's teeth and to encourage rupturing of the dispenser 70 early in the brushing process. The socket may also position the dispenser 70 beyond the cleaning elements 64 as discussed above, which would encourage even greater and immediate contact with the user's teeth.

[69] The cleaning elements 64 may comprise a variety of configurations as discussed above, such as a circular configuration as shown in FIG. 1. FIG. 16 illustrates an example of an oval configuration, wherein the cleaning elements 64 are arranged in a plurality of concentric rings 65a, 65b, 65c, surrounding the socket 68. One of such rings is a partial ring comprised of partial ring sections 65d, 65e defined along the upper and lower edges 61, 63 of the outer surface 62 of the head 60, which sections 65d, 65e comprise the equivalent of a so-called power tip that is designed to provide a cleaning edge that extends beyond the majority of the field of cleaning elements for increased efficacy.

[70] Any suitable oral care products could be dispensed from the dispenser. Such products include, but are not limited to the gel capsule 32 as previously described and could contain toothpaste, tooth powder or could be a small vial of mouthwash having a gel, a powder or a liquid. Such a vial could be separately included in a package containing the toothbrush. The materials could be flavored and could be provided in sets of different flavors and/or different characteristics such as medicaments, numbing materials, etc.

[71] Where the dispensers 32 are in the form of beads, different beads or capsules could be used with different colors/flavors to enhance consumer appeal. As described the capsule 32 could be an impregnated bead that burst. Suitable beads include those supplied by Mane Inc.

[72] Any suitable methods may be used for forming toothbrush 10 and its various components. For example, multi-component injection molding could be used to integrally couple various components such as the cleaning elements and the head and/or the handle. This could be done in an automated or multiple step process. The handle could be rotocast blow molded to form a hollow squeeze handle that would be usable in the embodiment shown in FIG. 11.

[73] FIGS. 12-13 show different manners of packaging toothbrushes in accordance with this invention. As shown in FIG. 12, for example, a single package 50 could contain a plurality of toothbrushes 10 all of which could be the same or could differ from each other. The package 50 could be of any conventional construction, such as a blister pack, which might include a hole 52 to permit the package to be hung for display purposes.

[74] FIG. 13 illustrates a variation wherein the package 54 includes one or more toothbrushes 10 and a plurality of other components 56 which could be accessories or dispensers or other components. The components could include a small vial of mouthwash. Preferably, the package 50 or 54 would be hermetically sealed to assure freshness. Such hermetic sealing is particularly desired to prevent moisture from reaching gel capsule 32 and causing the capsule to burst.

[75] As is apparent the features herein provide an oral care toothbrush that may be small in size and portable and can be conveniently used away from home under circumstances, such as travel, where water is not readily available.

[76] The features herein could be practiced with a combination of various components that do not involve "toothbrush" usage. In that sense these features may be used in any oral care device or the like, rather than strictly being a toothbrush. Where used as a toothbrush or the like, the features herein may have the advantages, because of the size and configuration, to allow discreet hygienic use, such as no fingers in the mouth, adapting it to be readily used in public areas.

[77] FIG. 17 illustrates another variation in which the head or carrier 80 may have an oval shape, and which may have a series of retaining members 81, such as prongs or biasing members, to hold an oral care dispenser, such as a bead of packed dentifrice or capsule (not shown in the figure), in place prior to use. The retaining members 81 may help retain the bead or capsule at a higher elevation with respect to the field of oral care elements (e.g., bristles 26), to expose more surface area of the bead, dispenser or capsule 32 to the user's saliva to improve the "mouth-feel" and expedite the dissolving of the bead, dispenser or capsule. As illustrated, the retaining members 81 may retain the bead, dispenser or capsule beneath the distal ends of the bristles 26, so as to keep the bead, dispenser or capsule submerged within the field of bristles 26, such that the bristles extend beyond the bead, dispenser or capsule at the bristles' distal ends.

[78] The retaining members 81 may be made of the same material as the bristles 26, or alternatively they may be made of a different material having greater rigidity than the bristles. In one construction, the retaining members 81 may be made of the same material as elastomer portions 18.

[79] The number of retaining members 81 used may vary depending on the type of bead or capsule, and the amount of retention force assistance. As illustrated in FIG. 18, four retaining members 81 may be used at four cardinal points around the perimeter of the bead or capsule. Greater or fewer retaining members 81 may be used. For example, some embodiments might use three retaining members 81 at triangular points around the perimeter, while other embodiments might use five, six, or more prongs around the perimeter. The retaining members 81 may be positioned such that the bead or capsule is held in a centered position with respect to the bristles 26.

[80] As also shown in Figure 18, the bristles 26 may vary in diameter at their proximate ends, so that bristles in different areas of the field have different thicknesses and rigidity or axial stiffness as measured from the longitudinal axis of the bristle. In such a construction, inner or central region bristles 26b are stiffer than the outer or peripheral region bristles 26c. The bristles 26 of the carrier 80 may taper towards their distal ends, as seen in Figure 17.

[81] With reference to Figure 18, the variable stiffness arrangement of the field of bristles 26 forms a structure for incremental radial flow control of oral care solution/material during a brushing operation for efficient cleaning. This feature is particularly useful for low viscosity oral care solutions released from the dispenser 32. Nevertheless, oral care solutions of higher viscosity can be used in the carrier 80. The bristles surrounding retaining members 81 are independently flexible. In this regard, during a brushing operation, the free ends (e.g., tip) of the stiffer bristles 26b bend relative to their, respective vertical axis less than the outer bristles 26c (e.g., bristles near the periphery). Hence, a portion of the dentifrice stays longer in the central region of the brush head by reduced dynamic bending or action of the stiffer bristles. The sweeping or oscillating motion of the carrier 80 transfers a portion of the retained liquid to the outer region of the carrier 80. While the outer bristles 26c are less stiff, the dynamic bending relative to their vertical axis additionally causes the outer bristles to receive a portion of the dentifrice from the central region of the carrier 80. In this construction, effective cleaning of the tissue surfaces in the mouth may be obtained though the combined use of the variable stiffness bristle field mechanically scrubbing the tissue surfaces and the beneficial effects of applying the

oral care material from the dispenser in the oral cavity. In this way, the bristles field provides a limited and controlled flow of the dentifrice or other oral care material to the outer bristles and maintains sufficient flexibility to provide greater user comfort and improved cleaning of the oral tissues.

[82] With reference to FIGS. 17-20, in one construction, a basin, or cavity 100 is provided in carrier 80 below the dispenser 32. As can be seen in FIGS. 18 and 19, basin 100 can be a concaved structure or hemispherical structure disposed in the interior area, beneath and between the retaining members 81. While a concaved structure is shown, other shapes for the basin 100 are possible, such as a triangular prism, a square prism or a rectangular prism. The basin 100 serves to retain a portion of the oral care material from the dispenser 32 to extend the beneficial cleaning effects of the oral care material during brushing. In this regard, the sweeping or oscillating motion of the carrier 80 transfers a portion of the retained liquid to inner region bristles 26b of the carrier 80.

[83] In one construction, the retaining members 81 are columnar-like structures that extend upwardly from the carrier 80. The retaining members 81 may curve inwardly to further assist in holding the bead or capsule in place. Figure 19 illustrates a close-up cross-sectional view, showing such curved retaining members 81. Such curved retaining members 81 may have a length that extends more than halfway up (or down, depending on angle of view) the diameter of the bead or capsule 32 for retention. Hence, a length portion of the retaining members may be acutely disposed with respect to a vertical axis of the carrier 80 for retention. The combination of retaining members 81 provides a compressive force to hold the dispenser 32 in place. The inwardly disposed engaging surface 85 is generally smooth to reliably resist prematurely rupturing the dispenser 32 before use. (See FIG. 17) Also, the smooth and curved characteristic of engaging surface 85 provides for a generally uniform distribution of pressure on the surface of the dispenser 32. This construction thus reduces thin wall stress on the surface of the dispenser 32 to reliably resist prematurely rupturing the dispenser 32 before use. For example, shock forces acting on the toothbrush can be dissipated during transport operations.

[84] The retaining members 81 may assist in rupturing the bead or capsule during brushing, and may have a flat surface at a distal end 82 to form a corner edge

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83 against the bead or capsule for this purpose. With reference to FIGS. 17 and 19, some of the bristles 26 may extend from the retaining members 81. In this construction, a portion of the base of the bristle extends from a rear/back of the retaining member 81. This provides a compact space-saving head structure and also provides flow control benefits of the oral care material in the bristle field.

[85] As illustrated in FIG. 19, the block 22 may be made of the same material as some or all of the bristles 26, as discussed above, which may be a different material from other portions of the handle. Alternatively, the handle and block may be made of the same material, with the bristles 26 being made of a different material.

[86] Figure 20 illustrates a cross-sectional view of a toothbrush having the head or carrier structure shown in FIGS. 17-19. The carrier 80 may be angled at a 10° angle with respect to the handle, representing a less-angled head than that shown in previous figures. An angle ranging from 8° to 12° may assist in improving a user's brushing technique. As with FIG. 19, FIG. 20 also shows an example arrangement of materials, where the block 22 may be made of the same materials as some or all of the bristles 26 and portions of the handle. Alternatively, the handle may be made of the same material as the block 22 and/or bristles 26.

[87] Hence, in some embodiments, an oral care implement may include a rupturable dispenser with a dentifrice, as a connected unit or the various other combinations of components and materials as described. A toothbrush may have a toothpick which enables cleaning between the teeth. A dispenser containing a dentifrice or other oral care material can be connected in the bristle or cleaning element portion of the toothbrush for dispensing the dentifrice to the teeth to provide teeth cleaning and breath freshening or other oral care benefits to a user. In one construction, the oral care elements are configured to slow a radial flow of the oral care material released from the dispenser near an interior region of the carrier and increase a radial flow of the oral care material away from the interior region.

[88] Other embodiments will be apparent to those skilled in the art from consideration of the specification disclosed herein. It is intended that the specification and examples be considered as exemplary only, with the true scope of the invention being indicated by the following claims.

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CLAIMS:

1. An oral care implement, comprising:

a handle; a carrier at an end of the handle; a cleaning block on the carrier; a plurality of retaining members extending outwardly from the cleaning block; and oral care elements extending from the cleaning block, wherein the retaining members have an arcuate shape and provide an inward bias force for retaining an oral care dispenser therebetween.
2. The oral care implement of claim 1, wherein the retaining members are surrounded by the oral care elements.
3. The oral care implement of claim 1, wherein at least one of the oral care elements extends from one of the retaining members.
4. The oral care implement of claim 1, wherein the oral care elements comprise a first set of elements proximate to the oral care dispenser and a second set of elements surrounding the first set of elements, at least one of the elements of the first set having a different stiffness from at least one of the elements of the second set.
5. The oral care implement of claim 1, further comprising the oral care dispenser retained by the retaining members.
6. The oral care implement of claim 1, wherein the carrier includes a basin below the retaining members and the oral care dispenser is disposed above the basin.
7. The oral care implement of claim 1, wherein the retaining members are curved inward toward the oral care dispenser.
8. The oral care implement of claim 7, wherein the oral care elements include a first set of elements proximate to the oral care dispenser and a second set of elements surrounding the first set of elements, the oral care elements of the first set being stiffer than the oral care elements of the second set.

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9. The oral care implement of claim 8, wherein the oral care elements, the retaining members, and the cleaning block are the formed of the same material.
10. The oral care implement of claim 8, wherein the oral care elements and the retaining members are comprised of different materials.
- 5 11. The oral care implement of claim 1, wherein a first subset of the oral care elements has a different proximal end diameter from proximal end diameters of a second subset of the oral care elements.
12. The oral care implement of claim 1, wherein the carrier is placed at an angle ranging from about eight to ten degrees with respect to the handle.
- 10 13. The oral care implement of claim 1, wherein the oral care elements include a first set of elements proximate to the oral care dispenser and a second set of elements surrounding the first set of elements, the oral care elements of the first set being stiffer than the oral care elements of the second set.
14. An oral care implement, comprising:
- 15 a handle having a carrier; a cleaning block on the carrier; oral care elements extending from the cleaning block and a plurality of members extending outwardly from the cleaning block adjacent to the oral care elements, and the members are curved inward toward the oral care dispenser; wherein the members are for holding an oral care dispenser in the carrier.
- 20 15. The oral care implement of claim 14, wherein said oral care elements are bristles.
16. The oral care implement of claim 15, wherein the members are surrounded by said bristles.
17. The oral care implement of claim 14, wherein the plurality of members
- 25 includes four columnar extensions placed at cardinal points around the oral care dispenser.

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18. The oral care implement of claim 14, further comprising the oral care dispenser held in place by the members.

19. The oral care implement of claim 18, wherein the oral care dispenser comprises a rupturable capsule.

5 20. The oral care implement of claim 18, wherein the members have generally smooth engaging surfaces for holding the oral care dispenser.

21. The oral care implement of claim 18, wherein the oral care elements comprise a first set of elements proximate to the oral care dispenser and a second set of elements surrounding the first set of elements, at least one of the elements of the first set having a
10 different stiffness from at least one of the elements of the second set.

22. The oral care implement of claim 21, wherein the oral care elements of the first set are stiffer than the oral care elements of the second set.

23. The oral care implement of claim 14, wherein the oral care elements and said members are comprised of the same material.

15 24. The oral care implement of claim 14, further comprising a cavity in the carrier to accommodate placement of the oral care dispenser to be held by the members.

25. The oral care implement of claim 14, wherein the members are positioned to hold the oral care dispenser in a generally centered position with respect to the oral care elements.

20 26. The oral care implement of claim 14, wherein a first subset of said oral care elements has a different proximal end diameter from the proximal end diameters of a second subset of said oral care elements.

27. The oral care implement of claim 14, wherein said oral care elements are tapered bristles wherein each bristle has a larger diameter at a proximal end than a distal end.

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28. An oral care implement, comprising:

a handle with a carrier; a cleaning block on the carrier; a field of bristles extending from the cleaning block; a plurality of prongs located within the field; and an oral care dispenser retained in the field by the plurality of prongs.

5 29. The oral care implement of claim 28, wherein the prongs hold said oral care dispenser in a central position with respect to said carrier.

30. The oral care implement of claim 28, wherein the prongs are curved inward at distal ends toward said oral care dispenser.

31. The oral care implement of claim 28, wherein the oral care dispenser comprises
10 a bead of packed dentifrice.

32. The oral care implement of claim 28, wherein the oral care dispenser is a capsule.

33. An oral care implement, comprising:

a handle;

15 a carrier at an end of the handle, the carrier comprising a front surface and a back surface;

a cleaning block on the carrier, the cleaning block extending through the carrier and comprising a portion exposed on the front surface of the carrier and a portion exposed on the back surface of the carrier;

20 a gel on the cleaning block;

a plurality of retaining members extending outwardly from the cleaning block; wherein the retaining members are in contact with the gel; and

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oral care elements extending from the cleaning block and surrounding the retaining members, wherein the oral care elements extend outwardly from the cleaning block for a first distance, the retaining members extend from the cleaning block a second distance that is less than the first distance.

5 34. The oral care implement of claim 33, wherein at least one of the oral elements extends from one of the retaining members.

35. The oral care implement of claim 33, wherein the oral care elements comprise a first set of elements proximate to the gel and a second set of elements surrounding the first set of elements.

10 36. The oral care implement of claim 33, wherein the retaining members have an arcuate shape.

37. The oral care implement of claim 33, further comprising an oral care dispenser for holding the gel, the oral care dispenser retained by the retaining members.

15 38. The oral care implement of claim 33, wherein the carrier includes a basin below the retaining members.

39. The oral care implement of claim 33, wherein the retaining members are curved inward toward the gel.

40. The oral care implement of claim 33, wherein the oral care elements, and the retaining members are the formed of the same material.

20 41. The oral care implement of claim 33, wherein the oral care elements comprise a first subset of elements having a first proximal end diameter and a second subset of elements having a second proximal end diameter that is different from the first proximal end diameter.

25 42. The oral care implement of claim 33, wherein the carrier is placed at an acute angle to a longitudinal axis facing away from the handle, the acute angle ranging from about eight to ten degrees with respect to the handle.

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43. An oral care implement, comprising:

a handle having a carrier comprising a front surface and a back surface;

a cleaning block on the carrier, the cleaning block extending through the carrier and comprising a portion exposed on the front surface of the carrier and a portion exposed on
5 the back surface of the carrier;

oral care elements extending from the cleaning block; and

a plurality of members extending outwardly from the cleaning block; wherein the members contact an oral care material in the carrier,

the cleaning block and the oral care elements are formed of the same material.

10 44. The oral care implement of claim 43, wherein said oral care elements are bristles.

45. The oral care implement of claim 44, wherein the members are surrounded by said bristles.

46. The oral care implement of claim 43, further comprising an oral care dispenser
15 for holding the oral care material, the oral care dispenser held in place by the members.

47. The oral care implement of claim 46, wherein the oral care dispenser comprises a rupturable capsule.

48. The oral care implement of claim 46, wherein the members are curved inward toward the oral care dispenser.

20 49. The oral care implement of claim 48, wherein the members have generally smooth engaging surfaces for holding the oral care dispenser.

50. The oral care implement of claim 46, wherein the oral care elements comprise a first set of elements proximate to the oral care dispenser and as second set of elements

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surrounding the first set of elements, at least one of the elements of the first set having a different stiffness from at least one of the elements of the second set.

51. The oral care implement of claim 43, wherein the oral care elements and said members are comprised of the same material.

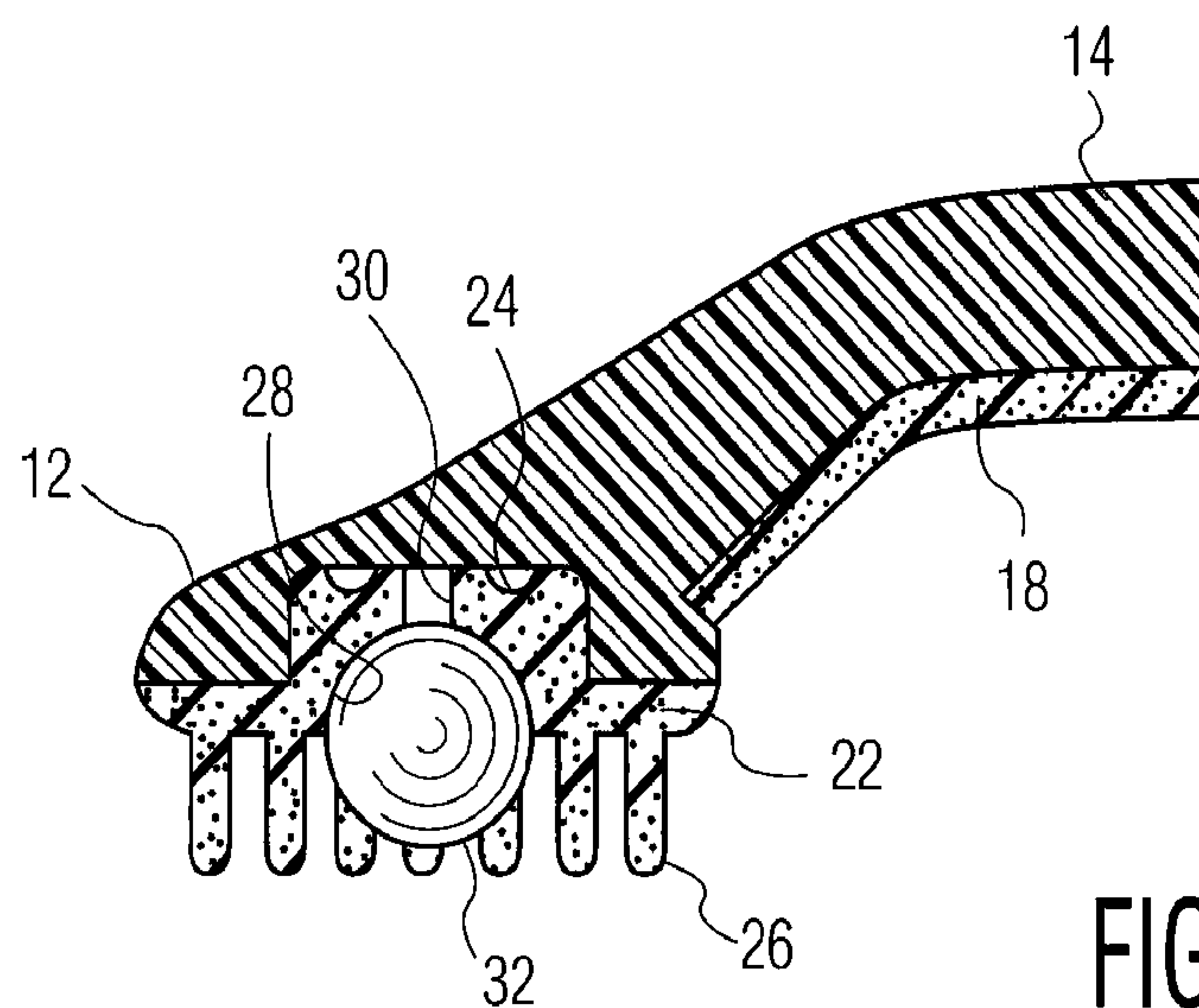
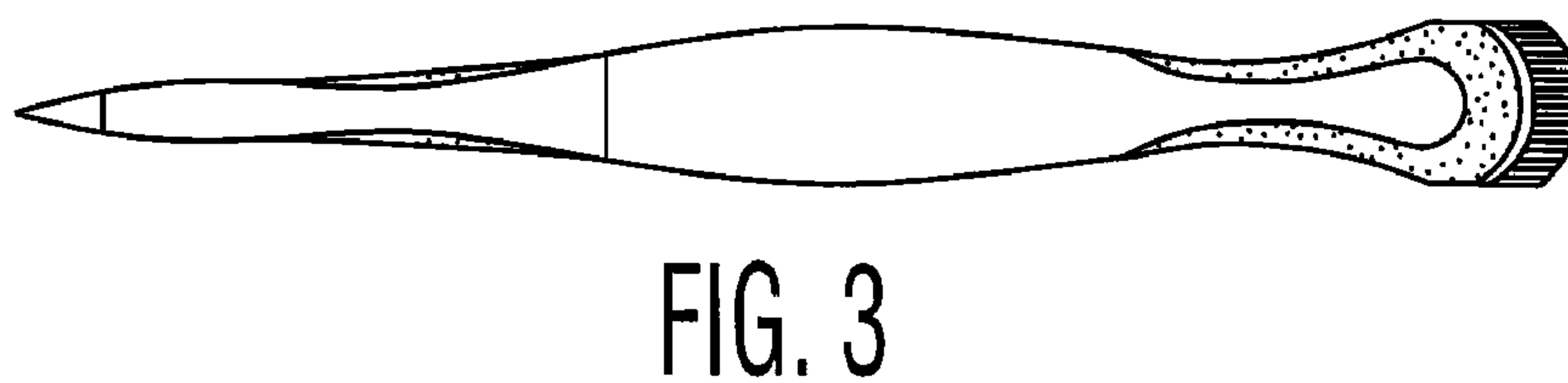
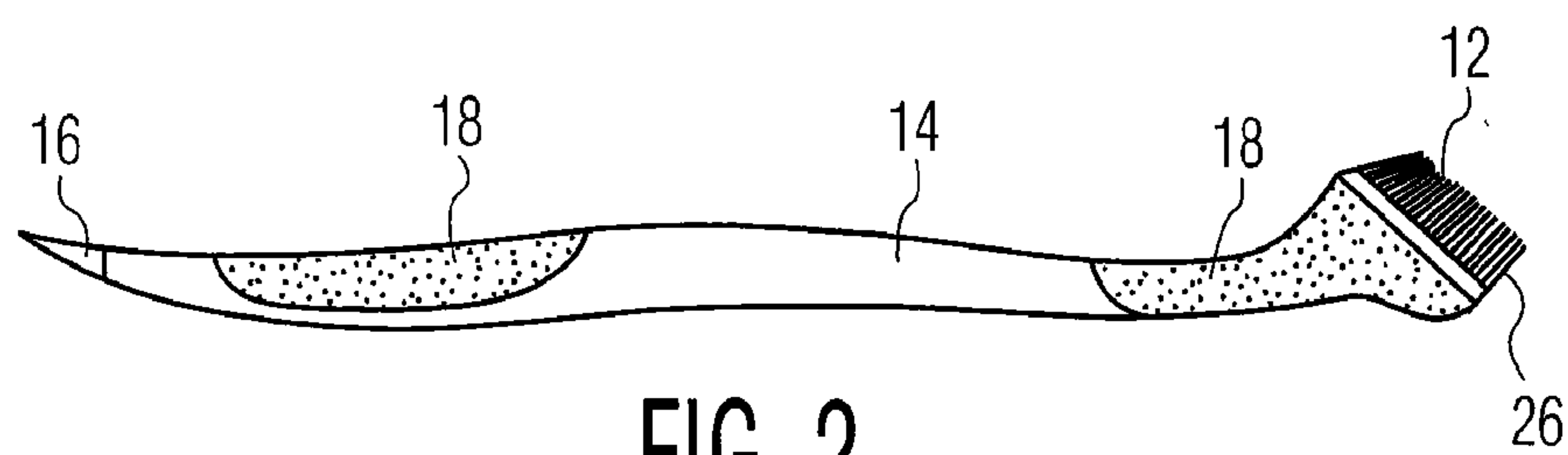
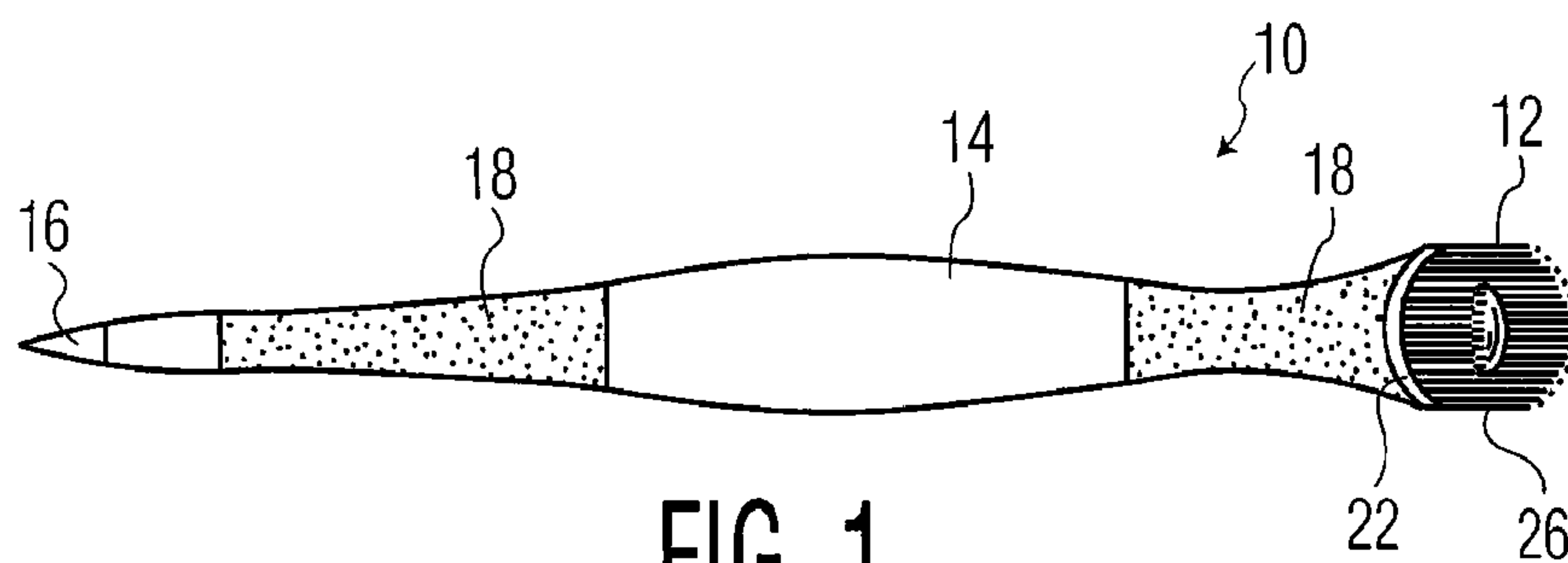
5 52. The oral care implement of claim 43, further comprising a cavity in the carrier to accommodate placement of an oral care dispenser for holding the oral care material.

53. The oral care implement of claim 43, wherein the members are positioned to hold the oral care material in a generally centered position with respect to the oral care elements.

10 54. The oral care implement of claim 43, wherein a first subset of said oral care elements has a different proximal end diameter from proximal end diameters of a second subset of said oral care elements.

55. The oral care implement of claim 43, wherein said oral care elements are tapered bristles wherein each bristle has a larger diameter at a proximal end than a distal end.

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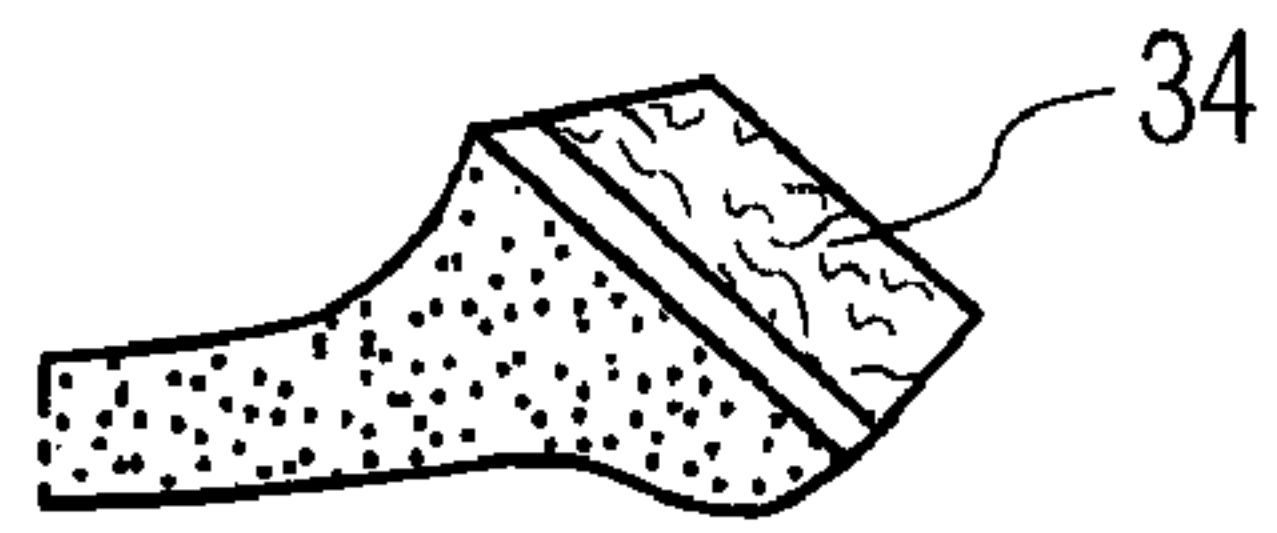


FIG. 5

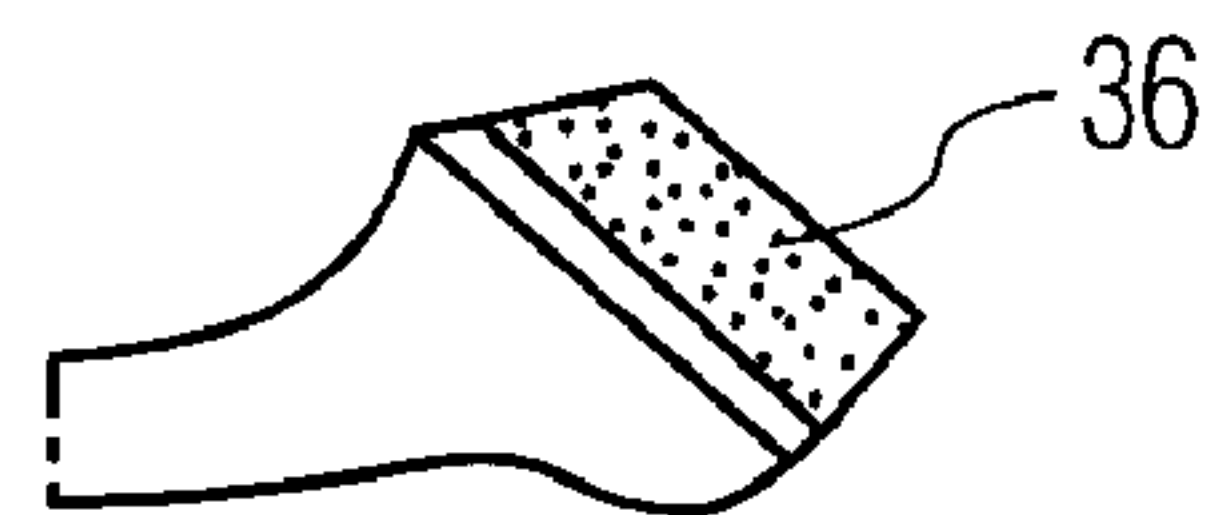


FIG. 6

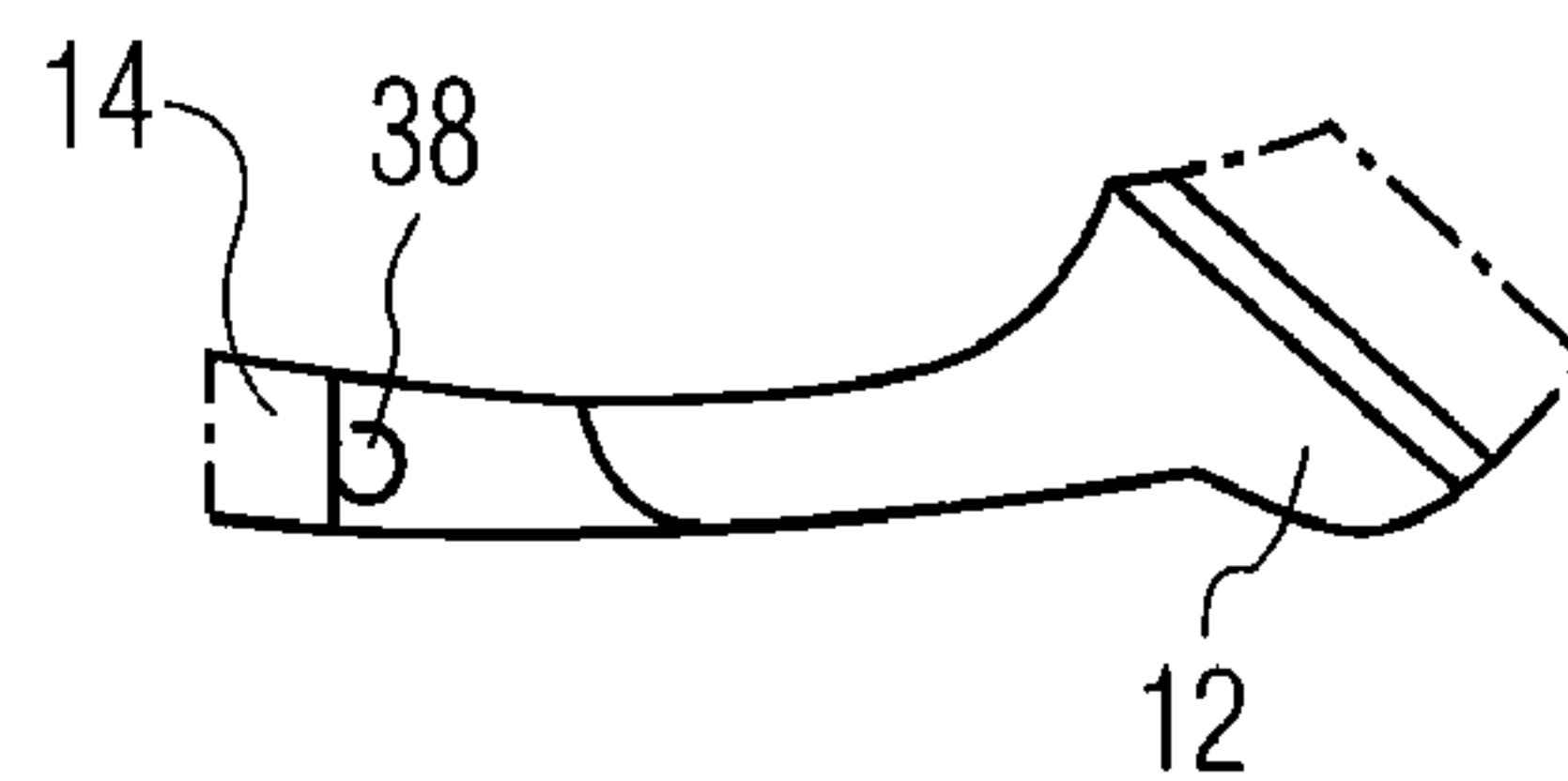


FIG. 7

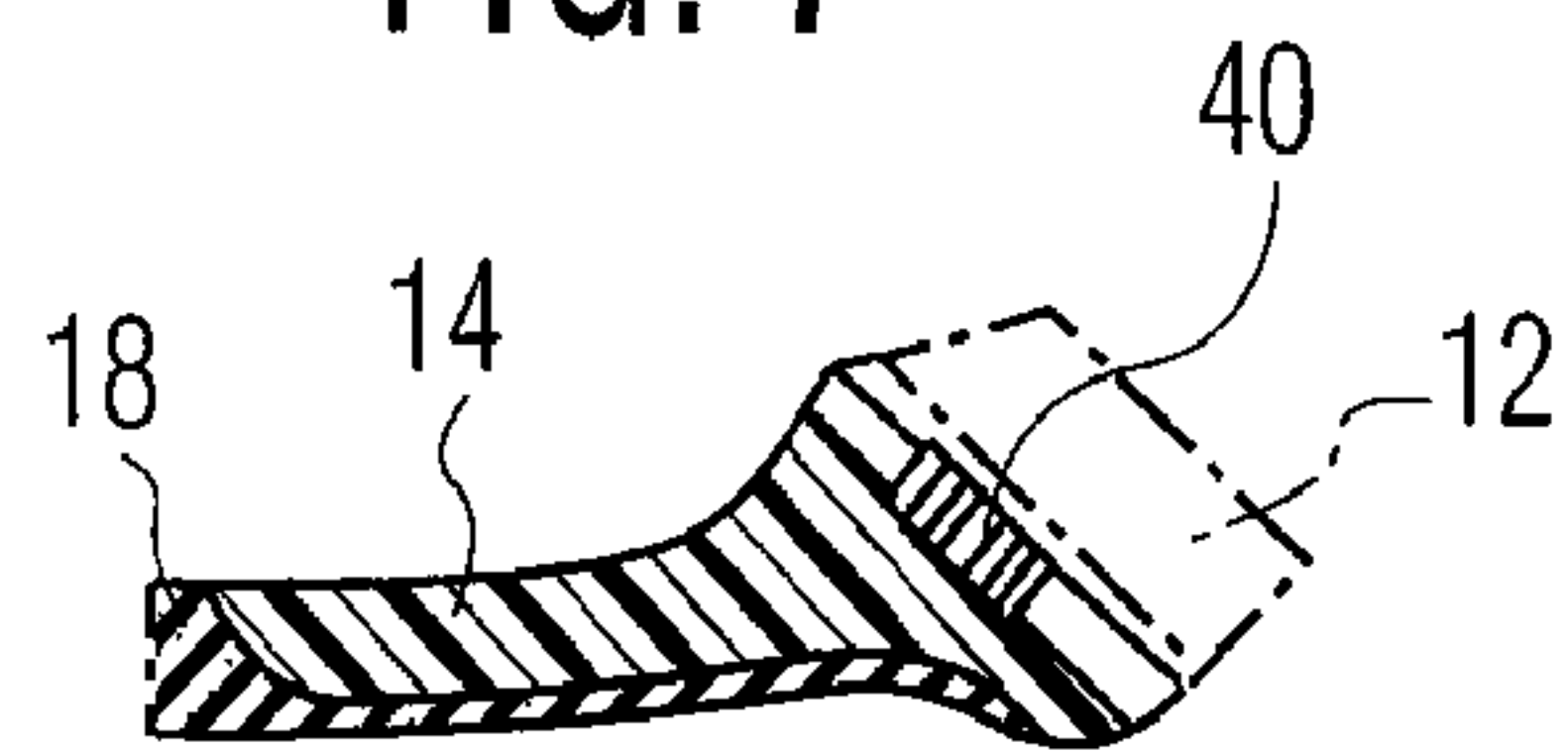


FIG. 8

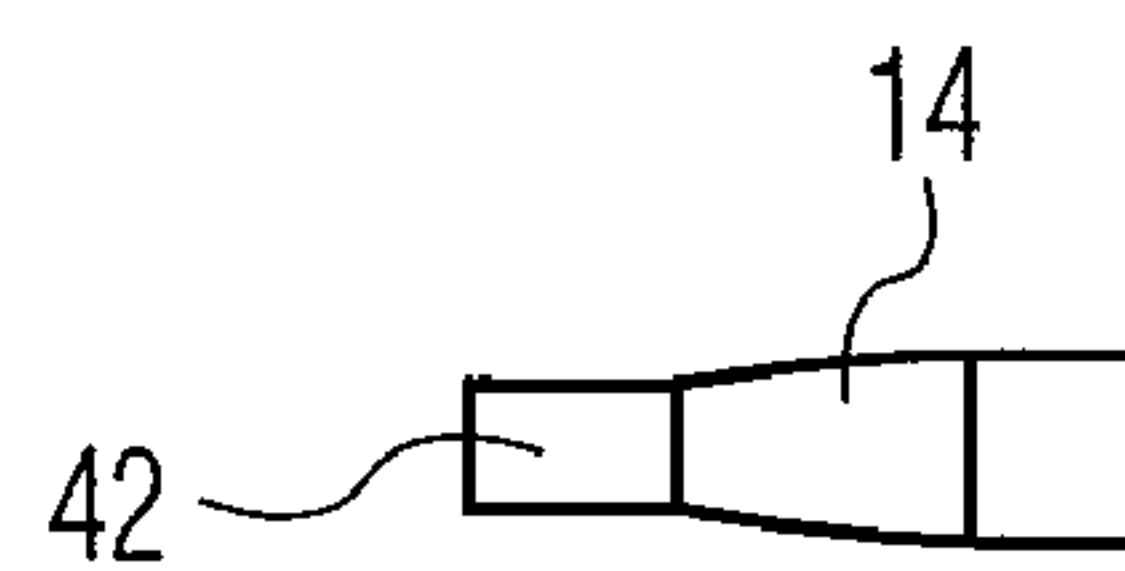


FIG. 9

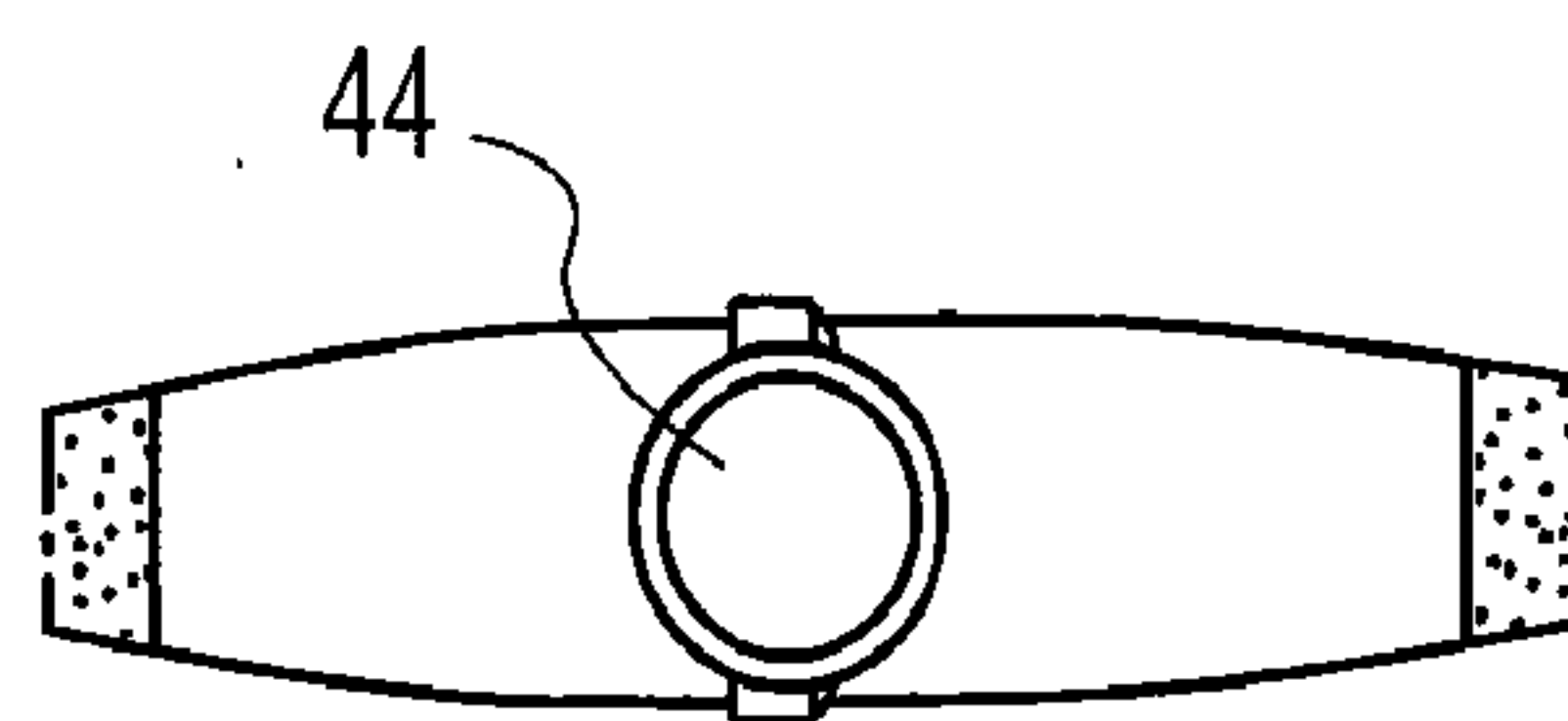


FIG. 10

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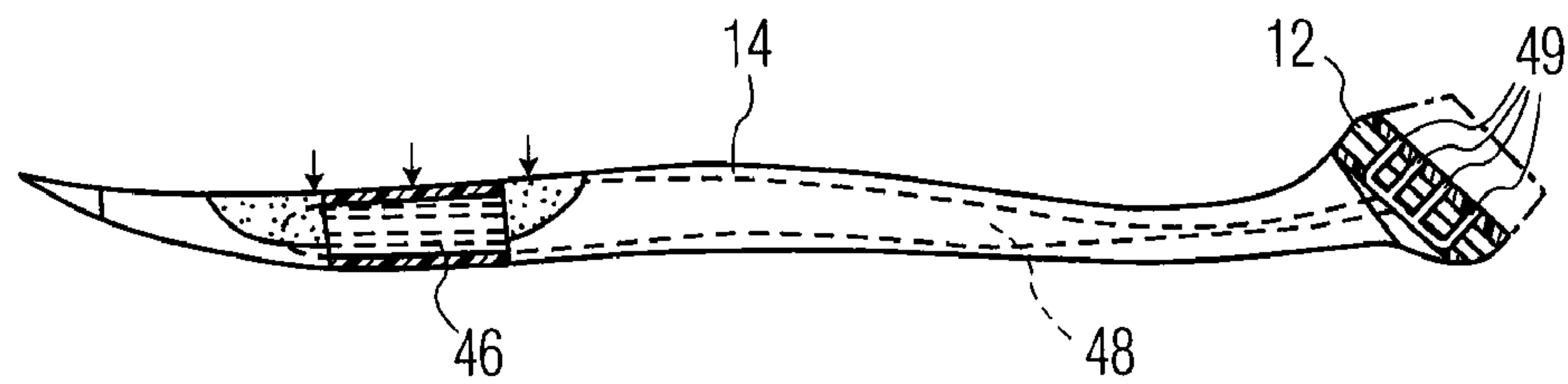


FIG. 11

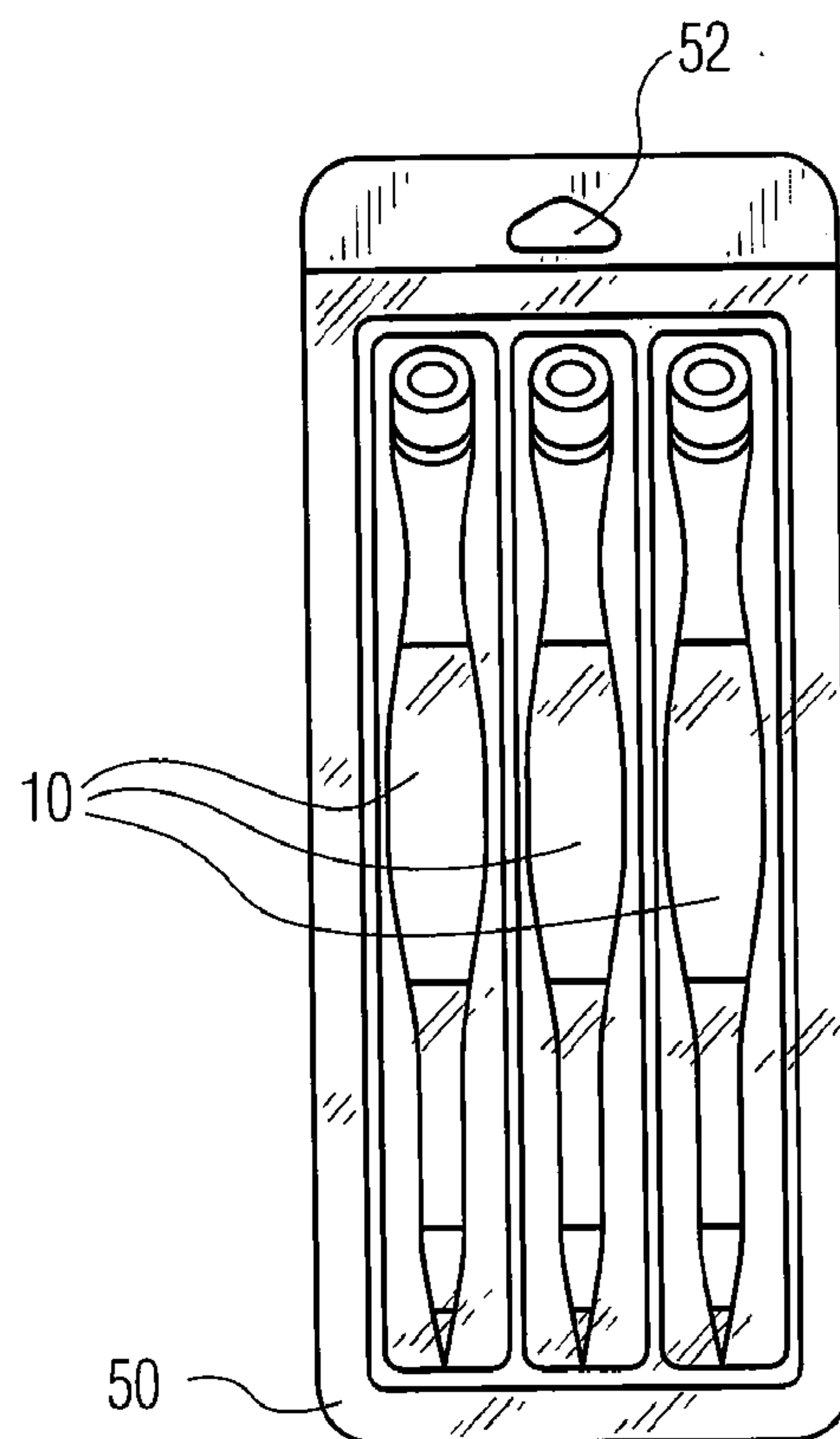


FIG. 12

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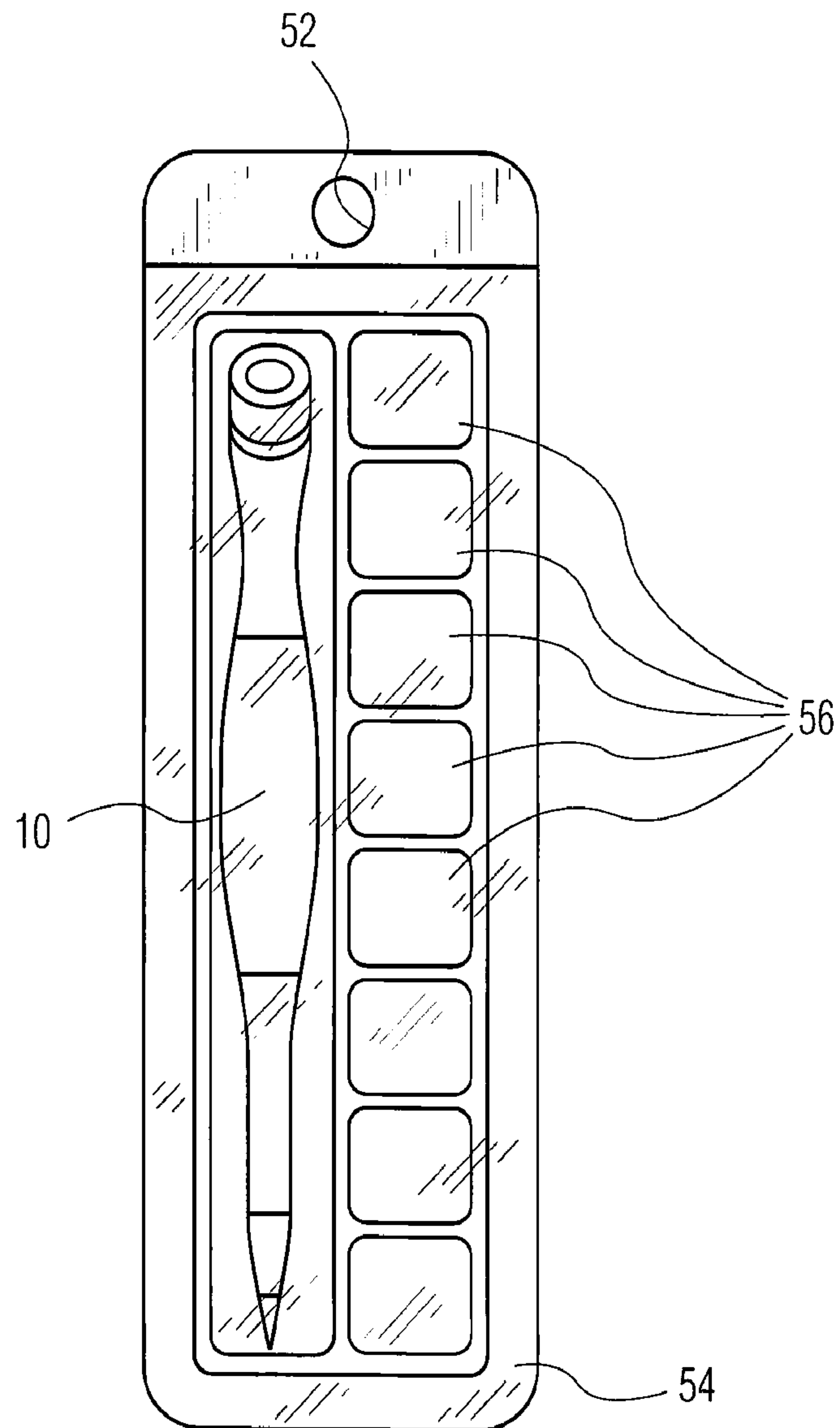


FIG. 13

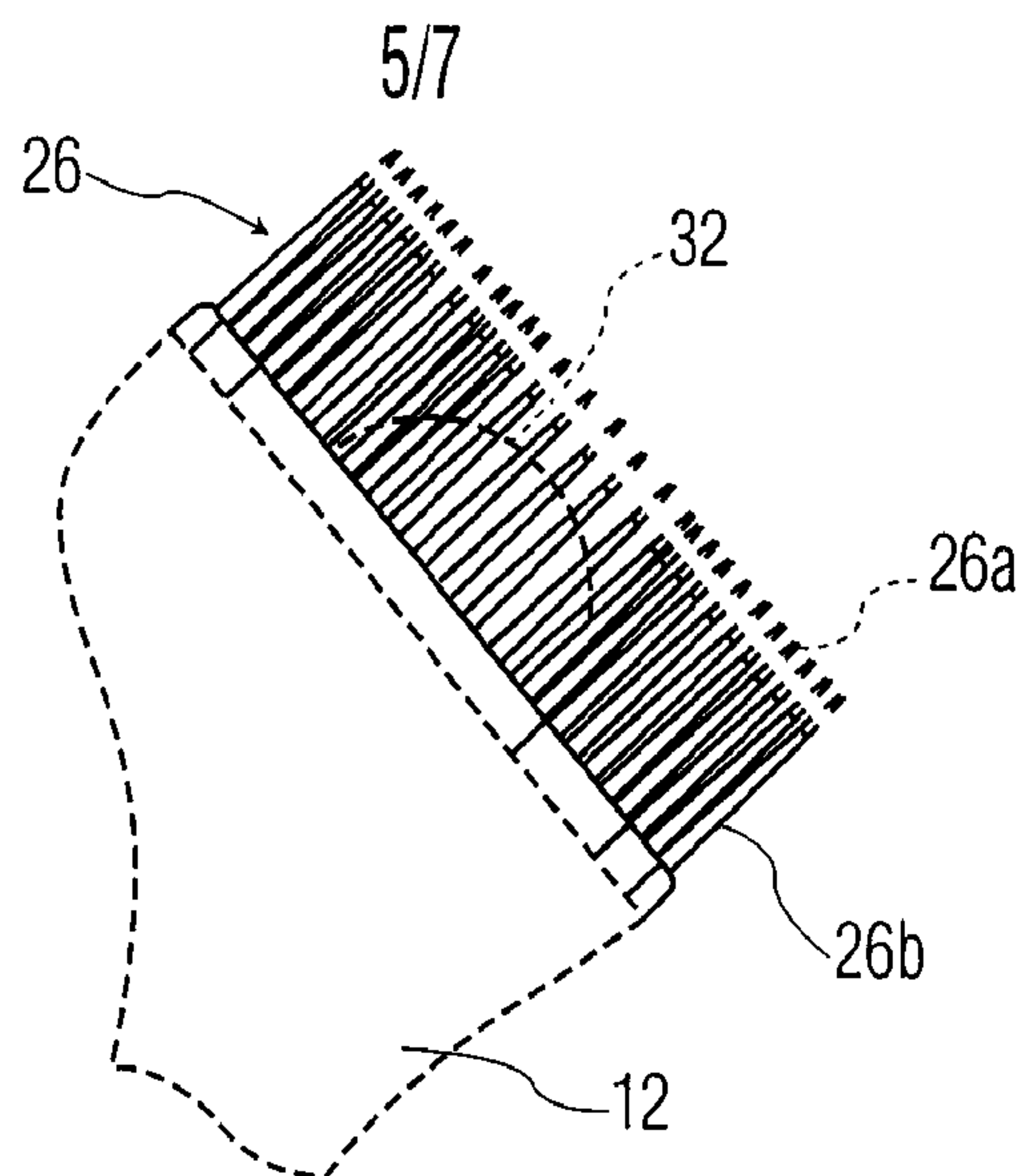


FIG. 14

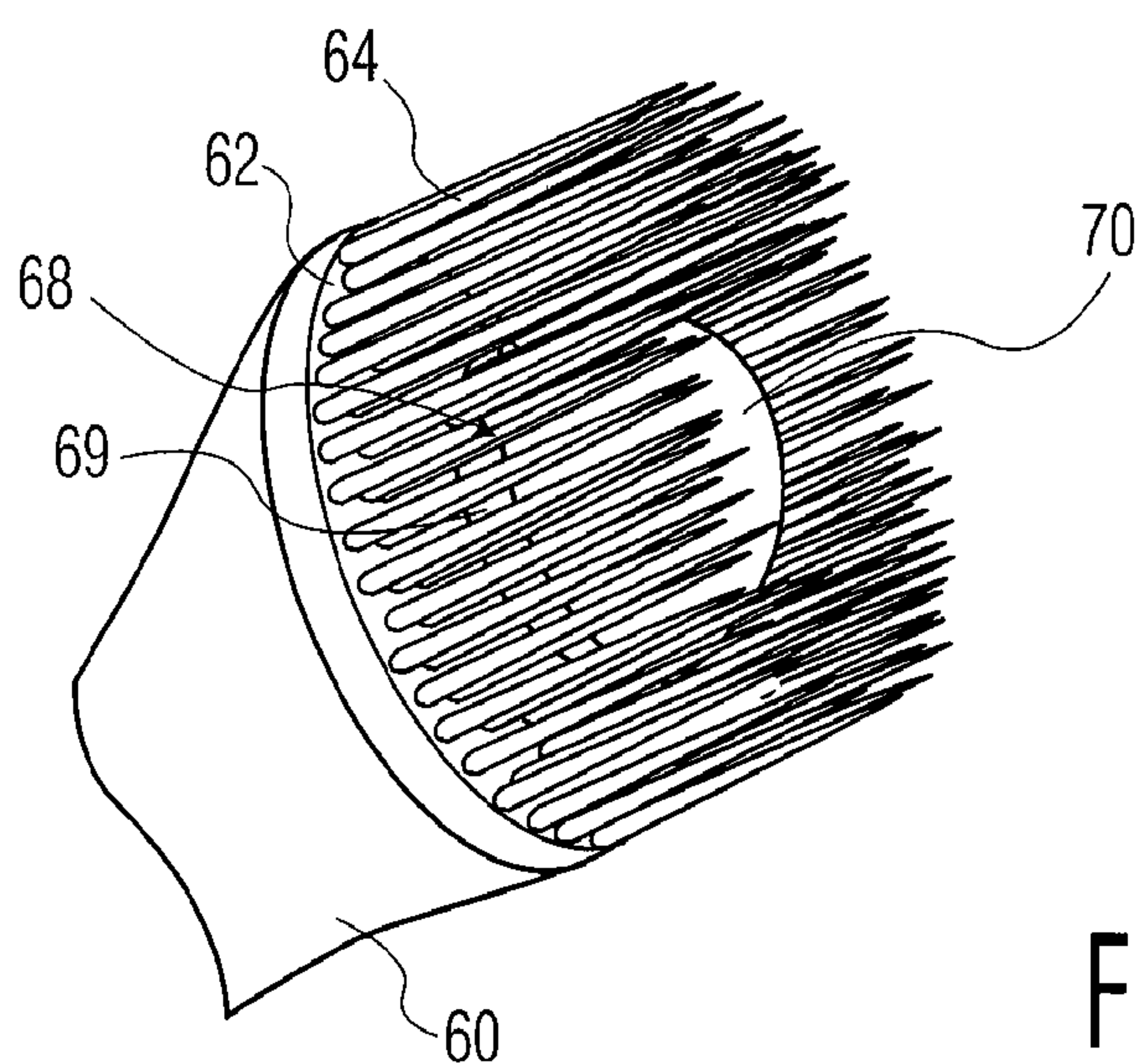


FIG. 15

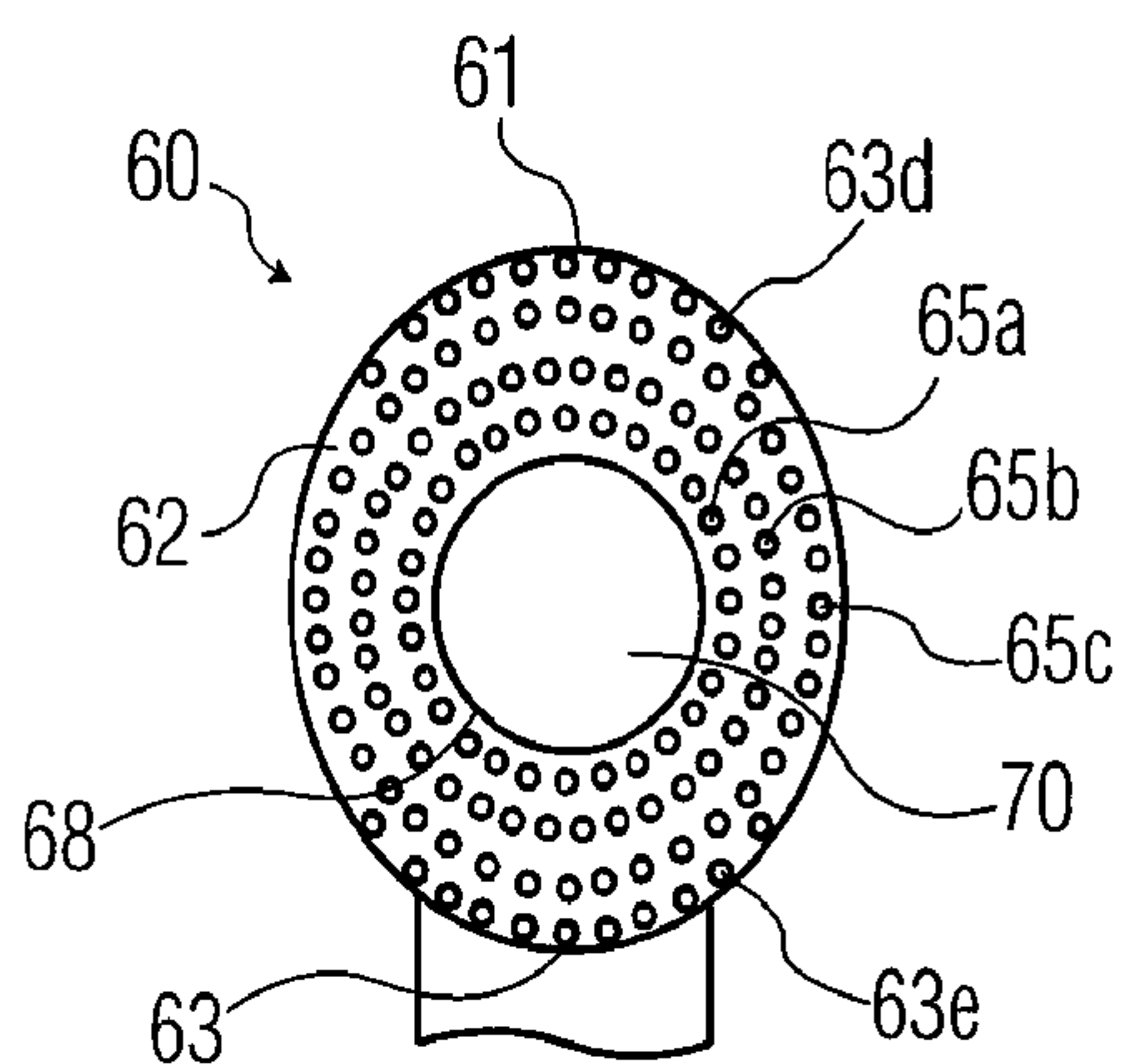


FIG. 16

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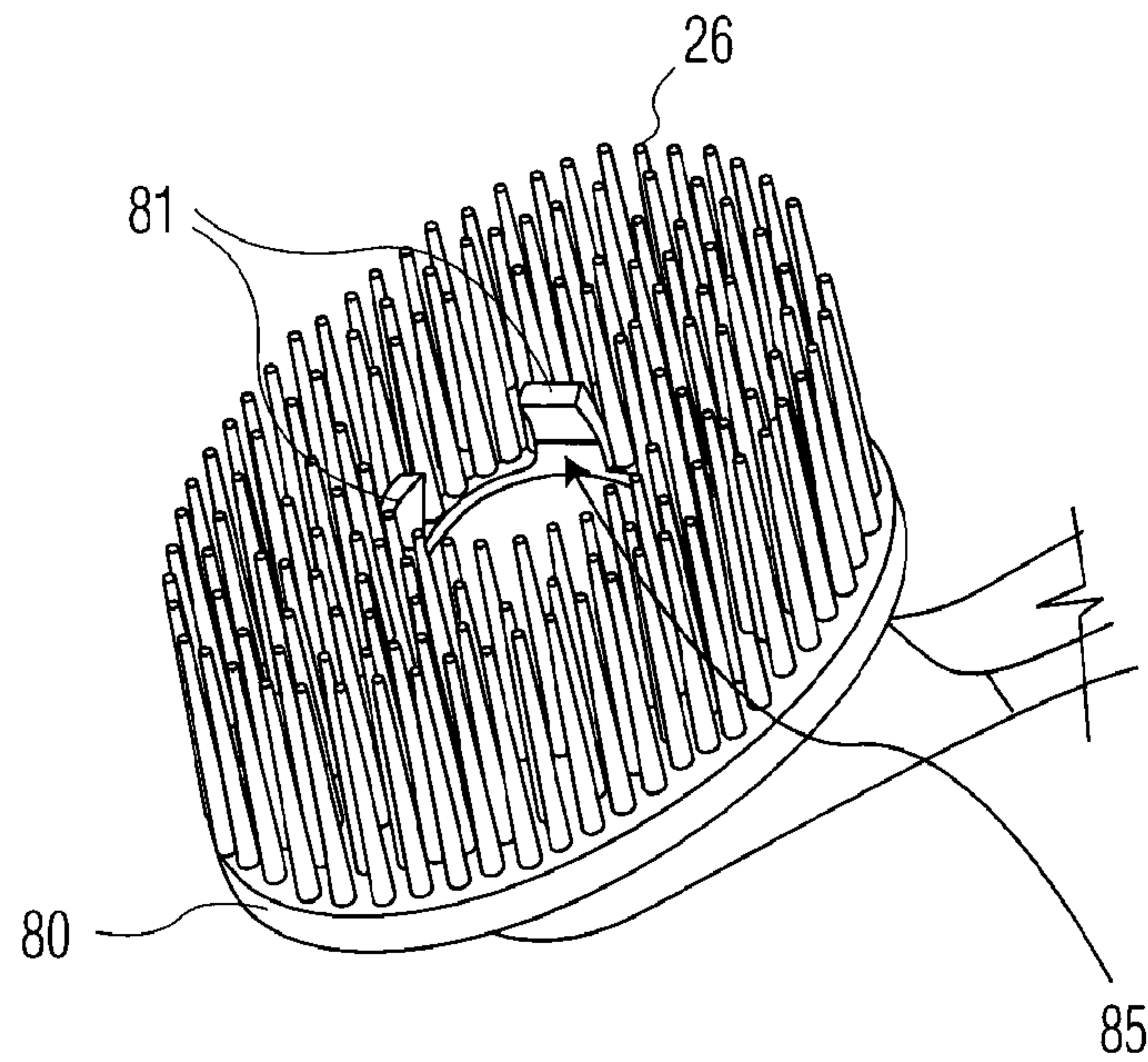


FIG. 17

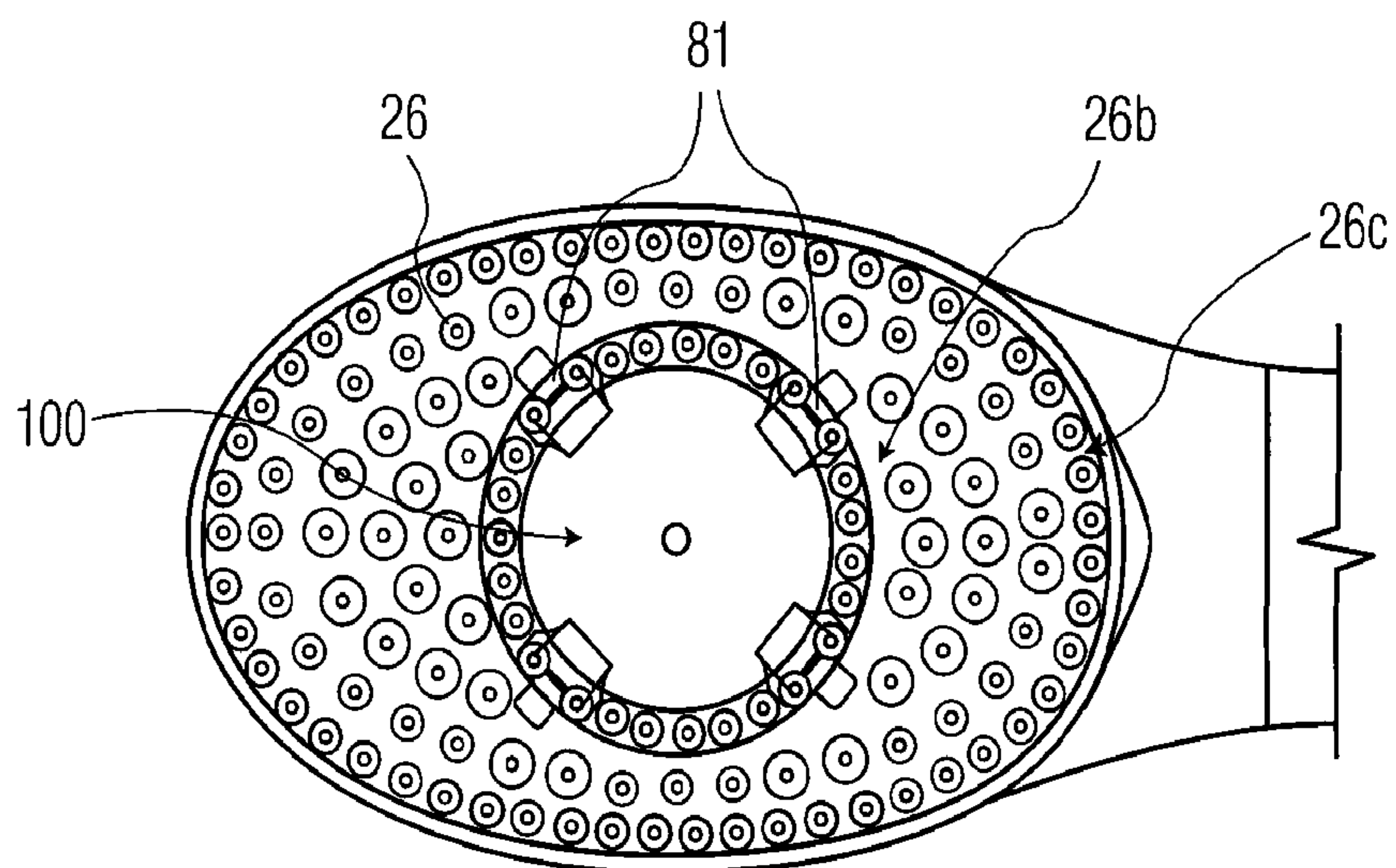


FIG. 18

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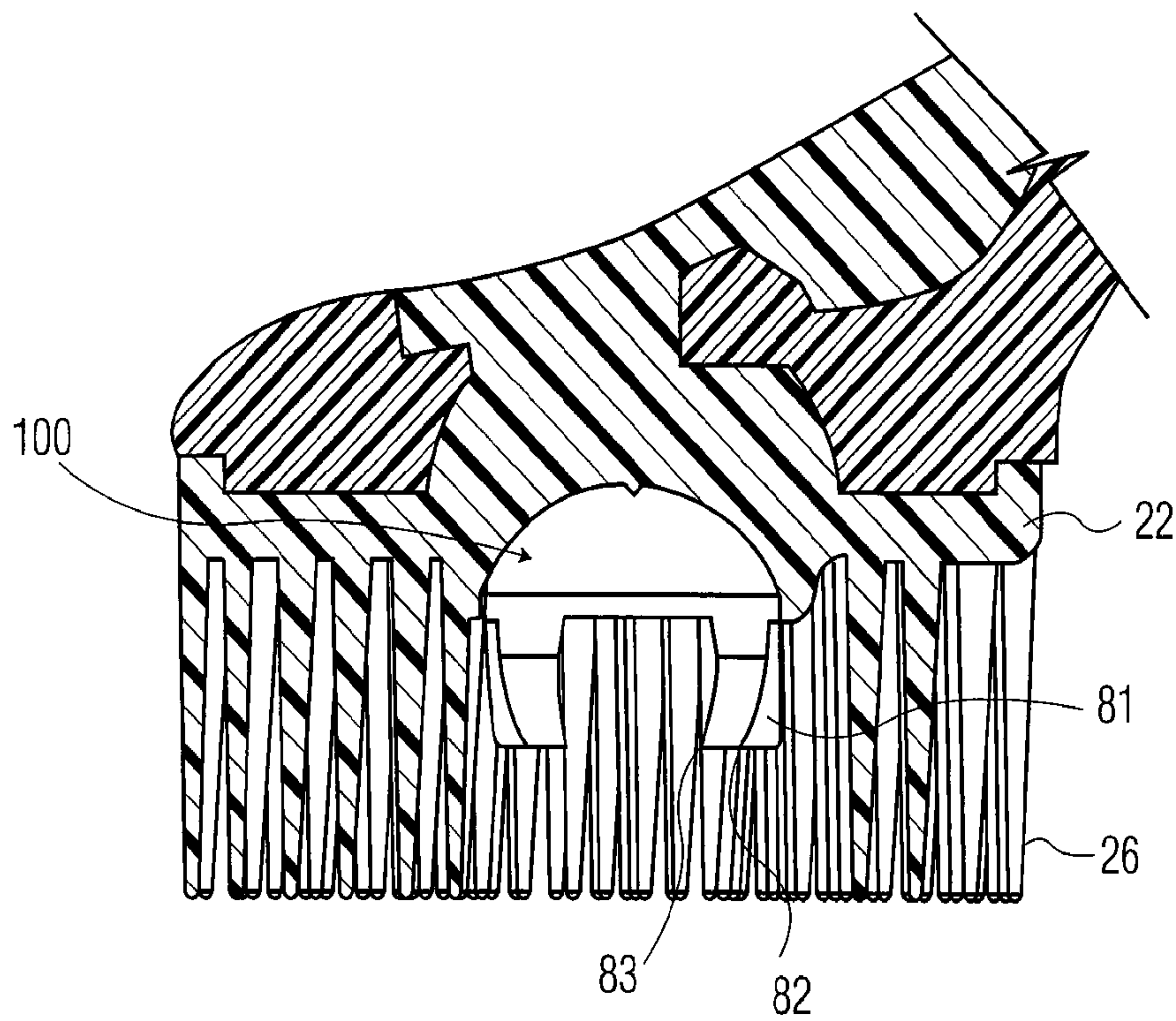


FIG. 19

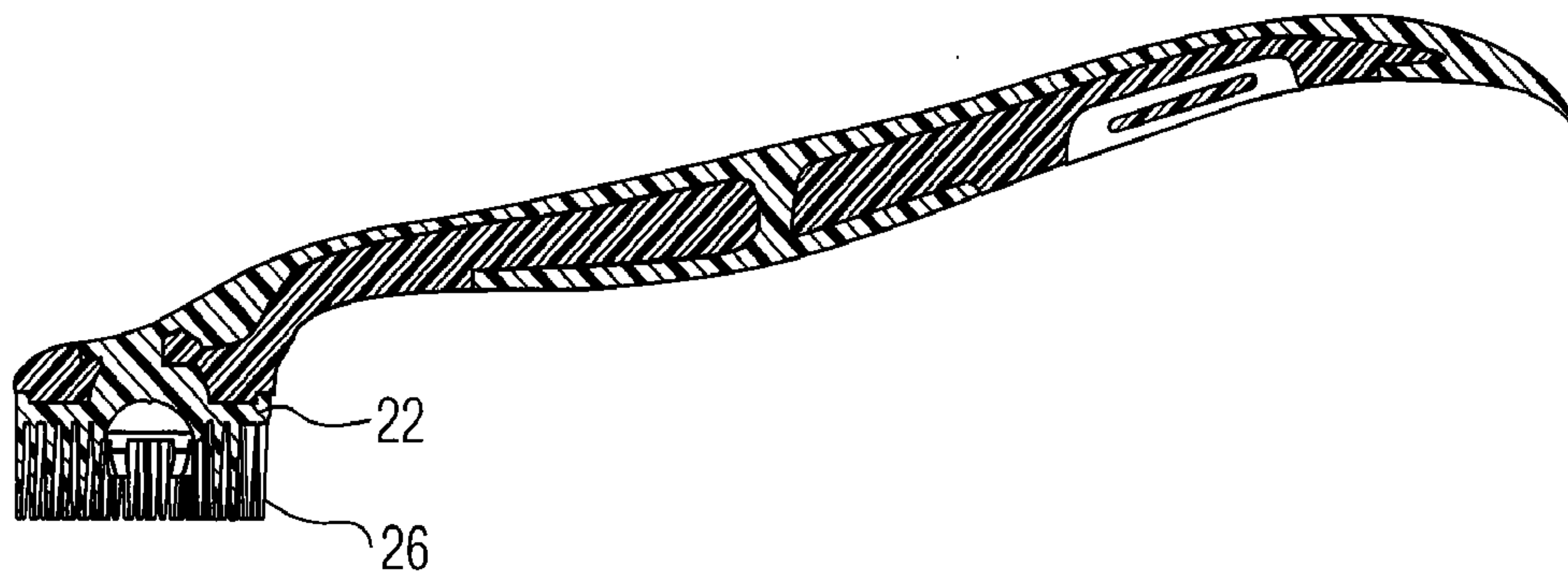


FIG. 20

