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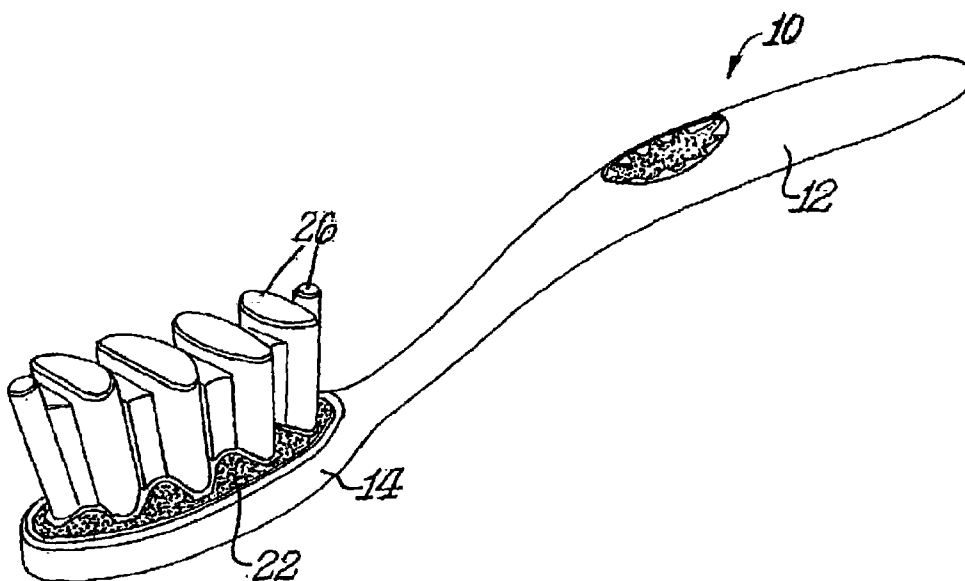
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(54) Title: TOOTHBRUSH



(57) Abstract: A toothbrush includes a handle and a head mounted to the handle. The head may generally include a membrane attached to it and configured for attachment to a cleaning element. The membrane may be generally dome shaped and may be resiliently flexible when a brushing force is applied. A plurality of cleaning elements is mounted to the membrane. The cleaning elements may be attached using anchor free tufting. In addition, the cleaning elements may be sufficiently spaced so as to allow separation of the melted portion of the cleaning elements. In another arrangement, the head may also include walls or dams positioned between the cleaning elements. The walls prevent the melted portion of the cleaning elements from merging with the melted portion of another cleaning element. This isolation of the molten nylon allows the cleaning elements to move independently of each other.

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## TITLE OF THE INVENTION

## TOOTHBRUSH

## CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation-in-part of U.S. Patent Application No. 11/053,583 filed February 8, 2005, which is a continuation of Application No. PCT/US03/24878 filed August 8, 2003, which claims the benefit of U.S. Provisional Application No. 60/402,162, filed August 9, 2002. The contents of these applications are incorporated by reference.

## FIELD OF THE INVENTION

[0002] The present invention is directed to a manually held and operated toothbrush or to a powered toothbrush which includes a handle and a head.

## BACKGROUND OF THE INVENTION

[0003] The head of a conventional toothbrush usually has a flat or slightly altered surface to which cleaning elements are attached. Usually the cleaning elements are strands of plastic material(s) formed into tufts or other groupings. The strand groupings are attached to the head either before or after forming the toothbrush handle.

[0004] Various attempts have been made for providing flexibility to the manner in which the bristles are attached. Various approaches have also been taken wherein the bristle carrying surface of the head is not flat. U.S. Patent No. 1,688,581, for example, discloses a toothbrush having a bristle carrying member which is ordinarily bowed inwardly into the hollow head. The bristle carrying member can be bowed outwardly by manipulating a wire mounted in the toothbrush.

## BRIEF SUMMARY OF THE INVENTION

[0005] The present invention pertains to a toothbrush having an oral care region attached to a handle. The oral care region has a membrane which provides flexible movement of tooth cleaning elements.

[0006] In one embodiment, a toothbrush includes an oral care region with a membrane having attachment of at least one tooth cleaning element. The membrane may be generally curvilinear shaped and resiliently flexible when a brushing force is applied to the tooth cleaning element. In another embodiment, tooth cleaning

elements are mounted to the membrane. The tooth cleaning elements may be attached using an anchor free tufting process. In an alternative embodiment, the cleaning elements may be spaced so as to allow separation of a melted proximal portion of the cleaning elements and a portion of the membrane extends downwardly from an underside thereof and between adjacent cleaning elements.

[0007] In another embodiment, a toothbrush head includes a portion membrane material depending downwardly and a positioned between the islands of tooth cleaning elements. The portion of membrane material prevents flow of a melted nylon material of the cleaning elements from merging with the melted portion of another cleaning element. The isolation of the molten nylon material enables the cleaning elements to move independently of each other during a brushing operation to enhance oral care.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Figure 1 is a perspective view of a toothbrush;

[0009] Figure 2 is a side elevational view of the toothbrush shown in Figure 1;

[0010] Figure 3 is a front elevational view of the toothbrush shown in Figures 1-2;

[0011] Figure 4 is a cross-sectional view taken through Figure 3 along the line 4-4;

[0012] Figure 5 is a front elevational view of a powered toothbrush;

[0013] Figure 6 is a perspective view of a toothbrush having elastic areas in the head and handle to allow deflection of the brush, bristles and handle for better teeth cleaning and control in accordance with a further embodiment;

[0014] Figure 7 is a side elevational view of the toothbrush shown in Figure 6;

[0015] Figure 8 is a top plan view of the toothbrush shown in Figures 6-7;

[0016] Figure 9 is a side elevational view of the toothbrush of Figure 6 showing deflection in the open area under the bristles and the handle area;

[0017] Figure 10 is a top plan view of a powered toothbrush in accordance with the embodiment of Figures 6-9;

[0018] Figure 11 is a perspective view of a toothbrush formed in accordance with still another embodiment;

[0019] Figure 12 is a side elevational view of the toothbrush shown in Figure 11;

[0020] Figure 13 is a top plan view of the toothbrush shown in Figures 11-12;

[0021] Figure 14 is an end elevational view of the toothbrush shown in Figures 11-13 in its original closed position;

[0022] Figure 15 is a cross-sectional view taken through Figure 13 along the line 15-15, but with the brush head in its hinged open position and omitting some of the cleaning elements;

[0023] Figure 16 is a front elevational view of a powered toothbrush in accordance with the embodiment of Figures 11-15;

[0024] Figure 17 is a rear view of a toothbrush head according to one embodiment;

[0025] Figure 18 is a cross-sectional view of a cleaning element of the toothbrush head of Figure 17 taken along line 18-18;

[0026] Figure 19 is a rear view of an alternate arrangement of the toothbrush head of Figure 17;

[0027] Figure 20 is a rear view of the toothbrush head of Figure 17 schematically illustrating additional features;

[0028] Figure 21 is a rear view of a toothbrush head according to an alternate embodiment;

[0029] Figure 22 is a cross-sectional view of a barrier wall of the toothbrush head of Figure 21; and

[0030] Figure 23 is a rear view of an alternate arrangement of the toothbrush head of Figure 21.

#### DETAILED DESCRIPTION OF THE INVENTION

[0031] Figures 1-4 illustrate a toothbrush 10 in accordance with one embodiment of the invention. As shown therein, toothbrush 10 includes a handle 12 and a head 14. Handle 12 may include a suitable grip pad 16 made of an elastomer material. The focus of this improvement is primarily directed to the structure of head 14. As shown in Figure 4, head 14 has a base portion 18 with an upstanding wall 20 to create a peripheral frame extending outwardly above base portion 18. In

one embodiment, a membrane 22 is attached to frame 20 completely along its periphery. Membrane 22 in its initial non-use condition is convex or bowed outwardly as best shown in Figure 4. The convex bowing is provided both in the longitudinal and transverse directions, thus presenting a dome-like outer surface 24 to which cleaning elements 26 are connected.

[0032] In one embodiment, cleaning elements in the form of strands or bristles are attached via in-molded technology (IMT) methods. The strands utilizing IMT methods are preferably attached during formation of the toothbrush handle or at least during formation of the head which is the portion of the toothbrush to which the strands and other materials are attached. Referring to Figures 1-4 and Figure 5, the use of thin cross-sections of material for membrane 22 so that it is flexible and resilient. The cross-section shown, for example, in Figure 4 is formed like a moon crescent thus representing a shape similar to the dome.

[0033] Alternatively, the toothbrush is particularly suitable for cleaning elements in the form of strands or bristles attached via anchor free tufting (AFT). In the AFT toothbrush brush making process, described in detail in U.S. Patent No. 6,779,851, nylon is fed into a pre-molded plate that can be made from any thermoplastic or elastomer material or combination thereof. This nylon may be processed into bristle tufts of various sizes and shapes. The non-use or proximal end of the nylon is heated and melted to retain the nylon in the brush head when a reasonable pulling force is applied. This head plate may then be ultrasonically welded to a pre-molded handle that has a peripheral wall or frame on which the head plate will rest and become fused to the handle.

[0034] Because of the open space 28 between base portion 18 and membrane 22, the membrane displaces from its original dome-like shape to be distorted into other shapes as the cleaning elements or bristles 26 contact the teeth of a user. Thus, the dome 22 has a thin membrane of material or combinations of material that can flex to become altered from its original shape and recover to its original shape randomly during brushing. The bristles 26 are attached to the flexible dome and move accordingly, creating a random topology and by doing so, improves the

cleaning of the teeth. The moving bristle strands have more degrees of motion than other toothbrushes and thus represent a different and unique tooth brushing device.

[0035] Referring to Figure 3, in the illustrated embodiment, the head 14 is generally oval shape and the membrane 22 has a corresponding oval shape. Any suitable form of cleaning elements may be used as the cleaning elements 26 in the broad practice of the invention. The term "cleaning elements" is intended to be used in a generic sense which could include conventional fiber bristles or massage elements or other forms of cleaning elements such as elastomeric fingers or walls arranged in a circular cross-sectional shape or any type of desired shape including straight portions or sinusoidal portions. Where bristles are used, the bristles could be mounted to tuft blocks or sections by extending through suitable openings in the tuft blocks so that the base of the bristles is mounted within or below the tuft block and below membrane 22.

[0036] It is to be understood that the specific illustration of the cleaning elements is for exemplary non-limiting purposes. The toothbrush can be provided with various combinations of the same or different cleaning element configurations (such as stapled or in-molded technology bristles, anchor free technology (AFT), etc.) and/or with the same bristle or cleaning element materials (such as nylon bristles, spiral bristles, rubber bristles, etc.). Similarly, while Figure 2 illustrates the cleaning elements to be generally perpendicular to the outer surface 24 membrane 22 or head 14 some or all of the cleaning elements may be angled at various angles with respect to the outer surface of head 14. It is thereby possible to select the combination of cleaning element configurations, materials and orientations to achieve specific intended results to deliver additional oral health benefits, like enhanced cleaning tooth polishing, tooth whitening and/or massaging of the gums.

[0037] In one embodiment, cleaning elements 26 are IMT bristles. Although Figures 1-3 illustrate the membrane 22 to occupy generally the entire head 14, the invention may be practiced where the head 14 is of sufficient size that it could include other bristle carrying surfaces adjacent to the dome shape membrane 22.

[0038] Although Figures 1-4 illustrate a manually operated toothbrush, an embodiment 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.

[0039] Figure 5 illustrates a toothbrush 10A which includes a power driven movable disc or section 30 having cleaning elements. The movable section 30 could be oscillated rotationally such as by using the type of drive mechanism shown in U.S. Patent No. 5,625,916, or could move in and out using the type of drive mechanism shown in U.S. Patent No. Re 35,941, all of the details of both patents are incorporated herein by reference thereto. Alternatively, the other types of drives referred to above could move section 30 in other manners and directions. Although Figure 5 shows movable section 30 to be at the distal end of the head, the movable section(s) could be located at any desired location on the head.

[0040] Handle 12, base 18 and frame 20 are preferably made of hard plastic materials which are used for manual toothbrushes. As noted, however, a characteristic of dome shape membrane 22 is that it is made of a flexible resilient material such as an elastomer capable of being moved from its original position and then returning to that original position.

[0041] Membrane 22 may be secured to frame 20 in any suitable manner. Thus, for example, frame 20 includes inwardly inclined surfaces for receiving membrane 22. Other structural arrangements may be used within the practice of this invention to mount membrane 22 on head 14.

[0042] Figures 6-9 illustrate a manual toothbrush 10 in accordance with another embodiment. This is a variation of the prior embodiment using a trampoline type structure to achieve an up and down motion. As shown therein toothbrush 110 includes a handle 112 and a head 114. Handle 112 may include a suitable area 116 made of an elastomeric material. This elastomeric portion of the handle is preferably molded with an open area 118 which is readily deformable by the user. The elastomeric material 16 on the top side of the handle 12 (as viewed in Figures 6, 7 and 9) will yield under pressure of the user's fingers to provide a better grip on the handle while providing a more comfortable feel to the handle. Figure 9 illustrates this elastomeric portion 116 of the handle 112 in a depressed state. The downward arrow in this Figure represents the pressure applied by the toothbrush user. The open area 118 is thereby minimized. As soon as the user's pressure is released, the properties of the elastomeric portion 116 of the handle 112 return the elastomeric material 116 to its original shape illustrated in Fig. 6.

[0043] A similar flexible, deformable open area 120 is created in the head by inclusion of an elastomeric portion 122 in the head overlying open area 120. Cleaning elements 124 are arrayed in the elastomeric portion of the head and fastened thereto by known methods including in-molded technology (IMT). Bristle attachment utilizing IMT methods generally occurs during formation of the toothbrush handle or at least during formation of the elastomeric portion 122 of the head 114.

[0044] In use, the application of pressure by the toothbrush user causes a like pressure of the teeth against cleaning elements 124 as illustrated by the arrow in Figure 9. This causes deflection of the elastomeric portion 122 of head 114 which in turn causes a reorientation of cleaning elements relative to the teeth being cleaned. As the user's pressure is reduced, the open area 120 of head 114 opens up causing the cleaning elements to follow the shape of the teeth being brushed and thereby improving the cleaning of the teeth. When all user pressure is released, the open area 120 returns to its original shape.

[0045] The elastomeric portion 122 of head 114 should be a material or combinations of material that can flex to become altered from its original shape and



recover to its original shape randomly during brushing. The cleaning elements, for example, bristles, are attached to the flexible membrane creating a flexible orientation of cleaning elements 124 which improves the cleaning of the teeth. The moving bristle strands have considerable degrees of motion and thus provide a unique tooth brushing experience.

[0046] Any suitable form of cleaning elements may be used as the cleaning elements 124 in the broad practice of this invention, as discussed with the embodiments of Figures 1-5. It is to be understood that the specific illustration of the cleaning elements is merely for exemplary purposes. The invention can be practiced with various combinations of the same or different cleaning element configurations (such as stapled, in-molded technology bristles, or AFT, etc.) and/or with the same bristle or cleaning element materials (such as nylon bristles, spiral bristles, rubber bristles, etc.) Similarly, while Figures 7 and 9 illustrates the cleaning elements to be generally perpendicular to the elastomeric portion 122 of head 114, some or all of the cleaning elements may be angled at various angles. It is thereby possible to select the combination of cleaning element configurations, materials and orientations to achieve specific intended results to deliver additional oral health benefits, like enhanced cleaning, tooth polishing, tooth whitening and/or massaging of the gums.

[0047] Portions of handle 112 and head 114, may be made of a rigid plastic material which is used for manual toothbrushes. As noted, however, a feature of this toothbrush is use of elastomeric portions 116 of the handle and/or elastomeric portion 122 of head 114, such as an elastomer capable of being moved from its original position and then returning to its original position.

[0048] An embodiment may also be practiced where the head 114 includes one or more power or electrically operated movable sections carrying cleaning elements.

[0049] Figure 10 illustrates a toothbrush 110A which includes a power driven movable disc or section 150 having cleaning elements. The movable section 150 could be similar to section 30 of Figure 5. Although Figure 10 shows movable section 150 to be at the one end of the head, as with Figure 5, the movable section(s) could be located at any desired location on the head.

[0050] In another embodiment, a toothbrush includes a head longitudinally separated into side by side areas by means of a flexible hinge structure that serves as a spring to return the brush head materials and cleaning areas to their original position. Figures 11-13 illustrate a toothbrush 210 which includes an elongated handle 212 and a head 214. A portion of handle 212 may be recessed at gripping area 216 between shoulders 218 and 220. Shoulder 218 could extend outwardly a sufficient distance to act as a hook or ledge to facilitate hanging the toothbrush in an inverted condition.

[0051] Head 214 and handle 212 are elongated and have a longitudinal axis. As shown in Figures 14 and 15, head 214 includes a spine 222 which extends collinear with the longitudinal axis or major axis of the toothbrush handle and head. As a result, head 214 is separated into two side by side longitudinal sections 224, 226 connected to the spine 222. Spine 222 is made of a resilient material such as an elastomer which is sufficiently flexible as to be movable and yet return to its original position. As a result, spine 222 functions as a hinge axis whereby the side by side sections 224, 226 may move or pivot about the spine away from the original position shown in Figure 14 to an open position such as shown in Figure 15 when the cleaning elements on the sections 224, 226 contact the teeth. Then sections 224, 226 return to their original position under the influence of the resilient hinge or spine 222. Preferably hinge or spine 222 is confined to head 214.

[0052] As illustrated, each of the sections 224, 226 includes sets of cleaning elements. For example, an outer set of cleaning elements 228 is located at the outer periphery of each section 224, 226 while an inner set of cleaning elements 230 is located closer to the spine 222. Preferably, the terminal surfaces 232 of the inner cleaning elements 230 are tapered toward the hinge axis 222 so that the adjacent terminal ends 232 of each inner set of cleaning elements forms an obtuse angle as indicated by the letter A in Figure 14 when the brush head is in its original position.

[0053] The outer sets of cleaning elements 228 extend outwardly a longer distance from the outer surface of the sections than do the inner cleaning elements 230. As a result, the combined cleaning elements are designed to wrap around the

edge of the teeth for simultaneous possible contact with both the front and top of the teeth. See Figure 14. During use the brush head is pressed against the edge of the teeth causing the flexible hinge to open and close during cleaning.

[0054] As illustrated in Figures 11-13 in a preferred practice of the invention the outer sets of cleaning elements 228 are bristle bundles of plaque bristles. The inner sets of cleaning elements 230 may be bristles formed by in-molded technology (IMT) where sets of bristles are fused together at one end and the fused end is inserted in a mold cavity during the manufacture of the head.

[0055] Figure 15 shows the sections 224,226 in their open position. Figure 15 omits some of the cleaning elements so as to provide a better understanding of how the cleaning elements are mounted. As shown therein, the plaque bristles 228 are in the form of bristle bundles or tufts inserted into individual holes 234 in bristle container 236. The inner sets of cleaning elements 230 are IMT bristles mounted in IMT container 238. The IMT containers 238 may be made of soft flexible elastomer material integral with hinge axis 222, as shown in Figure 15.

[0056] As shown in Figures 11-13 the bristle container 236 does not extend completely to the distal end of the head 214. Accordingly, side plates 240 are provided on each side of the head longitudinally abutting against bristle containers 236 and disposed against containers 238 for the remaining length of containers 238 so that a smooth contour results along the side of the head 214. Side plates 240 may also be made of a soft, flexible elastomer material.

[0057] As best shown in Figures 11-12 each inner row of IMT bristles 230 has its bristles spaced apart or staggered so that the inclined IMT bristles of each section may fit between the spacing of adjacent IMT bristles of the other section.

[0058] Although Figures 11-15 illustrate a preferred form of cleaning elements to be the plaque bristles and IMT bristles, any suitable form of cleaning elements may be used as the cleaning elements 228 and 230 as previously described. Thus the term "cleaning elements" is intended to be used in a generic sense which could include conventional fiber bristles or massage elements or other forms of cleaning elements such as elastomeric fingers or walls arranged in a circular cross-sectional shape or any type of desired shape including straight portions or sinusoidal

portions. Where bristles are used, the bristles could be mounted to tuft blocks or sections by extending through suitable openings in the tuft blocks so that the base of the bristles is mounted within or below the tuft block.

[0059] Similarly, it is to be understood that the specific illustration of the cleaning elements is for exemplary non-limiting purposes. An embodiment can be practiced with various combinations of the same or different cleaning element configurations (such as stapled or IMT bristles, AFT, etc.) and/or with the same bristle or cleaning element materials (such as nylon bristles, spiral bristles, rubber bristles, etc.) Similarly, while Figure 12 illustrates the cleaning elements to be generally perpendicular to the outer surface of head 214 some or all of the cleaning elements may be angled at various angles with respect to the outer surface of head 214. It is thereby possible to select the combination of cleaning element configurations, materials and orientations to achieve specific intended results to deliver additional oral health benefits, like enhanced cleaning tooth polishing, tooth whitening and/or massaging of the gums.

[0060] Handle 212 could be made of a conventional hard plastic material which could, however, include a soft elastomer section 242 near the head 214. Bristle containers 236,236 could also be made of a hard plastic material while side plates 240 and IMT containers 238 are made of a soft elastomer material. By having the bristle containers 236 mounted against the IMT containers 238, the bristle containers 236 and their cleaning elements 228 move along with the movement of the IMT containers 238 in response to the IMT bristles 230 contacting the teeth. If desired, the bristle containers 236 may also be made of a soft elastomer material.

[0061] Although Figures 11-13 illustrate a manually operated toothbrush, the invention may also be practiced where the head includes one or more power or electrically operated movable sections carrying cleaning elements. Figure 6 illustrates a toothbrush 210 which includes a power driven movable disc or section 250 having cleaning elements, similar to the movable sections of toothbrushes 10A and 110A.

[0062] Figure 17 illustrates a toothbrush head according to yet another arrangement. The head comprises an oral care region for having elements for

brushing teeth or tissue in the mouth. It should be noted that, although the toothbrush head shown in Figure 17 is generally used with a manual toothbrush, the head and method of manufacturing the head, may also be used with a toothbrush that includes one or more power or electrically operated moveable sections carrying cleaning elements.

[0063] Figure 17 illustrates a toothbrush head 300 having a peripheral wall or frame 302 as previously described with respect to FIG. 4. The toothbrush head 300 also includes an elastomeric membrane 304 that is connected to the peripheral frame 302 and provides a foundation to which various tooth cleaning elements may be mounted or otherwise attached. In addition, the head 300 includes tooth cleaning elements 308 mounted to the head 300 via the membrane 304. The term "cleaning elements" is intended to be used in a generic sense which could include conventional fiber bristles or massage elements or other forms of cleaning elements such as elastomeric fingers or walls arranged in a circular cross-sectional shape or any type of desired shape including straight portions or sinusoidal portions.

[0064] In the arrangement shown in Figure 17, the tooth cleaning elements are mounted using Anchor Free Tufting (AFT) as described above. The tooth cleaning elements, such as bristle tufts or elastomeric members, are depicted as round in the FIG. 17. Nevertheless, tooth cleaning elements having alternate shapes may also be used. For example, shapes such as square, rectangular, etc., may be used, as shown in Figure 19. During the AFT process, the tooth cleaning elements provides in a nylon material are heated and the proximal end of the tooth cleaning elements 308a, 308b, 308c melts to bind or fuse the tooth cleaning elements 308a-c to the membrane 304. A schematic representation of the molten nylon 310 is shown in Figure 17 and Figure 19. In Figure 19, toothbrush 350 includes tooth cleaning elements 358a, 358b, 358c in a square shape.

[0065] Figure 18 illustrates a tooth cleaning element 308 attached by anchor free tufting, for example. Tooth cleaning element 308 is visible with the distal end 320 at the top. The proximal end 322 is at the bottom and a portion of the proximal end 322 is shown as melted. This melting occurs when a heating element is applied and causes the nylon to fuse to the back side of the membrane 304. Elastomeric

backing 325 is also shown. This backing 325 is attached to the backside of the head 300 and aids in sealing the head to prevent toothpaste and debris from collecting on the back side of the tooth cleaning elements.

[0066] In one embodiment, to enable the tooth cleaning elements to move independently of each other, the molten nylon associated with each tooth cleaning element should be free of contact with molten nylon of other tooth cleaning elements. In the arrangement of Figures 17, 19 and 20 the tooth cleaning elements are spaced sufficiently apart so as to allow the molten nylon of each tooth cleaning element to be separate or isolated from the molten nylon of other tooth cleaning elements. For instance, in Figure 20, tooth cleaning elements 308a, 308b, 308c may be spaced a distance "X" between the periphery tooth cleaning elements. In one embodiment, this spacing may be between 0.3 mm to 0.5 mm. Nevertheless, other values may be used. In addition, the edge of the molten nylon regions 310a, 310b, 310c may be separated from the neighboring molten nylon by a spacing "Y" having a range of values between 0.05 mm to 0.1 mm. Nevertheless, other values may be used. Aspects of the arrangements shown in FIGS. 17, 19 and 20 can be applied to the arrangements of toothbrushes shown in FIGS. 1-16.

[0067] To further enable movement of the tooth cleaning elements 308, a force in the z-direction is generally applied to the tooth cleaning elements after they have been heated and attached to the membrane 304. This force acts to loosen the attachment or detach the nylon at the perimeter of the head 300. The applied force is generally greater than the value of brushing forces during a normal brushing operation. In order to overcome this attachment, a plate may be lowered onto the head 300 via a pneumatic cylinder, mechanical movement, hydraulic cylinder, etc. This plate forces the nylon downward towards the elastomer on the back of the head. The plate is generally moved a predetermined distance at a predetermined force to break bonds of the nylon tooth cleaning element field from the perimeter of the head. This operation further enables the tooth cleaning elements to be resiliently flexible during brushing. Thus, the tooth cleaning elements 308a-c in the form of bristles are attached to the membrane and move accordingly, creating a random topology and by doing so, improves the cleaning of the teeth. The moving bristle

strands have more degrees of motion than other toothbrushes and thus represent a different and unique tooth brushing device.

[0068] The toothbrush and tooth cleaning element arrangement described enables not only movement of the bristles independently of each other, but also allows movement of the membrane around the tooth during brushing. This arrangement provides of a compound movement of the tooth cleaning elements. For instance, the membrane 304 and tooth cleaning elements 308 may be resiliently flexible when brushing forces are applied. Such flexibility may include rotation of the distal tip of the tooth cleaning element through a 360degree arc, as indicated by arrow 330 in Figure 18. In addition, this flexibility may include z-axis compression of the membrane 304 and tooth cleaning elements 308, as shown in Figure 18, to allow tooth cleaning elements to encompass the tooth. This movement facilitates enhanced brushing of the lingual and facial surfaces with the dentifrice retained on the tooth cleaning element. In addition, z-axis movement of the tooth cleaning elements facilitates improved interproximal cleaning as well as cleaning of the crowns of the molars.

[0069] Figure 21 illustrates a toothbrush head according to still another arrangement. The head 400 of Figure 21 includes a peripheral wall or frame 402. The head 400 also includes an elastomeric membrane 404 connected to the peripheral frame 402 and provides a foundation to which various tooth cleaning elements may be mounted. In addition, the head 400 includes tooth cleaning elements 408a, 408b, 408c that are connected to the membrane 404 via molten nylon 410.

[0070] In the arrangement of Figure 21, the head 400 includes a plurality of walls or dams 412. The walls 412 may be molded into the back of the head 400 and may act as a barrier for molten nylon 410. In one arrangement, the walls 412 are elastomeric and are molded into the back of the membrane 404. The walls 412 are generally directed downward, toward the back of the head 400 and in a direction opposite the tooth cleaning elements 408. To attach or mount the tooth cleaning elements by way of anchor free tufting, a heating element is applied to the tooth cleaning elements 408a-c and the proximal end of the tooth cleaning elements 408a-c will melt to the back side of the membrane 404. The molten nylon 410 will spread

around the area of the tooth cleaning elements 408a-c. The walls 412 may be generally spaced a distance D from the center of the cleaning element, as shown in Figure 23, to isolate the molten nylon of each tooth cleaning element 408a-c and prevent the molten nylon 410 of one tooth cleaning element from fusing with the molten nylon of another tooth cleaning element.

[0071] In the arrangement of Figure 21, a single heating element may be used to apply high temperature to melt the nylon at a melt flow temperature. In an alternate arrangement, separate heating elements may be used for each tooth cleaning element in order to prevent the wall 412 from coming in contact with the heating element. In yet another arrangement, one heating element may be used, however, this heating element may include machine areas such that no contact is made with the nylon tooth cleaning elements in designated areas.

[0072] Figure 22 is a cross-sectional view of the arrangement of Figure 21. The peripheral frame 402 is shown with the membrane 404 attached. In addition, the wall or dam 412 is shown molded into the membrane 404 and extending downward toward the back of the head 400. Shown behind the molded wall 412 is a tooth cleaning element 408. The molten nylon attaching the tooth cleaning element to the head 400 is not visible since the wall 412 prevents the molten nylon from flowing around it. In addition, a backing 420 is shown. The backing may comprise an elastomeric material and generally seals the head 400 from the backside (e.g., opposite of the tooth cleaning elements) to prevent dentifrice and debris from collecting on the underside of the tooth cleaning elements.

[0073] Figure 23 illustrates another arrangement according to this embodiment. As shown, tooth cleaning elements 508 form a generally rectangular shape of a tuft of bristles. In another arrangement, the walls 512 are shown having a slight curvature. This curvature may aid in the shape of the walls 512 following the contour of the dome shaped membrane. The walls 512 may also be formed in alternate shapes to be tailored to the shapes of the tooth cleaning elements and to further enable movement of the tooth cleaning elements independently of the other tooth cleaning elements.



[0074] The embodiment described in which walls or dams are used to prevent molten nylon associated with each tooth cleaning element from fusing with molten nylon associated with another cleaning element enables the cleaning elements to move independently of each other. The distal tip of the tooth cleaning elements may move through a 360 degree arc, as indicated by arrow 330 in Figure 18. In addition, the tooth cleaning elements may also move in a z-direction to allow tooth cleaning elements to encompass the tooth. This movement facilitates enhanced brushing of the lingual and facial surfaces with the dentifrice retained on the tooth cleaning element. In addition, z-direction movement of the tooth cleaning elements facilitates improved interproximal cleaning as well as cleaning of the crowns of the molars.

[0075] Although the subject matter has been described in language specific to certain structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims. Numerous other embodiments, modifications and variations within the scope and spirit of the appended claims will occur to persons of ordinary skill in the art from a review of this disclosure.

## CLAIMS

1. A toothbrush, comprising:
  - a handle;
  - an oral care region secured to the handle and the oral care regionfurther including:
  - an upstanding wall to create a peripheral frame;
  - a membrane connected to the peripheral frame and configured for attachment of tooth cleaning elements;
  - a plurality of tooth cleaning elements connected to the membrane such that the first plurality of tooth cleaning elements moves independently of each other, wherein the tooth cleaning elements are sufficiently spaced to allow attachment to the membrane individually; and a portion of the membrane extending downwardly from an underside thereof and between adjacent tooth cleaning elements.
2. The toothbrush of claim 1, wherein at least one of the plurality of tooth cleaning elements comprises a tufts of bristles.
3. The toothbrush of claim 2, wherein the tufts of bristles are formed of nylon.
4. The toothbrush of claim 2, wherein the plurality of tooth cleaning elements are attached using anchor free tufting.
5. The toothbrush of claim 1, wherein the portion of the membrane is arcuate shaped.
6. The toothbrush of claim 1, wherein the membrane has a convex shaped.

7. The toothbrush of claim 6, wherein the membrane is resiliently flexible when a brushing force is applied thereto.

8. A toothbrush, comprising:  
a handle;  
an oral care region connected to the handle and the oral care region further including;  
an upstanding wall to create a peripheral frame;  
a membrane connected to the peripheral frame and configured for attachment of the tooth cleaning elements;  
a plurality of tooth cleaning elements secured to the membrane such that each of the plurality of tooth cleaning elements moves independently of the others; and  
at least one wall disposed between the plurality of tooth cleaning elements and configured to contain a spread of a melted portion of the plurality of tooth cleaning elements and to prevent the melted portion from one of the plurality of tooth cleaning elements from merging with the melted portion of another of the plurality of tooth cleaning elements.

9. The toothbrush of claim 8, wherein the plurality of tooth cleaning elements includes tufts of bristles.

10. The toothbrush of claim 9, wherein the tufts of bristles are formed of nylon.

11. The toothbrush of claim 8, wherein at least one of the tooth cleaning elements is comprises an elastomeric material.

12. The toothbrush of claim 8, wherein the plurality of tooth cleaning elements are attached using anchor free tufting.

13. The toothbrush of claim 8, wherein the at least one wall is molded into the head.

14. The toothbrush of claim 8, wherein the at least one wall is formed of an elastomer.

15. The toothbrush of claim 8, further including a second plurality of tooth cleaning elements attached to the membrane and disposed between the first plurality of tooth cleaning elements.

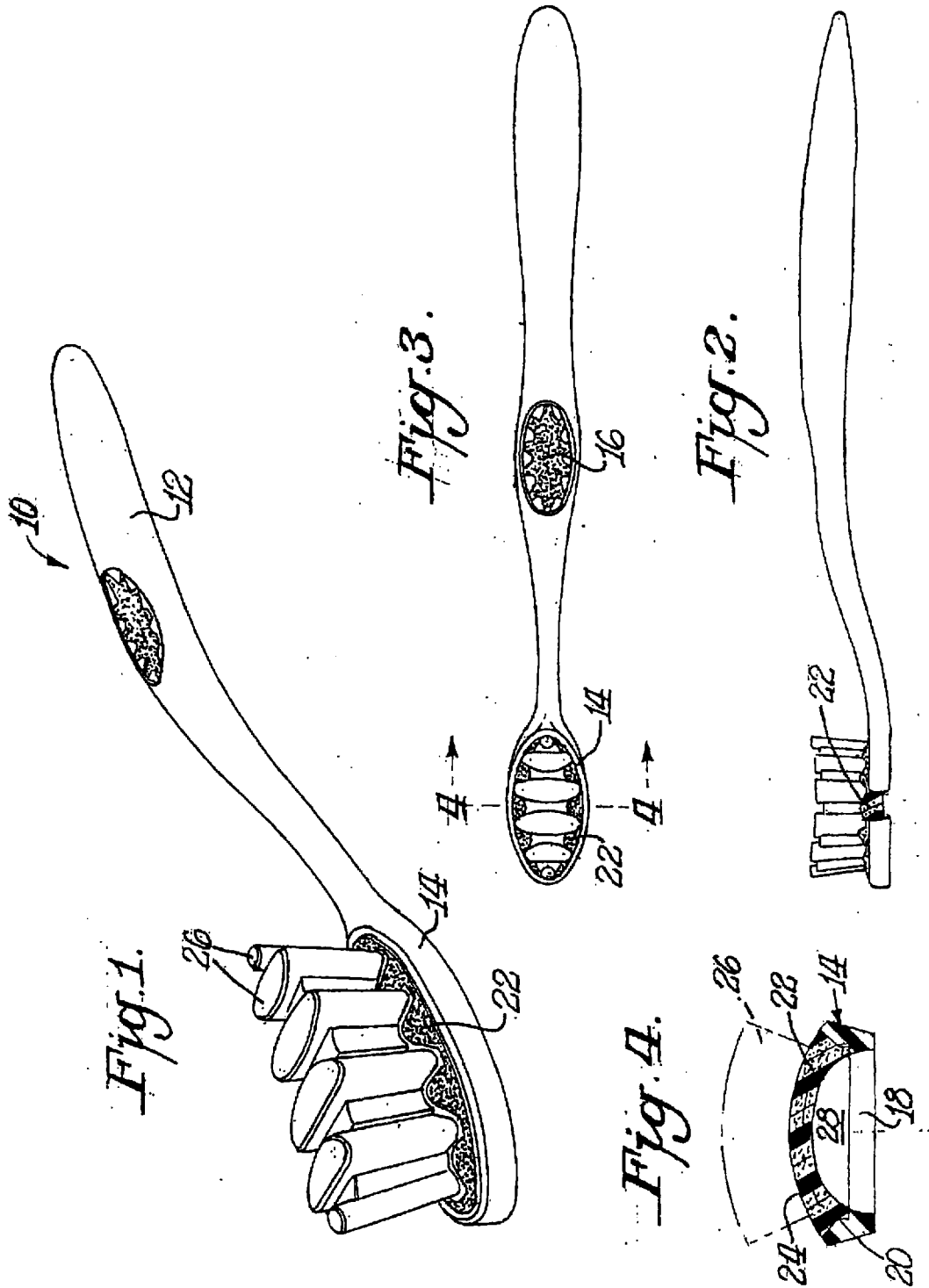
16. The toothbrush of claim 8, further including a power supply and drive system for moving portions of the head for moving at least one tooth cleaning element..

17. A method of manufacturing a toothbrush, comprising:  
connecting a membrane to a peripheral frame of a head of the toothbrush;  
providing a wall to the membrane;  
providing a plurality of tooth cleaning elements on the membrane and between the plurality of walls; and  
heating a proximal portion of the plurality of tooth cleaning elements such that the proximal end melts to attach each of the plurality of tooth cleaning elements to the membrane and wherein the melted portion of the tooth cleaning elements is isolated from the melted portion of other tooth cleaning elements by the plurality of walls.

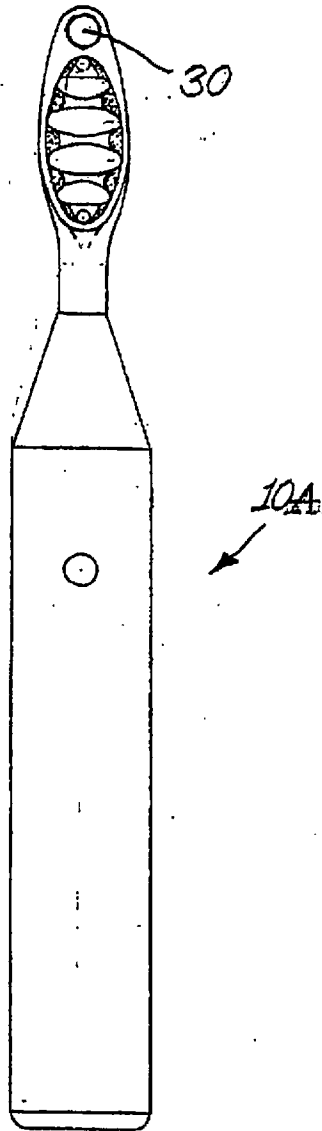
18. The method of manufacturing a toothbrush of claim 17, wherein the step of inserting a plurality of walls includes molding the walls into the head of the toothbrush.

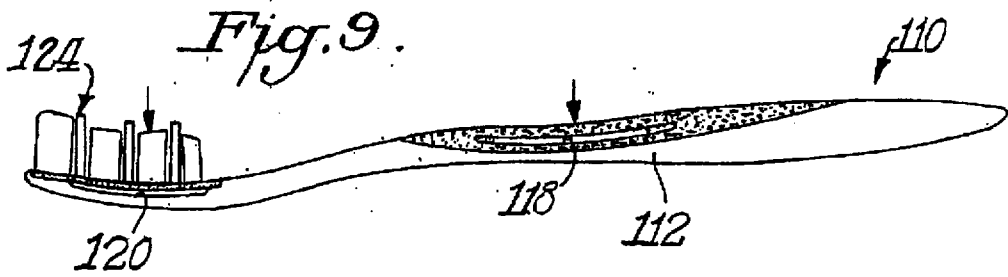
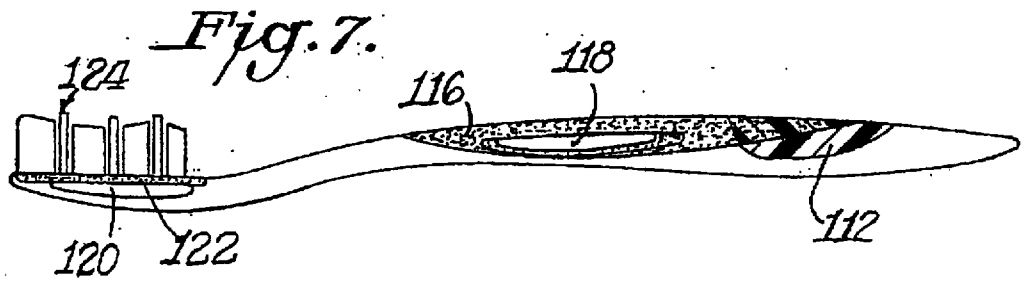
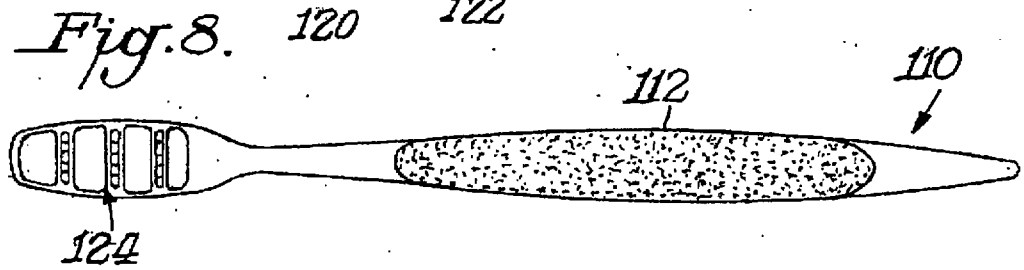
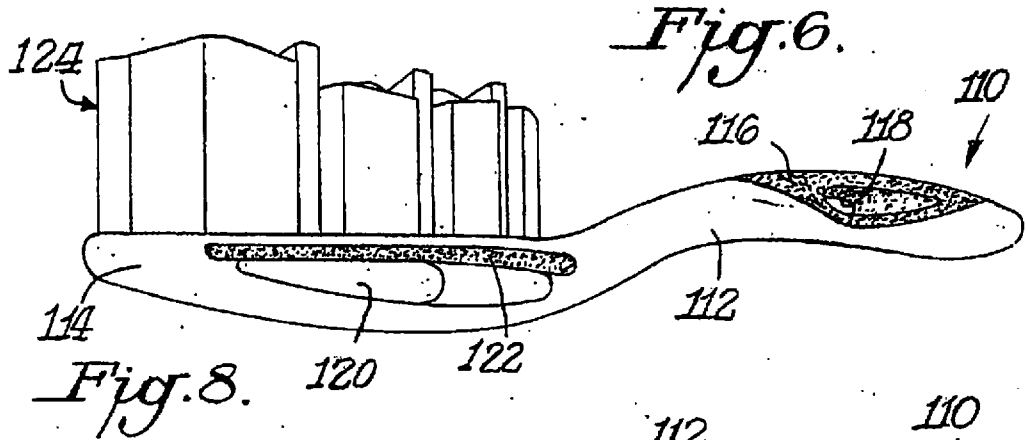
19. The method of manufacturing a toothbrush of claim 17, wherein the step of connecting the membrane includes connecting the membrane such that it is substantially dome shaped.

20. The method of manufacturing a toothbrush of claim 19, wherein the step of connecting the membrane further includes connecting the membrane such that it is resiliently flexible when a brushing force is applied.



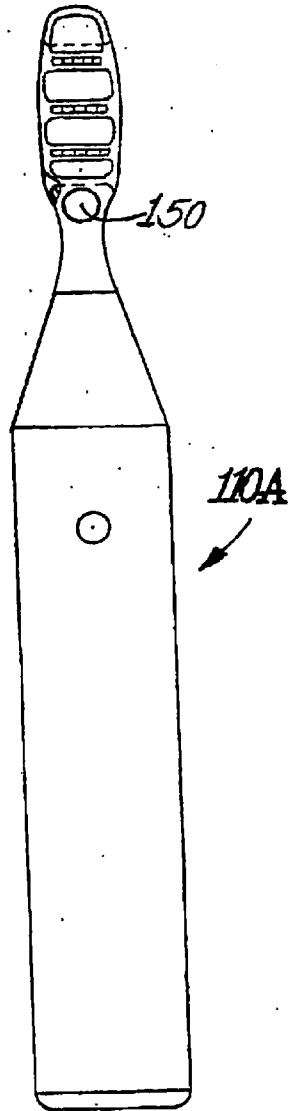
*Fig. 5.*

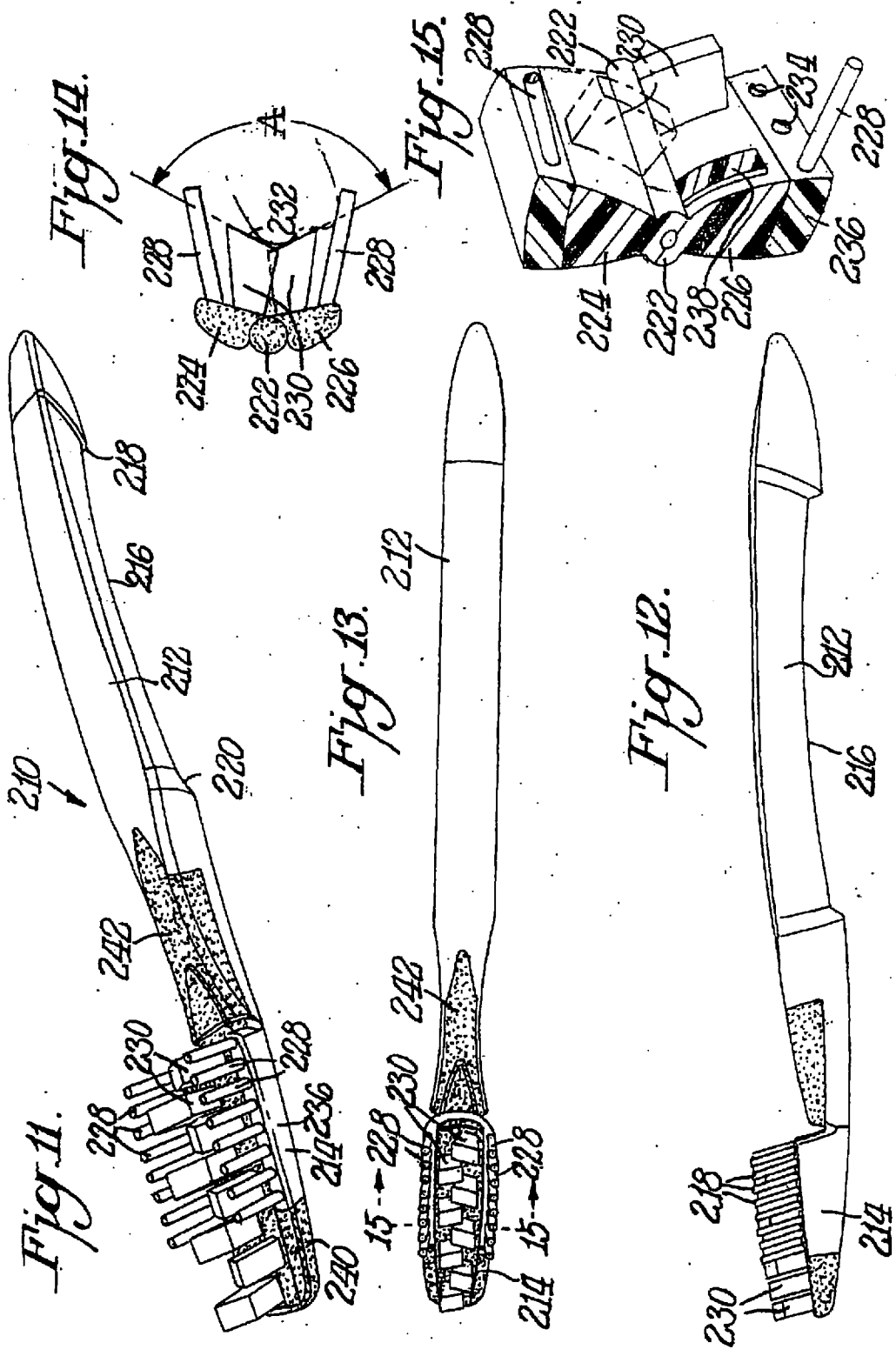






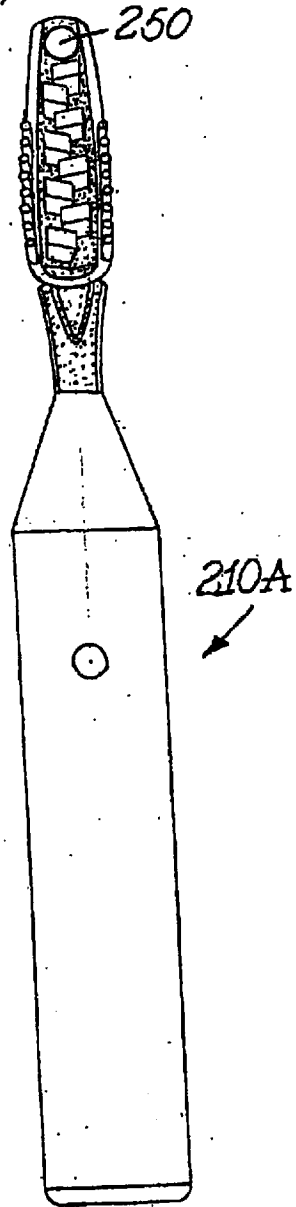
*Fig. 10.*





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*Fig. 16.*



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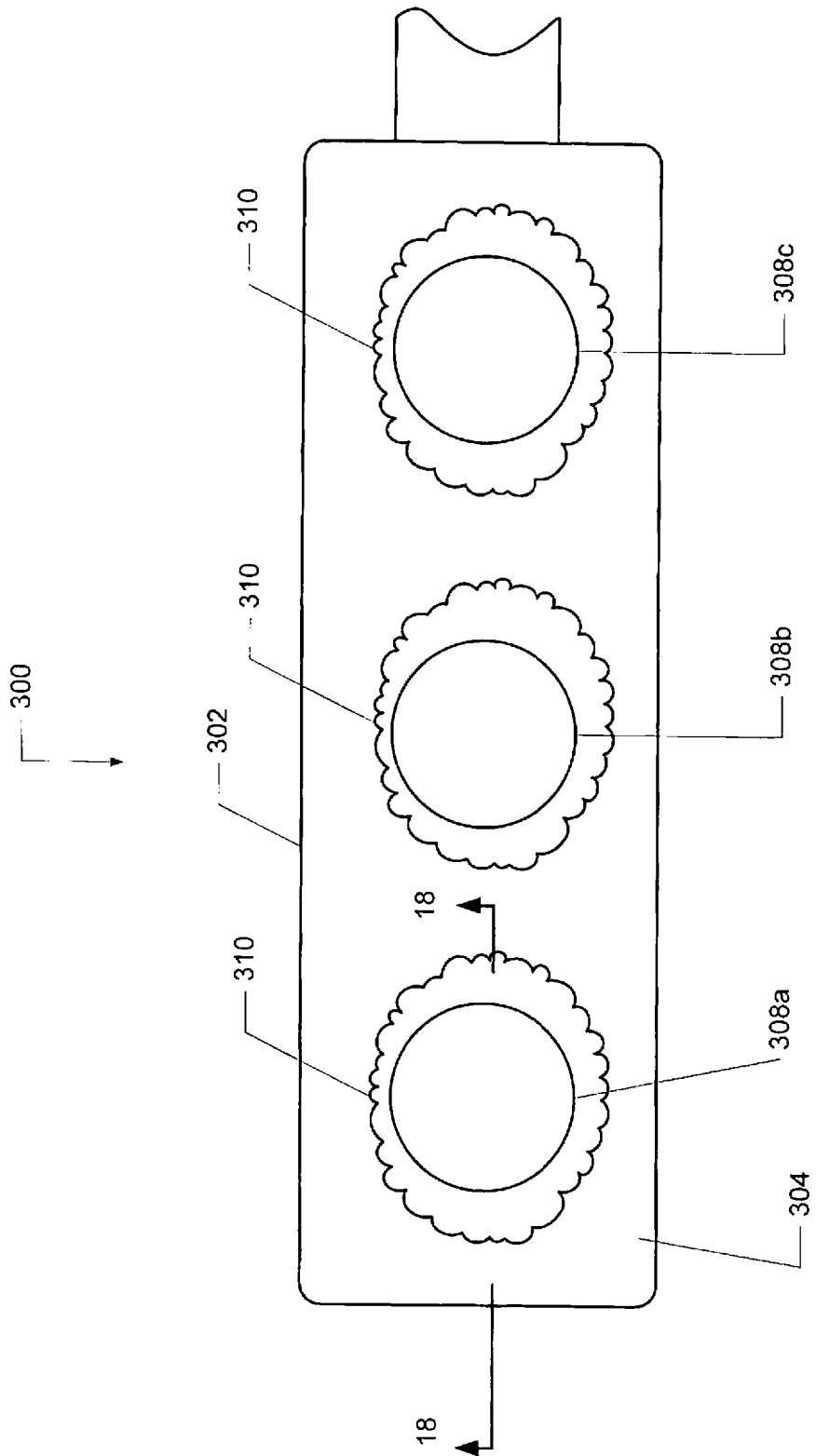


FIG. 17

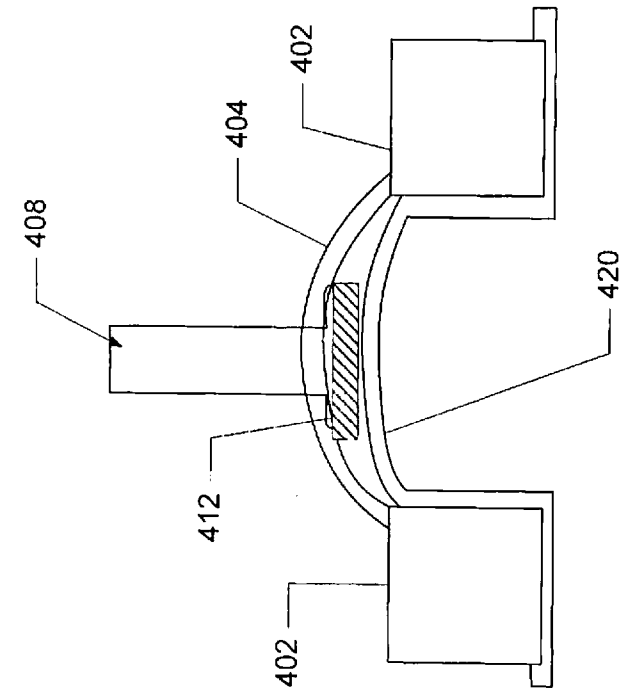


FIG. 22

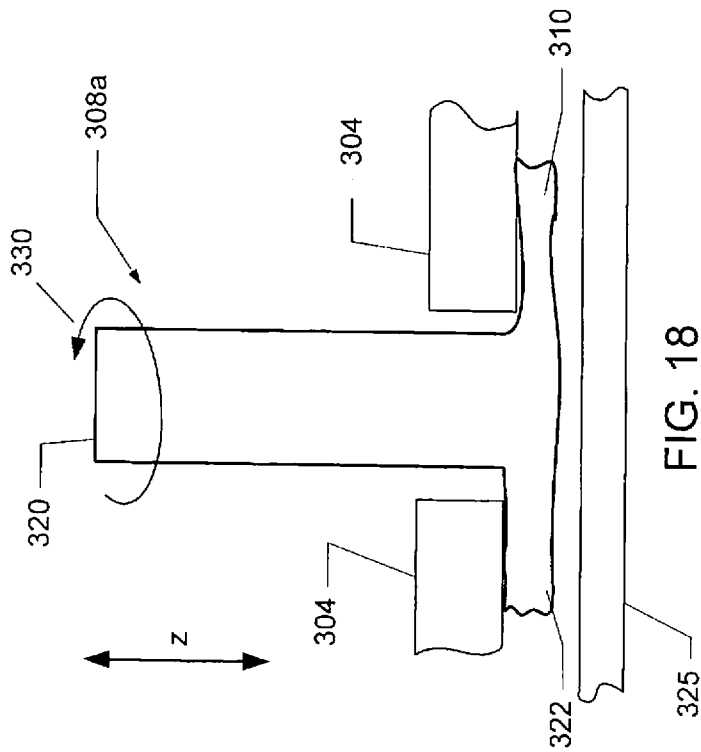


FIG. 18

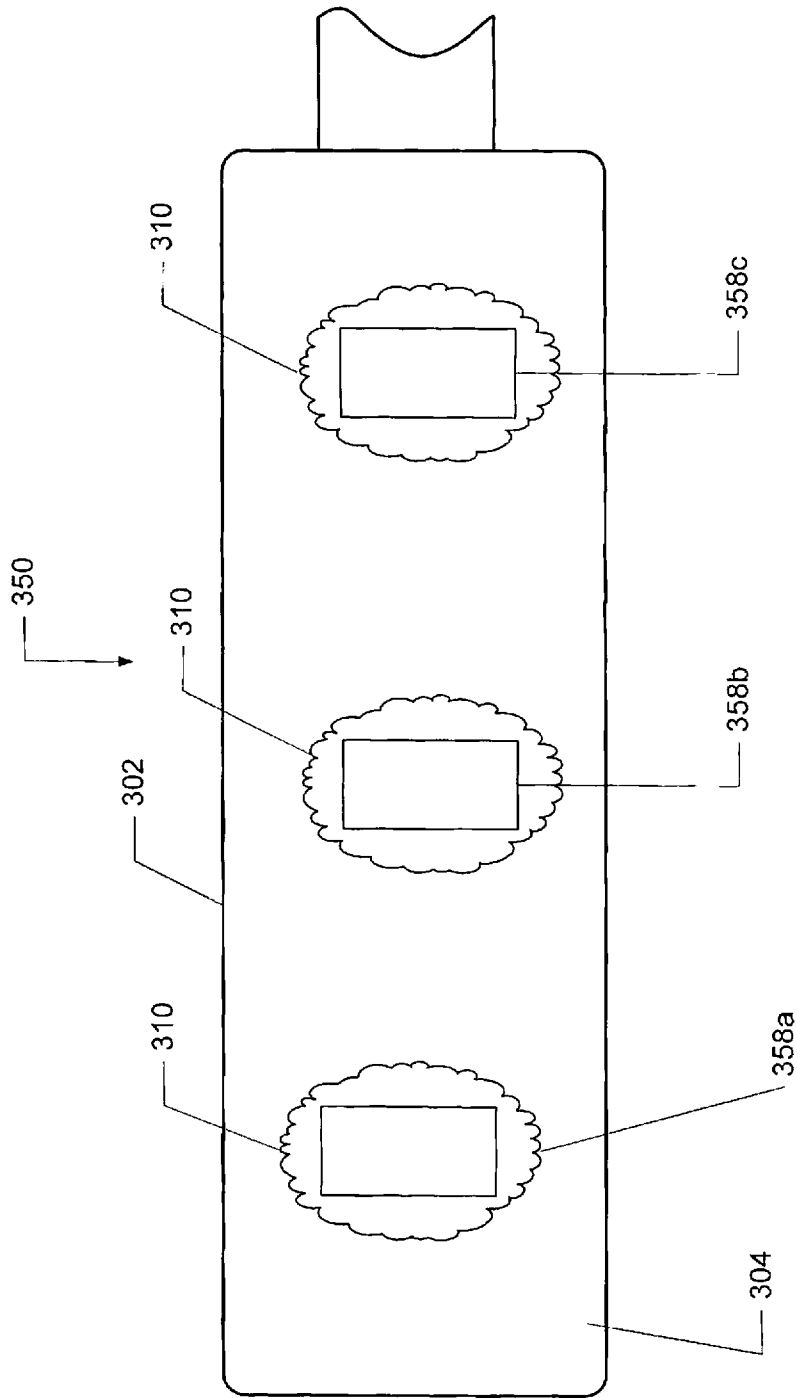


FIG. 19

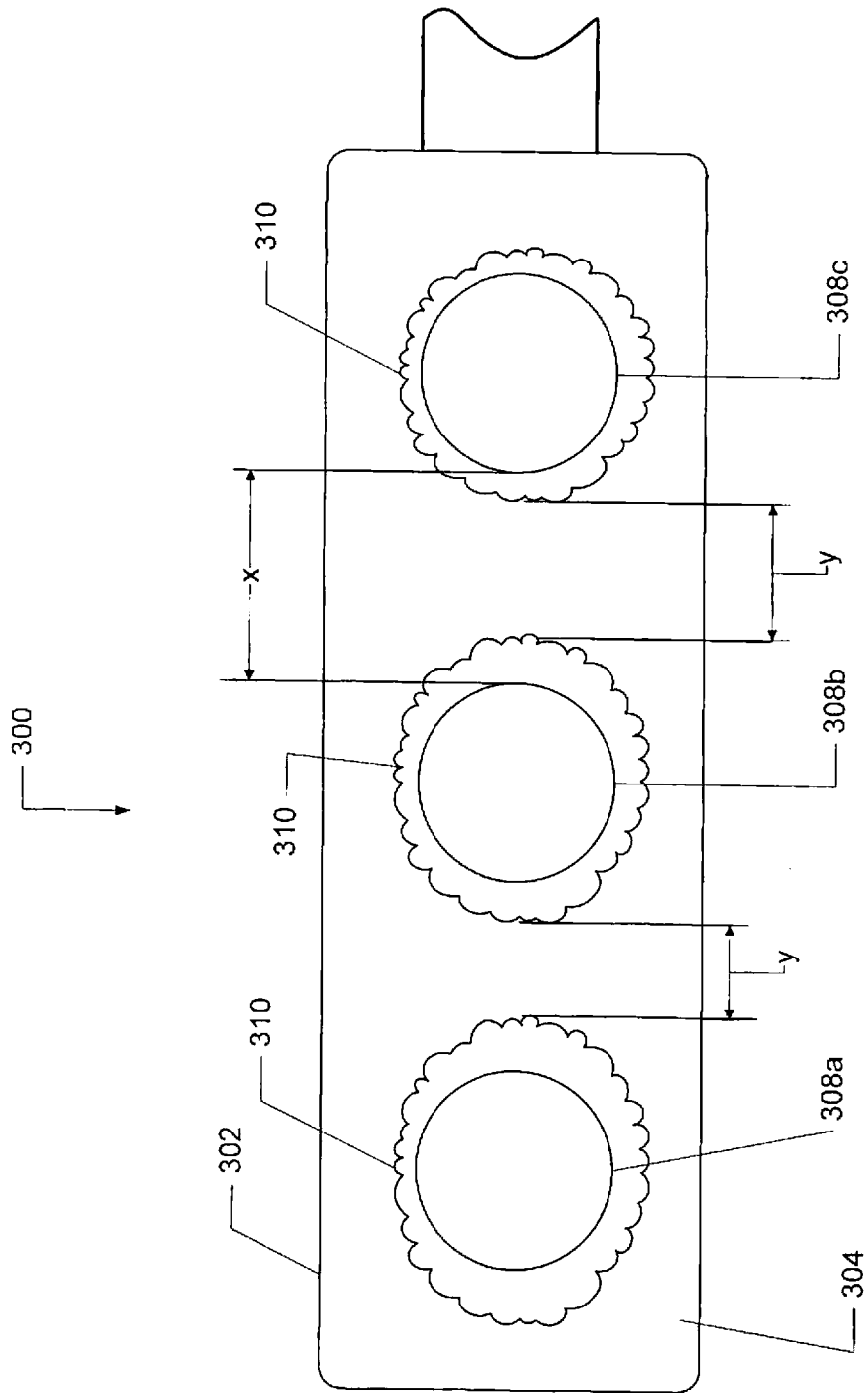


FIG. 20

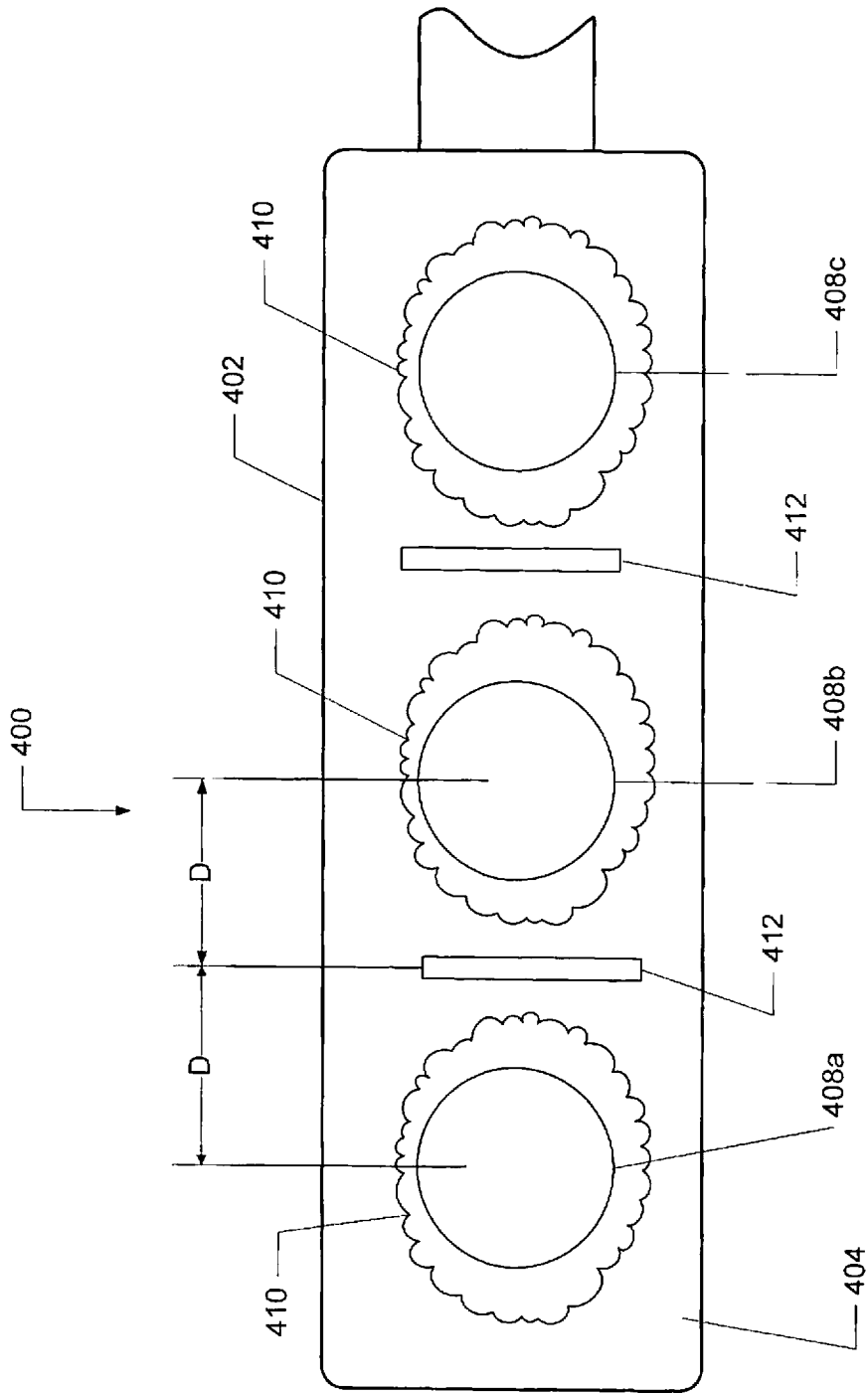


FIG. 21



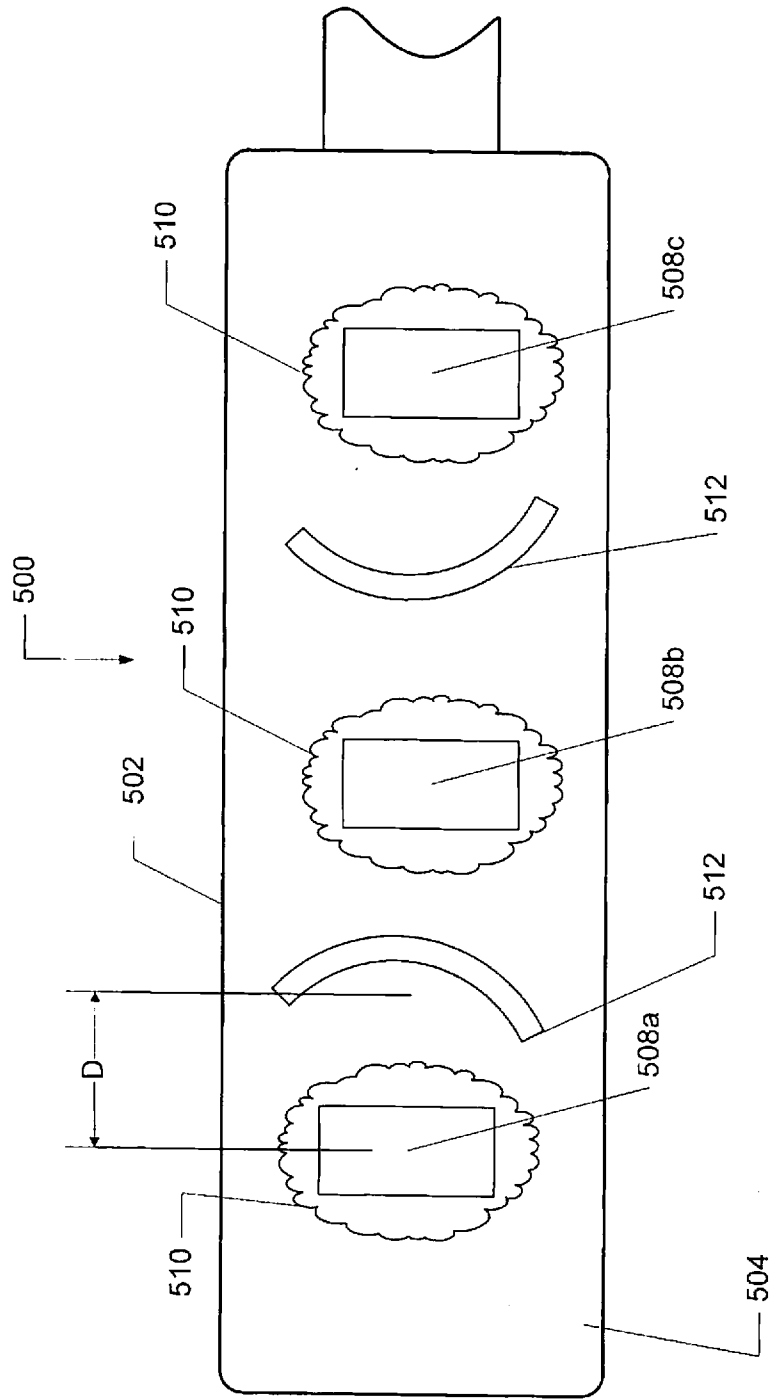


FIG. 23

## INTERNATIONAL SEARCH REPORT

International application No

PCT/US2007/087141

A. CLASSIFICATION OF SUBJECT MATTER  
 INV. A46B7/06 A46B9/06

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 practical, search terms used)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 2005/188488 A1 (MOSKOVICH ROBERT [US] ET AL) 1 September 2005 (2005-09-01) the whole document	1-16 17-20
X A	WO 2006/012956 A (UNILEVER NV [NL]; UNILEVER PLC [GB]; LEVER HINDUSTAN LTD [IN]; DAVIES) 9 February 2006 (2006-02-09) the whole document	1-16 17-20
X A	WO 94/13174 A (SCHEIER PAUL A [US]; SCHEIER LUISE A [US]) 23 June 1994 (1994-06-23) the whole document	1-16 17-20
X A	US 2 706 825 A (BLAKEMAN AMORON R) 26 April 1955 (1955-04-26) the whole document	1-16 17-20

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Date of the actual completion of the international search

6 March 2008

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No  
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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X	US 2005/188487 A1 (MOSKOVICH ROBERT [US] ET AL) 1 September 2005 (2005-09-01)	1-16
A	the whole document -----	16-20

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Information on patent family members

International application No

PCT/US2007/087141

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