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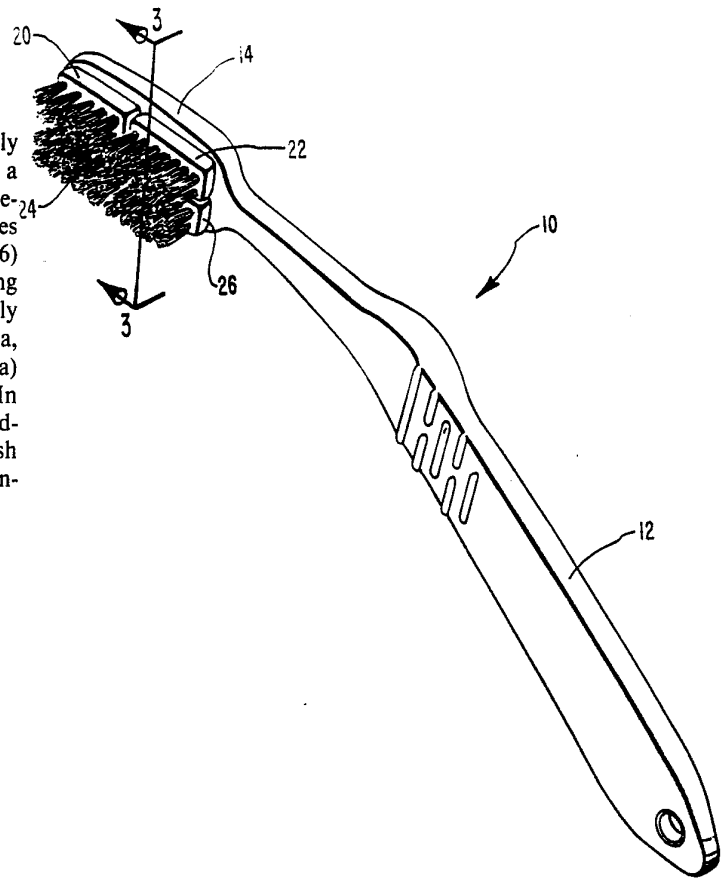
(54) Title: ROCKER TOOTHBRUSH

(57) Abstract

A toothbrush (10) is disclosed which automatically provides an up-down stroking action in concert with a side-to-side stroking action as the brush is stroked side-to-side along the teeth of a user. The brush incorporates two pairs of elongate bristle-carrying pads (20, 22, 24, 26) with the pads of each pad is hinged to the pad-holding end (14) of the brush with the hinge axis being angularly related to the elongate axis of the pad. The hinge (30a, 33a) may comprise a relatively thin elongate web (40a) having a substantially hour-glass cross-sectional shape. In another embodiment each pad (200, 202, 204, 206) is slidably engaged with the pad-holding end (14) of the brush with the sliding axis being angularly related to the elongate axis of the pad.



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ROCKER TOOTHBRUSH

1. Field of the Invention

The present invention is in the field of toothbrushes, particularly toothbrushes devised to impart an up-down motion as the brush is stroked side-to-side along a user's teeth.

2. Technology Review

Throughout the years a large variety of toothbrushes have been devised with the objective in mind of providing a brush that does a better job of cleaning teeth. In general, all brushes have in common an elongate member with a handle to be grasped by the user and bristles positioned at one end for brushing against the teeth. Some have employed elongate members with straight handles and some have employed members with angled handles.

Most dentists have usually advised their patients to brush with up-and-down strokes across their teeth rather than side-to-side strokes. However, this practice is awkward and consequently not faithfully followed. At least one important reason for such up-and-down stroking is to cause the bristles to penetrate slightly between the teeth and gum. Most periodontal disease originates as a result of bacteria residing in this region. Brushing in this manner minimizes the start and growth of such disease. Such brushing has been deemed so advisable that some brushes have been devised with electric means, such as vibrators, to effect such a motion. However, these are expensive and have not generally found favor with the public. Consequently, it seemed desirable to have a toothbrush which did not incorporate a vibrator but which would permit a user to brush in a convenient side-to-side fashion while at the same time effecting an up-and-down motion of the bristles so as to penetrate slightly the

space between the teeth and gum. However, such a brush has not heretofore been available.

BRIEF SUMMARY OF THE INVENTION

The present invention seeks to resolve the problem as noted above and to provide other improvements.

Briefly summarized, the foregoing advantages are realized by the toothbrush of the present invention. One embodiment comprises a brush having an elongate handle with means at the distal end devised to hold the bristles. The bristles are affixed in separate bristle-holding elongate pads which are configured so as to be pivotally attached to cooperating pad-holding mean. Alternatively, the bristles are affixed in bristle-holding elongate pads which are integral with and configured so as to be hingedly attached to the pad-holding distal end of the toothbrush.

Preferably, there will be four such bristle-holding pads although there could be more or less. Each pad is of elongate configuration devised so as to secure, preferably, two elongate rows of bristles. The bristles are of conventional design as are found in other toothbrushes.

The pads are so sized and configured as to permit a pair of pads to be preferably positioned in a side-by-side relationship with a relatively small space between, for reasons explained below. A second similar pair of pads is preferably positioned in an end-to-end relationship to the first pair with a relatively small space between. The entire assembly of four pads is so sized and configured as to occupy approximately the same area at the distal end of the toothbrush as do the bristles in conventional toothbrushes.

As noted above, each pad is pivotally attached to the pad-holding distal end of the toothbrush. The pivotal attachment comprises, preferably, an elongate pivot hinge, positioned so as to have the pivotal axis form an acute

angle with respect to the elongate axis of the pad. The pivotal axis of a pair of pads are preferably so arranged as to form a substantially "V" configuration. However, as noted above, adjacent pads have a space between them, and therefore the apex at the "V" is open, i.e., the legs of the "V" do not come completely together.

Alternatively, each pad is hingedly attached to the pad-holding distal end of the toothbrush. The hinged attachment comprises, preferably, an elongate web, interconnecting the pad to the distal end of the toothbrush, and positioned so as to have the hinge axis form an acute angle with respect to the elongate axis of the pad. The hinge axes of a pair of pads are preferably so arranged as to form a substantially "V" configuration. However, as noted above, adjacent pads have a space between them, and therefore the apex at the "V" is open, i.e., the legs of the "V" do not come completely together.

Additionally, each pair of pads is, preferably, so arranged that the corresponding open apexes of the "V"s are adjacent to each other although there is a space between, as noted above. Alternatively, the pairs could be so arranged that the mouths of the "V"s were adjacent each other.

The pivot hinge comprises, preferably, a rod-like member which is an integral part of the pad and is positioned at the bottom of the pad, and an elongate receiving receptor which is an integral part of the pad-holding end of the brush.

The rod-like member comprises a rod having a truncated circular cross-section and also having an elongate protruding web which serves to connect the rod-like member to the bottom of the pad. The truncated circular segment of the perimeter comprises somewhat more than a semi-circle. The protruding web is configured with a relatively

short, but preferred, connecting dimension, as to be described in more detail below.

The receiving receptor is fashioned as a groove in the pad-holding end of the brush, and likewise has a truncated circular cross section which comprises somewhat more than a semi-circle. The radius of the circular segment of the receiving receptor is slightly greater than the radius of the circular segment of the rod-like member, being so sized that when the rod-like member is engaged with the receiving receptor it fits snugly, but not tightly, therein, thus allowing it to pivot freely, but not loosely. Thus, as the rod-like member pivots back and forth, the bristle-holding pad rocks back and forth. The importance of the connecting dimension of the protruding web on the rod-like member now becomes apparent. This dimension must be such as to permit the base of the pad to be spaced above the pad-holding end of the brush so as to allow the pad to rock a preferred amount before it strikes the pad-holding end. At the same time this dimension must not be too great or the pad would rock too far. Preferably the configuration will be such that the pad can rock back and forth through an angle of approximately ±.

The reason for the spacing between adjacent pads also now becomes apparent. The spacing is preferably such that as adjacent pads rock oppositely so as to bring the bristles towards each other the bristles impact each other but do not significantly intermesh. Furthermore, the pads rock without mutual interference.

With regard to the embodiment featuring an integral hinge, the integral hinge comprises, preferably, a relatively thin elongate web which is an integral part of the distal end of the toothbrush and is positioned so as to interconnect the bottom of the pad to the pad-holding distal end of the brush. The web comprises a substantially hour-glass shaped cross-section which, as indicated, serves

to connect the bottom of the pad to the distal end of the brush. The web is configured with a relatively short, but preferred, connecting dimension, as to be described in more detail below.

As the hinge pivots back and forth, the bristle-holding pad rocks back and forth. The importance of the connecting dimension of the web now becomes apparent. This dimension must be such as to permit the base of the pad to be spaced above the pad-holding end of the brush so as to allow the pad to rock a preferred amount before it strikes the pad-holding end. At the same time this dimension must not be too great or the pad would rock too far. Preferably the configuration will be such that the pad can rock back and forth through an angle of approximately 45°.

The invention also comprises an alternate embodiment of the pivotal engagement means. In this alternate embodiment a pair of knobs are employed rather than a rod-like member, and a pair of knob-receiving receptors ar employed rather than an elongate receiving receptor. The pair of knobs protrude from opposite ends of the pad and are positioned along the pivotal axis of the pad. The knob-receiving receptors are emplaced and configured so as to snugly, but not tightly, engage and secure therein the pair of knobs when emplaced therein.

The use of the toothbrush will now be explained. As noted before, each pad has its pivotal axis arranged to be at an acute angle with respect to the elongate longitudinal axis of the pad. As the brush is stroked side-to-side along the teeth of a user the pads move back and forth in a longitudinal direction. At the same time, as can be shown by a kinematic analysis, the pair of pads which has the apex of its "V" shape facing the direction of motion will rock transverse to the direction of motion, outwardly and oppositely to each other, thus spacing their bristles farther apart. Conversely, the pair of pads which has the

mouth of its "V" shape facing the direction of motion will rock transverse to the direction of motion, inwardly and oppositely to each other, thus bringing their bristles closer together. Thus as the brush is stroked side-to-side along the sides of a user's teeth each pair of bristles rocks first one way and then the other, providing an up-and-down motion. A kinematic analysis shows that the tip of any given bristle follows an elliptical trajectory as the brush is stroked side-to-side, thus resulting in a swirling motion. Thus, an enlarged area is brushed by the bristles over that provided by an ordinary brush. Furthermore, this effects an action whereby the bristles penetrate slightly into the space between the teeth and gum of a user. This has been found to be very beneficial in mitigating against periodontal disease.

The pads, webs and body of the toothbrush are preferably molded from a plastic which is sufficiently strong, but yet somewhat elastic, such that the rod-like members can be snapped into position in the receptors, at least when still warm after being removed from the molds. The web hinges preferably assume a neutral position when not being activated.

As a further refinement, drain holes are preferably provided through the body of the brush which communicate at one end with the pivotal engagement means or web hinges and at the other end with open space. Thus the pivot or brush can be washed and kept free of debris.

A still further embodiment of the invention employs means whereby the pads incorporate slide members which engage sideways, thus providing a sliding up-down motion of the bristles rather than a rocking up-down motion.

In this embodiment a pair of transverse elongate rod-like members are incorporated respectively at opposite ends of each pad. These slide members protrude from the pad and are positioned such that their axes form an acute angle

with the elongate axis of the pad, the angle being somewhat less than 90°. These slide members comprise rods having a truncated circular cross-section, and also having an elongate protruding web which serves to connect the rod to the bottom of the pad. The truncated circular segment of the perimeter comprises somewhat more than a semi-circle. The protruding web is configured with a relatively short connecting dimension servicing to connect the slide member to the pad and to space it slightly therefrom.

The receiving receptor is fashioned as a groove in the pad-holding end of the brush, and likewise has a truncated circular cross section which comprises somewhat more than a semi-circle. The radius of the circular segment of the receiving receptor is slightly greater than the radius of the circular segment of the slide member, being so sized that when the slide member is engaged with the receiving receptor it fits snugly, but not tightly, therein, thus allowing it to slide freely, but not loosely. Thus, as the slide member slides back and forth, the bristle-holding pad slides back and forth.

As with the previous embodiments there are preferably two pairs of pads per toothbrush. These pads, in the illustrated embodiment, are configured and emplaced such that the slideway axes of a pair of pads form a substantially "V" configuration, with a slight space between them such that the apex of the "V" is open. The two pairs of pads are so emplaced that one pair is end-to-end adjacent to the other pair, and such that either the apexes of the "V"s, or, alternatively, the mouths of the "V"s are adjacent each other. Applying the same kinematic analysis as before it can be shown that a side-to-side brushing of the teeth, i.e., back-and-forth motion of the brush along is longitudinal axis, will effect an up-down motion of the pads, wherein one pair of pads slides towards each other as the other pair slides away from each other,

which motion reverses as the motion of the brush is reversed.

It should be noted that for purposes of this specification both the pivotal axis and the slideway axis, as discussed above, are alternatively termed the transverse motion axis, being the axis along which, or about which, a transverse motion of a pad takes place as the brush is stroked along the elongate axis of the pad.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to more fully understand the manner in which the above-recited advances of the invention are obtained, a more particular description of the invention will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. Understanding that these drawings depict only one or more typical embodiments of the invention and are therefore not to be considered limiting of its scope, the presently preferred embodiments and the presently understood best mode of the invention will be described with additional detail through use of the accompanying drawings in which:

Figure 1 is a perspective view of one embodiment of the toothbrush having two pairs of bristle-carrying pads with two rows of bristles on each pad;

Figure 2 is a perspective view showing the pad-holding end of the toothbrush with the pads removed, and also showing the four pads after removal but positioned in their normal position with respect to each other;

Figure 3 is a cross sectional view taken along line 3-3 of Figure 1, to an enlarged scale;

Figure 4 is a cross sectional view corresponding to Figure 3 except with the pads shown rocked towards each other;

Figure 5 is a cross sectional view corresponding to Figure 3 except with the pads shown rocked away from each other;

Figure 6 is a schematic representation of the forces acting on the pads so as to cause them to rock towards each other;

Figure 7 is similar to Figure 6 except that the forces cause the pads to rock away from each other;

Figure 8 is an exploded perspective view of another embodiment of the present invention showing the pad-holding end of the toothbrush with integral hinges artificially severed, for clarity;

Figure 9 is a cross sectional view of the toothbrush embodied in Figure 8 with the integral hinges no longer being artificially severed.

Figure 10 is a cross sectional view corresponding to Figure 9 except with the pads shown rocked away from each other;

Figure 11 is a cross sectional view corresponding to Figure 9 except with the pads shown rocked towards each other;

Figure 12 is a cross-sectional view corresponding to Figure 10 showing the bristles penetrating the gum line; and

Figure 13 is a view corresponding to Figure 12 except with the brushes rocked towards each other.

Figure 14 is a perspective view of another embodiment of the invention with one pad shown removed;

Figure 15 is a cross sectional view taken along the line 15-15 of Figure 14, with the pads removed, to an enlarged scale;

Figure 16 is a cross sectional view taken along the line 16-16 of Figure 14;

Figure 17 is an exploded perspective view of still another embodiment of the invention; and

Figure 18 is a cross sectional view taken along the line 18-18 of Figure 17.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference is now made to the drawings wherein like parts are designated with like numerals throughout.

Referring first to Figure 1, the toothbrush 10 is shown having a conventional elongate handle 12 and a bristle pad-holding end 14 configured in conformity with the present invention. As shown in Figures 1 and 2, there are preferably four bristle-holding pads, 20, 22, 24, and 26, which engage the pad-holding end 14. Likewise, as shown, there are preferably two rows of bristles per pad although there may be more or less.

As shown best in Figure 2, each pad is devised so as to be pivotally attached to the pad-holding end 14. The pivotal attachment for each pad comprises a hinge which in turn comprises a rod-like member, such as 30, affixed to pad 26, and a receiving receptor 32 affixed to pad-holding end 14. Similarly, for rod-like members 33, 34, 35 there are receiving receptors 36, 37, 38.

Preferably, rod-like member 30 is fashioned as an integral part of pad 26, as shown best in Figure 3. Likewise, receiving receptor 32 is fashioned as an integral part of pad-holding end 14.

Rod-like member 30 is configured so as to be substantially circular, but truncated, in cross-section having an elongate protruding web 40 extending from a small segment of the perimeter of member 30, such that the circular segment of member 30 comprises somewhat more than a semi-circle.

Receiving receptor 32 is an elongate groove configured so as to be substantially circular in cross section, but being truncated such that the circular engagement comprises somewhat more than a semi-circle.

The radius of the circular segment of member 30 is slightly less than the radius of the circular segment of receptor 32. The radii are chosen such that member 30 engages receptor 32 snugly, but not tightly. Thus member 30 can pivot freely in receptor 32 when a pivotal force is applied to pad-holding end 26, normally by way of the bristles. However, the engagement is snug enough that member 30 does not pivot by itself merely due to gravitational forces.

Rod-like member 30 is assembled to pad-holding end 14 by being snapped into place. In order to make this possible member 30 and pad-holding end 14 are fashioned, preferably, from a molded plastic material which has sufficient strength to make the toothbrush substantially rigid, but at the same time has sufficient elasticity that member 30 can be snapped into receptor 32 even though the opening in member 32 is less than the diameter of member 30. It has been found that this snap-fitting can be most easily effected when the parts are still warm as they come from the mold. Once engaged the assembly is substantially permanent. A satisfactory material is polycarbonate.

With this assembly, then, as pivotal forces, depicted schematically as f, and f_2 in Figure 3, are alternately applied to the bristles, as explained in more detail below, pad 26 rocks back-and-forth. The angle α (see Figure 4) through which the pad can rock is determined by the dimensions of protruding web40 and the contour of pad-holding end 14. As shown, pad-holding end 14 has inclined surfaces 42 and 44 against which surfaces 46 and 48 of pad 26 abut when pad 26 is rocked to its limits. This is shown best in Figures 4 and 5. Preferably, the configuration is such that pad 26 can rock through the angle α of approximately $\pm$ 45°, i.e. 22.5° in each direction, although this angle is not critical. However, it should preferably be within the range of 10° to 90°.

The spacing "d," see Figure 3, between adjacent pads 26 and 22 is such that when the pads are rocked towards each other the tips of the bristles impact each other but do not substantially intermesh, as shown in Figure 4. The spacing is also such that pads 26 and 22 do not interfere with each other when rocked through their respective maximum angles, as depicted in Figure 4.

A significant advantage of the toothbrush of this invention is the greater area of a tooth that is covered as the brush is stroked from side-to-side by a user. As depicted in Figure 3 the up-down dimension that is covered by a brush that did not rock is depicted as "k." In Figure 5 this dimension for a brush that does rock is depicted as "m." As can be seen, "M" is significantly greater than "k."

Another significant advantage accruing from the use of the invention is the cleaning that occurs between the tooth and the gum line, as depicted in Figure 5. As the pads rock outwardly, some of the bristles protrude slightly into the space between the tooth and the gum, as shown. This cleaning action significantly reduces the onslaught of periodontal disease.

Another feature of the invention is the incorporation of drain holes, such as 50 shown in Figures 2 and 3. A plurality of drain holes communicate at one end with the hinge and at the other end with open space, all as shown. These facilitate the cleaning of the brush, especially the hinge, by allowing water to circulate therethrough.

The rocking action is now explained in more detail. As shown in Figure 2 the rod-like member, such as 30, of each pad, such as 26, is so positioned that it forms an acute angle "ß" with respect to the elongate axis of the pad. Likewise, of course, the receptor 32 forms a similar angle with respect to the elongate axis of the pad-holding end 14 of the brush. Adjacent pads 22 and 26 are

positioned such that rod-like members 30 and 33 form substantially a "V" shape with the apex of the "V" in the center of the brush and the mouth of the "V" at the end. Likewise, pads 20 and 24 are similarly positioned, with the apex of the "V" formed by members 34 and 35 adjacent to the apex of the "V" formed by members 30 and 33. Although this is preferred configuration the pads can be so positioned that the mouths of the "V"s are adjacent rather than the apexes of the "V"s.

Now, as the brush is stroked along the sides of a user's teeth in a direction as indicated by "x," Figure 2, pads 20 and 24 will rock outwardly, oppositely from each other, so as to spread their corresponding bristles further apart. At the same time pads 22 and 26 will rock inwardly so as to cause their corresponding bristles to come together. When the brush is stroked in the other direction, as indicated by "y," the pads will rock oppositely. This back-and-forth stroking of the brush will effect repetitive rocking motions of the pads. This produces a swirling motion of the bristles on the teeth wherein any given bristle follows an elliptical trajectory on the teeth. As a consequence, each tooth is brushed in all directions. Stated another way, an up-down brushing is effected simultaneously with a side-to-side brushing.

The forces which create these rocking motions are evident from a simple kinematic analysis as shown in Figures 6 and 7. Referring to Figure 6, 60 and 62 represent, in schematic form, the tips of bristles in pads 22 and 26. "a" represents the direction of a force transmitted to these bristle tips with a_1 being its magnitude. For bristle tips 60, a_1 is composed of forces a_2, directed along the elongate axis of the bristles, and a_3, orthogonal thereto. The force a_3 acts at the end of a crank arm of the pivot comprised of rod-like member 30 and receptor 32. The crank arm is comprised of a combination

of the bristles, the pad 26, and the protruding web 40. As can be seen, this force then rotates the tips of the bristles, and thus the pad inwardly. Similarly, for bristle tips 62, a_1 is composed of forces a_5, directed along the elongate axis of the bristles, and a_4, orthogonal thereto. Thus, in a similar manner a_4 rotates the tips of the bristles, and thus the pad, inwardly.

The forces of Figure 7 can be analyzed in similar fashion. Since force "b" is directed oppositely to force "a" of Figure 6, the bristles rotate oppositely, as depicted by force arrows b_3 and b_4, which thus rock the pads outwardly.

An alternate embodiment of the invention is shown in Figure 8, each pad is devised so as to be hingedly attached to the pad-holding end 14a. The attachment for each pad comprises a web hinge, such as 30a, affixed to a pad such as 26a. Similarly, for pads 20a, 22a and 24a there are hinges 35a, 33a and 34a.

Preferably, hinge 30a is fashioned as an integral part of pad 26a and pad-holding end 14a, as shown best in Figure 9. Likewise, hinges 35a, 33a and 34a are fashioned as an integral part of pad-holding end 14a and their corresponding pads.

Hinge 30a is configured so as to be substantially hour-glass shaped in cross section having an elongate web 40a extending from pad-holding end 14a to pad 26a.

Thus member 26a can pivot freely when a pivotal force is applied to pad-holding end 26a, normally by way of the bristles. However, the web is stiff enough that member 26a does not pivot by itself merely due to gravitational forces.

With this assembly, then, as pivotal forces, depicted schematically as f, and f_2 in Figure 9, are alternately applied to the bristles, as explained in more detail below, pad 26a rocks back-and-forth. The angle α (see Figure 10)

through which the pad can rock is determined by the dimensions of web 40a and the contour of pad-holding end 14a. As shown, pad-holding end 14a has surfaces 42a and 44a against which surfaces 46a and 48a of pad 26a abut when pad 26a is rocked to its limits. This is shown best in Figures 10 and 11. Preferably, the configuration is such that pad 26a can rock through an angle of approximately 45°, i.e., 22.5°(α) in each direction, although this angle is not critical. However, it should preferably be within the range of 10° to 90°.

The spacing "d," see Figure 9, between adjacent pads 26a and 22a is such that when the pads are rocked towards each other the tips of the bristles impact each other but do not substantially intermesh, as shown in Figure 11. The spacing is also such that pads 26a and 22a do not interfere with each other when rocked through their respective maximum angles, as depicted in Figure 11.

A significant advantage of the toothbrush of this invention is the greater area of a tooth that is covered as the brush is stroked from side-to-side by a user. As depicted in Figure 9 the up-down dimension that is covered by a brush that did not rock is depicted as "k." In Figure 10 this dimension for a brush that does rock is depicted as "m." As can be seen, "m" is significantly greater than "k."

Another significant advantage accruing from the use of the invention is the cleaning that occurs between the tooth and the gum line, as depicted in Figure 12. As the pads rock outwardly, some of the bristles protrude slightly into the space between the tooth and the gum, as shown. This cleaning action significantly reduces the onslaught of periodontal disease.

Another feature of the invention is the incorporation of drain holes, such as 50a shown in Figures 8, 9, 10 and 11. A plurality of drain holes communicate at one end with

the space near the hinge and at the other end with open space, all as shown. These facilitate the cleaning of the brush, especially the hinge, by allowing water to circulate therethrough.

The rocking action is now explained in more detail. As shown in Figure 8 the hinge, such as 30a, of each pad, such as 26a, is so positioned that it forms an acute angle "β" with respect to the elongate axis of the pad. Adjacent pads 22a and 26a are positioned such that hinges 30a and 33a form substantially a "V" shape with the apex of the "V" in the center of the brush and the mouth of the "V" at the end. Likewise, pads 20a and 24a are similarly positioned, with the apex of the "V" formed by hinges 34a and 35a adjacent to the apex of the "V" formed by hinges 30a and 33a. Although this is a preferred configuration the pads can be so positioned that the mouths of the "V"s are adjacent rather than the apexes of the "V"s.

Now, as the brush is stroked along the sides of a user's teeth in a direction as indicated by "x," Figure 8, pads 20a and 24a will rock outwardly, oppositely from each other, so as to spread their corresponding bristles further apart. At the same time pads 22a and 26a will rock inwardly so as to cause their corresponding bristles to come together. When the brush is stroked in the other direction, as indicated by "y," the pads will rock oppositely. This back-and-forth stroking of the brush will effect repetitive rocking motions of the pads. This produces a swirling motion of the bristles on the teeth wherein any given bristle follows an elliptical trajectory on the teeth. As a consequence, each tooth is brushed in all directions. Stated another way, an up-down brushing is effected simultaneously with a side-to-side brushing.

The forces which create these rocking motions are evident from a simple kinematic analysis shown previously in Figures 6 and 7. Referring to Figure 6, 60a and 62a

represent, in schematic form, the tips of bristles in pads 22a and 26a. "a" represents the direction of a force transmitted to these bristle tips with a_1 being its magnitude. For bristle tips 60a, a_1 is composed of forces a_2, directed along the elongate axis of the bristles, and a_3, orthogonal thereto. The force a_3 acts at the end of a crank arm of the hinge. The crank arm is comprised of a combination of the bristles, the pad 22a, and the web 33a. As can be seen, this force then rotates the tips of the bristles, and the thus the pad inwardly. Similarly, for bristle tips 62a, a_1 is composed of forces a_5, directed along the elongate axis of the bristles, and a_4, orthogonal thereto. Thus, in a similar manner a_4 rotates the tips of the bristles, and thus the pad, inwardly.

The forces of Figure 7 can be analyzed in similar fashion. Since force "b" is directed oppositely to force "a" of Figure 6, the bristles rotate oppositely, as depicted by force arrows b_3 and b_4, which thus rock the pads outwardly.

An alternative embodiment of the invention is shown in Figures 14 and 15. In this embodiment the hinge means comprises a pair of knobs 100 and 102 integral with respective opposite ends of a pad 104. Knobs 100 and 102 protrude outwardly from pad 104 and are positioned so as to lie along a pivotal axis, ß, as shown in Figure 15, wherein the pivotal axis forms an angel ß with respect to the longitudinal axis of the pad within the range of 10° to 90°, preferably being about 45°.

Pads 110, 112 and 114 have similar respective knobs, not shown, Each knob, such as 128 and 130 shown in Figure 16, is preferably configured as a short round post having a rounded semi-spherical end as shown. The pad-holding end 14 of the brush has a turned-up lip 142 fashioned around its perimeter, and also extending across the central region of pad-holding end 14, being orthogonal to the elongate

axis of pad-holding end 14. Turned-up lip 142 has receptors such as 152, 154, 156, 158, 160, 162, 164, 166, fashioned therein, each of which, such as 152, is configured and emplaced so as to receive and secure a corresponding knob, such as 100, snugly but not nightly. Each receptor has a semi-spherical shape, having a radius slightly greater than the radius of a knob.

Pads 104 and 110 are configured and emplaced such that their pivotal axes form a "V" shape, having an open apex which is adjacent to pads 112 and 114. Pads 112 and 114 are configured and emplaced such that their pivotal axes form a "V" shape with the apexes of the "V" being adjacent to the axis of the "V" of pads 104 and 110.

By applying the same kinematic analysis as before it can be seen that as the brush is stroked back and forth along its longitudinal axis, across the teeth of a user, apex 104 and 110 rock first towards each other and then away from each other along their pivotal axis. At the same time pads 112 and 114 rock first away from each other and then towards each other along their pivotal axis.

A still further embodiment of the invention is shown in Figure 17. This embodiment relies on a sliding action of the pads rather than a rocking action. As before, four pads 200, 202, 204 and 206 are emplaced, pads 200 and 202 being emplaced as an adjacent side-by-side pair, and 204 and 206 emplaced as an adjacent side-by-side pair, also being emplaced in an end-to-end fashion adjacent to pads 200 and 202.

Each pad, such as 200, has a pair of elongate slide members, such as 210 and 212, integral with the bottom of the pad, as shown in Figure 17. These slide members are emplaced near respective opposite ends of the pad, are parallel to each other, and have their axis forming an angle ß within the range of 10° to 90°, preferably about 45°, with respect to the longitudinal axis of the pad.

Pad-holding end 14 has slideways, such as 220 and 222, fashioned therein, configured and emplaced so as to receive, and secure, corresponding slide members 210 and 212. Slideways 220 and 222 are somewhat longer than slide members 210 and 212 so as to allow a controlled amount of sliding motion, as shown best in Figure 18.

Slide members 210, 212, 230, 232, 234, 236, 238, and 240 are fashioned as rods having a truncated circular cross section comprising somewhat more than a semicircle, and being connected to the bottom of respective pads 200, 202, 204, and 206 by respective webs such as 250 shown in Figure 12.

Slideways 220, 222, 260, 262, 264, 266, 268 and 270 are fashioned as groves also having a truncated circular cross section comprising somewhat more than a semicircle, and having a radius slightly greater than the radius of the slide members.

By applying the same kinematic analysis as for the other embodiments it can be seen that as the brush is stroked along its longitudinal axis pads 200 and 206 slide towards each other, and vice versa as the brush is stroked backwards.

In summary, all of the stated advancements have been achieved by the instant invention. As illustrated by the kinematic analysis an up-down motion is provided as the brush strokes the teeth in a side-to-side fashion. Further this up-down motion permits the bristles of the brush to penetrate the gum line, and to cover a wider area than would otherwise be possible. Additionally, the combination of the up-down motion and the side-to-side motion effects a brushing of the teeth at all angles, and imparts a swirling motion to the bristles as they cross the teeth. And lastly, this up-down motion is provided without the use of electric vibrators or equivalents.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. A toothbrush devised to effect both an up-down motion and a side-to-side motion of bristles as said brush is stroked side-to-side along a user's teeth, comprising:

(a) one or more elongate bristle-carrying pads, each pad having an elongate axis and a transverse motion axis;

(b) an elongate body of said brush having an elongate axis, a handle end, and a pad-holding end; and

(c) transverse means whereby an approximately side-to-side longitudinal motion of said bristles in contact with a user's teeth, effected by a substantially back-and-forth longitudinal force applied to said bristles, effects an approximately up-down motion of said bristles having a component of motion approximately orthogonal to said longitudinal force.

2. A toothbrush as defined in Claim 1 wherein the transverse motion axis comprises a pivotal axis, and the transverse means comprises pivotal engagement means for the pad-holding end to engage the bristle-carrying pads whereby each pad is free to rock back and forth about the respective pivotal axis of said pad.

3. A toothbrush as defined in Claim 2 comprising further, rocking means whereby a repetitive side-to-side stroking of the brush in contact with a user's teeth along the elongate axis of the body of the brush effects a pivotal rocking motion of the pads about their respective pivotal axes, thus imparting a substantial up-down rocking motion to the pads.

4. A toothbrush as defined in Claim 3 wherein the rocking means whereby a repetitive side-to-side stroking of

the brush in contact with a user's teeth along the elongate axis of the body of the brush effects a pivotal rocking motion of the pads about their respective pivotal axes comprises a pivotal engagement means wherein the pivotal axis of each pad forms an acute angle with respect to the elongate axis of the pad.

5. A toothbrush as defined in Claim 4 wherein the pivotal engagement means comprises hinge means, wherein the hinge means comprises:

(a) a rod-like member, having an elongate axis, which is an integral part of, or is affixed to, the pad in a spaced relationship; and

(b) an elongate receiving receptor, having an elongate axis, which is an integral part of, or is affixed to, the pad-holding end, being so devised as to snugly, but not tightly, engage and secure therein said rod-like member when emplaced therein, thus allowing said rod-like member to pivot therein.

6. A toothbrush as defined in Claim 5 wherein the rod-like member and the receiving receptor are so sized and shaped as to form cross-sectional configurations comprising, in part, substantially truncated circular segments, each segment being greater than a semicircle; wherein the cross-sectional radius of the circular segment of the rod-like member is slightly less than the cross-sectional radius of the circular segment of the receiving receptor; and wherein the elongate axis of the rod-like member and the elongate axis of the receiving receptor approximately coincide when the receiving receptor engages the rod-like member.

7. A toothbrush as defined in Claim 4 wherein the pivotal engagement means comprises hinge means wherein the hinge means comprises:

(a) a pair of knobs integral with and protruding from opposite ends of the pad and positioned along the pivotal axis of the pad; and

(b) a pair of knob-receiving receptors which are an integral part of, or are affixed to, the pad-holding end, and are strategically positioned and configured so as to snugly, but not tightly, engage and secure therein said pair of knobs when emplaced therein, thus allowing said knobs to pivot therein.

8. A toothbrush as defined in Claim 1 devised to effect both an up-down motion and a side-to-side motion of bristles as said brush is stroked side-to-side along a user's teeth, wherein the one or more elongate bristle-carrying pads comprises two or more pairs of elongate bristle-carrying pads, each pad having an elongate axis and a transverse motion axis and configured such that one pad of each pair is positioned in an adjacent side-by-side relationship to the other pad of said pair; and wherein each pair of pads is positioned in an adjacent end-to-end relationship to another pair of pads.

9. A toothbrush as defined in Claim 8 wherein the transverse motion axis comprises a pivotal axis, and the transverse means comprises pivotal engagement means for the pad-holding end to engage the bristle-carrying pads whereby each pad is free to rock back and forth about the respective pivotal axis of said pad.

10. A toothbrush as defined in Claim 9 comprising, further, rocking means whereby a repetitive side-to-side stroking of the brush in contact with a user's teeth along

the elongate axis of the body of the brush effects a pivotal rocking motion of the pads, about their respective pivotal axes, thus imparting a substantial up-down rocking motion to the pads.

11. A toothbrush as defined in Claim 10 wherein the rocking means whereby a repetitive side-to-side stroking of the brush in contact with a user's teeth along the elongate axis of the body of the brush effects a pivotal rocking motion of the pads about their respective pivotal axes comprises a pivotal engagement means wherein the pivotal axis of each pad forms an acute angle with respect to the elongate axis of the pad.

12. A toothbrush as defined in Claim 11 wherein the pivotal engagement means comprises hinge means wherein the hinge means comprises:

(a) a rod-like member, having an elongate axis, which is an integral part of, or is affixed to, the pad in a spaced relationship; and

(b) an elongate receiving receptor, having an elongate axis, which is an integral part of, or is affixed to, the pad-holding end, being so devised as to snugly, but not tightly, engage and secure therein said rod-like member when emplaced therein, thus allowing said rod-like member to pivot therein.

13. A toothbrush as defined in Claim 12 wherein the rod-like member and the receiving receptor are so sized and shaped as to form cross-sectional configurations comprising, in part, substantially truncated circular segment of the rod-like member is slightly less than the cross-sectional radius of the circular segment of the receiving receptor; and wherein the elongate axis of the rod-like member and the elongate axis of the receiving

receptor approximately coincide when the receiving receptor engages the rod-like member.

14. A toothbrush as defined in Claim 9 wherein the pivotal engagement means comprises hinge means wherein the hinge means comprises:

(a) a pair of knobs integral with and protruding from opposite ends of the pad and positioned along the pivotal axis of the pad; and

(b) a pair of receptors which are an integral part of, or are affixed to, the pad-holding end, and are strategically positioned and configured so as to snugly, but not tightly engage and secure therein said pair of knobs when emplaced therein, thus allowing said knobs to pivot therein.

15. A toothbrush as defined in Claim 1 devised to effect both a up-down motion and a side-to-side motion of bristles as said brush is stroked side-to-side along a user's teeth, wherein the one or more elongate bristle-carrying pads comprise two or more pairs of elongate bristle-carrying pads, each pad having an elongate axis and a transverse motion axis, and configured such that on pad of each pair is positioned in an adjacent ent-to-end relationship to another pair of pads, such that the transverse motion axes of a first pair of side-by-side adjacent pads form substantially a "V" shape with an open mouth and an open apex and the transverse motion axes of a second pair of side-by-side adjacent pads form substantially a "V" shape with an open mouth and an open apex.

16. A toothbrush as defined in Claim 15 wherein the transverse motion axis comprise a pivotal axis, and the transverse means comprises pivotal engagement means for the

pas-holding end to engage the bristle-carrying pads whereby each pad is free to rock back and forth about the respective pivotal axis of said pad.

17. A toothbrush as defined in Claim 16 comprising, further, rocking means whereby a repetitive side-by-side stroking of the brush in contact with a user's teeth along the elongate axis of the body fo the brush effects a pivotal axes, thus imparting a substantial up-down rocking motion to the pads.

18. A toothbrush as defined in Claim 17 wherein the rocking means whereby a repetitive side-to-side stroking of the brush in contact with a user's teeth along the elongate axis of the body of the brush effects a pivotal rocking motion of the pads about their respective pivotal axes comprises a pivotal engagement means wherein the pivotal axis of each pad forms an acute angle with respect to the elongate axis of the pad.

19. A toothbrush as defined in Claim 15 wherein the apexes of the "V" shapes of end-to-end adjacent pairs of pads are positioned approximately adjacent each other.

20. A toothbrush as defined in Claim 15 wherein the mouth of the "V" shapes of end-to-end adjacent pairs of pads are positioned approximately adjacent each other.

21. A toothbrush as defined in Claim 16 wherein the pivotal engagement means comprises hinge means wherein the hinge means comprises:

(a) a rod-like member, having an elongate axis, which is and integral part of, or is affixed to, the pad in a spaced relationship; and

(b) Am elongate receiving receptor, having an elongate axis, which is an integral part of, or is affixed to, the pad-holding end, being so devised as to snugly, but not tightly, engage and secure therein said rod-like member when emplaced therein, thus allowing said rod-like member to pivot therein.

22. A tooth brush as defined in Claim 21 wherein the rid-like member and the receiving receptor are so sized and shaped at to form cross-sectional configurations comprising, in part, substantially truncated circular segments, each segment being greater than a semicircle; wherein the cross-sectional radius of the circular segment of said receiving receptor; and wherein the elongate axis of said rod-like member and the elongate axis of said receiving receptor approximately coincide when said receiving engages said rod-like member.

23. A toothbrush as defined in Claim 16 wherein the pivotal engagement means comprise hinge means wherein the hinge means comprises:

(a) a pair of knobs integral with and protruding from opposite ends of the pas and positioned along the pivotal axis of the pad; and

(b) a pair of receptors which are an integral part of, or are affixed to, the pad-holding end, and are strategically positioned and configured so as to snugly, but not tightly, engage and secure therein said pair of knobs when emplaced therein, thus allowing said knobs to pivot therein.

24. A toothbrush as defined in Claim 23 wherein the rod-like member and the receiving receptor are so sized and shaped, and fabricated of material having sufficient

elasticity, that said rod-like member can be snapped into place in said receiving receptor.

25. A toothbrush as defined in Claim 23 comprising further on or more drain holes passing through the body of the brush, said drain holes communicating at one end with the pivotal engagement means of a pad and at the other end with open space.

26. A toothbrush as defined in Claim 15 wherein one of more of the elongate bristle-carrying pads is so devised as to engage two or more rows of bristles.

27. A toothbrush as defined in Claim 15 wherein the pads are molded from a plastic material.

28. A toothbrush as defined in Claim 15 wherein the body of the brush is molded from plastic material.

29. A toothbrush as defined in Claim 18 wherein the acute angle is within the range of 10° to 90°.

30. A toothbrush as defined in Claim 15 wherein the means for the pad-holding end to engage the bristle-carrying pads comprises means for each pad to be so emplaced so that said pad can rock aback and forth about its pivotal axis, at least partially, without interference with either the pad-holding end or an adjacent pad.

31. A toothbrush as defined in Claim 30 wherein the means for each pad to be emplaced is so devised that each pad can rock back and forth through an angle of at least ± 20°.

32. A toothbrush as defined in Claim 15 wherein the transverse motion axis comprises a slideway axis, and the transverse means comprise slideway engagement means for the pad-holding ent to engage the bristle-carrying pads whereby each pad is free to slide back and forth along a respective slideway axis of said pad.

33. A toothbrush as defined in Claim 32 comprising, further, sliding means whereby a repetitive side-to-side stroking of the brush in contact with a user's teeth allowing the elongate axis of the body of the brush effects a sliding motion of the pads, along their respective slideway axes, thus imparting a substantial up-down sliding motion to the pads.

34. A toothbrush as defined in Claim, 33 wherein the sliding means whereby a repetitive side-to-side stroking of the brush in contact with a user's teeth along the elongate axis of the body of the brush effects a siding motion of the pads along their respective slideway axes comprises a sliding engagement means wherein the slideway axis of each pad forms an acute angle with respect to the elongate axis of the pad.

35. A toothbrush as defined in Claim 32 wherein the apexes of the "V" shapes of the end-to-end adjacent pairs of pads are positioned approximately adjacent each other.

36. A toothbrush as defined in Claim 32 wherein the mouths of the "V" shapes of end-to-end adjacent pairs of pads are positioned approximately adjacent each other.

37. A toothbrush as defined in Claim 32 wherein the slideway engagement means comprises:

(a) a pair of elongate slide members each having an elongate axis, which are an integral part of, ot ate attaches to. the pad, being positioned, respectively, near opposite ends of said pad; and

(b) a pair of elongate slideways which are an integral part of, or are affixed to, the pad-holding end being so devised as to snugly, but not tightly, engage, and secure therein said slide members when emplaced therein, thus allowing said slide members to slide therein.

38. A toothbrush as defined in Claim 37 wherein the slide member and the slideway are so sized and shaped as to form cross-sectional configurations comprising, in part, substantially truncated circular segments, each segment being greater that a semicircle; wherein the cross-sectional radius of the circular segment of said slide member is slightly less than the cross-sectional radius of the circular segment of the slideway; and wherein the elongate axis of the slide member and the elongate axis of the slideway approximately coincide when the slideway engages the slide member.

39. A toothbrush as defined on Claim 37 wherein each sliding member and each slideway are so sized and shaped, and fabricated of material having sufficient elasticity, that said slide member can be snapped into place in said slideway.

40. A tooth brush as defined in Claim 32 comprising further one or more drain holes passing through the body of the brush, said drain holes communicating at one end with space between the body of the toothbrush and the pad and at the other end with open space.

41. A toothbrush as defined in claim 32 wherein one or more of the elongate bristle-carrying pads is so devised as to engage two of more rows of bristles.

42. A toothbrush as defined in Claim 32 wherein the pads are molded from a plastic material.

43. A toothbrush as defined in Claim 32 wherein the body of the brush is molded from plastic a material.

44. A toothbrush as defined in Claim 34 wherein the acute angle is within the range of 10° to 90°.

45. A toothbrush as defined in Claim 37 wherein each slideway is configured so as to have an axial dimension grater than the axial dimension of the slide member, and further wherein each slideway in terminated at each end sp as to limit the amount of travel of the slide member in the slideway.

46. A toothbrush as defined in Claim 45 wherein each slideway and slide member to slide a distance of approximately 3/16 inches.

47. A toothbrush devised to effect both an up-down motion and a side-to-side motion of bristles as said brush is stroked side-to-side along a user's teeth, comprising:

(a) one or more elongate bristle-carrying pads, each pad having an elongate axis and a transverse motion axis, wherein the transverse motion axis comprises a hinge axis.

(b) an elongate body of said brush having an elongate axis, a handle end, and a pad-holding end; and

(c) transverse means whereby an approximately side-to-side longitudinal motion of said bristles in contact with a user's teeth, effected by a substantially back-and-forth longitudinal force applied to said bristles, effects an approximately up-down motion of said bristles having a component of motion approximately orthogonal to said longitudinal force.

48. A toothbrush as defined in Claim 47 wherein the transverse means comprises a hinge engagement means for the pad-holding end to engage the bristle-carrying pads whereby each pad is free to rock back and forth about the respective hinge axis of said pad.

49. A toothbrush as defined in Claim 48 comprising further, rocking means whereby a repetitive side-to-side stroking of the brush in contact with a user's teeth along the elongate axis of the body of the brush effects a pivotal rocking motion of the pads about their respective hinge axes, thus imparting a substantial up-down rocking motion to the pads.

50. A toothbrush as defined in Claim 49 wherein the rocking means whereby a repetitive side-to-side stroking of the brush in contact with a user's teeth along the elongate axis of the body of the brush effects a pivotal rocking motion of the pads about their respective pivotal axes comprises a hinge engagement means wherein the hinge axis of each pad forms an acute angle with respect to the elongate axis of the pad.

51. A toothbrush as defined in Claim 50 wherein the hinge engagement means comprises a web, having an elongate

axis, which is an integral part of, and interconnects, a pad and the pad-holding end in a spaced relationship.

52. A toothbrush as defined in Claim 51 wherein the hinge is so sized and shaped as to form a cross-sectional configuration having a substantially hour-glass shape.

53. A toothbrush as defined in Claim 48 devised to effect both an up-down motion and a side-to-side motion of bristles as said brush is stroked side-to-side along a user's teeth, wherein the one or more elongate bristle-carrying pads comprises two or more pairs of elongate bristle-carrying pads, each pad having an elongate axis and a transverse motion axis and configured such that one pad of each pair is positioned in an adjacent side-by-side relationship to the other pad of said pair; and wherein each pair of pads is positioned in an adjacent end-to-end relationship to another pair of pads.

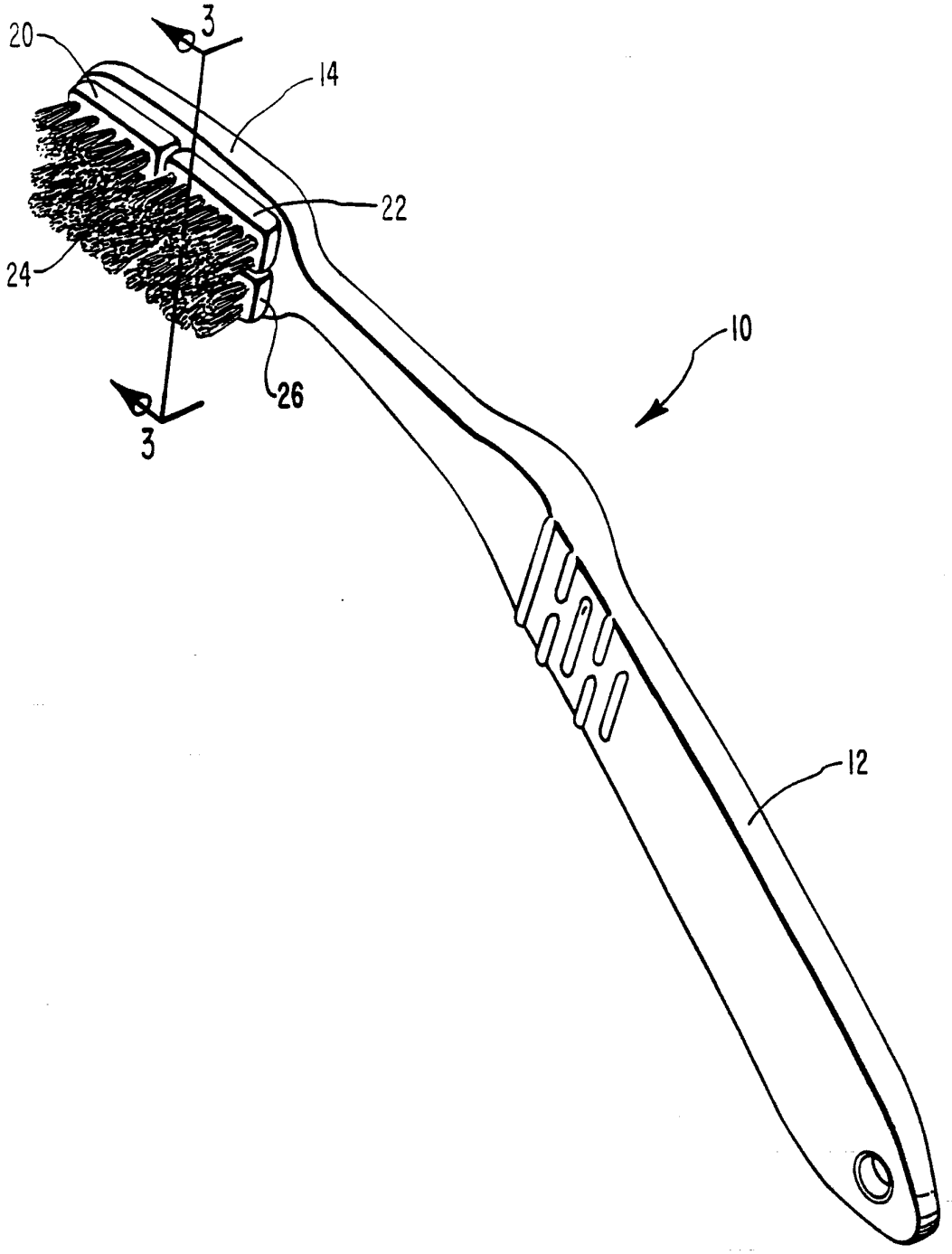

FIG. 1

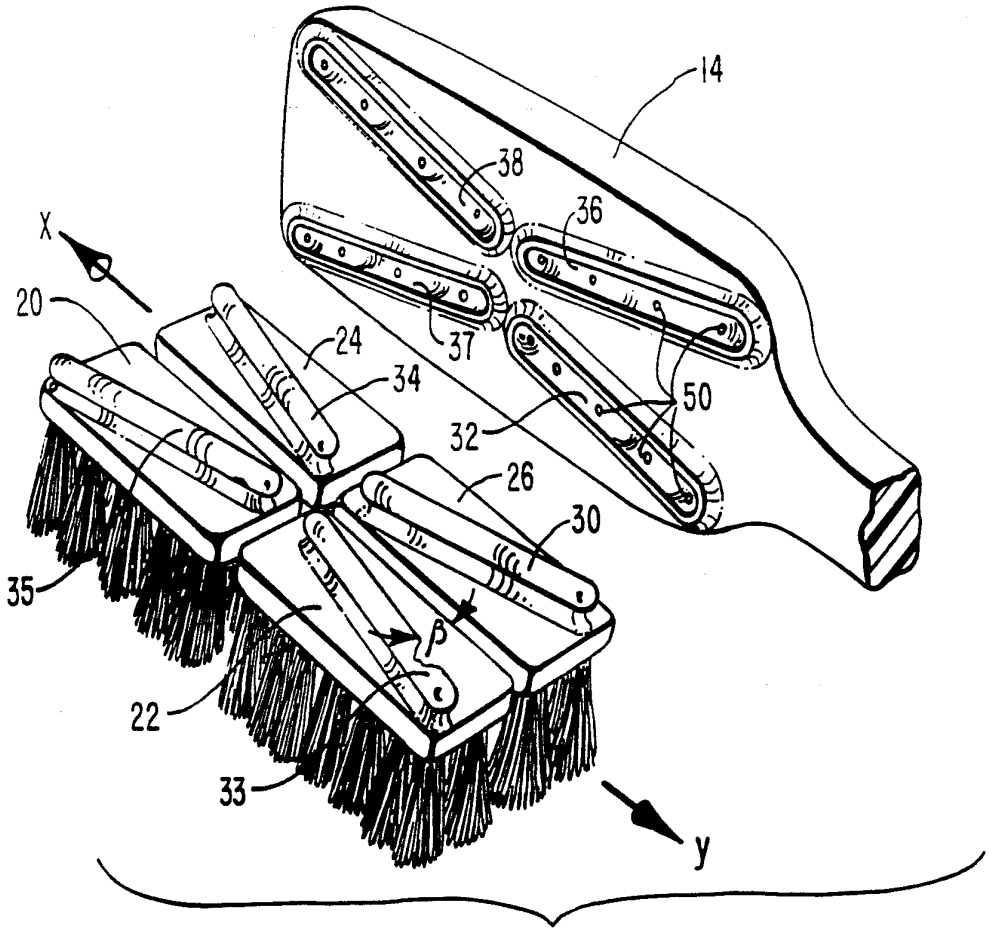
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FIG. 2

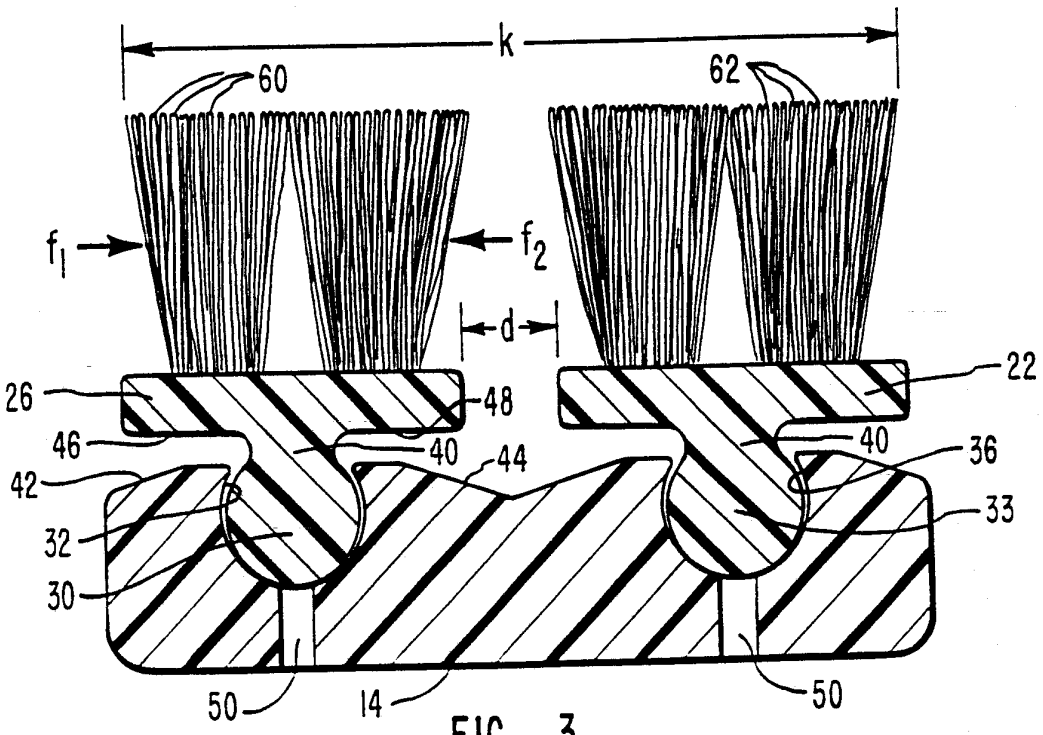
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FIG. 3

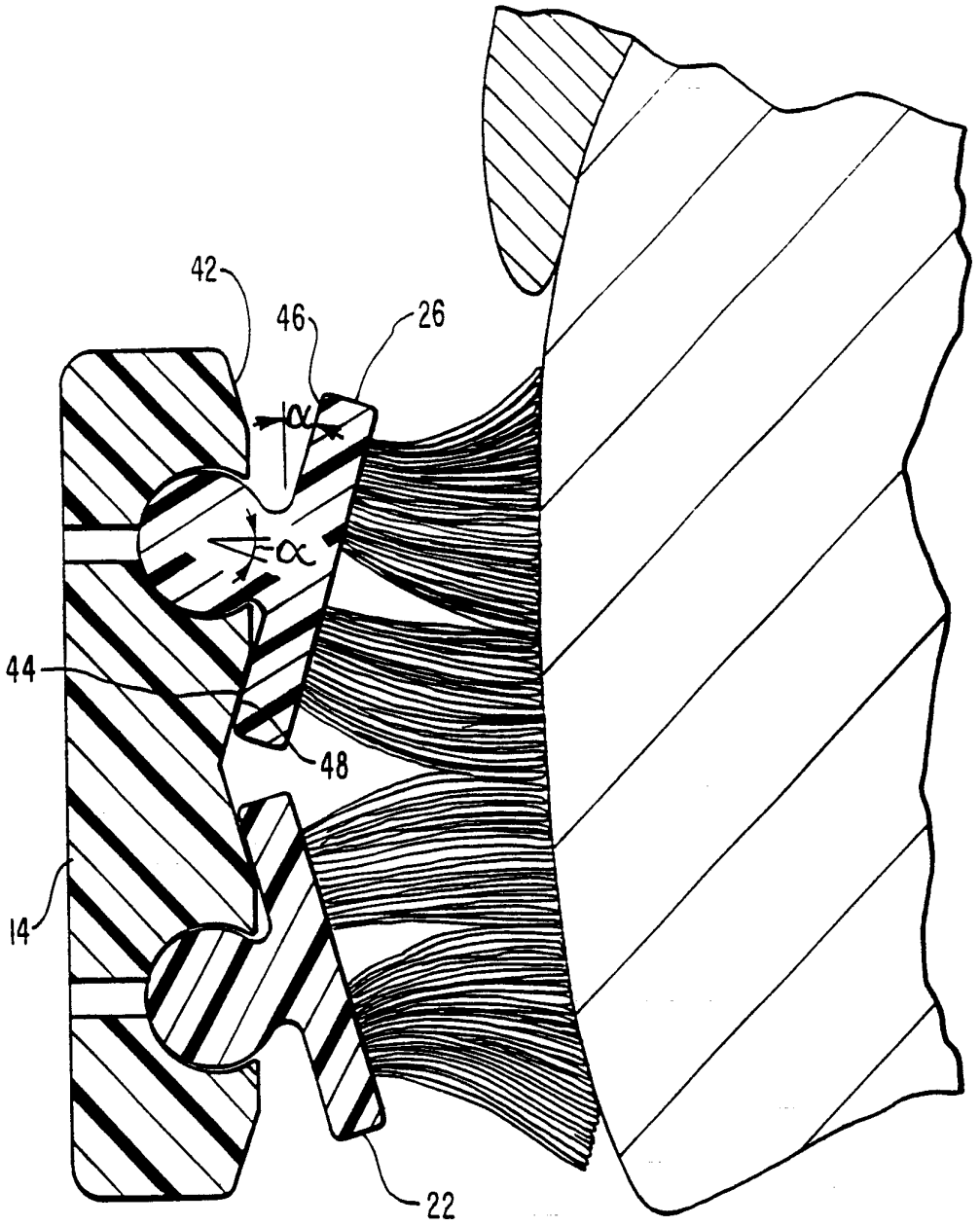

FIG. 4

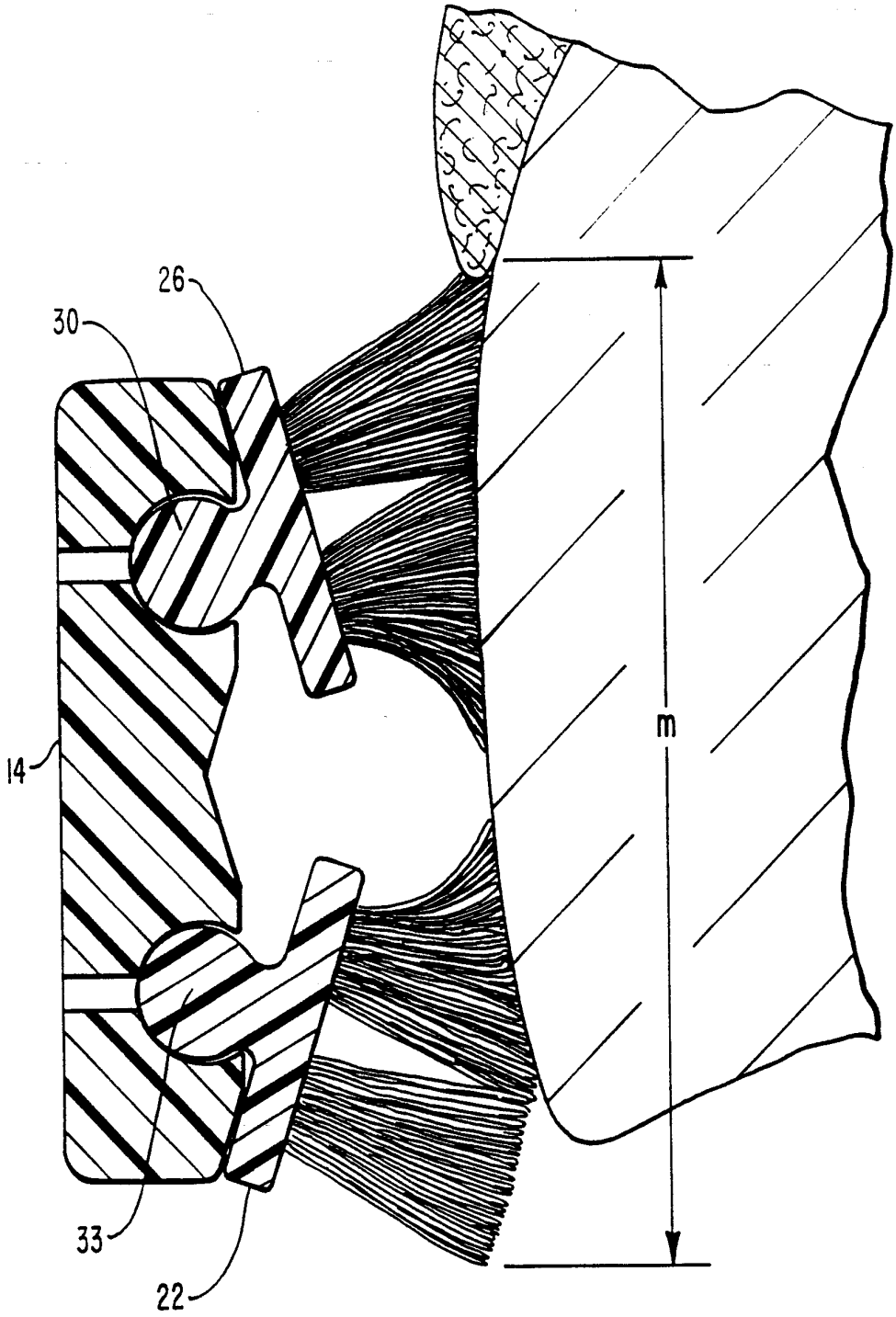

FIG. 5

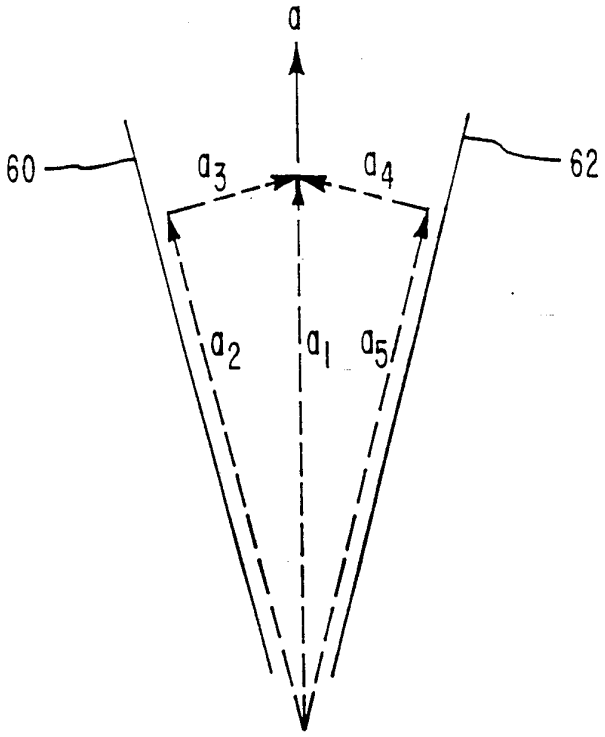

FIG. 6

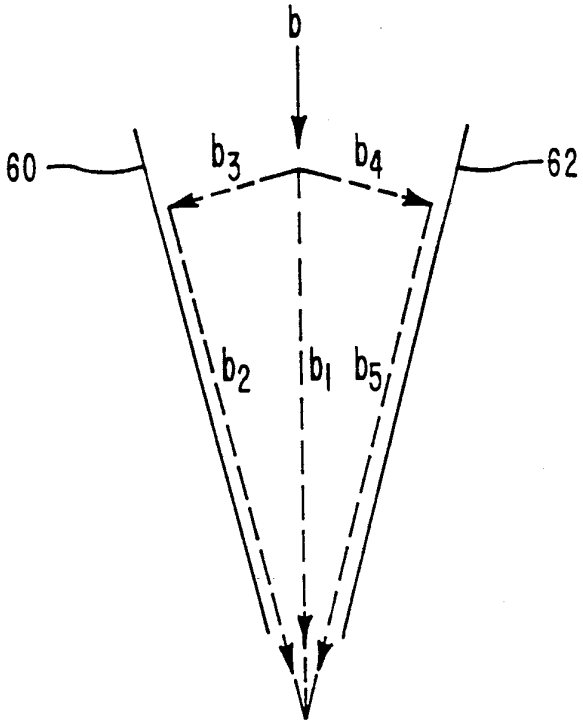

FIG. 7

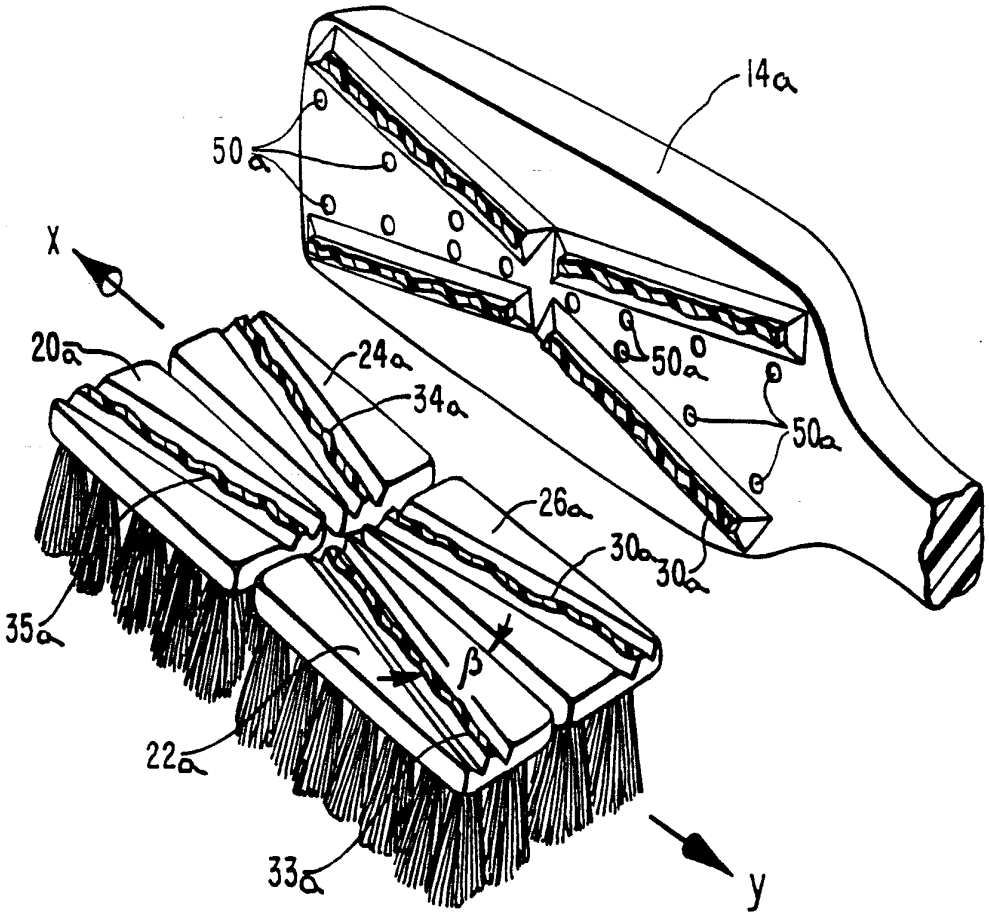

FIG. 8

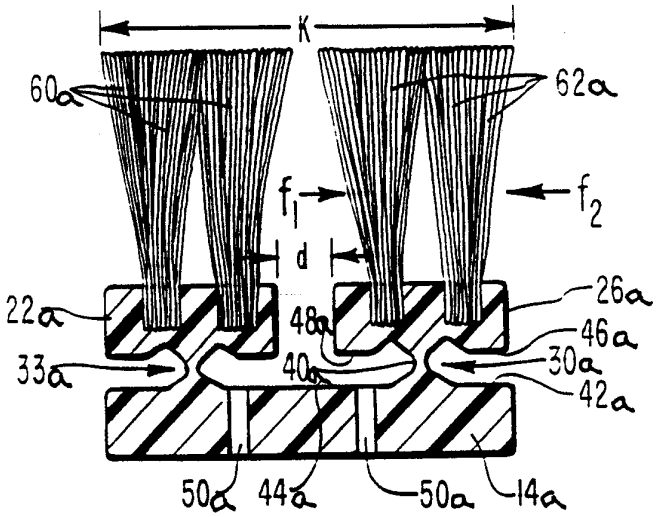

FIG. 9

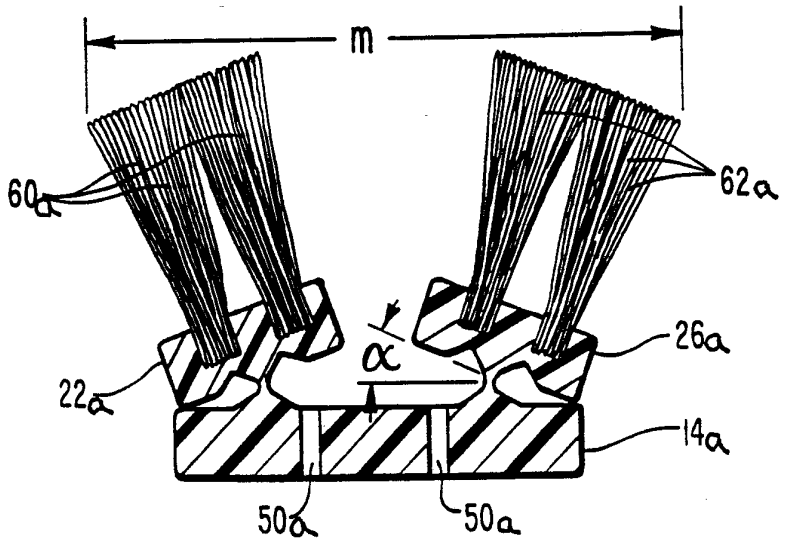

FIG. 10

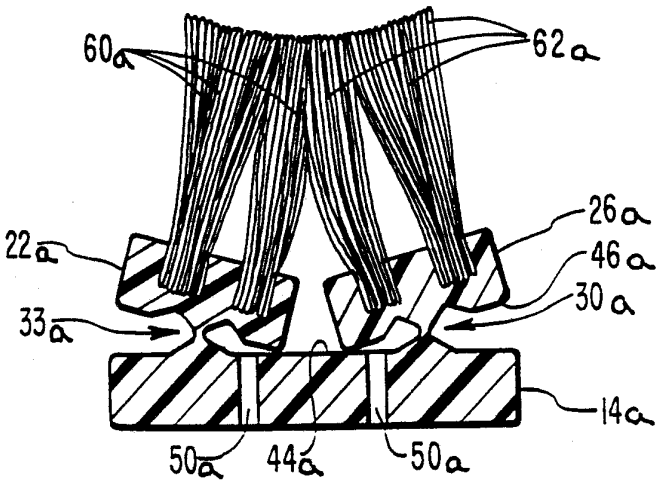

FIG. 11

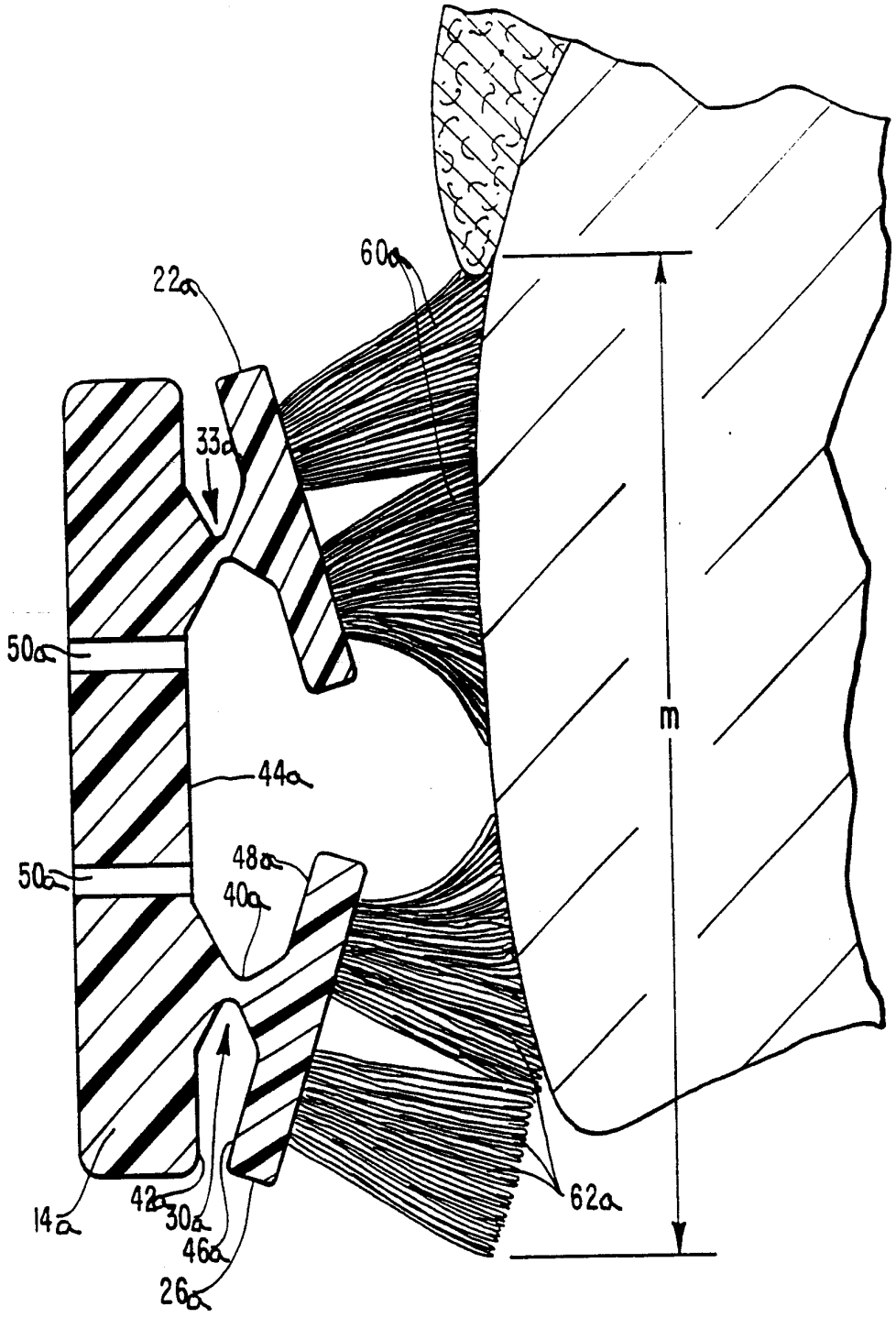

FIG. 12

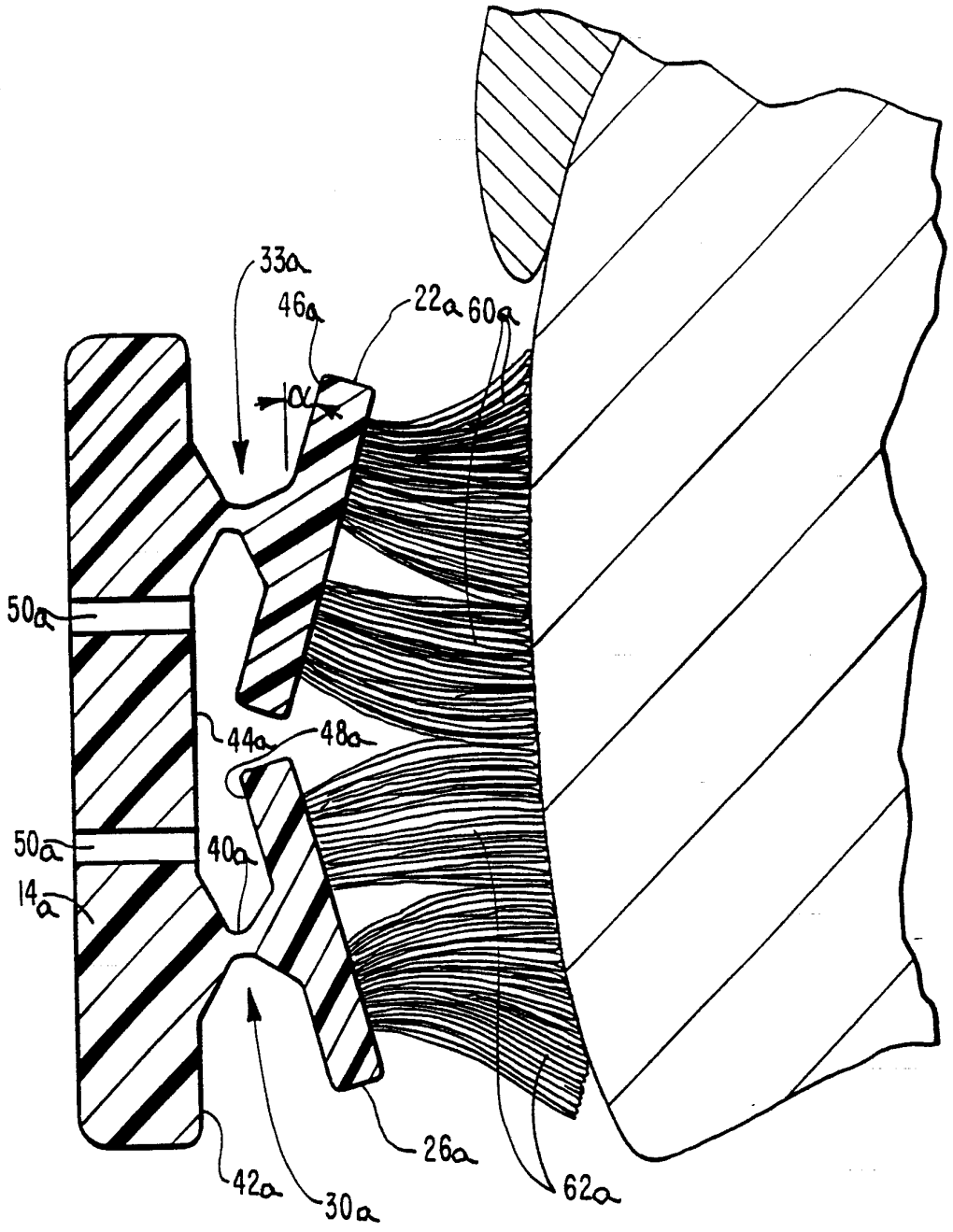

FIG. 13

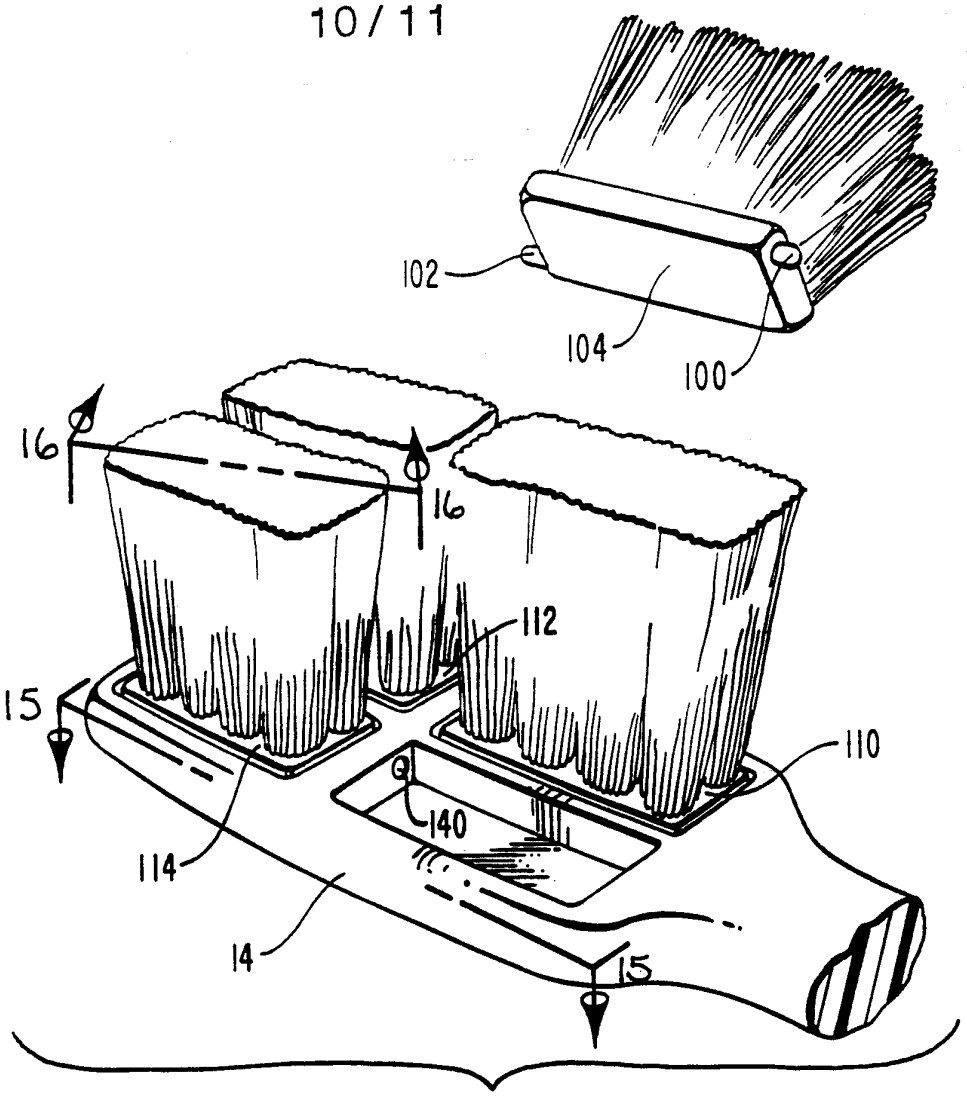
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FIG. 14

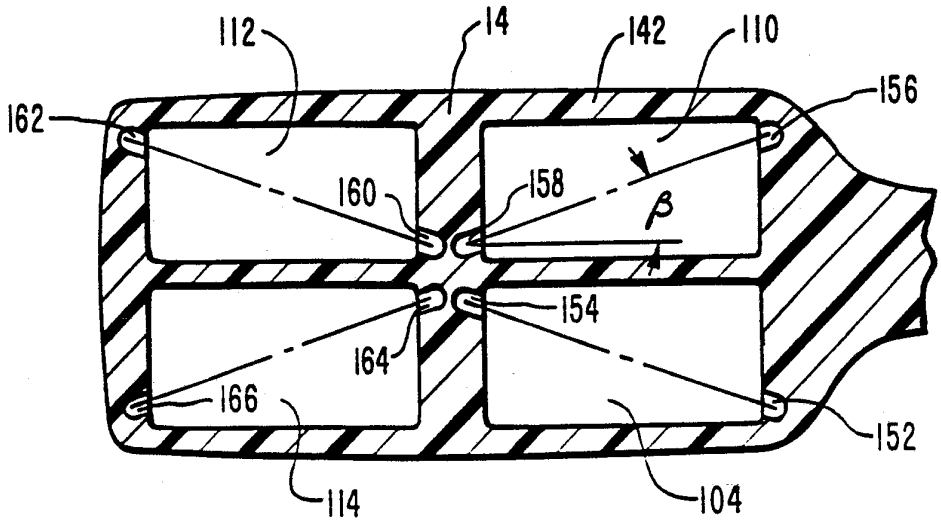
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FIG. 15

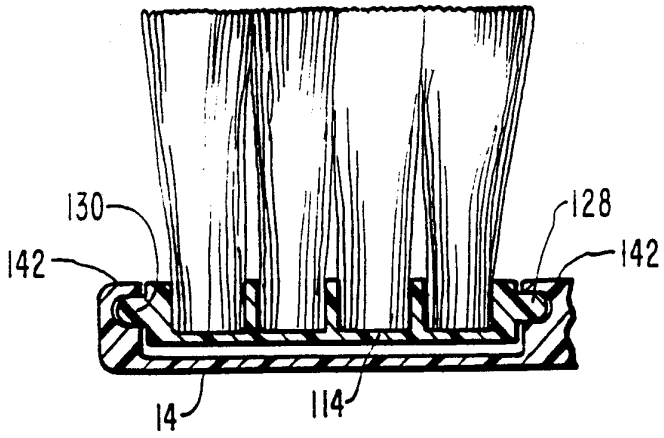

FIG. 16

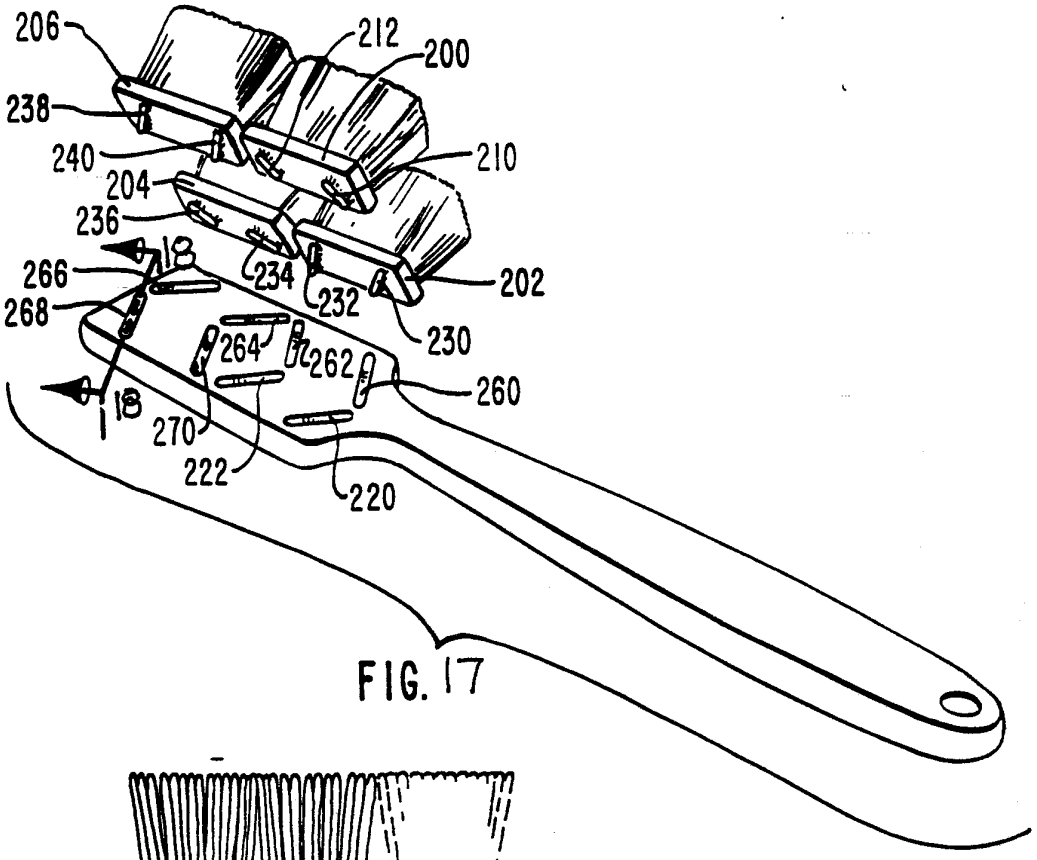

FIG. 17

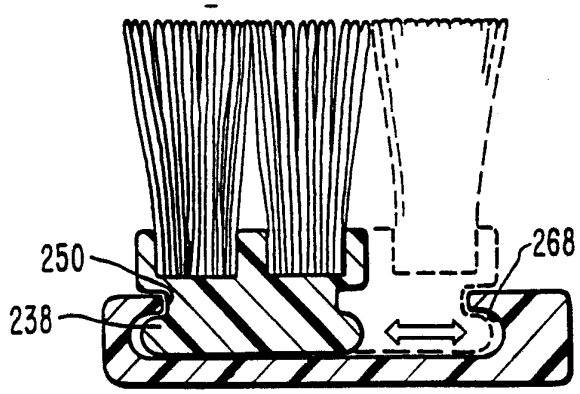

FIG. 18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/02937

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :A46B 9/04
US CL :15/167.1,172,201; D4/105
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)

U.S. : Please See Extra Sheet.

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US,A 2,263,802 (GRUSIN) 25 NOVEMBER 1941 SEE ENTIRE DOCUMENT	1-4,8-11,15-20,28-31 53
X Y	US,A 2,172,624 (ROBERT) 12 SEPTEMBER 1939 SEE ENTIRE DOCUMENT	47-50 5,12,21,26, 27
Y	US,A 3,879,791 (ISLER) 29 APRIL 1975 SEE ENTIRE DOCUMENT	32,33,41,42,43
Y	US,A 2,582,552 (MARCO) 15 JANUARY 1952 SEE ENTIRE DOCUMENT	40
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[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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Date of the actual completion of the international search 28 AUGUST 1992	Date of mailing of the international search report 08 SEP 1992
Name and mailing address of the ISA/ Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE	Authorized officer CHARLES COOLEY Telephone No. (703) 308-0112

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INTERNA ONAL SEARCH REPORT

International application No.
PCT/US92/02937

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Classification System: U.S.

15/106,110,159R,160,176.1-176.6,194,202; 433/141,142; 128/62A; 132/308; 403/331,381,291; 16/223-225,227,260,DIG.13/ D4/104,106-113,119,130,132,134,137