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EP 0663162 A WO 96/09781 A WO 94/09677 A
US 5137039 A

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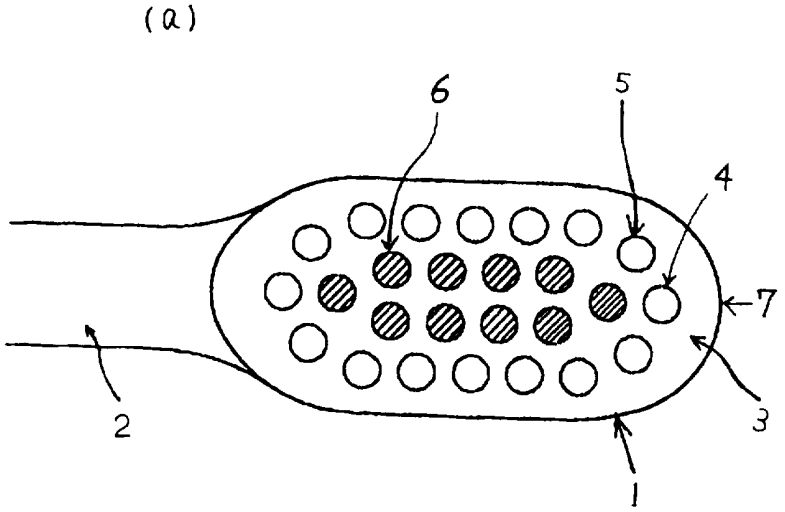
INT CL^6 A46D
Online : WPI

(54) Abstract Title
Toothbrush bristles

(57) A toothbrush head comprises tufts 4, 5 of bristles of polygonal cross-section, and tufts 6 of bristles of sheath-core construction which shows in cross-section as concentric circles. The polygonal bristles enable the cleaning of flat tooth surfaces and gum massage. The sheath-core bristles have a hard core for penetration between teeth and a softer sheath reducing bending. The cross-sections, lengths, profiles, tip shapes and materials of the bristles are extensively described.

Figure 1



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(1)

Figure 1

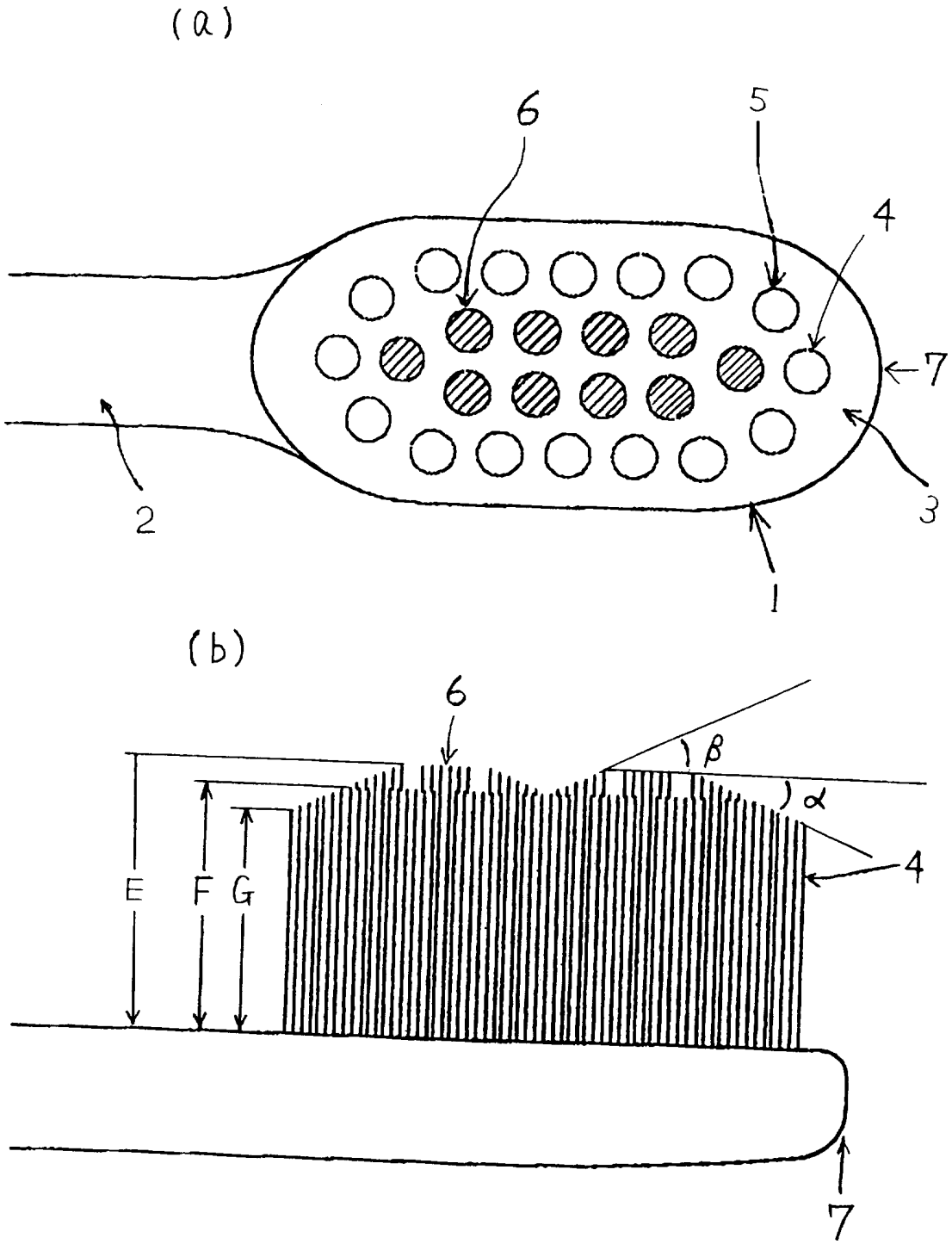


Figure 2

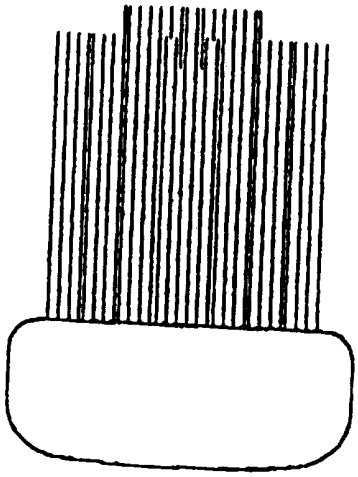
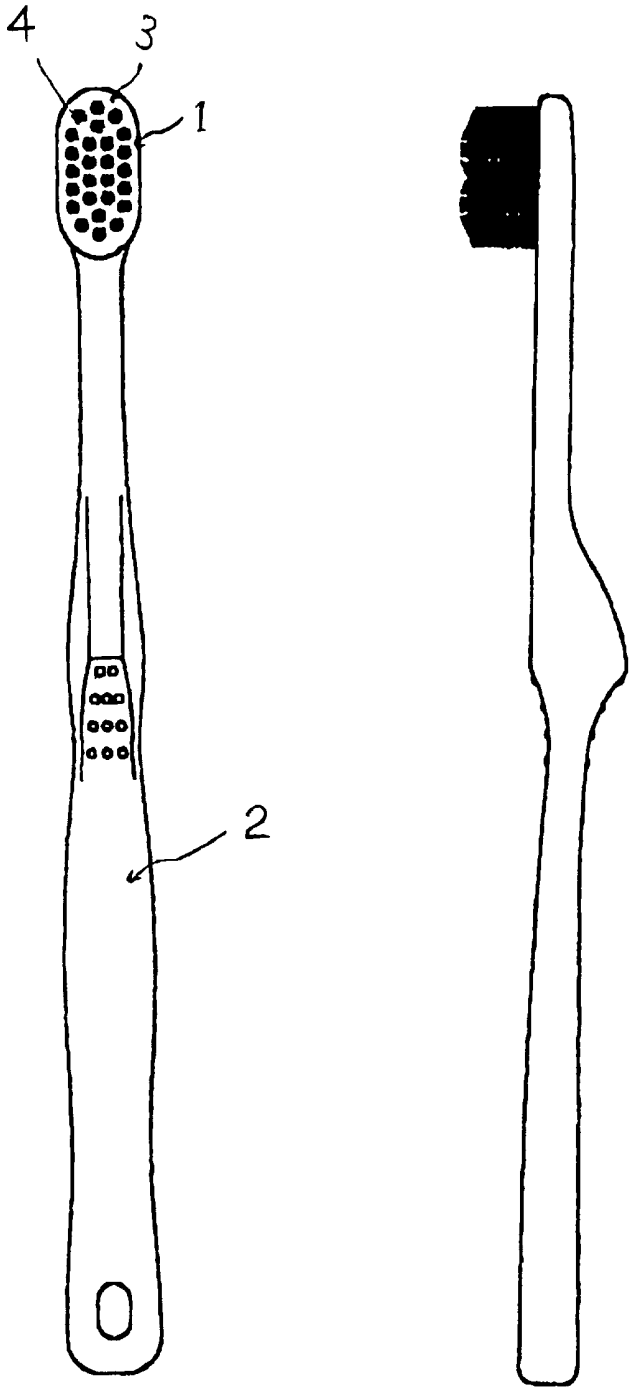


Figure 3



(4)

Figure 4

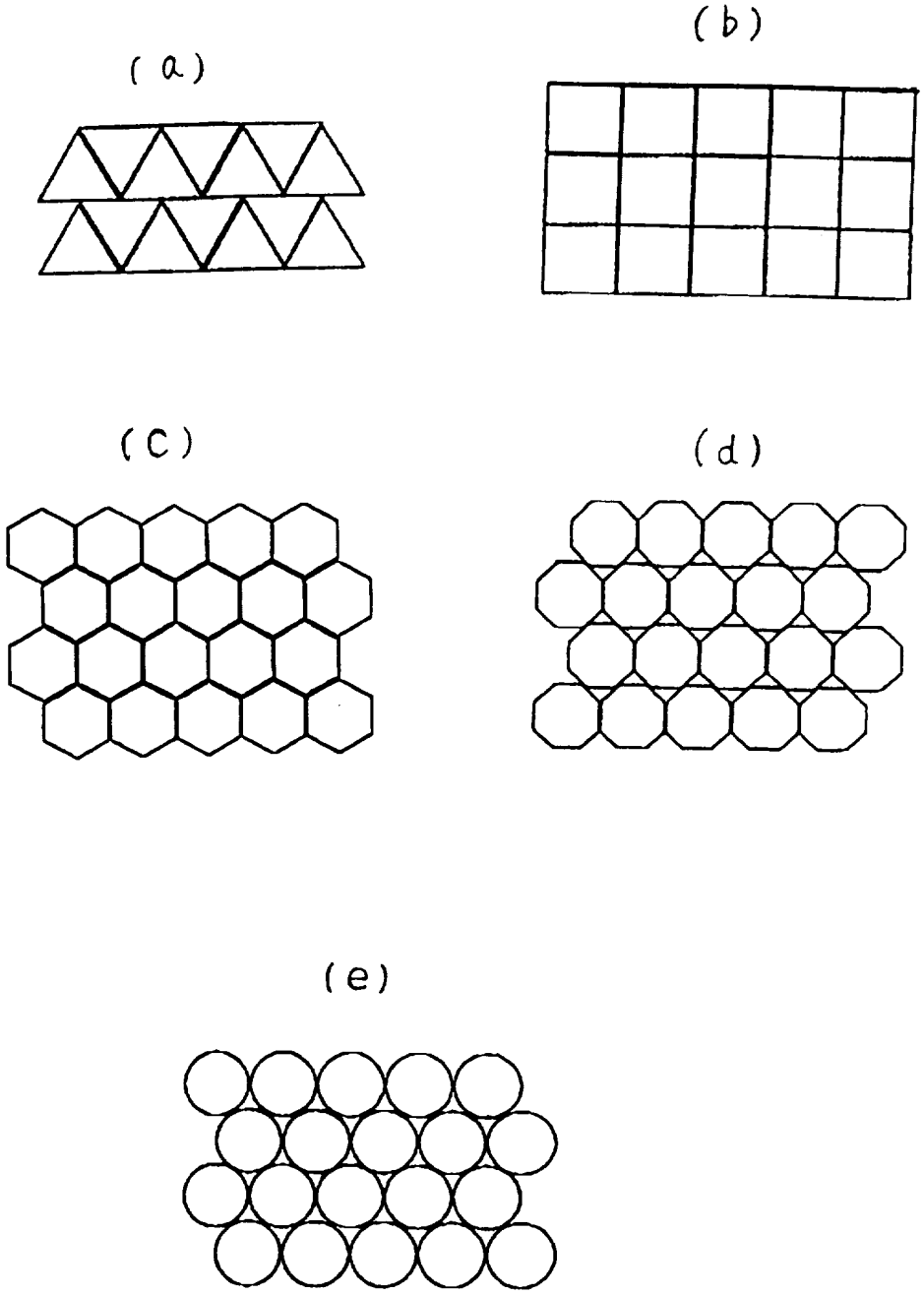


Figure 5

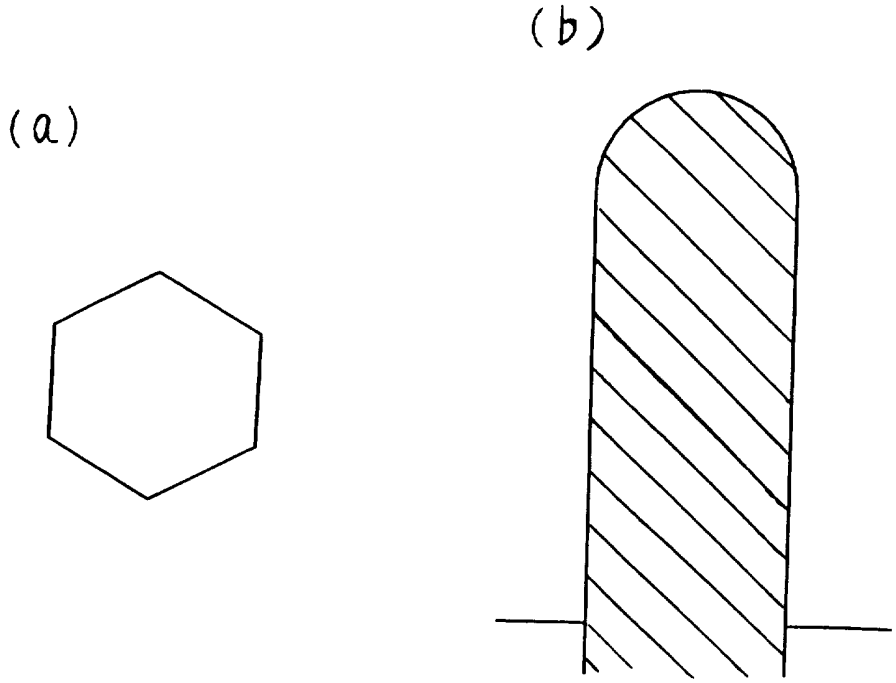
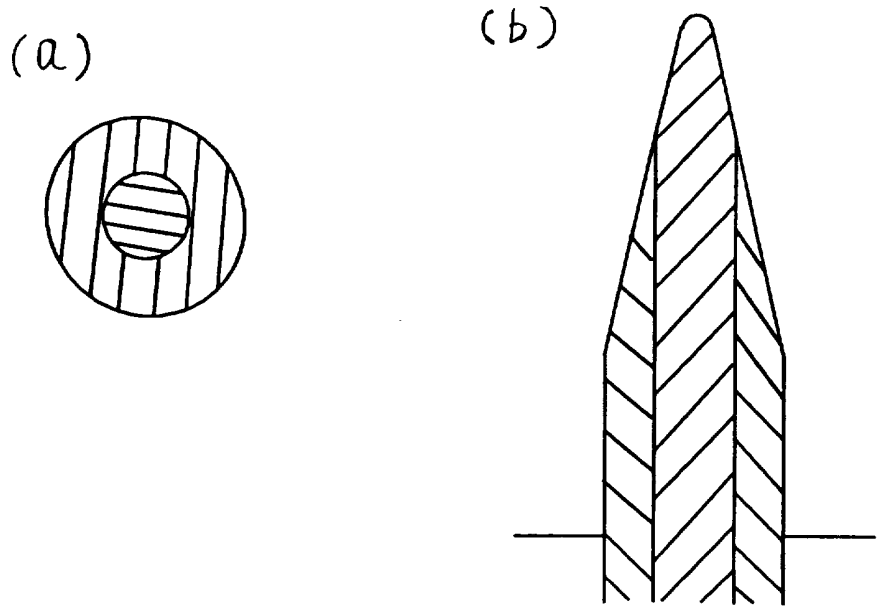


Figure 6



(6)

Figure 7

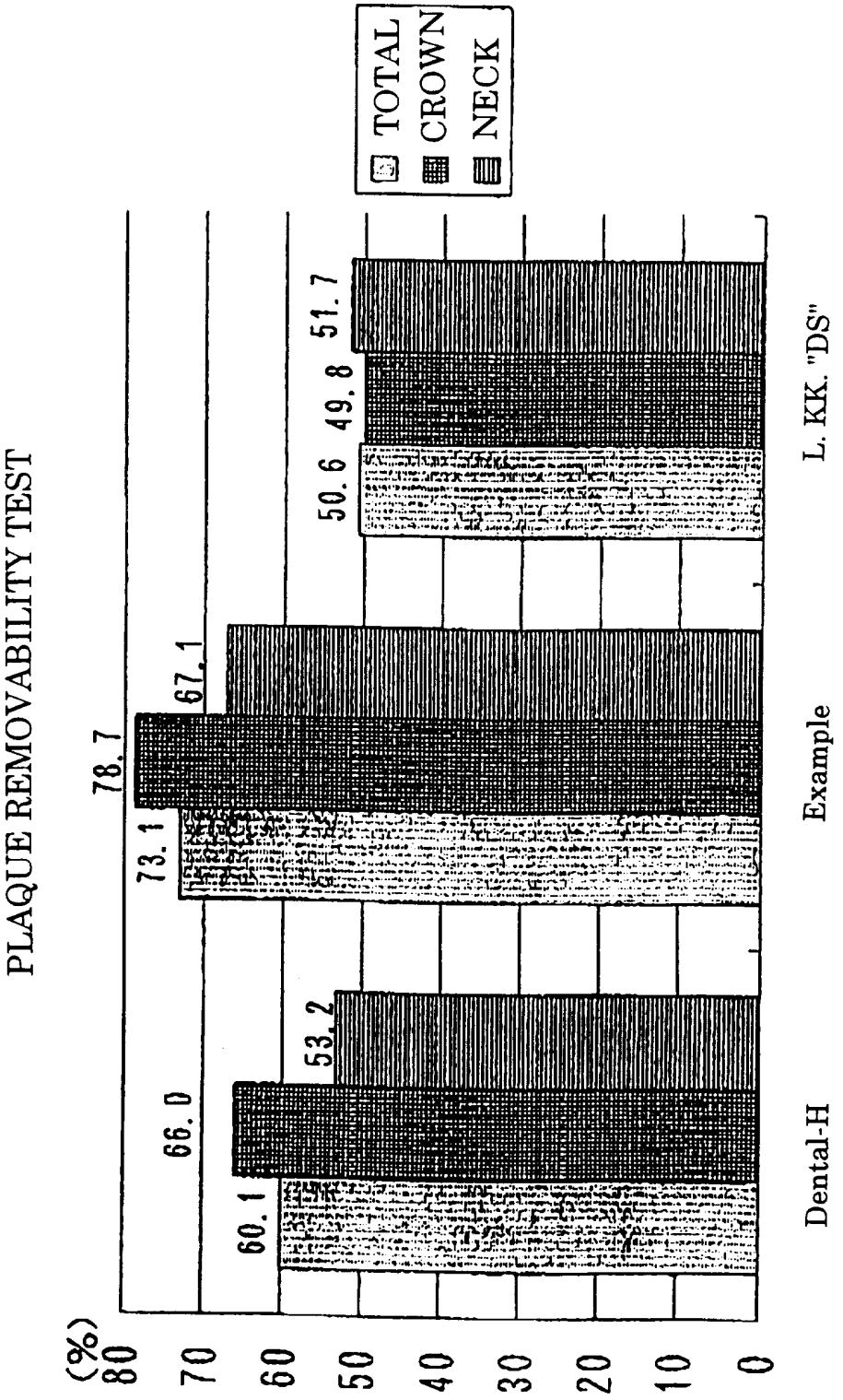

PLAQUE REMOVABILITY TEST
TOTAL
CROWN
NECK
(%)
80
70
60
50
40
30
20
10
0
78.7
73.1
66.0
60.1
67.1
53.2
50.6
49.8
51.7
Dental-H
Example
L. KK. "DS"

Figure 8

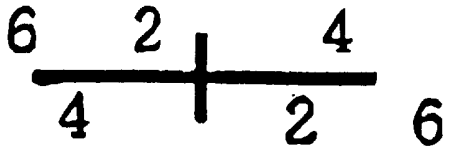
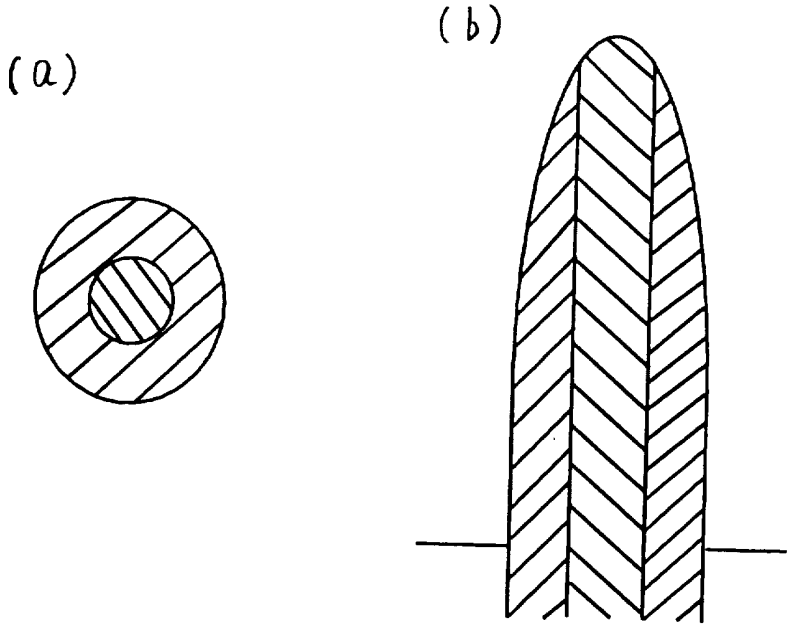


Figure 9



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TOOTHBRUSH

Technical Field of the Invention

This invention aims to provide a toothbrush which can effectively remove by brushing plaque on surfaces such as between teeth or between teeth and gums where plaque is easy to accumulate and at the same time massage gums.

Prior Art

Toothbrushing has become an established custom for public people in everyday lives in recent years. The toothbrushing aims to prevent dental caries, periodontitis and foul breath and to massage gums, and which is widely done using toothbrush. The toothbrushes are used to remove plaque adhered to teeth as well as food residue between teeth and to massage gums as well. For conventional toothbrush filament, mainly monofilament made of uniform resin with round sectional shape has been used. Concerning tip shape of such monofilaments, hemispherical or tapering shape is known. Further toothbrushes are known which uses filaments with only one tip shape or two or more tip shapes for individual tuft and they are embedded in tuft holes on the block head.

Further many kinds of toothbrushes have been further developed, for example, (1) to remove effectively plaque or food residue adhered to tooth surfaces, surfaces between teeth, those between teeth and gums, on molars and so forth, cutting shape of the toothbrush bristles are designed such as flat cut, angular cut (Laid-open Utility Model 106522/87), mountain shape cut (Laid-open Utility Model 82023/91), different level double surface cut, etc. (2) since filament materials which will not hurt teeth or gums and can effectively remove plaque are preferred for toothbrushes, nylon resins are generally used as filament material of bristles, however toothbrushes using polybutylene terephtharate or those using two materials jointly (Laid-open Utility Model 81355/77, Laid-open Utility Model 31837/83), (3) as to thickness of the bristles, to conform to toothbrush bristle

hardness description,"hard", "medium" and "soft" and to remove plaque effectively, toothbrushes using bristles with a same diameter or with two or more diameters (Laid-open Utility Model 121431/89), (4) toothbrushes whose filament tips are hemispherical (Laid-open Utility Model 97923/86) or tapering shapes (Laid-open Utility Model 154/94).

Problems the Invention Aims to Solve

As public interest in oral care grows strong in recent years, to remove effectively plaque which will cause carious teeth or periodontitis, a number of toothbrushes have been developed as shown above. However in the case of toothbrushes whose bristles have all needlelike tapering tips to remove plaque adhered to the surface between teeth and gums, because the bristles near tips becomes too thin and too flexible, the bristle tips lose their stiffness necessary to remove plaque sufficiently, and the purpose of toothbrushes to prevent periodontitis cannot be attained after all.

On the other hand, toothbrushes whose bristle ends being round or hemispherical are suitable to clean flat surfaces of teeth or to massage gums, however it is difficult for such toothbrushes to remove plaque between teeth or in boundary spaces between teeth and gums because the bristle tips are too thick to enter such boundary spaces to remove plaque therein. That is, it is difficult for conventional toothbrushes having bristles with same tip shape or those with different tip shapes being uniformly mixed to clean up in every nook and corner in the mouth.

Means to Solve the Problems

This invention provides a toothbrush effective regardless of toothbrushing method or technique to prevent carious teeth or periodontitis which can more easily and effectively clean up in every nook and corner in the mouth than conventional ones, that is, the toothbrush can remove plaque and food residue adhered to surfaces between teeth, between teeth and gums and occlusal surface and give a proper stimulus to gums by massaging to quicken the circulation of the blood.

In the drawings, Figure 1(a) illustrates a plan view of a block

head of a toothbrush in accordance with the present invention and Figure 1(b) a side view thereof. Figure 2 illustrates a front view of brush portion and a block head of a toothbrush in accordance with the present invention. Figure 3(a) illustrates a plan view of a toothbrush in accordance with the present invention, and Figure 3(b) a side view thereof. Figure 4(a) to (d), each illustrates a portion of sectional view showing condition polygonal filaments being densely embedded, that is, Figure 4(a) shows a trigonal filament, (b) a tetragonal filament, (c) a hexagonal filament and (d) a octagonal filament, and Figure 4(e) illustrates the condition of conventional filaments having round cross section. Figure 5(a) illustrates a cross section of a hexagonal filament and Figure 5(b) longitudinal section. Figure 6(a) illustrates a cross section of a sheath-core structural filament and Figure 6(b) longitudinal section. Figure 7 shows bar graphs summarizing results of plaque removability test. Figure 8 illustrates positions of teeth which plaque removability is evaluated in the test for plaque removability. Figure 9(a) illustrates a cross section of another example than Figure 6 of a sheath-core structural filament whose thickness smoothly reduces from the root portion having constant thickness toward the tip, and Figure 9(b) longitudinal section thereof.

Embodiment of the Invention

The present invention relates to a toothbrush whose bristles composed of filaments with polygonal cross section being densely embedded along the periphery of the block head. Using the filaments with polygonal section makes it possible to clean up effectively flat surfaces of teeth and give a proper massage effect to gums by utilizing its angular shape of the polygon. When the polygonal filaments are arranged along the periphery of the block head in particular, above effects can be obtained without making every filament polygonal because the angular shape of the side of the filament will work effectively. Further the polygonal filament can be arranged densely in the limited narrow space.

In the present invention the sectional shape of the polygonal filament can be any polygons such as trigon, tetragon, pentagon, hexagon, octagon, and so forth, in particular, polygons such as

trigon, tetragon, pentagon, hexagon, octagon, and so forth which are angular and do not form space when they are embedded are preferred, and more preferred is hexagon because hexagon has many angles and can form honeycomb-like structure. The tip of the polygonal filament is preferably round or hemispherical shape. By making the tip hemispherical, better gum massaging effect is provided.

The polygonal filament of the present invention can be produced by any known methods and can be easily obtained from du Pont under the trademark of "Tynex" hexagonal filament.

The material of the polygonal filament can be, for example, nylon, polyethylene terephthalate and polybutylene terephthalate, however the material is not limited thereto.

The thickness of the polygonal filament is not in particular restricted, however 0.1 to 0.5mm in maximum dimension is preferred and 0.13 to 0.3mm in maximum dimension is more preferred.

The tip of the polygonal filament is preferably processed into round shape or hemispherical shape. The process can be done either before or after tuft embedment. This process can be performed by, for example, filament tip rounding treatment however is not limited thereto.

Another characteristics of the present invention is to embed sheath-core structural filament which having sheath material being arranged around the core material so that the cross section is concentric circles where the material of the core is different from that of the sheath. Such a sheath-core structural filament can exert respective functions of the sheath and core materials because of the difference of their physical properties. That is to say, when the tip of the sheath-core structural filament is processed to a tapering or circular cone shape, a harder core material of the filament tip can effectively clean up surfaces between teeth, boundary surfaces of teeth and gums and occlusal surface. And a softer material of the sheath prevents bending of the harder core material and further facilitates the tip to reach and go into uneven portion of the surface between teeth, boundary surface of teeth and gums and occlusal surface. When such sheath-core structural filament is embedded in

central section of the block head, above-said effects can be given if not making all filaments sheath-core structure. In the present invention, the tapering shape or circular cone shape includes, as shown in Figure 9, the shape whose diameter smoothly decreases from the root portion having constant diameter toward the tip without forming an edge such as an ellipsoid of revolution as well as the shape forming an edge between the root portion and the circular cone portion such as the shape shown in Figure 6.

Material of the sheath-core structural filament can be, for example, polyamides such as nylon; polyesters such as polyethylene terephthalate and polybutylene terephthalate, however is not limited thereto. It is preferable to use a harder material for the core than the sheath. Such combination can be, for example, polyesters especially polybutylene terephthalate for the core and polyamides especially nylon for the sheath.

The sheath-core structural filament of the present invention can be produced by any known methods.

The tip of the sheath-core structural filament is preferably processed into tapering shape or circular cone shape. The process can be done either before or after tuft embedment. This processing can be performed by, for example, filament tip rounding treatment however is not limited thereto.

The embedding method of tufts composed of such filaments is not particularly restricted. Materials of the block head, neck portion and handle of the toothbrush in this invention are not particularly limited however can be nylon, polyethylene terephthalate, polybutylene terephthalate, polyimides, polycarbonates, polyacetal, ABS (Acrylonitrile-Butadiene-Styrene copolymeric resin), etc.

The inventors have unexpectedly found that by embedding the two kinds of filaments on a block head, the effects of both filaments are not canceled each other instead both filaments exerts their respective functions synergistically. To enhance such effects, It is preferred that bristles of polygonal filament are embedded in outer line of tuft holes on said block head and the sheath-core structural bristles are embedded in central section of the block head.

Tufts of the sheath-core structural filament and those of the polygonal filament of the toothbrush preferably form 3 to 6 lines, in particular 3 to 5 lines, lined in width direction of the block head. Less than 3 lines, effect of using the polygonal filament and the sheath-core structural filament jointly cannot be attained. More than 6 lines are not preferred because of the difficulty of tuft embedment and the block head must be widened.

The bristle lengths of the outermost lines are preferably shorter than those of the other inner lines, which is one to three or four lines. Thereby plaque on the surfaces between teeth or between teeth and gums can be effectively removed. Further the bristles of the inner liners are cut to form continuous six or more cut surfaces lined in the longitudinal direction. Thereby it is possible to adjust performance of plaque removal to dentition.

Brief Description of the Drawings

Figure 1 a block head of a toothbrush of the present invention;

Figure 2 a block head and a brush portion of the toothbrush;

Figure 3 whole shape of the present toothbrush;

Figure 4 sectional views of some examples of polygons of polygonal filaments densely embedded;

Figure 5 cross and longitudinal sections of hexagonal filament;

Figure 6 cross and longitudinal sections of sheath-core structural filament;

Figure 7 bar graphs of plaque removability test results;

Figure 8 teeth position subjected to the plaque removability test;

Figure 9 another cross and longitudinal sections of sheath-core structural filament.

In the Figures, the following reference symbols are used:

1●●●●●block head, 2●●●●●handle, 3●●●●●block head surface, 4 and 5●●●●●tufts of polygonal filaments, 6●●●●●tuft composed of sheath-core structural filament, 7●●●●●brush end, α●●●●●angle of the first cut surface to the block head surface, β●●●●●angle of the third cut surface to the block head surface.

Referring now to Figure 1, in said six cut surfaces of the toothbrush, the bristles of the first cut surface nearest to the brush end are preferably cut so that the brush end bristle is shortest and the bristles lengthen toward the handle at an angle to the block head surface of 15° to 50° at the brush end, preferably 20° to 30°, then at the first to third bristle row from the brush end, preferably the third row, replaced without difference in level by second cut surface which forms the first top horizontal cut surface.

The bristles of the third cut surface continuing from the second cut surface become short from the handle side of the second cut surface at an angle 15° to 50° to the block head surface, preferably 20°to 30°, to form the bottom at the third to sixth row from the brush end, preferably between fourth and fifth row. The bottom can be, for example, a cross line of the third cut surface and fourth cut surface and a flat plane or curved plane formed between the third cut surface and fourth cut surface approximately parallel to the block head surface.

The fourth, fifth and sixth cut surfaces can be symmetrical to the first, second and third cut surfaces about the perpendicular plane including the block head and said bottom line as shown in Figure 1(b), however are not restricted thereto and their longitudinal length can _____

be changed. In such cases, the bristle lengths of the fourth cut surface preferably corresponds to those of the third cut surface, likewise the fifth to the second and the sixth to the first.

The ratio of the height of the top horizontal cut surface: E to the height of the bottom: F is; E/F=1.05 to 1.2, and the ratio of the height of the top horizontal cut surface: E to the height of lowest part of first cut surface: G is; E/G=1.1 to 1.3. By adopting the ratio in such range, high plaque removability is realized.

The bristle lengths of the tufts embedded outer lines are not restricted in particular as far as above said conditions are satisfied, however the surface formed by tips of the bristles embedded outer lines is preferably parallel to the block head surface and the bristle length thereof is about the same as that of the bottom.

Preferably the bristle length of the first top horizontal cut surface is substantially the same as that of the second top horizontal cut surface.

In the present invention, tufts lined in a width direction of the block head embedded densely outermost lines or along the periphery of the block head effectively clean up the flat surface of teeth and massage gums owing to the effect of the sharp angular filament. The hard material of the filament core having circular cone shape tips in the central section of the block head and enclosed with the polygonal filament bristles or sandwiched between the two outer lines of polygonal filament effectively clean up the surfaces between teeth, boundary surfaces between teeth and gums and occlusal surface, the soft material of the sheath prevent bending of the hard material of the core to facilitate the tip to reach the surfaces between teeth, boundary surfaces between teeth and gums and occlusal surface. That is to say, by embedding two kinds of filaments having different tip shapes at appropriate areas on the block head where respective functions and effects can be realized and by adopting cutting shape of bristles conforming to dentition, the toothbrush can easily and effectively clean up in every nook and corner in the mouth.

The toothbrush of the present invention has excellent durability

and the bristles of polygonal filament having round tip effectively remove plaque adhered to flat surfaces of teeth while massaging the gums during toothbrushing. Further tufts of sheath-core structural filaments having circular cone shape tips in the central section of the block head and surrounded by the polygonal filament tufts or sandwiched between two outer lines of polygonal filament tufts freely reach the surfaces between teeth, boundary surfaces between teeth and gums and occlusal surface and effectively remove plaque adhered thereto without harming teeth or gums.

Examples

The present invention will be illustrated according to Examples. In Figure 1, a number of tufts including the tufts 4 and 5 composed of hexagonal filament having round-shaped tip capable of being densely embedded owing to the sectional shape are embedded along the periphery of the block head 1. A number of tufts including tuft 6 composed of sheath-core structural filament surrounded by said hexagonal filament tufts including 4 and 5 are embedded in the central portion of the brush. The bristle length of the hexagonal filament tufts does not exceed those of the sheath-core structural filament tufts embedded in the central section of the brush made of two different materials so that the cross section becomes concentric circles. Further, the tufts of the sheath-core structural filament including tufts 6 in Figure 1(b) are cut to form six cut surfaces arranged in longitudinal direction of the brush. And after cutting the tufts including tuft 6, the tips of the hexagonal filament bristles including those of tufts 4 and 5 were processed to round shape and the tips of the sheath-core structural filament bristles including those of tuft 6 were processed to tapering shape or circular cone shape.

【0017】

The hexagonal filament in the Example was 7.8 mil (0.2mm) in dimension made of nylon formed by extrusion molding.

The bristle length of the hexagonal filament in the Example was uniformly 10mm. The core material of the sheath-core structural filament was polyethylene terephthalate, sheath material thereof was polyamide and the filament diameter was 0.2mm.

Cutting shape of the sheath-core structural filament was shown in Figure 1(b). After cutting, the tips of the polygonal filaments were rounded to hemispherical shape. Further the tips of the sheath-core structural filaments were processed to tapering shape or circular cone shape.

Test for plaque removability evaluation

Test method:

The test for plaque removability was performed using a toothbrush shown in Figure 3 made according to the Example and as control examples an article on the market A (Dental-H (trademark) from Johnson & Johnson K.K.) and an article on the market B ("DS" toothbrush from L. K.K.) as follows:

30 subjects were selected having healthy gums and recognized no gum involution or irregular dentition and having more than 20 teeth to be tested except for prosthetic teeth and dental caries in the mouths.

The teeth to be tested were scaled and polished seven days before the test started and the tooth condition was plaque-scored as 0. Then toothbrush to be tested was designated for each subject and subjects were taught how to brush teeth. All the oral care was stopped before 24 hours from the time test started and evaluated the plaque accumulating condition. After the evaluation, subjects started brushing using designated toothbrush under investigation of the evaluator, and thereafter the brushing plaque accumulating condition was measured. The same procedure was performed for the other two toothbrushes, and evaluations were done once a week.

The test order of toothbrush for each subject was changed considering learning of the brushing method of subjects.

The plaque accumulating condition was evaluated by dyeing liquid PROSPEC(GC Company) dye according to Plaque Control Record (O'Lreary 1978, PCR). For the testing positions, teeth in the mouth were divided into six sections inside surface and outside surface respectively considering plaque distributing parts (neighboring surface, neck portion of teeth 1/3) as shown Fig. 8, that is, the

second and sixth teeth left side from the center of upper jaw, the fourth tooth right side therefrom, and the fourth tooth left side from the center of lower jaw, the second and sixth teeth right side therefrom.

Information as to hurting of gums, handlability, etc. was gathered by questionnaires. Brushing method was according to scrubbing method, 6 sections for outer tooth surfaces, 5 sections for inner tooth surfaces were at least brushed, and brushing was done at least ten times for each section and for five minutes a mouth.

Test results:

The results were shown in Table 1 and Figure 7. The toothbrush of the present invention showed excellent plaque removability in the evaluations as to crown and neck of teeth as well as total evaluation.

Effect of the Invention

In the present invention, tufts of polygonal filament having round tip lined in a width direction of the block head embedded densely both outermost lines or along the periphery of the block head effectively clean up the flat surface of teeth and massage gums due to the cross sectional shape of the filament, and the hard material of the filament cores having circular cone ends embedded in the central section of the block head and surrounded by the polygonal filament tufts or sandwiched between the two outer lines of polygonal filament tufts effectively clean up the surfaces between teeth, boundary surfaces between teeth and gums and occlusal surface, the soft material of the sheath prevent bending of the hard material of the core to facilitate the tips to reach the surfaces between teeth, boundary surfaces between teeth and gums and occlusal surface. That is to say, by using two kinds of filaments having different tip shapes and embedding them at appropriate portion on the block head where respective function and effect can be realized and by adopting cuttings of the bristles conforming to dentition, the toothbrush can easily and effectively clean up in every nook and corner in the mouth.

Table 1

	Dental-H	Example	L. KK. "DS"
TOTAL	60. 1	73. 1	50. 6
CROWN	66. 0	78. 7	49. 8
NECK	53. 2	67. 1	51. 7

Claims

1. A toothbrush comprising a block head having brush portion composed of tufts embedded on the block head, a handle and a neck portion connecting said block head with the handle, wherein a part of said tufts embedded to form brush portion are made up of filament with polygonal cross section, and the rest of the tufts embedded are made up of sheath-core structural filament whose core material is covered with sheath material so that the cross section thereof is concentric circles.

2. The toothbrush according to claim 1 wherein said tufts of polygonal filament are embedded in tuft holes which mainly forms outer line of tuft holes on said block head, and tufts of the sheath-core structural filament are embedded in the rest of tuft holes.

3. The toothbrush according to claim 1 or 2 wherein said tufts of polygonal filament are embedded in tuft holes along periphery of said block head and tufts of the sheath-core structural filament are embedded in the rest of tuft holes so that the polygonal filament tufts surround the sheath-core structural filament tufts.

4. The toothbrush according to any one of claims 1 to 3 wherein said polygon of the polygonal filament is trigon, tetragon, pentagon, hexagon or octagon.

5. The toothbrush according to any one of claims 1 to 4 wherein said polygon of the polygonal filament is hexagon.

6. The toothbrush according to any one of claims 1 to 5 wherein said core part of the sheath-core structural filament is made of polyester resin and said sheath part thereof is polyamide resin.

7. The toothbrush according to any one of claims 1 to 6 wherein the tips of the sheath-core structural filaments have a circular cone shape and the points thereof are made of polyester resin, and the tips of said polygonal filaments have a round shape.

8. The toothbrush according to any one of claims 2, 4, 5, 6 and 7 where the tufts of sheath-core structural filaments, those of polygonal filaments and bristles thereof comprising:

a) said tufts forming three to six lines lined in width direction of the block head,

b) the bristle lengths constructing both outermost lines are shorter than those of the other inner lines of tufts,

c) the bristles of said inner lines being cut so as to form continuous six or more cut surfaces lined in longitudinal direction of the toothbrush.

9. The toothbrush according to claims 1 where the tufts of sheath-core structural filaments, those of polygonal filaments and bristles thereof comprising:

a) said tufts forming three to five lines lined in width direction of the block head,

b) the bristle lengths constructing both outermost lines are shorter than those of the other inner one to three lines of tufts,

c) the bristles of said inner lines being cut so as to form continuous six cut surfaces lined in longitudinal direction,

d) in the cut surfaces, the bristles of the first cut surface nearest to the brush end being cut so that the brush end bristles are shortest and the bristles lengthen toward the handle at an angle from the block head surface of 20° to 30° at the brush end to be replaced by the second cut surface which forming the first top horizontal cut surface at the third bristle row from the brush end without difference in level,

e) the bristles of the third cut surface continuing from the second cut surface become short from the handle side of the second cut surface at an angle 20° to 30° to the block head surface to form the bottom at fourth or fifth row from the brush end,

f) the fourth, fifth and sixth cut surfaces are symmetrical to the first, second and third cut surfaces about the perpendicular plane including the block head and said bottom line,

g) the ratio of the height of the top horizontal cut surface: E to the height of the bottom: F is; E/F=1.05 to 1.2,

h) the ratio of the height of the top horizontal cut surface: E to the height of lowest part of the first cut surface: G is; E/G=1.1 to 1.3 and,

i) the surface formed by the tips of the bristles embedded outer rows is parallel to the block head surface and the bristle length thereof is about the same as that of the bottom.

10. The toothbrush according to any one of claims 1 to 9 where the

bristle lengths of the first and second top horizontal cut surfaces are substantially the same.

11. A toothbrush substantially as hereinbefore described with reference to the drawings.

The Patent Office

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Application No: GB 9811134.7 **Examiner:** G WERRETT
Claims searched: 1-11 **Date of search:** 27 July 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): A4K.

Int Cl (Ed.6): A46D.

Other: Online : WPI.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 0663162 A1	(PROCTER) see e.g. page 2, line 35 on.	1.
X	WO 96/09781 A1	(LOCILENTO) see e.g.page 3, line 19 on.	1.
X	WO 94/09677 A1	(GILLETTE) see e.g.page 12, line 23.	1.
X	US 5137039	(KLINKHAMMER) see e.g. Col. 20, ll 15-66.	1.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.