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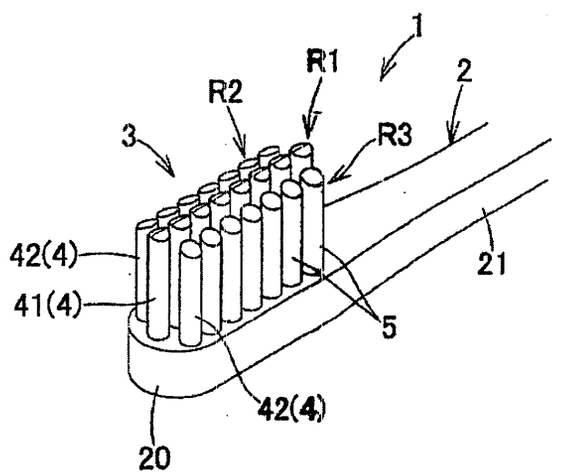
(54) TOOTH BRUSH

(57) A tooth brush which is excellent in durability and can give a high massaging effect to a person even with weak gum with a low stimulus and without damaging the gum in various tooth brushing methods, especially in a Bass method. The toothbrush comprises bristles (4) tufted on an toothbrush head (20), wherein thermoplastic elastomer bristles (41, ----) are tufted in the inner portion (R1) in a width direction of the toothbrush head (20) and synthetic resin bristles (42, ----) harder than the thermoplastic elastomer bristles are tufted in the both outer portion (R2, R3) in a width direction of the toothbrush head (20) respectively. Especially, each tuft (5) tufted on the toothbrush head (20) is so trimed that bristles (4) are continuously or stepwise shorter from the inner portion to the outer portion in the width direction

Fig. 1



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Description

Technical Field

[0001] The present invention relates to a toothbrush.

Background Art

[0002] Conventionally, a toothbrush has been proposed in which soft bristles, such as polyester thermoplastic elastomer, are tufted in outer portion in the width direction of a toothbrush head of the toothbrush and hard bristles, such as nylon, are tufted in an inner portion in the width direction of a toothbrush head of the toothbrush and which provides a massaging effect to the gum by the outer soft bristles at the outer portion, while maintaining a cleaning effect by the hard bristles at the inner portion mainly in the case of horizontal brushing method (rolling-stroke method) (e.g., Patent Documents 1 and 2).

[0003] There are various brushing methods, such as a scrubbing method and a Bass method, in addition to the rolling-stroke method. Thus, it is necessary to employ the various methods while combining the advantages of each method. In particular, the Bass method refers to a method of finely vibrating a toothbrush while tilting the toothbrush by 45° angle to the gum line, and is a cleaning method having a relatively high cleaning effect in the dental grooves where a dental plaque is easily accumulated. However, when the above-described toothbrush is applied, the hard bristles at the inner portion damage the gum. Thus, the above-described toothbrush cannot be used for persons with weak gum.

[0004] Moreover, although the above-described toothbrush can massage the gum by the soft bristles at the outer portions when horizontally brushed, such soft bristles are spread out in a short period of time in the course of using, giving a problem with durability.

[0005]

Patent-Document 1: Japanese Examined Utility Model Publication No. 6-12647
Patent Document 2: Japanese Unexamined Patent Application Publication (Translation of PCT Application) No. 2002-514946

Disclosure of the Invention

Technical Problems to be Solved

[0006] In view of the above-described circumstances, the present invention aims to provide a toothbrush which gives a high massaging effect to persons with weak gum while reducing the stimulus and not damaging the gum in various kinds of brushing methods, especially in the Bass method and which is excellent also in durability.

Means to Solve the Problems

[0007] The present invention is a toothbrush in which bristles are tufted in a toothbrush head so as to solve the above-described problems. The toothbrush is structured such that thermoplastic elastomer bristles made of a polyester elastomer or a polyamide elastomer are tufted in the inner portion in the width direction of a toothbrush head and bristles made of synthetic resin harder than the thermoplastic elastomer bristles are tufted in the outer portions in the width direction of a toothbrush head.

[0008] Here, it is preferable that the diameter of the thermoplastic elastomer bristles be 0.1 mm to 0.4 mm. The number of bristle tufting rows (row of tufts) is not limited, and is preferably 3 to 5 rows, and particularly preferably 3 rows. Among the above, in the case of thermoplastic elastomer bristles, the number of bristle tufting rows is preferably 1 to 3 rows.

[0009] Moreover, it is preferable that synthetic resin bristles harder than the thermoplastic elastomer bristles be tufted in the tip portion and the base end portion in the longitudinal direction in the inner portion in the width direction of a toothbrush head.

[0010] In particular, it is a preferable that, among tuft holes of a toothbrush head, a tuft made of the thermoplastic elastomer bristles is tufted in each tuft holes except tuft holes at the tip and the base end near the neck of handle in the longitudinal direction in a single inner row or a plurality of inner rows, and a bristle made of the synthetic resin bristles is tufted in the tuft holes at the tip and the base end of the inner row(s) and in each tuft hole in both outer rows.

[0011] Moreover, it is preferable that the synthetic resin bristle be made of a polyester resin in which one or two or more members selected from polyethylene terephthalate, polytrimethylene terephthalate, and polybutylene terephthalate have been melt-mixed, or a polyamide resin, or be a sheath-core type composite filament formed of a core filament made of a polyamide resin and a sheath portion made of a polyester resin.

[0012] Moreover, it is preferable that the bristle length of each bristle tufted in a toothbrush head becomes successively or stepwise shorter from the inner portion to the outer portion in the width direction.

[0013] In particular, as viewed in a cross section, the angle of inclination of a straight line, which passes through the tip of the bristles at the central portion and the tip of the bristle at the outermost sides, relative to a tufting surface is preferably 5 to 40˚ angle, and most preferably 10 to 30˚ angle. Moreover, the bristle length of the bristles at the outermost side is shorter than the bristle length of the bristles at the central portion by preferably 0.5 to 2.5 mm, and more preferably 1.0 to 2.0 mm.

[0014] Specifically, it is preferable that the line passing through the tip of each bristle substantially linearly incline from the central portion to the outer portion in the width direction and the bristle length of each bristle become successively shorter from the central portion to the outer portion.

[0015] Moreover, according to another preferable example, the bristles of the tufts tufted in each tuft hole have the same bristle length; the bristle length of the bristles of the tufts at the outer portions are shorter than the length of the bristles of the tufts at the inner portion in the width direction of a toothbrush head; and the length of each bristle becomes stepwise shorter from the central portion to the outer portion.

[0016] The thermoplastic elastomer bristles are preferably made of thermoplastic elastomer having a hardness of 30D to 100D.

Effects of the Invention

[0017] According to the toothbrush structured as described above of the present invention in this application, the above-described thermoplastic elastomer bristles are tufted in the inner portion in the width direction of a toothbrush head which contacts sensitive portions of the gum or the interproximal portions in the Bass method, and thus the gum or the interproximal portions are hard to damage and massaging effect of the gum is provided. Moreover, since synthetic resin bristles harder than an elastomer are tufted in the outer portion which contacts the tooth surface in the Bass method, cleaning effect of the tooth surface, the interproximal portions, and the gum can be improved; and the elastomer bristles at the inner portion are supported by the synthetic resin bristles at the outer portion to thereby prevent the elastomer bristles from spreading out, accordingly resulting in increased durability and the improvement in the cleaning effect by the elastomer bristles.

[0018] Moreover, since the diameter of the thermoplastic elastomer bristle is set to 0.1 mm to 0.4 mm, narrow part cleaning effect with the elastomer bristles for boundaries between the teeth and the gum and interproximal gaps can be improved.

[0019] Moreover, since synthetic resin bristles harder than the thermoplastic elastomer bristles are tufted in the tip hole and the hole nearest to the neck of handle in the central row and the outer rows, the soft elastomer bristles can be supported by the hard synthetic resin bristles from the longitudinal direction and the width direction, i.e., all directions, to thereby prevent the soft elastomer bristles from spreading out, resulting in that the cleaning effect by the elastomer bristles and the durability can be further improved.

[0020] Moreover, since the bristle length of each bristle tufted in a toothbrush head becomes successively or stepwise shorter from the inner portion to the outer portion in the width direction, the synthetic resin bristles at the outer row opposite to the side contacting the tooth surface can be avoided from contacting the gum at the time of cleaning by the Bass method; a sufficient massaging effect and narrow part cleaning effect can be obtained by the long elastomer bristles; and sufficient cleaning effect can be maintained by the synthetic resin bristles at the side contacting the tooth surface. Moreover, since the synthetic resin bristles at the outer rows are short as described above, the contact between the synthetic resin bristles and the gum is reduced at the time when horizontally brushed to thereby prevent damaging the gum.

[0021] Since the thermoplastic elastomer bristles are made of a thermoplastic elastomer having a hardness of 30D to 100D, outstanding cleaning effect can also be obtained simultaneously with that the stimulus to the gum is suppressed to thereby achieve a favorable massaging effect.

Brief Description of the Drawings

[0022]

Fig. 1 is a perspective view illustrating an essential part of a toothbrush according to a first embodiment of the present invention.

Fig. 2 is a side view illustrating the same part as in Fig. 1 as viewed from the tip side in the longitudinal direction.

Fig. 3 is a plan view illustrating the same part as in Fig. 1.

Fig. 4 is an explanatory view illustrating the usage manner of the toothbrush according to the first embodiment of the present invention by Bass method.

Figs. 5(a) and (b) are explanatory views illustrating modified examples in the first embodiment, respectively.
Figs. 6(a) and (b) are explanatory drawings illustrating other modified examples.
Fig. 7 is a perspective view illustrating an essential part of a toothbrush according to a second embodiment of the present invention.
Fig. 8 is a side view illustrating the same part as in Fig. 7 as viewed from the tip side in the longitudinal direction.
Fig. 9 is a plan view illustrating the same part as in Fig. 7.
Fig. 10 is an explanatory view illustrating the usage manner of the toothbrush according to the second embodiment of the present invention by Bass method.
Figs. 11(a) and (b) are explanatory views illustrating an essential part of a synthetic resin bristle in the second embodiment.
Figs. 12(a) and (b) are explanatory views illustrating modified examples of the synthetic resin bristle in the second embodiment.
Figs. 13(a) to (e) are explanatory views illustrating other modified examples of the synthetic resin bristle in the second embodiment.
Figs. 14(a) and (b) are explanatory views illustrating still other modified examples of the synthetic resin bristle in the second embodiment.

Description of Reference Numerals

[0023]

1.	Toothbrush
2.	Toothbrush body
3.	Brush part
4.	Bristle
5.	Tuft
20.	Toothbrush head
20a.	Tuft hole
21.	Neck of handle
41.	Thermoplastic elastomer bristle
42.	Synthetic resin bristle
60.	Sheath portion
61.	Core filament
63.	Unit cross sectional element
θ.	Angle of inclination
h1, h2.	Bristle-length difference
R1, R2, R3, R10, R11.	Portion

Best Mode for Carrying Out the Invention

[0024] Hereinafter, embodiments of the present invention will be described in detail with reference to the attached drawings.

[0025] Fig. 1 is an explanatory view illustrating a structure of the toothbrush according to the present invention. Figs. 1 to 6 illustrate a first embodiment, and Figs. 7 to 14 illustrate a second embodiment. In Figs. 1 to 14, the reference numerals 1, 2, and 3 denote a toothbrush, a toothbrush body, and a brush part, respectively.

[0026] A feature of a toothbrush 1 according to the present invention resides in that bristles 4 are tufted in a toothbrush head 20 as illustrated in Fig. 1 in which thermoplastic elastomer bristles 41, ... are tufted in an inner portion R1 in the width direction of a toothbrush head 20 and synthetic resin bristles 42,... harder than the thermoplastic elastomer bristles are tufted in outer portions R2 and R3 in the width direction of a toothbrush head 20.

[0027] First, the first embodiment of the present invention will be described with reference to Figs. 1 to 6.

[0028] As illustrated in Fig. 1, the toothbrush 1 of this embodiment is equipped with a toothbrush body 2 made of a synthetic resin and a brush part 3 provided on a toothbrush head 20 of the toothbrush body 2. The toothbrush body 2 is composed of a toothbrush head 20, a neck of handle 21, and a handle (not shown) which have been integrally molded by injection molding of a synthetic resin, such as polypropylene, for example.

[0029] As illustrated also in Fig. 2, the brush part 3 provided on a toothbrush head 20 is obtained by two-folding a tuft 5 obtained by bundling a plurality of bristles 4, ... into a U shape; inserting and fixing (driving) the tuft 5 in each tuft hole 20a of a toothbrush head 20 with an anchor wire (also referred to as a metal wire material, a wire staple, etc.); and then trimming the tip of each tuft 5 to the equal length.

[0030] In addition to the method using an anchor wire as described above, employable as a method of fixing the bristles 4 to a toothbrush head 20 are the same bristle tufting methods as conventional bristle tufting methods, such as an in-mold method which involves heat sealing the base part of the tuft in which bristles are similarly bundled to form a fusion lump, placing the base part in a molding cavity at the time of shaping of a toothbrush body, and fixing the bristles to the toothbrush head by integral molding, and a fuse in method.

[0031] In this example, three tuft rows are provided along the longitudinal direction of a toothbrush head 20 in which one central row is a tuft row of thermoplastic elastomer bristles 41, ... and each outer row parallel thereto is a tuft row of the synthetic resin bristles 42,... harder than the thermoplastic elastomer bristles. It should be noted that it is a matter of course that the number of tuft rows, the number of the tufts forming each row, and the arrangement relationship are not limited at all in the present invention.

[0032] Specifically, the thermoplastic elastomer bristles 41 are made of thermoplastic elastomer having a hardness of 30D to 100 D, such as a polyester elastomer or a polyamide elastomer, and the diameter is set to 0.1 mm to 0.4 mm. When the diameter is smaller than 0.1 mm, a sufficient durability cannot be obtained. In contrast, when the diameter is larger than 0.4 mm, the cleaning effect of gaps decrease. More preferably, the diameter is set to 0.15 to 0.25 mm. Moreover, when the hardness is lower than 30D, the cleaning effect cannot be obtained. In contrast, when the hardness is higher than 100D, the stimulus to the gum is too strong. Preferably, the hardness is set to 55 to 80D.

[0033] The thermoplastic elastomer is engineering plastic having rubber elasticity. Usable as the thermoplastic elastomer are polyester elastomers, such as "Hytrel" (manufactured by Du Pont-Toray Co., Ltd.), "Arnitel" (manufactured by Akzo), "Gaflex" (manufactured by GAF), and "Pelprene" (manufactured by Toyobo Co., Ltd.) and polyamide elastomers, such as, "Grilax" (manufactured by DIC Corporation) and "Pebax" (manufactured by Atochem).

[0034] The synthetic resin bristles 42 are harder than the thermoplastic elastomer bristles 41. Usable as a material thereof are synthetic resins known as bristles of a toothbrush, such as: a polyamide resin, such as nylon or aramid; a polyester resin in which one or two or more members selected from polybutylene terephthalate, polypropylene terephthalate (polytrimethylene terephthalate), and polyethylene terephthalate have been melt-mixed; and a polyolefin resin, such as polypropylene and polyethylene.

[0035] In particular, a synthetic resin made of nylon or a polyester resin in which one or two or more members selected from polyethylene terephthalate, polytrimethylene terephthalate, and polybutylene terephthalate have been melt-mixed is preferable from the viewpoint that excellent cleaning effect can be obtained.

[0036] As illustrated in Fig. 2, each tuft 5 tufted in a toothbrush head 20 is trimmed in such a manner that the bristle length of the bristles 4 becomes successively shorter from the inner portion to the outer portion in the width direction. More specifically, the tufts of thermoplastic elastomer bristles 41 at the central row are trimmed in such a manner that the length of the bristles at the central portion is the highest and the length thereof becomes gradually shorter towards both outer portions and the synthetic resin bristles 42 at the outer rows are trimmed in such a manner that the length thereof becomes gradually shorter from the inner portion to the outer portion.

[0037] In this example, the line passing through the tip of each bristle is trimmed in such a manner as to substantially linearly incline from the central portion to the outer portion in the width direction. The angle of inclination θ to the head surface is set to 5 to 40° angle. The bristle length difference h1 between the bristles (thermoplastic elastomer bristles 41) at the central portion and the bristles (synthetic resin bristles 42) at the outermost side is set to 0.5 to 2.5 mm.

[0038] Thus, by reducing the length of bristles at the outer portions, the following effects can be achieved in Bass method of finely vibrating a toothbrush in the vertical direction while tilting the toothbrush to the gum by 45° angle as illustrated in Fig. 4: a sufficient massaging effect and narrow part cleaning effect can be obtained by the long elastomer bristles 41; sufficient cleaning effect can be maintained by the synthetic resin bristles at a side contacting the tooth surface; and the synthetic resin bristles at a lower part can be avoided from contacting the gum to damage the gum. When the bristle length difference h1 is smaller than 0.5 mm, the feeling that the toothbrush contacts the teeth and the gum is almost the same with a feeling that the bristles having the same length (straight line) contact the teeth and the gum, and thus the length difference is hard to recognize; the massaging effect by the elastomer bristles cannot fully be obtained; a possibility that the synthetic resin bristles at a lower part contact the gum during cleaning becomes high. In contrast, when the bristle length difference h1 is larger than 2.5 mm, the elastomer bristles become excessively long, and thus the tip thereof are not sufficiently supported by the synthetic resin bristles, resulting in that the massaging effect and narrow part cleaning effect decrease, and also cleaning effect decrease because the synthetic resin bristles at an upper part do not sufficiently contact the tooth surface. More specifically, only the central portion contacts the brushing target, and thus cleaning effect to the tooth surface cannot be expected.

[0039] It should be noted that similarly preferable are a toothbrush in which the bristles are trimmed in such a manner as to incline in a substantially curved shape as illustrated in Fig. 5(a) and a toothbrush in which only the synthetic resin bristles 42 at the outer rows are similarly trimmed while inclining in such a manner that the synthetic resin bristles 42 at the outer rows are shorter than the thermoplastic elastomer bristles 41 at the central row and the outer portions of the outer rows are shorter and that the tip of the tuft of the thermoplastic elastomer bristles 41 at the central row are horizontally trimmed as illustrated in Fig. 5(b). Also in this case, the angle of inclination θ of a straight line, which passes

through the tip of the bristles at the central portion and the tip of the tuft at the outermost side, relative to a tufting surface as viewed in a cross section is preferably adjusted to 5 to 40° angle.

[0040] Moreover, a toothbrush is also preferable in which, in the inner portion R1 in the width direction of a toothbrush head, the synthetic resin bristles 42 harder than the thermoplastic elastomer bristles 41 are tufted in a portion R10 at the tip in the longitudinal direction and a portion R11 at the base end in the longitudinal direction as illustrated in Fig. 6 (a). In the illustrated examples, the tuft made of the synthetic resin bristles is tufted in each tuft hole at the tip and the base end in the longitudinal direction of the central row and each tuft hole forming both the outer rows sandwiching the central row. Thus, the thermoplastic elastomer bristles 41,... are surrounded by the hard synthetic resin bristles 42 from all directions in the width direction and the longitudinal direction, resulting in that the cleaning effect by the elastomer bristles 41 and the durability further increase.

[0041] In this case, the synthetic resin bristles 42 in the portions R10 and R11 may be the same in the bristle length as the thermoplastic elastomer bristles 41. However, as illustrated in Fig. 6(b), it is preferable that the synthetic resin bristles 42 in the portions R10 and R11 be trimmed while inclining in such a manner that the tip of the tufts of the synthetic resin bristles 42 in the portions R10 and R11 are shorter than the thermoplastic elastomer bristles 41 and the outer portions, i.e., the tip and the base end in the longitudinal direction of the central row, are shorter than the central portion similarly as in the synthetic resin bristles 42 at the outer portions R2 and R3, to thereby avoid the synthetic resin bristles 42 from contacting the gum.

[0042] The tip of each tuft 5 is trimmed in such a manner as to incline in the width direction, and may be trimmed in such a manner as to form an uneven surface also in the longitudinal direction. Moreover, when the tip of the thermoplastic elastomer bristle 41 or the synthetic resin bristle 42 is processed into a tapered shape, the insertion properties to a narrow part are improved.

[0043] Next, the second embodiment of the present invention will be described with reference to Figs. 7 to 14.

[0044] In the toothbrush 1 of this embodiment, similarly as in the above-described first embodiment, three tuft rows are provided along the longitudinal direction of a toothbrush head 20 in which one central row is a tuft row of thermoplastic elastomer bristles 41, ... and each outer row parallel thereto is a tuft row of the synthetic resin bristles 42, ... harder than the thermoplastic elastomer bristles, respectively.

[0045] As illustrated in Figs. 7 and 8, each tuft 5 is tufted in such a manner that the tip of each tuft 5 becomes substantially horizontal or the tip of each tuft 5 is substantially horizontally trimmed after tufting. The trimming is performed in such a manner that the bristle length of the bristles 4 becomes successively shorter from the inner portion to the outer portion in the width direction (one level difference in this embodiment). More specifically, the bristle length of the synthetic resin bristles 42 forming the tufts at the outer rows is shorter than the bristle length of the thermoplastic elastomer bristles 41 forming the tufts at the central row. The bristle length difference h2 is set to 0.5 to 2.5 mm, and the angle of inclination θ of a straight line, which passes through the tip of the bristles at the central portion and the tip of the bristle at the outermost side, relative to a tufting surface as viewed in a cross section is set to 5 to 40° angle.

[0046] Thus, similarly as in the case of the first embodiment described above, in the Bass method of finely vibrating a toothbrush in the vertical direction while tilting the toothbrush to the gum by 45° angle as illustrated in Fig. 10, a sufficient massaging effect and narrow part cleaning effect can be obtained by the long elastomer bristles 41; sufficient cleaning effect can be maintained by the synthetic resin bristles at a side contacting the tooth surface; and the synthetic resin bristles at a lower part can be avoided from contacting the gum to damage the gum.

[0047] In this example, with respect to especially the synthetic resin bristles 42 forming the tufts at the outer rows, the cross section is formed of a filament made of a synthetic resin having a sheath-core type composite and three core filaments 61 are projected from the tip of a sheath portion 60 as illustrated in Fig. 11. Such a synthetic resin can be produced by dissolving the sheath portion 60 from the tip to thereby expose a core filament 61, which is achieved by forming the core filament 61 using a material containing a polyamide resin, such as nylon, as a main component; forming the sheath portion 60 using a composite synthetic resin monofilament made of a material containing a polyester resin, such as polybutylene terephthalate, as a main component; immersing the above in a chemical solution, such as caustic soda. In the case of such a synthetic resin bristle, the dental plaque removing effect and cleaning effect in narrow parts, such as the interproximal portions and the boundaries between the teeth and the gum, are improved.

[0048] In the example shown in Fig. 11, three core filaments are projected. The number of projected core filaments may be 1 (as illustrated in Fig. 12), 2, or 4 or more. Moreover, the tapered shape at the tip of the sheath portion 60 or the exposure length of the core filament 61 can be suitably adjusted by the concentration of the chemical solution, immersion time, speed of pulling the resultant from the chemical solution, etc. The tapered shape at the tip of the sheath portion increases insertion properties and accessibility into narrow parts in the mouth. The tip shape of the core filament 61 is suitably determined, and can be processed into proper shapes, such as the shape of a hemisphere.

[0049] In addition to the sheath-core type composite, by immersing, in a solution, such as alkali or acid, the tip of a filament made of a synthetic resin having a cross sectional shape in which a plurality of unit cross sectional elements 63 are connected as illustrated in Figs. 13(a) and 13(b), a tapered bristle in which tapered branch bristles in the number according to the number of the connected unit cross sectional elements are formed on the tip of the bristle can be formed

as a tapered bristle used as the synthetic resin bristle 42. The shape and the length of the branch bristles can be suitably adjusted by the concentration of a chemical solution, immersion time, speed of pulling up the resultant from the chemical solution, etc.

[0050] Similarly, Fig. 13(c) illustrates a tapered bristle formed of two unit cross sectional elements; Fig. 13(d) illustrates a tapered bristle formed of three unit cross sectional elements which are arranged in one row; and Fig. 13(e) illustrates a tapered bristle formed of four unit cross sectional elements. Similarly, a tapered bristle in which a tapered branch bristle(s) is(are) formed on the tip of the bristles can be formed. Moreover, as illustrated in Fig. 14, a core filament is formed in the central part of each unit cross sectional element, and each branch bristle can be formed into the same sheath-core type composite as the above.

[0051] By mounting the toothbrush described in each embodiment described above to a toothbrush body having a shortened handle and a driving unit, the toothbrush can also be applied to a brush of an electric toothbrush which vibrates the brush part 3.

Examples

[0052] Hereinafter, each embodiment of the present invention was subjected to a cleaning effect test, a durability test, and a sensory test, such as feeling of use, and the test results will be described.

[0053] Toothbrushes of Examples 1 to 6 and Comparative Examples 1 to 5 are as shown in Table 1. Each toothbrush is formed of three tuft rows (the central row and both outer portion rows). An "elastomer filament" is a bristle having a diameter of 0.2 mm made of a thermoplastic polyester elastomer ("Hytrel", manufactured by Du Pont-Toray). A "polyester bristle" is a bristle having a diameter of 0.15 mm made of a melt-mixture of polytrimethylene terephthalate and polybutylene terephthalate. A "sheath-core" is a bristle having a diameter of 0.19 mm formed of a core filament made of nylon and a sheath portion made of polybutylene terephthalate in which three core filaments are projected from the tip. A "roof shape" is a shape in which the tip of the bristles are trimmed in such a manner as to substantially linearly incline from the central portion to the outer portion in the width direction; the angle of inclination is set to 25˚ angle; and the bristle length difference of the bristles between the central portion and the outer end is set to 1.5 mm. A "(high inclination)" refers to a state where the angle of inclination is set to 40˚ angle and the bristle length difference between the bristles at central portion and the bristles at the outer portion is set to 2.5 mm. A "convex shape" refers to a state where the bristle length of bristles at outer rows is further shortened as compared with the bristle length of bristles at the central row; the bristle length difference (level difference) is set to 1.0 mm; and the angle of inclination of a straight line, which passes through the tip of the bristles at the central portion and the tip of the bristle at the outermost side, relative to a tufting surface is set to 25˚ angle. A "(large level difference)" refers to a state where the bristle length difference is set to 2.5 mm, and the angle of inclination of a straight line, which passes through the tip of the bristles at the central portion and the tip of the bristle at the outermost side, relative to a tufting surface is set to 40˚ angle.

[0054]

[Table 1]

	Central row	Outer row	Shape of trimmed bristles
Example1	Elastomer bristles	Polyester bristles	Roof shape
Example2	Elastomer bristles	Sheath-core filaments	Convex shape
Example3	Elastomer bristles	Polyester bristles	Roof shape (high inclination)
Example4	Elastomer bristles	Sheath-core filaments	Convex shape (large level difference)
Example5	Elastomer bristles	Polyester bristles	Straight shape
Example6	Elastomer bristles	Sheath-core filaments	Straight shape
Comparative Example1	Polyester bristles	Elastomer bristles	Straight shape
Comparative Example2	Elastomer bristles	Elastomer bristles	Straight shape
Comparative Example3	Polyester bristles	Polyester bristles	Roof shape
Comparative Example4	Polyester bristles	Polyester bristles	Roofshape (high inclination)
Comparative Example5	Polyester bristles	Polyester bristles	Straight shape

(Cleaning effect test)

[0055] An artificial plaque is adhered to an upper second premolar of a jaw model, and the jaw model is attached to a brushing simulation machine. Each toothbrush of Examples and Comparative Examples is placed in such a manner that one end of a bristle tufting part contacts the upper second premolar and a bristle tufting part covers the second premolars. Brushing is performed for 3 seconds while setting a stroke in the transverse direction to 20 mm and applying a load of 150 g. The area of the artificial plaque is measured and calculated in each part with an image analyzer. Then, a ratio of the area where the artificial plaque is removed to the area where the artificial plaque was adhered was defined as a plaque removal ratio. The results are shown in Table 2.

(Plaque removal ratio (%))

[0056]

◎; 90% or more,
○; 70 to lower than 90%,
△; 50 to lower than 70%
x; Lower than 50%

[0057]

[Table 2]

	Tooth surface portion			Cervical margin		
	Plaque removal ratio (%)	Standard deviation	Evaluation	Plaque removal ratio (%)	Standard deviation	Evaluation
Example1	99.34	0.48	◎	94.02	0.25	◎
Example2	99.09	0.47	◎	91.62	1.57	◎
Example3	67.65	0.95	Δ	90.45	1.56	◎
Example4	71.03	3.57	○	94.39	0.57	◎
Example5	93.69	0.27	◎	92.57	0.89	◎
Example6	94.67	1.28	◎	92.37	0.89	◎
Comparative Example1	81.46	1.68	○	85.21	4.10	○
Comparative Example2	81.06	5.01	○	83.82	1.11	○
Comparative Example3	96.27	0.43	◎	95.99	1.16	◎
Comparative Example4	96.92	0.33	◎	95.65	0.12	◎
Comparative Example5	92.68	2.30	◎	95.31	0.64	◎

[0058] Table 2 shows that Examples 1, 2, 5, and 6 (a roof shape and a convex shape) have a cleaning ability (average) and a cleaning stability (error) to the tooth surface portion which are equivalent to or more excellent than the conventional polyester bristles (Comparative Examples 3 to 5) and excellent cleaning effect both to the tooth surface portion and the cervical margin in comparison with Comparative Examples 1 and 2 each having a massaging effect.
In Examples 3 and 4, the cleaning effect of the tooth surface portion decrease. This shows that when the bristle length difference (inclination and level difference) is excessively large, the synthetic resin bristles at the outer portion cannot sufficiently contact the tooth surface.

(Durability test)

[0059] When the toothbrush was immersed in a warm water at 37˚C and reciprocated by 10,000 times while applying a load of 300 g, (A) the width of the bristle tufting part in the minor axis direction of the toothbrush of an initial state (width at the tip of the tufted bristles) and (B) the width of the bristle tufting part in the minor axis direction of the toothbrush in a state where the bristles are spread out after the toothbrush was reciprocated by 10,000 times were measured. Then, the durability was evaluated according to the following criteria based on the durability index (where the lower index indicates that the durability is more excellent) determining the durability baseline according to the following formula.

$$\text{Durability index (\%)} = [(B)/(A)]/100$$

(Evaluation criteria)

[0060]

◎: 100 to 150%,
○: 150 to 200%,
Δ: 200 to 250%,
×: Higher than 250%

[0061]

[Table 3]

	Durability index (%)	Evaluation
Example 1	176	○
Example2	156	○
Example4	165	○
Example6	157	○
Comparative Example2	220	Δ
Comparative Example3	171	○
Comparative Example4	174	○
Comparative Example5	168	○

[0062] Table 3 shows that Examples 1, 2, 4, and 6 have a difficulty of spreading out and durability which are equivalent to or higher than those of conventional polyester bristles (Comparative Examples 2 to 5), although Examples 1, 2, 4, and 6 use elastomer bristles.

(Sensory test)

[0063] Each toothbrush of Examples 1 to 6 and Comparative Examples 1 to 5 was subjected to sensory test in terms of the massaging feeling, existence of a stimulus, feeling of use, and ease of contacting the cervical margin by 10 subjects, and evaluated according to the following criteria.

(Massaging feeling)

[0064]

◎; Remarkably sensible
○; Sensible
△; Hardly sensible
×: Not sensible

(Existence of a stimulus)

[0065]

◎; No stimulus
○; Less stimulus
Δ; Slight stimulus
×: Strong stimulus

(Feeling of use and Ease of contacting the cervical margin)

[0066]

◎; Very Good
○; Good
Δ; Not so good
×: Bad

[0067]

[Table 4]

	Massaging feeling	Existence of a stimulus	Feeling of use	Ease of contacting the cervical margin
Example1	◎	◎	◎	◎
Example2	◎	◎	◎	◎
Example3	○	◎	○	◎
Example4	○	◎	○	◎
Example5	○	◎	○	Δ
Example6	○	◎	○	Δ
Comparative Example1	Δ	Δ	Δ	Δ
Comparative Example2	○	◎	×	Δ
Comparative Example3	×	×	○	○
Comparative Example4	×	×	○	○
Comparative Example5	Δ	Δ	○	Δ

[0068] Table 4 shows that Examples 1 and 2 have excellent brushing comfortability, feeling of use, and ease of contacting the cervical margin as compared with Comparative Examples 1 and 2 having a conventional massaging effect and polyester bristles (Comparative Examples 3-5).
In Examples 3 and 4, brushing comfortability and feeling of use decrease. This shows that when the bristle length difference (inclination and level difference) is excessively large, the elastomer bristles of the central row is too long, resulting in uncertain feeling similarly as in Comparative Example 2, and resulting in that sufficient cleaning feeling cannot be obtained because the synthetic resin bristles at the outer portions do not securely contact the tooth surface. It is revealed that, in Examples 5 and 6 having a straight line, the synthetic resin bristles at the outer portion contact the gum again. Thus, Examples 5 and 6 are inferior to Examples 1 and 2 in terms of the ease of contacting gum.

(Comprehensive evaluation)

[0069] Based on each evaluation of the cleaning effect, durability, and sensory test, points were given and averaged according to the following criteria, and the comprehensive evaluation was performed according to the following evaluation criteria.

◎; 3 points

○; 2 points
△; 1 point
x: 0 point

(Comprehensive evaluation criteria)

[0070]

◎; 2.5 points or more
○; 2.0 to lower than 2.5 points
△; 1.5 to lower than 2.0 points
×: Lower than 1.5

[0071]

[Table 5]

	Cleaning effect		Durability	Massaging feeling	Existence of a stimulus	Feeling of use	Ease of contacting the cervical margin	Comprehensive evaluation
	Tooth surface portion	Cervical margin						
Examplel	◎	◎	○	◎	◎	◎	◎	◎
Example2	◎	◎	○	◎	◎	B◎	◎	◎
Example3	Δ	◎	-	○	◎	○	◎	○
Example4	○	◎	○	○	◎	○	◎	○
Example5	◎	◎	-	○	◎	○	Δ	○
Example6	◎	◎	○	○	◎	○	Δ	○
Comparative Example1	○	○	-	Δ	Δ	Δ	Δ	×
Comparative Example2	○	○	Δ	○	◎	×	Δ	×
Comparative Example3	◎	◎	○	×	×	○	○	Δ
Comparative Example4	◎	◎	○	×	×	○	○	Δ
Comparative Example5	◎	◎	○	Δ	Δ	○	Δ	Δ

[0072] As described above, the embodiments of the present invention are described. However, it is a matter of course that the invention is not limited to the embodiments, and can be practiced with modification and alteration without departing from the scope of the invention.

Claims

1. A toothbrush, comprising a head in which bristles are tufted,
the head having:

   thermoplastic elastomer bristles containing a polyester elastomer or a polyamide elastomer being tufted in an inner portion in the width direction of the head; and
   synthetic resin bristles harder than the thermoplastic elastomer bristles being tufted in both outer portion in the width direction of the head.

2. The toothbrush according to claim 1, wherein the diameter of the thermoplastic elastomer bristles is 0.1 mm to 0.4 mm.

3. The toothbrush according to claim 1 or 2, wherein, in the inner portion in the width direction of the head, the synthetic resin bristles harder than the thermoplastic elastomer bristles are tufted in the tip side and the base end side in the longitudinal direction.

4. The toothbrush according to claim 3, wherein, among tuft holes of the head, a tuft made of the thermoplastic elastomer bristles are tufted in each tuft hole except tuft holes at the tip in the longitudinal direction in a single inner row or a plurality inner rows and tuft holes at the base end near a neck of handle in the longitudinal direction in a single inner row or a plurality inner rows, and a tuft made of the synthetic resin bristles are tufted in each tuft hole forming both outer rows sandwiching the single inner row or the plurality of inner rows.

5. The toothbrush according to any one of claims 1 to 4, wherein the synthetic resin bristle contains a polyamide resin or a polyester resin.

6. The toothbrush according to any one of claims 1 to 4, wherein the synthetic resin bristles contain nylon as a polyamide resin or a resin in which one or two or more members selected from polyethylene terephthalate, polytrimethylene terephthalate, and polybutylene terephthalate, which are polyester resins, have been melt-mixed.

7. The toothbrush according to any one of claims 1 to 4, wherein the synthetic resin bristles are sheath-core type composite filaments each containing core filaments made of a polyamide resin and a sheath portion made of polyester resin.

8. The toothbrush according to any one of claims 1 to 7, wherein the bristle length of each bristle tufted in the head becomes successively or stepwise shorter from the inner portion to the outer portion in the width direction.

9. The toothbrush according to claim 8, wherein the angle of inclination of a straight line, which passes through the tip of bristles at the central portion and the tip of bristles at the outermost portion, relative to a tufting surface as viewed in a cross section is 5 to 40 ˚ angle.

10. The toothbrush according to claim 8 or 9, wherein the bristle length of the bristles at the outermost side is shorter by 0.5 to 2.5 mm than the bristle length of the bristles at the central portion.

11. The toothbrush according to any one of claims 8 to 10, wherein a line passing through the tip of each tuft substantially linearly inclines from the central portion to the outer portion in the width direction, and the bristle length of each tuft becomes successively shorter from the central portion to the outer portion.

12. The toothbrush according to any one of claims 8 to 10, wherein the bristles of the tuft tufted in each tuft hole have the substantially same bristle length; the bristle length of the bristles of the tufts at the outer portions in the width direction of the head is shorter than the bristle length of the bristles of the tuft at the inner portion in the width direction of the head; and the bristle length of each bristle becomes stepwise shorter from the central portion to the outer portion.

13. The toothbrush according to any one of claims 1 to 12, wherein the thermoplastic elastomer bristles contain a

thermoplastic elastomer having a hardness of 30D to 100D.

Fig. 1

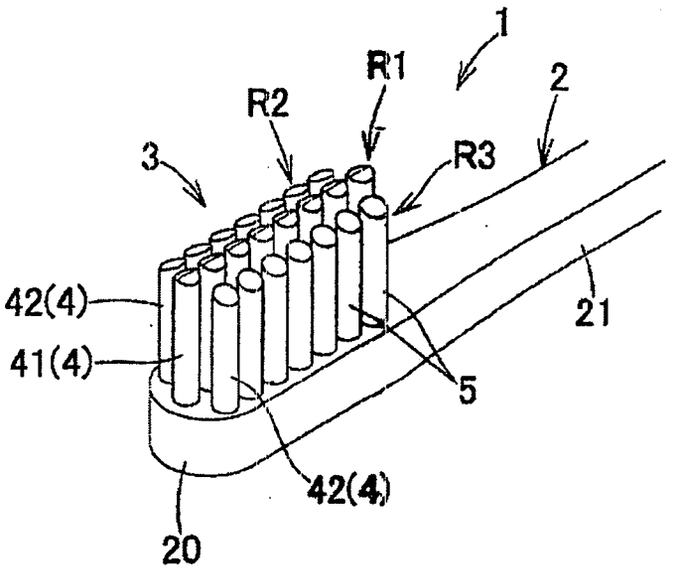

Fig. 2

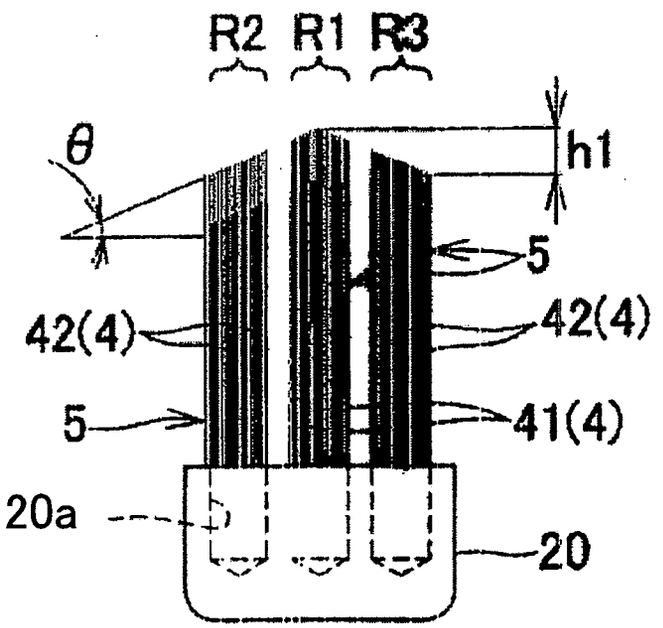

Fig. 3

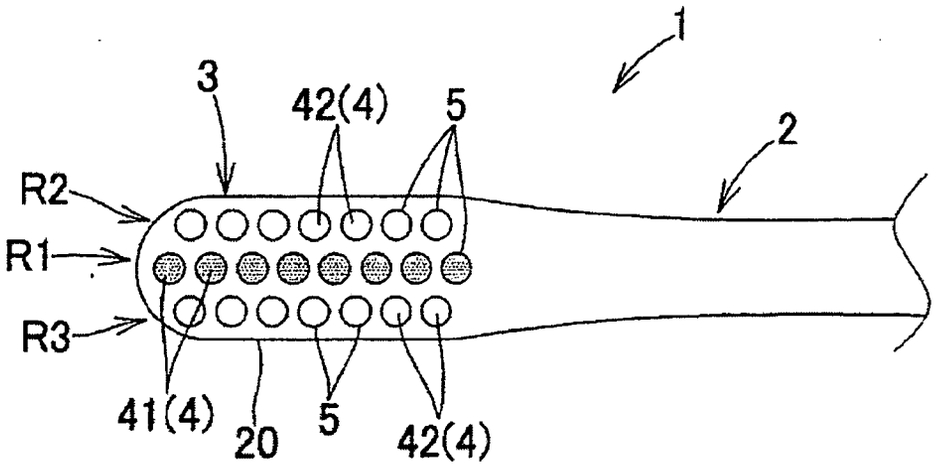

Fig. 4

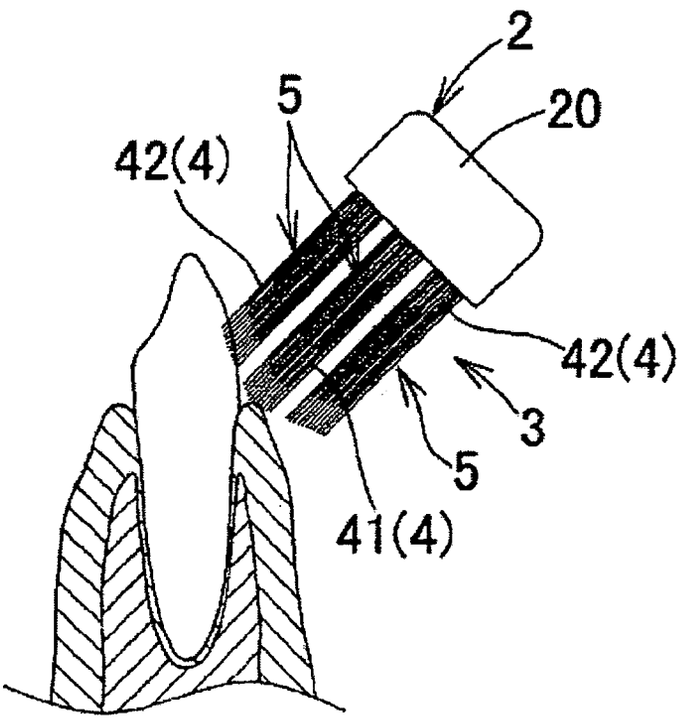

Fig. 5

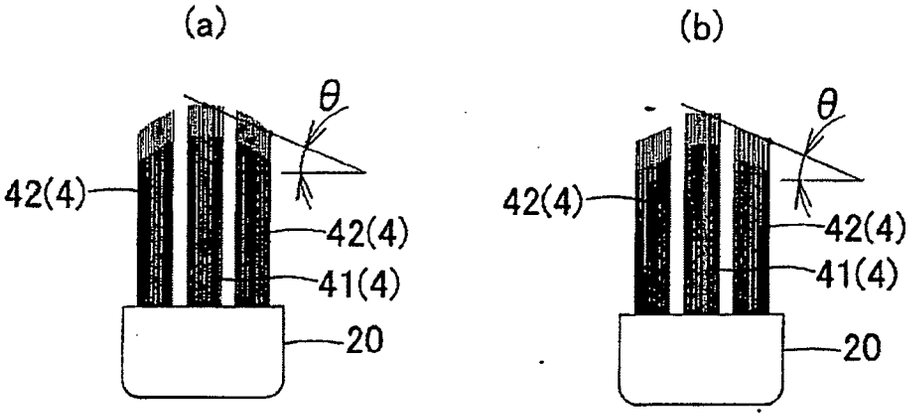
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Fig. 6

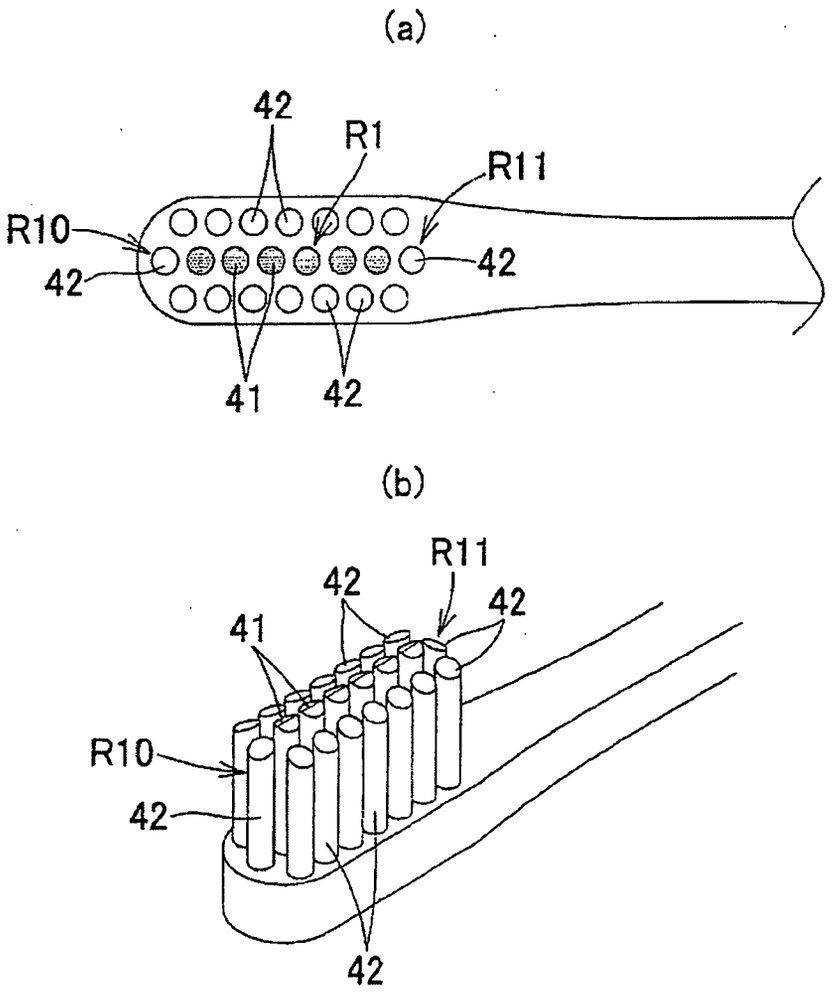
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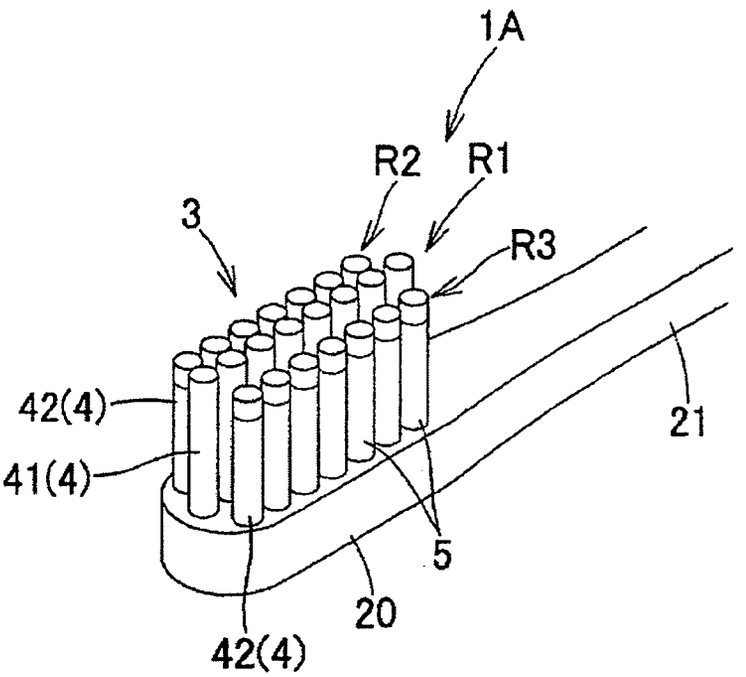
Fig. 7



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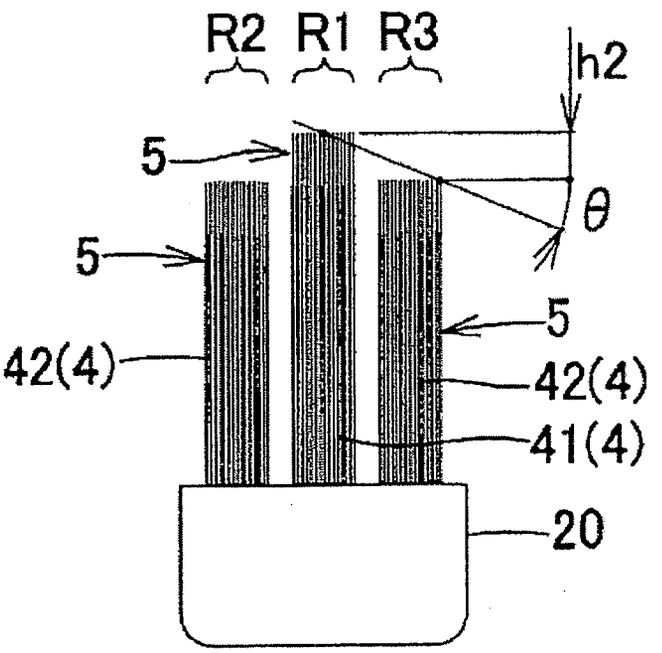

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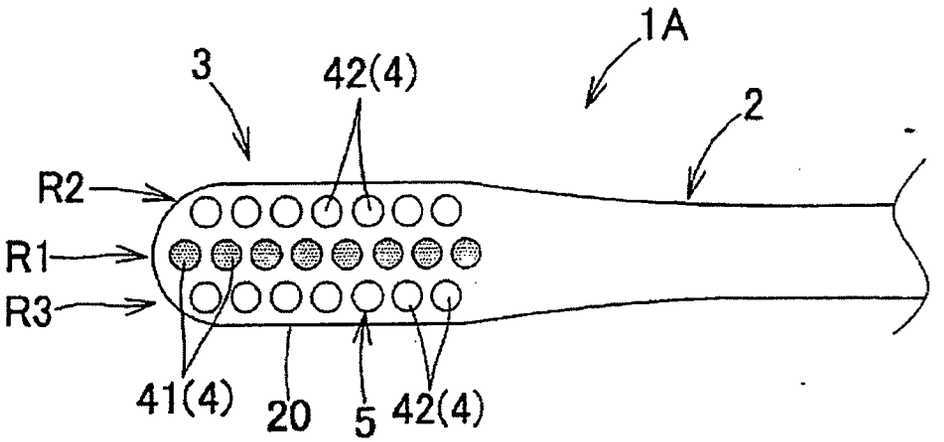

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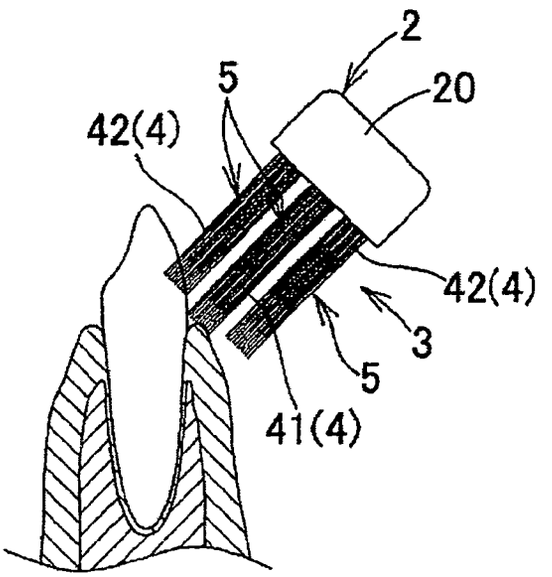

Fig. 11

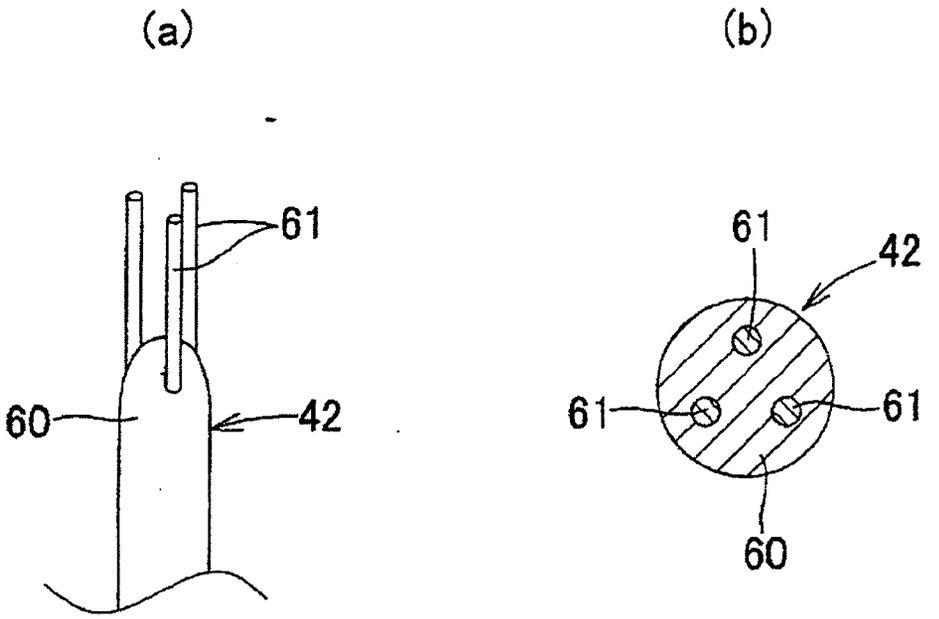

Fig. 12

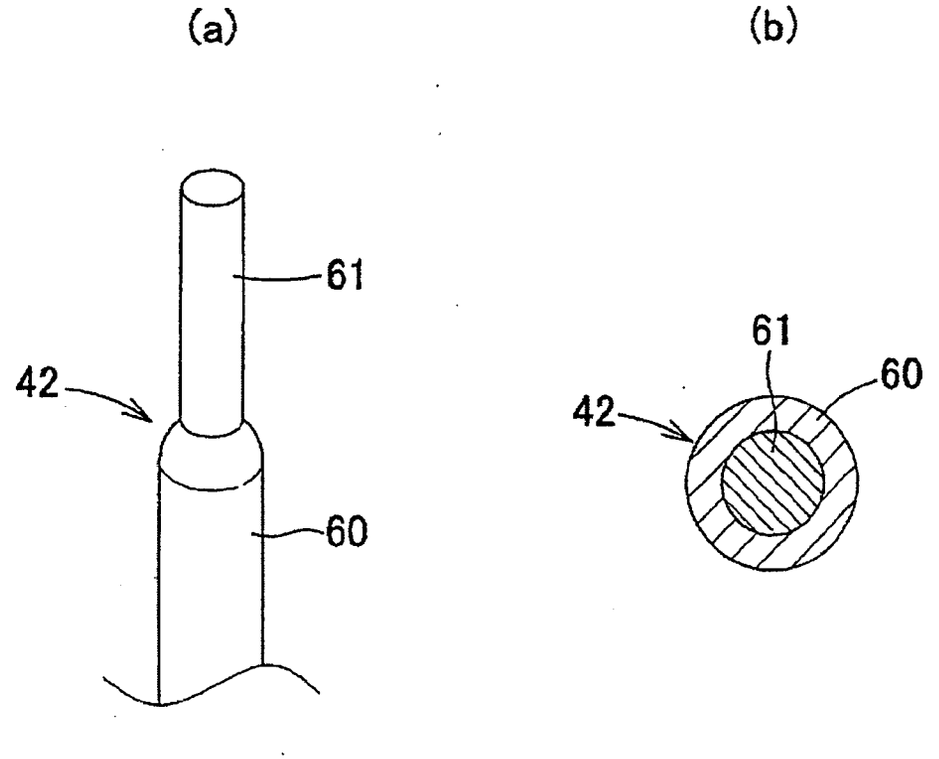

Fig. 13

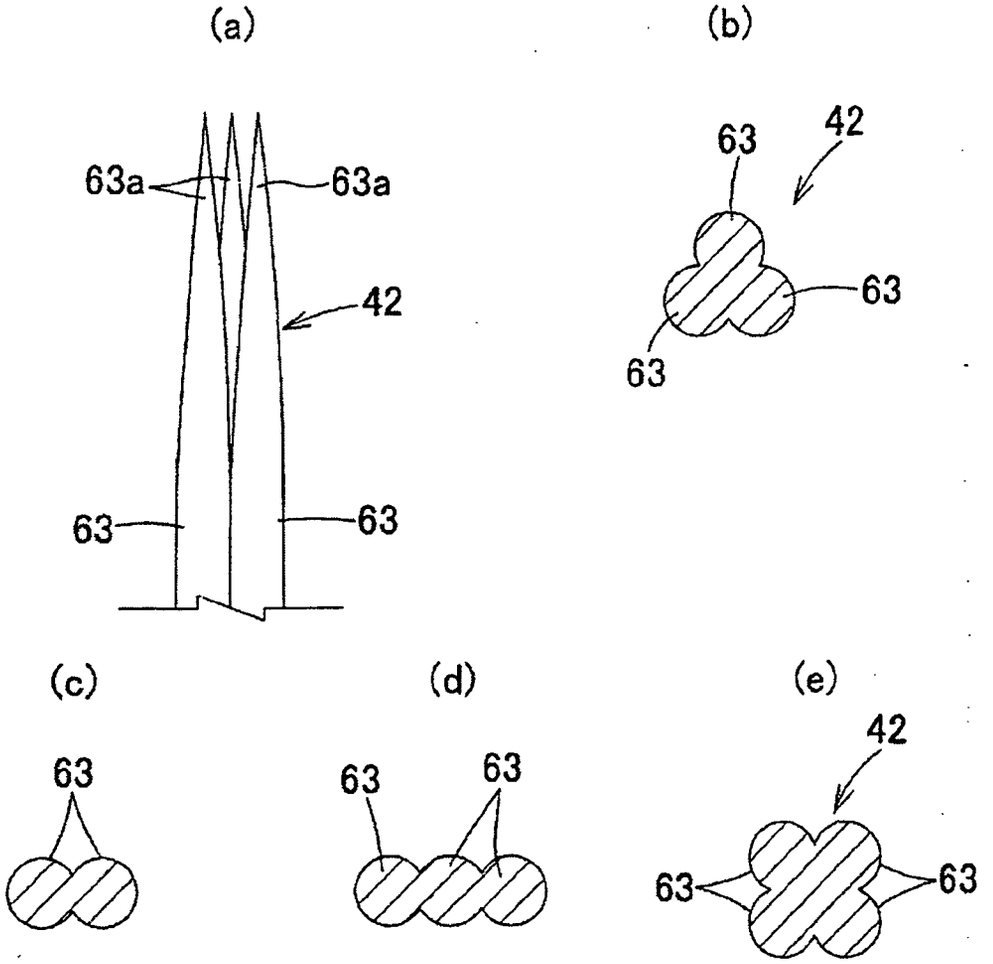
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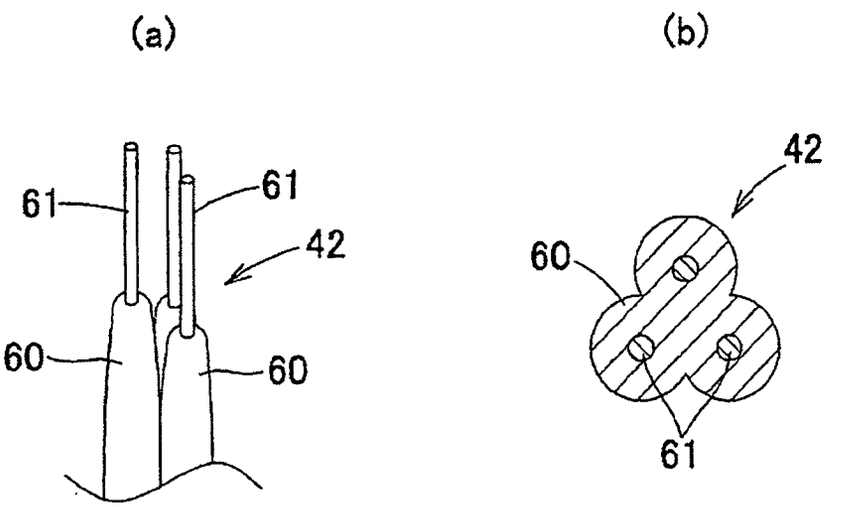
Fig. 14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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/057861

A. CLASSIFICATION OF SUBJECT MATTER
A46D1/00(2006.01)i, *A46B9/04*(2006.01)i, *A61C17/00*(2006.01)i, *D01F6/60*(2006.01)i, *D01F6/62*(2006.01)i, *D01F6/90*(2006.01)i, *D01F6/92*(2006.01)i, *D01F8/14*(2006.01)i
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)
A46D1/00, A46B9/04, A61C17/00, D01F6/60, D01F6/62, D01F6/90, D01F6/92, D01F8/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2007
Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007

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.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 53017/1989(Laid-open No. 143036/1990) (Lion Corp.), 04 December, 1990 (04.12.90), Page 3, line 19 to page 4, line 2; page 5, lines 17 to 20; Figs. 7 to 9 (Family: none)	1-13
Y	JP 2003-504100 A (Coronet-Werke GmbH.), 04 February, 2003 (04.02.03), Claim 10 & US 6772467 B1 & EP 1194055 A & WO 01/3544 A1 & DE 19932376 A & AU 5827700 A & BR 12440 A & CN 1360475 A & CZ 20014617 A	1-13

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Date of the actual completion of the international search	Date of mailing of the international search report
24 July, 2007 (24.07.07)	21 August, 2007 (21.08.07)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/057861

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 36-1767 Y1 (Satoru FUJIOKA), 02 February, 1971 (02.02.71), Full text; all drawings (Family: none)	3-13
Y	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 90203/1992(Laid-open No. 58719/1994) (Nozomi TOMITA), 16 August, 1994 (16.08.94), Par. No. [0024] (Family: none)	8-13
Y	JP 2003-503127 A (Unilever N.V.), 28 January, 2003 (28.01.03), Par. No. [0017] & US 6446295 B1 & EP 1191859 A & WO 01/1817 A1 & AU 5535200 A & BR 12015 A & CN 1359272 A & HU 201707 A & CA 2373650 A	13

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Patent documents cited in the description

- JP 6012647 A **[0005]**
- JP 2002514946 PCT **[0005]**