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(71) Applicant (for all designated States except US): **GLAXOSMITHKLINE CONSUMER HEALTHCARE GMBH & CO. KG** [DE/DE]; Bussmatten 1, Buehl, 77815 Baden (DE).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **KRAEMER, Hans** [DE/DE]; GlaxoSmithKline Consumer Healthcare GmbH & Co KG, Bussmatten 1, 77815 Buehl (Baden) (DE). **DAHLKOETTER, Claudia** [DE/DE]; GlaxoSmithKline Consumer Healthcare GmbH & Co KG, Bussmatten 1, 77815 Buehl (Baden) (DE).

(74) Agent: **WALKER, Ralph Francis**; GlaxoSmithKline, Corporate Intellectual Property CN925.1, 980 Great West Road, Brentford Middlesex TW8 9GS (GB).

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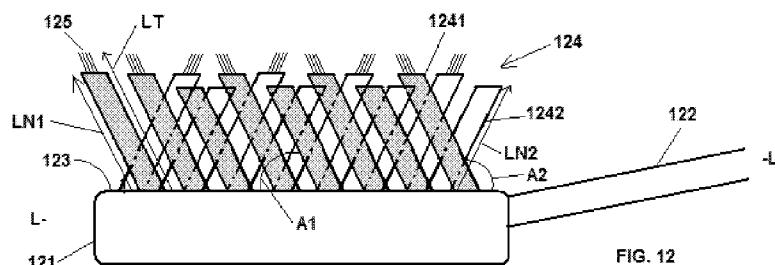
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(57) Abstract: A toothbrush head with bristles comprising tapered and non-tapered bristles, in which the non-tapered bristles extend to two different lengths from the face, being a first greater length LN<sup>1</sup> and a second shorter length LN<sup>2</sup>. In a preferred embodiment non-tapered bristles are combined with tapered bristles in tufts which are inclined in opposite directions away from and towards the grip handle.

## TOOTHBRUSH

This invention relates to toothbrushes, in particular to the bristle configuration of toothbrush heads. Especially this invention relates to improved toothbrush bristle configurations comprising tapered bristle filaments.

5       Toothbrushes are well known articles generally comprising a head for insertion in the user's mouth and a grip handle to be held during use, with a neck region in between. The toothbrush head normally has a surface, termed herein the "bristle surface" from which bristles extend from a lower end of the bristles closest to the bristle surface to an upper end distant from the bristle surface. Toothbrush bristles 10 are also well known articles, generally comprising a filament of a stiff but flexible material, disposed in tufts of plural filaments extending from the bristle surface. The polyamide Nylon is very frequently used as a toothbrush bristle material.

15      Although in most toothbrushes the bristle filaments have the same cross-section along their entire length from their lower to their upper end except for the extreme upper end which is end-rounded, it is also known to use tapered bristles which decrease in their cross section toward their upper end in a shallow generally conical sloping profile. Tapered bristles, being thinner at their upper end, have different bending and flexibility characteristics to non-tapered filaments. In particular 20 tapered bristles are known for efficacy in reaching into the spaces between the teeth, the so called "interproximal" spaces. For example such bristles are disclosed in EP-A-1 234 525, EP-A-1 415 572, US-A-6,546,586, WO-A-97/42853, WO-A-97/42854, WO-A-01/32053, WO-A-82741, EP-A-0 596 633 among others.

25      Particular relative dispositions of the tapered bristles on the bristle surface are also known. For example US-A-6,546,586 discloses a toothbrush head in which each tuft comprises plural bristle filaments made of polybutylene terephthalate in the form of shorter filaments of uniform cross section and longer filaments which taper toward their upper end. It is known to combine tapering and non-tapering bristles on a toothbrush head, e.g. from US-A-2006/0096053 which discloses a head for an electric toothbrush. It is also known from other disclosures to combine long and short bristle 30 filaments in a tuft e.g. US-A-3,103,679, WO-A-96/16571 and DE-A-35 28 596.

Generally there are two methods of producing such tapered bristles. One method is to chemically erode the ends of the bristle filaments. The other is to mechanically abrade them to a taper. It has previously been found difficult to accurately mechanically abrade bristle filaments in situ on a toothbrush head,

particularly to achieve differences in length between tapered and non-tapered bristles. A known toothbrush of the type disclosed in WO-A-96/16571 is known to have been unsuccessful commercially because of poor mouth feel. However recent new mechanical bristle abrasion technologies have opened up new possibilities for 5 exploring variations in length, inclination, tufting patterns etc. of tapered toothbrush bristles, especially in combination with non-tapered bristles.

It is an object of this invention to explore the possibilities of toothbrush heads with combinations of tapered and non-tapering bristles, especially with the intention of providing an improved toothbrush head incorporating tapered bristle filaments, e.g. 10 providing tooth cleaning, particularly in the interproximal spaces, at the gingival margin, in subgingival access, and also having manufacturing advantages. Other objects and advantages of the invention will be apparent from the following description.

According to a first aspect of this invention a toothbrush head is provided 15 having a bristle surface from which extend plural tufts of bristles, said bristles being arranged in plural tufts each of which contains plural bristles, said bristles comprising plural tapered bristles and plural non-tapered bristles, characterized in that said non-tapered bristles extend to two different lengths from the face, being a first greater length  $LN^1$  and a second shorter length  $LN^2$ .

The term “tapered bristles” is a term of the toothbrush bristle art, a synonym 20 being “pointed bristles” as for example used in US-A-2006/0096053, or “needle shaped bristles” as for example used in EP 1 425 989B. Such “tapered bristles” have a generally conical tapered profile over a substantial part of their length remote from the bristle face, e.g. 10-50% of their length remote from the bristle surface. “Non 25 tapered bristles” are differentiated from such tapered bristles in having a substantially uniform cross section along their length, except that conventionally their extreme ends remote from the bristle surface are rounded to help prevent damage to users’ soft tissues by otherwise jagged ends. In the art, bristles which are merely end rounded in this conventional manner are not considered to be “tapered bristles”.

In the toothbrush head of this invention the non-tapered bristles may for 30 example extend to substantially only two discrete lengths  $LN^1$  and  $LN^2$ , so that all of the non-tapered bristles are either only substantially of the length  $LN^1$  or  $LN^2$ , with no continuum of lengths of non-tapered bristles between these two lengths.

In the toothbrush head of this invention the tapered bristles may also for example extend to two different lengths from the face, being a first greater length  $LT^1$  and a second shorter length  $LT^2$ . For example such tapered bristles may extend to substantially only two discrete lengths  $LT^1$  and  $LT^2$ , so that all of the tapered bristles 5 are either only substantially of the length  $LT^1$  or  $LT^2$ , with no continuum of lengths of tapered bristles between these two lengths.

The present invention may be realized in various embodiments.

In one embodiment, one or more of the plural tufts may each comprise plural tapered bristles and plural non-tapered bristles in which the non-tapered bristles 10 extend to two different lengths from the face, being a first greater length  $LN^1$  and a second shorter length  $LN^2$ .

In this embodiment, in such one or more tuft, the tapered bristles may all be of substantially the same length  $LT$ , which may be longer than the first greater length  $LN^1$  of the non-tapered bristles. Alternatively in this embodiment, within such one or 15 more tuft, the tapered bristles may be of two or more respectively greater and shorter lengths  $LT^1$  and  $LT^2$ , and both  $LT^1$  and  $LT^2$  may be greater than the first greater length  $LN^1$  of the non-tapered bristles.

In another embodiment the tufts on the bristle surface comprises tufts which contain the non-tapered bristles, and in such tufts the non-tapered bristles extend to 20 the two different lengths from the face, being the first greater length  $LN^1$  and the second shorter length  $LN^2$ , and the tapered bristles are contained in tufts discrete from these. Such tufts which contain tapered bristles may contain only tapered bristles.

In this embodiment, in tufts containing tapered bristles the tapered bristles 25 may all be of substantially the same length  $LT$ , which may be longer than the first greater length  $LN^1$  of the non-tapered bristles. Alternatively in this embodiment, within such one or more tuft containing tapered bristles, the tapered bristles may be of two or more respectively greater and shorter lengths  $LT^1$  and  $LT^2$ , and both  $LT^1$  and  $LT^2$  may be greater than the first greater length  $LN^1$  of the non-tapered bristles.

In another embodiment the tufts on the bristle surface comprises tufts which contain the non-tapered bristles being only of the first greater length  $LN^1$ , and tufts 30 which contain non-tapered bristles being only of the second shorter length  $LN^2$ , and the tapered bristles are contained in tufts discrete from these tufts containing non-tapered bristles.

In this embodiment, in tufts containing tapered bristles the tapered bristles may all be of substantially the same length LT, which may be longer than the first greater length LN<sup>1</sup> of the non-tapered bristles. Alternatively in this embodiment, within such one or more such tuft, the tapered bristles may be of two or more 5 respectively greater and shorter lengths LT<sup>1</sup> and LT<sup>2</sup>, and both LT<sup>1</sup> and LT<sup>2</sup> may be greater than the first greater length LN<sup>1</sup> of the non-tapered bristles.

In these latter two embodiments one or more tufts containing non-tapered bristles may alternate longitudinally with one or more tufts containing tapered bristles. In the last-mentioned embodiment one or more tufts which contain non-tapered 10 bristles of the first greater length LN<sup>1</sup>, may alternate longitudinally with one or more tufts which contain the non-tapered bristles of the second shorter length LN<sup>2</sup>.

In another embodiment the tufts on the bristle surface comprise tufts which contain non-tapered bristles being of the first greater length LN<sup>1</sup>, and tufts which contain non-tapered bristles of the second shorter length LN<sup>2</sup>, and such tufts may also 15 contain tapered bristles.

For example in this last embodiment only the tufts which contain non-tapered bristles of the first greater length LN<sup>1</sup> may also contain the tapered bristles.

Alternatively only the tufts which contain the non-tapered bristles of the second shorter length LN<sup>2</sup> may also contain the tapered bristles. Alternatively both the tufts 20 which contain non-tapered bristles of the first greater length LN<sup>1</sup> and the tufts which contain the non-tapered bristles of the second shorter length LN<sup>2</sup>, may also contain the tapered bristles.

For example in this last embodiment the tapered bristles may all be of substantially the same length LT, which may be longer than the first greater length 25 LN<sup>1</sup> of the non-tapered bristles. Alternatively in this embodiment, the tapered bristles may be of two or more respectively greater and shorter lengths and such greater and shorter lengths may both be greater than the first greater length LN<sup>1</sup> of the non-tapered bristles. Alternatively in this embodiment the tapered bristles may be of two or more respectively greater and shorter lengths LT<sup>1</sup> and LT<sup>2</sup>, and both LT<sup>1</sup> and LT<sup>2</sup> 30 may be greater than the first greater length LN<sup>1</sup> of the non-tapered bristles. For example the difference between LT<sup>1</sup> and LT<sup>2</sup> may correspond to the difference between LN<sup>1</sup> and LN<sup>2</sup>.

According to a second aspect of this invention a toothbrush head is provided, being connected to or connectable to a toothbrush grip handle to thereby define a head

– grip handle longitudinal direction, the head being elongate in the longitudinal direction and having a width direction across the head perpendicular to the longitudinal direction, the head having a bristle surface from which plural tufts of bristles extend, the plural bristle tufts comprising;

5 at least one first tuft which is inclined in a direction having a longitudinal component at 75-85° to the bristle surface such that the ends of the bristles remote from the bristle surface are longitudinally further from the handle than the ends closest to the bristle surface,

10 at least one second tuft, widthways distanced from the first tuft, the second tuft being inclined in a direction having a longitudinal component at 75-85° to the bristle surface such that the ends of the bristles remote from the bristle surface are longitudinally closer to the handle than the ends closest to the bristle surface,

wherein in that at least one first tuft and/or at least one second tuft comprises tapered bristles,

15 and wherein the plural first tufts comprise first tufts having a greater length and first tufts having a lesser length, and the plural second tufts may comprise second tufts having a greater length and second tufts having a lesser length.

In this aspect preferably there are plural first tufts arranged along a line extending with a longitudinal direction component along the bristle surface, and plural 20 second tufts arranged along a line extending with a longitudinal direction component along the bristle surface, the line of first tufts being widthways distanced from the line of second tufts. Such a line may be parallel to the longitudinal direction, at an acute angle to the longitudinal direction, curved, zig-zag or sinuous. Across the width of the toothbrush head there may be plural such pairs of lines of first and second tufts.

25 In this aspect the respective greater lengths may be the same. The respective lesser lengths may be the same. In this embodiment the greater length of the first and second tufts may be the same, and the lesser length of the first and second tufts may be the same.

In this aspect, in a line of first tufts, individual tufts of the greater length may 30 alternate longitudinally with tufts of the lesser length. Similarly in a line of second tufts, individual tufts of the greater length may alternate longitudinally with tufts of the lesser length. Alternatively, in a line of tufts, individual tufts of the greater or lesser length may alternate longitudinally with two or more tufts of respectively the lesser or greater length. Alternatively, in a line of tufts, two or more tufts of the

greater or lesser length may alternate longitudinally with two or more tufts of respectively the lesser or greater length. In this embodiment suitably the length of the tapered bristles is greater than the lesser length of the first and second tufts, preferably greater than the greater length of the first and second tufts.

5 In this aspect preferably the angle of inclination is 78-82° to the bristle surface. Preferably all of the tufts are inclined at the same acute angle of inclination to the bristle surface, although first and second tufts are inclined in opposite directions.

In a third aspect of this invention the toothbrush head has a bristle surface from which plural tufts of bristles extend, the plural bristle tufts comprising;

10 at least one first tuft which is inclined in a direction having a longitudinal component at 75-85° to the bristle surface such that the ends of the bristles remote from the bristle surface are longitudinally further from the handle than the ends closest to the bristle surface,

15 at least one second tuft, widthways distanced from the first tuft, the second tuft being inclined in a direction having a longitudinal component at 75-85° to the bristle surface such that the ends of the bristles remote from the bristle surface are longitudinally closer to the handle than the ends closest to the bristle surface,

20 the plural first tufts comprise tufts comprising non-tapered bristles having a greater length  $LN^1$  and tufts comprising non-tapered bristles having a lesser length  $LN^2$ ,

and at least one first tuft and/or at least one second tuft also comprises tapered bristles.

In this aspect the respective greater lengths  $LN^1$  of non-tapered bristles in first and second tufts may be the same. In this embodiment the respective lesser lengths 25  $LN^2$  of non-tapered bristles in the first and second tufts may be the same.

In this aspect individual first tufts including non-tapered bristles of the greater length  $LN^1$  may alternate longitudinally with first tufts including non-tapered bristles of the lesser length  $LN^2$ . Similarly in a line of second tufts, individual second tufts including non-tapered bristles of the greater length  $LN^1$  may alternate longitudinally 30 with second tufts including non-tapered bristles of the lesser length  $LN^2$ .

Alternatively individual first tufts including non-tapered bristles of the greater length  $LN^1$  or lesser length  $LN^2$  may alternate longitudinally with two or more tufts including non-tapered bristles of respectively the lesser or greater length.

Alternatively, two or more tufts including non-tapered bristles of the greater LN<sup>1</sup> or lesser LN<sup>2</sup> length may alternate longitudinally with two or more tufts including non-tapered bristles of respectively the lesser length LN<sup>2</sup> or greater length LN<sup>1</sup>.

5 In this aspect suitably the length LT of the tapered bristles is greater than the lesser length LN<sup>2</sup> of the non-tapered bristles preferably greater than the greater length LN<sup>1</sup> of the non-tapered bristles.

In an embodiment longer tapering bristles and shorter tapering bristles differ in length by 7mm or less, e.g. 4mm or less, for example 2 to 4mm.

10 Typically the length to which the shorter tapering bristles extend from the bristle surface is 9 +/- 1mm and the length to which the shorter tapering bristles extend from the bristle surface is 13 +/- 1mm.

15 Typically the tapering bristles may be circular in cross section, typically 0.1 – 0.25 mm, e.g. 0.15 – 0.20 mm, at maximum. This is a typical standard dimension for toothbrush bristle filaments. In one construction each tuft may contain 2 – 12 longer tapering bristles, and 20 – 30 shorter tapering bristles.

It has been found that in a tuft which contains both non-tapering and tapering bristles, 5 - 7 tapering bristles and 26 – 28 non-tapering bristles in the tuft is a suitable number for an optimized effect.

20 It is found that this range of numbers of longer and shorter tapering bristles in the tufts can be advantageous in providing an acceptable mouth feel and in getting the longer bristles in between the teeth. Too few longer bristles may not feel comfortable to the user, too many and it may not be easy to get a larger number of the longer bristles between the teeth.

25 The longer and shorter tapering bristles may be disposed within tufts in various ways. For example the longer bristles may be disposed predominantly about the central longitudinal axis of the tuft. For example alternatively the longer bristles may be disposed essentially randomly within the tuft.

30 In the toothbrush head of this invention the tufts comprising tapering bristles may be disposed in various ways on the bristle surface of the head. For example all of the tufts on the toothbrush head may comprise such tufts, and may be disposed in a conventional pattern on the bristle surface. For example such tufts may be disposed in a pattern on the bristle surface of the head in combination with tufts comprising only non-tapered bristles.

Typically the tapering bristles may be made of polyamide, e.g. Nylon, particularly the material Tynex™. This is inter-alia due to the current state of optimization of available machines capable of abrading the ends of bristle filaments to a tapering profile, and the properties of such bristle filament materials as Tynex™.

5 In a preferred process, the toothbrush head of this invention may be made by a process in which the bristles which are to become tapered bristles are first fixed into the face and the upper ends of the bristles are then mechanically abraded into a tapered shape. Machines able to do such mechanical abrasion are known in the toothbrush manufacturing art.

10 This fixing may for example be by insertion into tuft socket holes in the face, or by the so-called “anchorless” process in which the bristles are fixed into the hot fluid plastics material of the head during the injection moulding process in which the head is made.

Alternatively bristle filaments may be purchased in an already tapered form.

15 There are two main types of such commercially available tapering bristle filaments.

Double ended bristle filaments are tapered at both ends and are normally mounted in a toothbrush bristle surface by folding them in the middle into a “U” shape and setting the folded middle region of the “U” shape in a socket hole in the bristle surface using a conventional “anchor”. In the toothbrush heads of this

20 invention the tapering and non-tapering bristle filaments may comprise such double-ended filaments, conventionally folded in a “U” shape with the bend of the “U” inserted into the socket hole and retained therein by a conventional metal anchor. In such a construction each length of “U” shaped filament provides two bristles extending from the bristle surface.

25 Single ended bristle filaments are tapered at only one end and are normally mounted in a toothbrush bristle surface by folding them close to the non-tapered end into a “J” shape and setting the folded end region of the “J” shape in a socket hole in the bristle surface using a conventional “anchor”.

30 In a further aspect the present invention provides a toothbrush provided with a head as described herein.

The handle and head of the toothbrush of this invention may be made of known materials such as plastics materials and elastomer materials and may incorporate known features. For example the handle may incorporate features which modify the flexibility of the handle, for example the folded region disclosed in EP-A-

0336641. For example the connection between the head and handle may be a flexible connection, for example as disclosed in WO-A-9724949. For example the head of the toothbrush may be divided into flexibly-linked segments for example as disclosed in WO-A-9707707. For example the connection between the head and handle may be a 5 flexible connection, and the head of the toothbrush may be divided into flexibly-linked segments for example as disclosed in WO-A-9837788.

The toothbrush of the invention may be a manual toothbrush, i.e. to be brought into contact with the user's head solely by hand action, or the toothbrush may be a power toothbrush in which the bristles of the head are moved by an electric, e.g. 10 battery powered, motor.

The invention will now be described by way of example only with reference to the accompanying figures.

Fig. 1 shows a toothbrush generally.

Figs. 2 to 11 show arrangements of bristles of a toothbrush head of the 15 invention.

Figs. 12 to 15 show arrangements of tufts which are inclined at a non perpendicular angle to the bristle surface.

In Fig. 1 a toothbrush is shown generally, comprising a head 10 for insertion in the user's mouth and a grip handle 11 to be held during use, with a neck region 12 in between. The toothbrush 10 has a longitudinal direction L-L in the head-handle 20 direction, shown by the hatched line. The toothbrush head 10 has a surface 13, termed herein the "bristle surface" from which plural tufts 14 of bristles (shown generally) extend from a lower end closest to the bristle surface to an upper end distant from the bristle surface 13 in a bristle direction B.

Fig. 1 also shows the ends remote from the bristle surface 13 of two bristles 14 in detail. 15 is a non-tapered bristle, and has a generally cylindrical profile for almost all of its length i.e. region 15A, e.g. 95% or more, and the extreme end 15B, ca. 5% or less is rounded in a smooth curved e.g. an ellipsoid. 16 is a tapered bristle, and has a generally cylindrical profile in its region 16A close to the bristle surface 13 and up to 30 ca. 70% or more of its length, but for the extreme part of its length over region 16B distant from the bristle surface, e.g. 30% or less it is tapered in a sharp generally conical point.

In Fig. 2, the bristle surface of an embodiment of a toothbrush of this invention is shown in a side view. In this embodiment the ends of a single tuft 21

(being a tuft 14 as seen in Fig.1) of bristles extending from the bristle surface 13 closest to the bristle surface and remotest from the bristle surface are shown in detail. The tuft 21 comprises tapered bristles 22 and plural non-tapered bristles 23, 24. The non-tapered bristles 23, 24 comprise non-tapered bristles 23 of a first greater length 5  $LN^1$  and non-tapered bristles 24 of a second shorter length  $LN^2$ . All of the non-tapered bristles are either of the first greater length  $LN^1$  or the second shorter length  $LN^2$ . In the embodiment shown in Fig. 2 all of the tapered bristles 22 are all of substantially the same length LT, which is longer than the first greater length  $LN^1$  of the non-tapered bristles 23.

10 In Fig. 3 a variant of the construction illustrated in Fig. 2 is shown. A single tuft 31 (being a tuft 14 as seen in Fig.1) comprises tapered bristles 32, 33 and plural non-tapered bristles 34, 35. The non-tapered bristles 34, 35 comprise non-tapered bristles 34 of a first greater length  $LN^1$  and non-tapered bristles 35 of a second shorter length  $LN^2$ . Within tuft 31 the tapered bristles 32, 33 are of two respectively greater 15 and shorter lengths  $LT^1$  and  $LT^2$ , and both  $LT^1$  and  $LT^2$  are greater than the first greater length  $LN^1$  of the non-tapered bristles 34. All of the non-tapered bristles are either of the first greater length  $LN^1$  or the second shorter length  $LN^2$ .

15 In Fig. 4 the bristle configuration of another embodiment of a toothbrush head of this invention is shown in a side view. In this embodiment plural tufts 41, 42 of bristles are shown extending from bristle surface 13. The tufts 41 contain the non-tapered bristles, and in such tufts 41 the non-tapered bristles extend to the two different lengths from the face, being the first greater length  $LN^1$  and the second shorter length  $LN^2$ . All of the non-tapered bristles are either of the first greater length 20  $LN^1$  or the second shorter length  $LN^2$ . Tufts 42 containing only tapered bristles are discrete from tufts 41. In the tufts 42 the tapered bristles are all of substantially the same length LT, which is longer than the first greater length  $LN^1$  of the non-tapered 25 bristles in tufts 41.

20 In Fig. 5 a variant of the configuration illustrated in Fig. 4 is shown, parts in common with Fig. 4 being numbered in common. In this variant within the tufts 51 tapered bristles are present having two respectively greater and shorter lengths  $LT^1$  and  $LT^2$ , and both  $LT^1$  and  $LT^2$  are greater than the first greater length  $LN^1$  of the non-tapered bristles in tufts 41. All of the tapered bristles are either of the first greater length  $LT^1$  or the second shorter length  $LT^2$ .

In Fig. 6 the bristle configuration of another embodiment of a toothbrush head of this invention is shown in a side view. In this embodiment the tufts 61 (general) on the bristle surface 13 comprise tufts 62 which contain non-tapered bristles being only of the first greater length  $LN^1$  and tufts 63 which contain non-tapered bristles being only of the second shorter length  $LN^2$ . All of the non-tapered bristles are either of the first greater length  $LN^1$  or the second shorter length  $LN^2$ . Tapered bristles are contained in tufts 64 discrete from these tufts 62 and 63 containing non-tapered bristles. In the tufts 64 containing tapered bristles the tapered bristles are of substantially the same length LT, which is longer than the first greater length  $LN^1$  of the non-tapered bristles in the tufts 62. Alternatively (not shown) LT may be the same as or less than the first greater length  $LN^1$ .

In Fig. 7 a variant of the construction in Fig. 6 is shown, features in common with Fig. 6 being numbered correspondingly. In Fig. 7 within tufts 71 the tapered bristles are of two respectively greater and shorter lengths  $LT^1$  and  $LT^2$ . In this variant both  $LT^1$  and  $LT^2$  may be greater than the first greater length  $LN^1$  of the non-tapered bristles in tufts 63. All of the tapered bristles in tufts 71 are either of the first greater length  $LT^1$  or the second shorter length  $LT^2$ .

In the embodiments of Figs. 4, 5, 6 and 7 one or more tufts 41, 62, 63 containing non-tapered bristles may alternate longitudinally with one or more tufts 42, 51, 64, 71 containing tapered bristles. For example one or more tufts 62 which contain non-tapered bristles of the first greater length  $LN^1$ , may alternate longitudinally with one or more tufts 63 which contain the non-tapered bristles of the second shorter length  $LN^2$ . For example this is shown in Figs. 6 and 7.

In Fig. 8 the bristle surface 13 of another embodiment of a toothbrush head of this invention is shown in a side view. In this embodiment the tufts on the bristle surface 13 comprise tufts 81 which contain non-tapered bristles being of the first greater length  $LN^1$ , and tufts 82 which contain non-tapered bristles of the second shorter length  $LN^2$ . All of the non-tapered bristles are either of the first greater length  $LT^1$  or the second shorter length  $LT^2$ . The tufts 82 also contain tapered bristles 83, all of the same length LT. The length LT is the same as the first greater length  $LN^1$ .

In Fig. 9 the bristle surface 13 of another embodiment of a toothbrush head of this invention is shown in a side view. In this embodiment the tufts on the bristle surface comprise tufts 91 which contain non-tapered bristles being of the first greater length  $LN^1$ , and tufts 92 which contain non-tapered bristles of the second shorter

length  $LN^2$ . All of the non-tapered bristles are either of the first greater length  $LN^1$  or the second shorter length  $LN^2$ . the tufts 91 also contain tapered bristles 93, all of the same length LT which is longer than  $LN^1$ .

In Fig. 10 the bristle surface 13 of another embodiment of a toothbrush head 5 of this invention is shown in a side view. In this embodiment the tufts on the bristle surface 13 comprise tufts 101 which contain non-tapered bristles being of the first greater length  $LN^1$ , and tufts 102 which contain non-tapered bristles of the second shorter length  $LN^2$ . All of the non-tapered bristles are either of the first greater length LT<sup>1</sup> or the second shorter length LT<sup>2</sup>. The both tufts 101 and 102 also contain tapered 10 bristles 103,104, all of the same length LT which is longer than  $LN^1$ .

In Fig. 11 the bristle surface 13 of another embodiment of a toothbrush head 15 of this invention is shown in a side view. In this embodiment the tufts on the bristle surface comprise tufts 111 which contain non-tapered bristles being of the first greater length  $LN^1$ , and tufts 112 which contain non-tapered bristles of the second shorter length  $LN^2$ . All of the non-tapered bristles are either of the first greater length LT<sup>1</sup> or the second shorter length LT<sup>2</sup>. Tufts 112 contain tapered bristles 113, and the tufts 111 contain tapered bristles 114. The tapered bristles 113 and 114 are respectively of two different lengths LT<sup>1</sup> and LT<sup>2</sup>, and the difference between LT<sup>1</sup> and LT<sup>2</sup> corresponds to the difference between  $LN^1$  and  $LN^2$ . All of the tapered bristles are 20 either of the first greater length LT<sup>1</sup> or the second shorter length LT<sup>2</sup>.

In the embodiments of Figs. 8, 9, 10 and 11 the tufts 81,82; 91,92; 101,102 and 111,112 alternate longitudinally along the bristle surface 13.

Figs. 12 – 17 exemplify toothbrush heads of the second and third aspects of this invention.

25 In Fig. 12 a side view of the head 121 and immediately longitudinally adjacent part of the neck 122 of a toothbrush of this invention is shown, looking in the width direction. Neck 122 connects the head 121 integrally to a grip handle (not shown). From bristle surface 123 extend plural tufts of bristles 124 overall. The plural bristle tufts 124 comprise plural first tufts 1241 inclined in a direction having a longitudinal 30 component at an acute angle “A1” 75-85° to the bristle surface such that the ends of the bristles 1241 remote from the bristle surface 123 are longitudinally further from the handle than the ends closest to the bristle surface 123. The tufts 124 further comprise plural second tufts 1242, widthways distanced from the first tufts 1241, the second tufts 1242 also being inclined in a direction having a longitudinal component

at acute angle "A2" 75-85° to the bristle surface such that the ends of the bristles remote from the bristle surface 123 are longitudinally closer to the handle than the ends closest to the bristle surface 123.

5 The first tufts 1241 and second tufts 1242 are arranged in respective lines extending with a longitudinal direction component along the bristle surface 123. Such an arrangement is more clearly shown in the plan view Fig. 13 which shows the direction in which the tufts 1241, 1242 incline.

10 As seen in Fig. 12 the plural first tufts 1241 and second tufts 1242 comprise tufts containing non-tapered bristles having a greater length  $LN^1$  and tufts containing non-tapered bristles having a lesser length  $LN^2$ . The respective greater lengths of tufts  $LN^1$  are the same, and the respective lesser lengths  $LN^2$  are the same.

15 The first and second tufts 1241 and 1242 which contain non-tapered bristles of the greater length  $LN^1$  also comprise tapered bristles 125 and these tapered bristles have a length LT greater than the length  $LN^1$  of the non tapered bristles therein such that the tapered bristles 125 extend beyond the ends of the non-tapered bristles therein.

As shown in Fig. 12 individual tufts of the greater length  $LN^1$  alternate longitudinally with tufts of the lesser length  $LN^2$ .

20 Longitudinally between the tufts 1241, 1242 of greater length  $LN^1$  which contain tapered bristles 125 are shorter tufts of length  $LN^2$  which do not contain tapered bristles but only non-tapered bristles.

25 In the construction shown in Fig. 13, adjacent the end of the head 121 furthest from the handle neck 122 is a cluster of plural tufts 126 which are inclined in the direction indicated by the arrow, i.e. the same direction as the first tufts 1241. These tufts 126 comprise non-tapered tufts of the same length as the non-tapered bristles in tufts 1241, and tapered bristles which have a length greater than the length of the non tapered bristles therein such that the tapered bristles extend beyond the ends of the non-tapered bristles in tufts 126.

30 Referring to Fig. 14 this shows another embodiment of this invention in a view analogous to Fig. 12. Fig. 14 shows a side view of the head 141 and immediately longitudinally adjacent part of the neck 142 which connects the head 141 integrally to a grip handle (not shown), looking in the width direction. From bristle surface 143 extend plural tufts of bristles 144 overall. The arrangement of the plural bristle tufts 144 is analogous to those 124 shown in Fig. 12, but in the arrangement shown in Fig.

14 tufts 145, 146 being of the lesser length also include tapered bristles 147 and non-tapered bristles, the length of the tapered bristles 145 being greater than the length of the non-tapered bristles therein. Tufts 148 of the greater length also include tapered bristles 149 and non-tapered bristles, the length of the tapered bristles 149 being  
5 greater than the length of the non-tapered bristles therein.

Referring to Fig. 15 this shows another embodiment of this invention in a view analogous to Fig. 14. Fig. 15 shows a side view of the head 151 and immediately longitudinally adjacent part of the neck 152 which integrally joins the head to the grip handle (not shown), looking in the width direction. From bristle surface 153 extend  
10 plural tufts of bristles 154 overall. The arrangement of the plural bristle tufts 154 is analogous to those 124 shown in Fig. 12, but in the arrangement shown in Fig. 15 the first tufts 155 being of the greater length consist entirely of tapered bristles having the greater length. Second tufts 156 having the greater length comprise both non-tapered bristles and tapered bristles 157, the tapered bristles 157 being longer than the non-  
15 tapered bristles in the tufts 156. Tufts 158 of a lesser length than the tufts 155, 156 comprise only non-tapered bristles.

Referring to Fig. 16 this shows a plan view of a toothbrush head 161 and part of the immediately adjacent neck 162 which connects the head 161 integrally to the grip handle (not shown), looking down on the bristle surface 163 in a direction  
20 perpendicular to the longitudinal direction L-L and the width direction W-W. In an arrangement similar to Fig. 13, a pattern of first tufts 164, 165 and second tufts 166 (generally) extend from the bristle surface 14, and arrows indicate the respective directions of inclination of the tufts 164, 165, 166. In Fig. 16 pairs of first tufts 1641,1642 which include tapered bristles and non tapered bristles, and in which the  
25 tapered bristles are longer than the non-tapered bristles, longitudinally alternate in a line with individual first tufts 1643 which consist only of non-tapered bristles. In the tufts 164,165,166 there are tufts which are respectively of greater and lesser length, e.g. analogously to the constructions of Figs. 12-15 above. In this arrangement the second tufts 165 and a further line of first tufts 166 consist entirely of non-tapered  
30 bristles. In this arrangement therefore, only the lines 164 of first tufts which are widthways outermost in the pattern of tufts 164,165,166 on the bristle surface 163 include tapered bristles.

Analogous to Fig. 13, adjacent the end of the head 161 furthest from the handle 162 is a cluster of tufts 167 of the greater length, which lean in the direction of

the first tufts 164,165, and which comprise non-tapered bristles and tapered bristles, the tapered bristles in these tufts 167 being longer than the non-tapered bristles.

It will be immediately apparent to those skilled in the art that tufts containing tapered bristles may be provided only in the widthways outermost lines of tufts can be 5 provided in other dispositions of tapered bristles e.g. as shown in Figs. 12-15.

For example, referring to Fig. 17 this shows a plan view of a toothbrush head 171 and part of the immediately adjacent neck 172 which connects the head integrally to the grip handle (not shown), looking down on the bristle surface 173 in a direction perpendicular to the longitudinal direction L-L and the width direction W-W. In an 10 arrangement similar to Fig. 16, a pattern of first 174,175 and second 176 tufts extend from the bristle surface 173 in an arrangement analogous to Fig. 16, arrows indicating the respective directions of inclination of the tufts. In Fig. 17 all of the first tufts 174 include tapered bristles and non tapered bristles, and in these tufts 174 the tapered bristles are longer than the non-tapered bristles therein. In the tufts 174, 175, 176 15 there are tufts which are respectively of greater and lesser length, e.g. analogously to the constructions of Figs. 12-16 above. In this arrangement the second tufts 176 and a further line of first tufts 175 consist entirely of non-tapered bristles. In this arrangement therefore, only the lines 174 of first tufts which are widthways outermost in the pattern of tufts 174, 175, 176 on the bristle surface 173 include tapered bristles. 20 Analogous to Fig. 13, adjacent the end of the head 171 furthest from the handle 172 is a cluster of tufts 177 of the greater length, which lean in the direction of the first tufts 174, and which comprise only non-tapered bristles.

Typically in Figs. 12-17 the greater length may be 11-13 mm and the lesser length 25 may be 9-11 mm. For example the tapered bristles may be 1 – 5 mm, for example 2 - 4 mm longer than the greater length.

**Claims.**

1. A toothbrush head having a bristle surface from which extend plural tufts of bristles, said bristles being arranged in plural tufts each of which contains plural bristles, said bristles comprising plural tapered bristles and plural non-tapered bristles, characterized in that said non-tapered bristles extend to two different lengths from the face, being a first greater length  $LN^1$  and a second shorter length  $LN^2$ .
2. A toothbrush head according to claim 1 wherein the non-tapered bristles extend to substantially only two discrete lengths  $LN^1$  and  $LN^2$ , so that all of the non-tapered bristles are either only substantially of the length  $LN^1$  or  $LN^2$ .
3. A toothbrush head according to claim 1 or 2 wherein the tapered bristles extend to two different lengths from the face, being a first greater length  $LT^1$  and a second shorter length  $LT^2$ .
4. A toothbrush head according to claim 3 wherein the tapered bristles extend to substantially only two discrete lengths  $LT^1$  and  $LT^2$ , so that all of the tapered bristles are either only substantially of the length  $LT^1$  or  $LT^2$ .
5. A toothbrush head according to any one of the preceding claims wherein one or more of the plural tufts each comprise plural tapered bristles and plural non-tapered bristles in which the non-tapered bristles extend to two different lengths from the face, being a first greater length  $LN^1$  and a second shorter length  $LN^2$ .
6. A toothbrush according to claim 5 wherein in said one or more tuft, the tapered bristles are all of substantially the same length  $LT$  longer than the first greater length  $LN^1$  of the non-tapered bristles.
7. A toothbrush according to claim 5 wherein in said one or more tuft, the tapered bristles are of two or more respectively greater and shorter lengths  $LT^1$  and  $LT^2$ , and both  $LT^1$  and  $LT^2$  being greater than the first greater length  $LN^1$  of the non-tapered bristles.

8. A toothbrush head according to any one of claims 1 to 4 wherein the tufts on the bristle surface comprise tufts which contain the non-tapered bristles, and in such tufts the non-tapered bristles extend to the two different lengths from the face, being  
5 the first greater length  $LN^1$  and the second shorter length  $LN^2$ , and the tapered bristles are contained in tufts discrete from these.

9. A toothbrush head according to claim 8 wherein in tufts containing tapered bristles the tapered bristles are all of substantially the same length LT, longer than the  
10 first greater length  $LN^1$  of the non-tapered bristles.

10. A toothbrush head according to claim 8 wherein in one or more tuft containing tapered bristles, the tapered bristles are of two or more respectively greater and shorter lengths  $LT^1$  and  $LT^2$ , and both  $LT^1$  and  $LT^2$  being greater than the first greater  
15 length  $LN^1$  of the non-tapered bristles.

11. A toothbrush head according to any one of claims 1 to 4 wherein the tufts on the bristle surface comprise tufts which contain the non-tapered bristles being only of the first greater length  $LN^1$ , and tufts which contain non-tapered bristles being only  
20 of the second shorter length  $LN^2$ , and the tapered bristles are contained in tufts discrete from these tufts containing non-tapered bristles.

12. A toothbrush head according to claim 11 wherein in tufts containing tapered bristles the tapered bristles are all of substantially the same length LT, longer than the  
25 first greater length  $LN^1$  of the non-tapered bristles.

13. A toothbrush head according to claim 11 wherein in tufts containing tapered bristles the tapered bristles are of two or more respectively greater and shorter lengths  $LT^1$  and  $LT^2$ , and both  $LT^1$  and  $LT^2$  are greater than the first greater length  $LN^1$  of the  
30 non-tapered bristles.

14. A toothbrush head according to any one of claims 1 to 4 wherein the tufts on the bristle surface comprise tufts which contain non-tapered bristles being of the first

greater length LN<sup>1</sup>, and tufts which contain non-tapered bristles of the second shorter length LN<sup>2</sup>, and such tufts may also contain tapered bristles.

15. A toothbrush head according to claim 14 wherein only the tufts which contain  
5 non-tapered bristles of the first greater length LN<sup>1</sup> also contain the tapered bristles.

16. A toothbrush head according to claim 15 wherein only the tufts which contain the non-tapered bristles of the second shorter length LN<sup>2</sup> also contain the tapered bristles.

10

17. A toothbrush head according to claim 15 wherein both the tufts which contain non-tapered bristles of the first greater length LN<sup>1</sup> and the tufts which contain the non-tapered bristles of the second shorter length LN<sup>2</sup> also contain the tapered bristles.

15

18. A toothbrush head according to claim 15 wherein the tapered bristles are all of substantially the same length LT, longer than the first greater length LN<sup>1</sup> of the non-tapered bristles.

20

19. A toothbrush head according to claim 15 wherein the tapered bristles are of two or more respectively greater and shorter lengths and such greater and shorter lengths are both greater than the first greater length LN<sup>1</sup> of the non-tapered bristles.

25

20. A toothbrush head according to claim 15 wherein the tapered bristles are of two or more respectively greater and shorter lengths LT<sup>1</sup> and LT<sup>2</sup>, and both LT<sup>1</sup> and LT<sup>2</sup> being greater than the first greater length LN<sup>1</sup> of the non-tapered bristles.

30

21. A toothbrush head, being connected to or connectable to a toothbrush grip handle to thereby define a head – grip handle longitudinal direction, the head being elongate in the longitudinal direction and having a width direction across the head perpendicular to the longitudinal direction, the head having a bristle surface from which plural tufts of bristles extend, the plural bristle tufts comprising;

at least one first tuft which is inclined in a direction having a longitudinal component at 75-85° to the bristle surface such that the ends of the bristles remote

from the bristle surface are longitudinally further from the handle than the ends closest to the bristle surface,

5 at least one second tuft, widthways distanced from the first tuft, the second tuft being inclined in a direction having a longitudinal component at 75-85° to the bristle surface such that the ends of the bristles remote from the bristle surface are longitudinally closer to the handle than the ends closest to the bristle surface,

wherein in that at least one first tuft and/or at least one second tuft comprises tapered bristles,

10 and wherein the plural first tufts comprise first tufts having a greater length and first tufts having a lesser length, and the plural second tufts may comprise second tufts having a greater length and second tufts having a lesser length.

15 22. A toothbrush head according to claim 21 wherein there are plural first tufts arranged along a line extending with a longitudinal direction component along the bristle surface, and plural second tufts arranged along a line extending with a longitudinal direction component along the bristle surface, the line of first tufts being widthways distanced from the line of second tufts.

20 23. A toothbrush head according to claim 21 or 22 wherein the respective greater lengths are the same.

24. A toothbrush head according to claim 21, 22 or 23 wherein the respective lesser lengths are the same.

25 25. A toothbrush head according to claim 24 wherein the greater length of the first and second tufts is the same, and the lesser length of the first and second tufts is the same.

30 26. A toothbrush head according to any one of claims 21 to 25 wherein in a line of first tufts, individual tufts of the greater length alternate longitudinally with tufts of the lesser length.

27. A toothbrush head according to claim 26 wherein in a line of second tufts, individual tufts of the greater length alternate longitudinally with tufts of the lesser

length.

28. A toothbrush head according to claim 1 which has a bristle surface from which plural tufts of bristles extend, the plural bristle tufts comprising;

5 at least one first tuft which is inclined in a direction having a longitudinal component at 75-85° to the bristle surface such that the ends of the bristles remote from the bristle surface are longitudinally further from the handle than the ends closest to the bristle surface,

10 at least one second tuft, widthways distanced from the first tuft, the second tuft being inclined in a direction having a longitudinal component at 75-85° to the bristle surface such that the ends of the bristles remote from the bristle surface are longitudinally closer to the handle than the ends closest to the bristle surface,

15 the plural first tufts comprise tufts comprising non-tapered bristles having a greater length  $LN^1$  and tufts comprising non-tapered bristles having a lesser length  $LN^2$ ,

and at least one first tuft and/or at least one second tuft also comprises tapered bristles.

29. A toothbrush head according to claim 28 wherein the respective greater 20 lengths  $LN^1$  of non-tapered bristles in first and second tufts is the same.

30. A toothbrush head according to claim 28 or 29 wherein the respective lesser lengths  $LN^2$  of non-tapered bristles in the first and second tufts is the same.

25 31. A toothbrush head according to claim 28, 29 or 30 wherein individual first tufts including non-tapered bristles of the greater length  $LN^1$  alternate longitudinally with first tufts including non-tapered bristles of the lesser length  $LN^2$ .

32. A toothbrush head according to claim 31 wherein in a line of second tufts, 30 individual second tufts including non-tapered bristles of the greater length  $LN^1$  alternate longitudinally with second tufts including non-tapered bristles of the lesser length  $LN^2$ .

33. A toothbrush head according to any one of claims 28 to 31 wherein individual first tufts including non-tapered bristles of the greater length  $LN^1$  or lesser length  $LN^2$  alternate longitudinally with two or more tufts including non-tapered bristles of respectively the lesser or greater length.

5

34. A toothbrush head according to any one of claims 28 to 31 wherein two or more tufts including non-tapered bristles of the greater  $LN^1$  or lesser  $LN^2$  length may alternate longitudinally with two or more tufts including non-tapered bristles of respectively the lesser length  $LN^2$  or greater length  $LN^1$ .

10

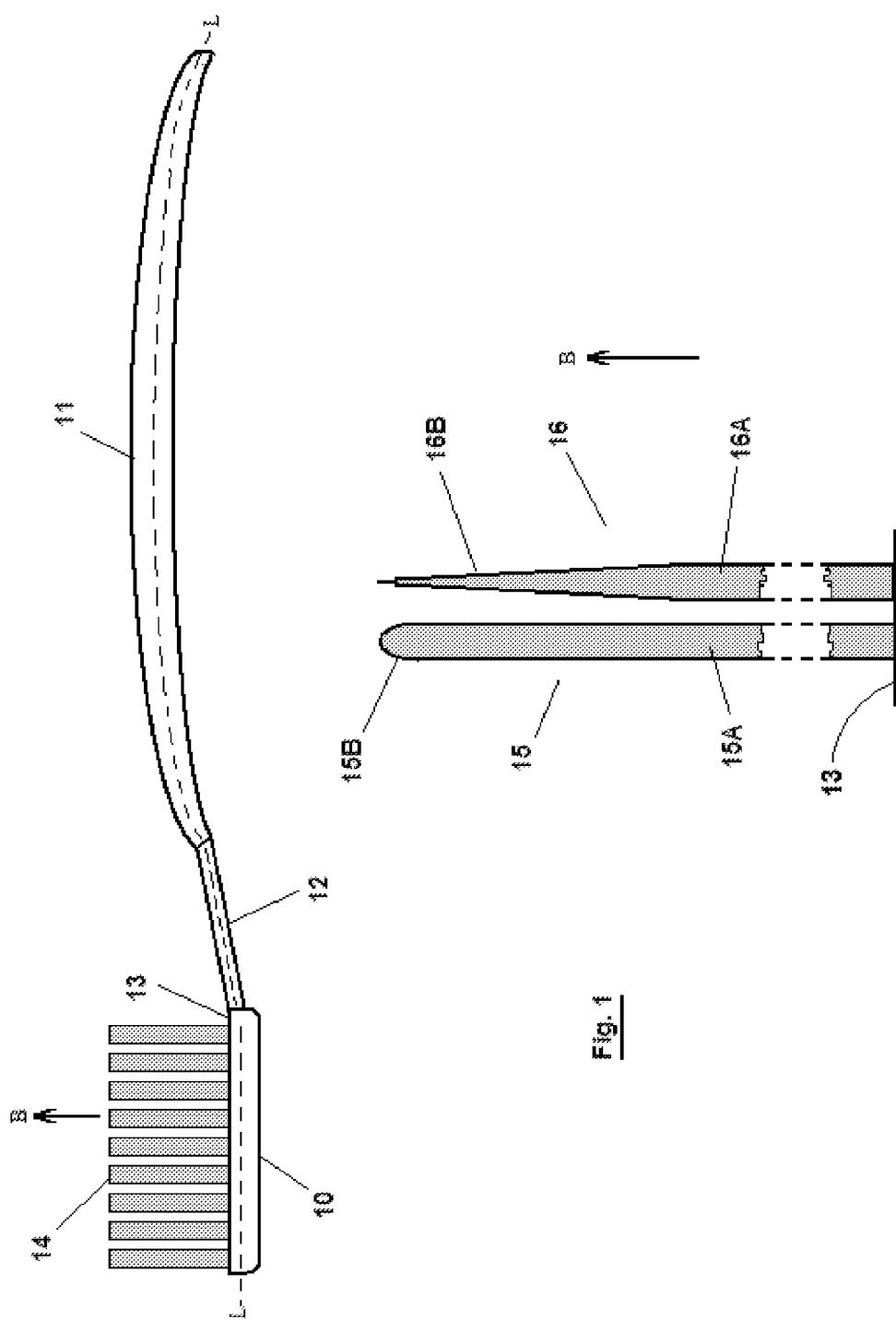
35. A toothbrush head according to any one of claims 28 to 34 wherein the length  $LT$  of the tapered bristles is greater than the greater than the greater length  $LN^1$  of the non-tapered bristles.

15

36. A toothbrush head according to any one of claims 21 to 35 wherein the angle of inclination is  $78-82^\circ$  to the bristle surface.

37. A toothbrush provided with a head according to any one of claims 1 to 37.

20



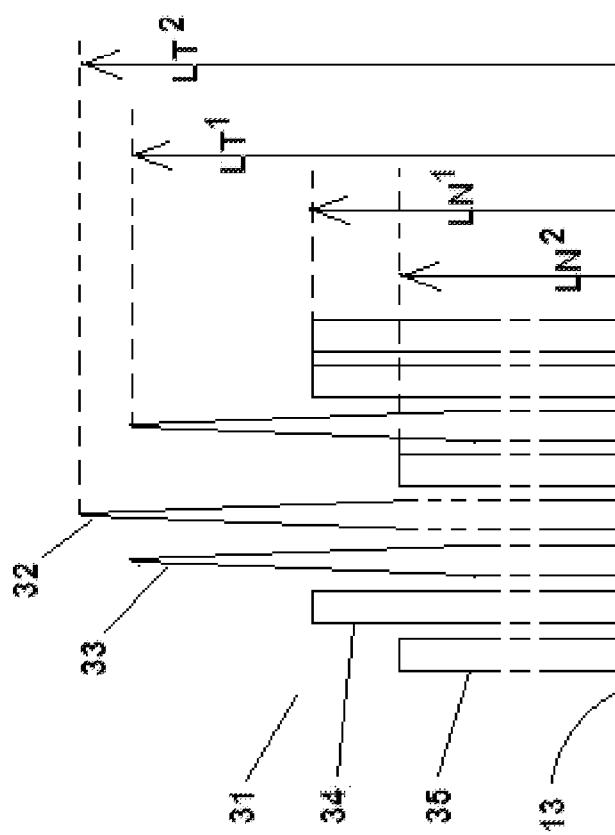


Fig. 3

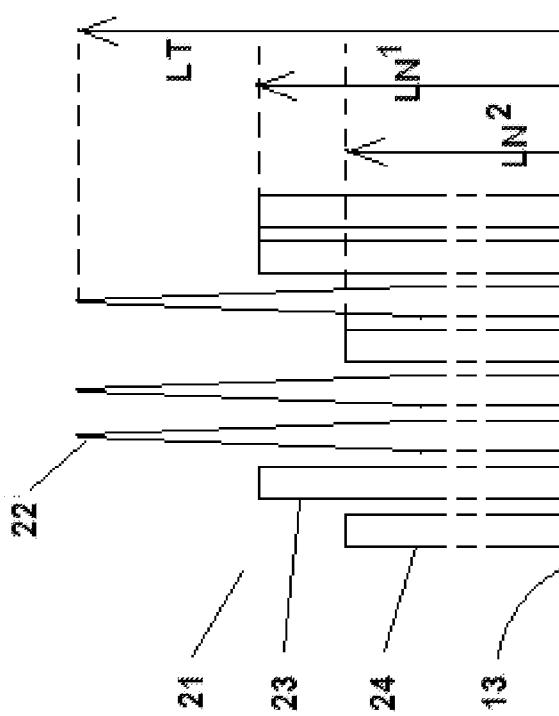


Fig. 2

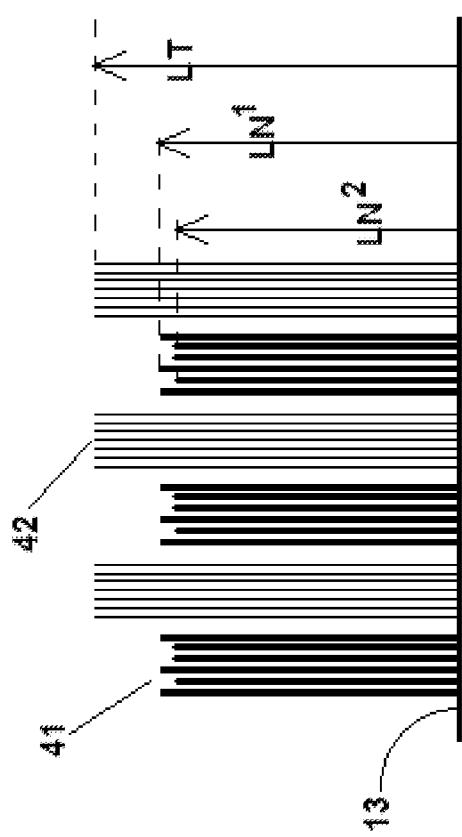


Fig. 4

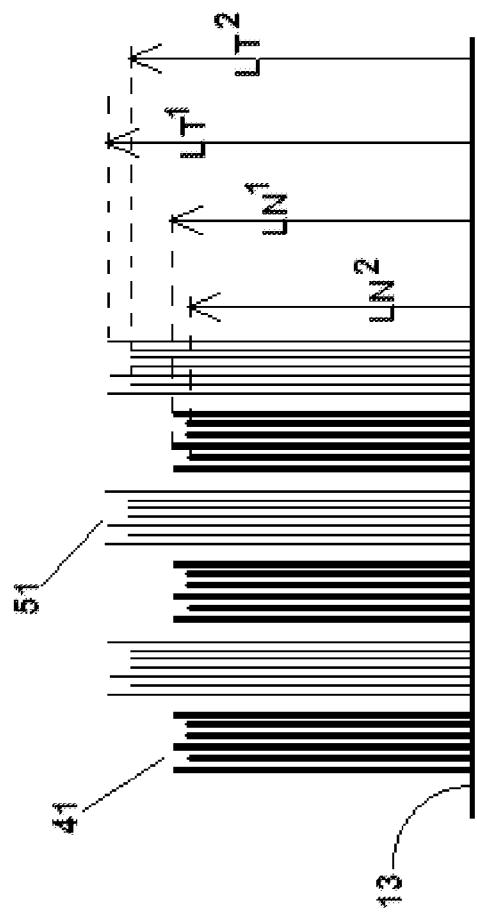


Fig. 5

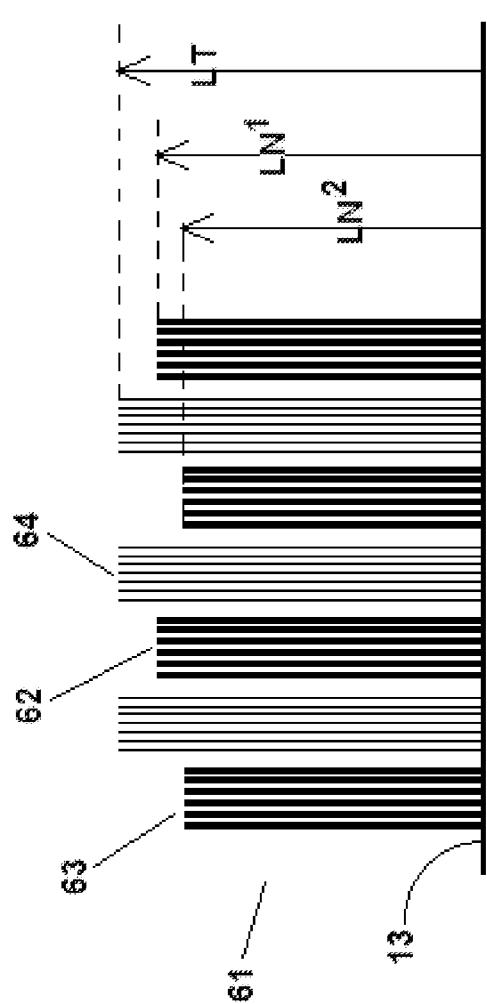


Fig. 6

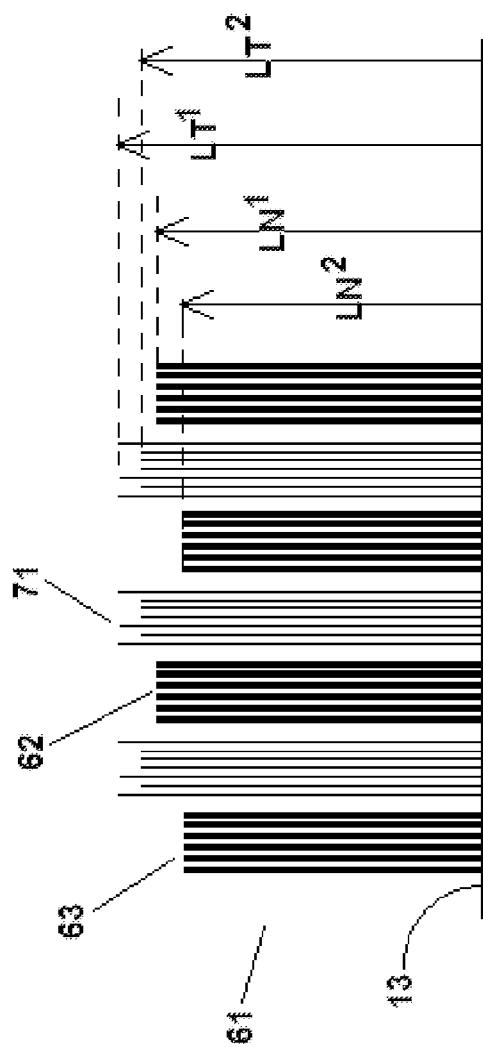


Fig. 7

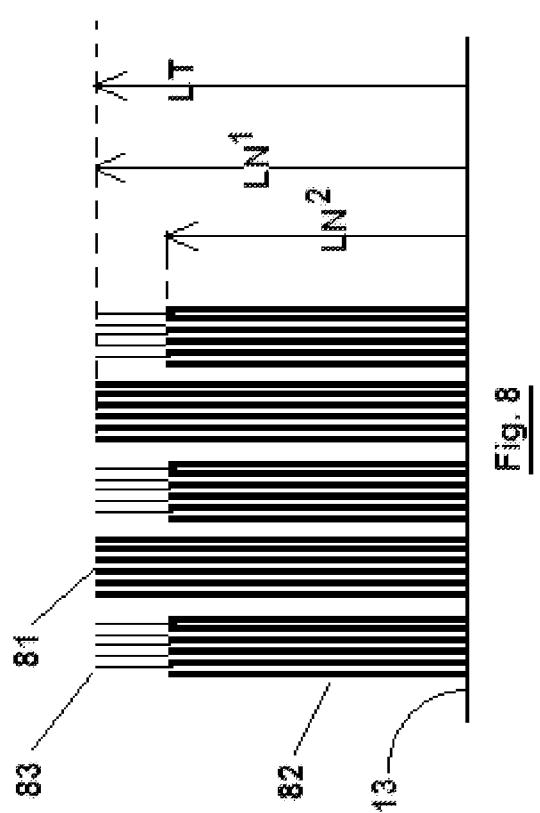


Fig. 8

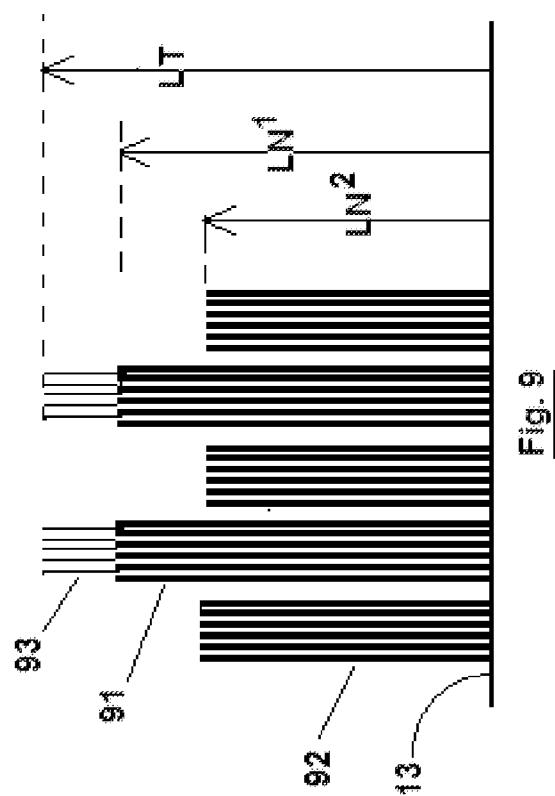


Fig. 9

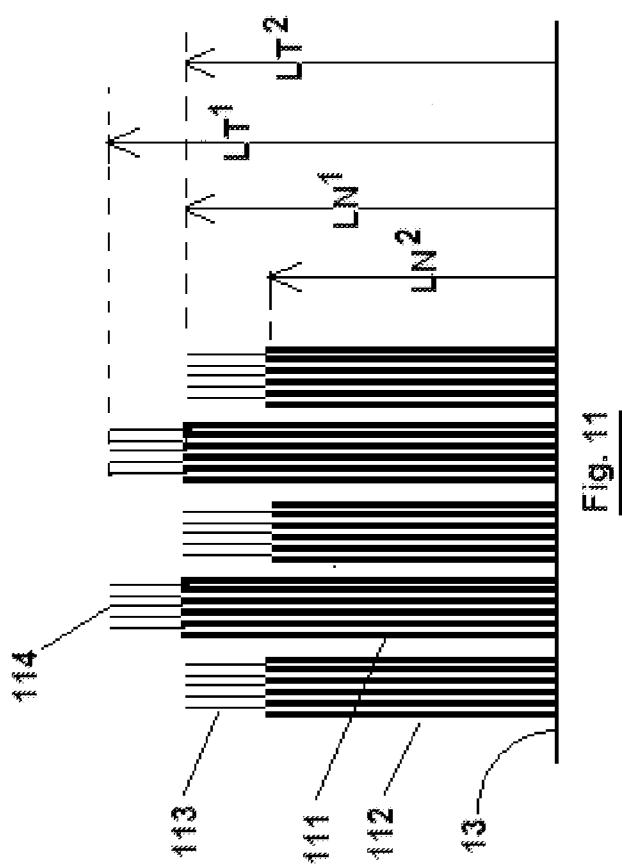


Fig. 11

Fig. 10

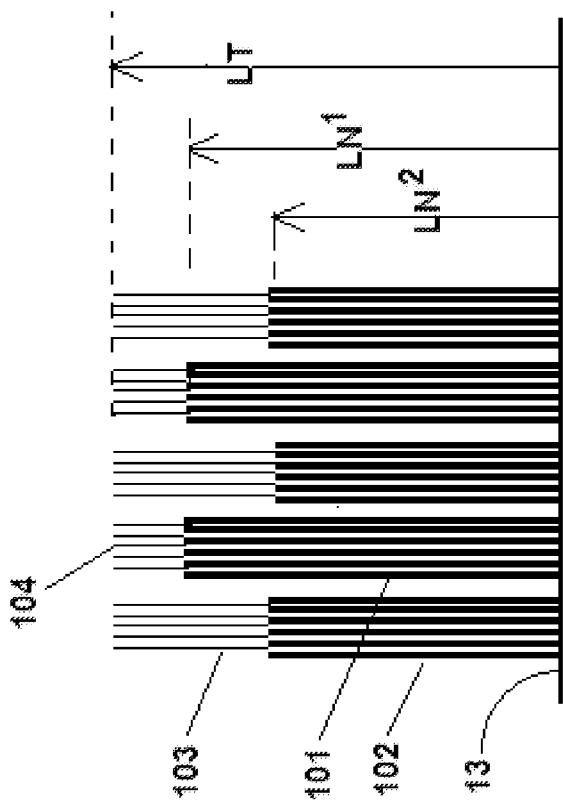
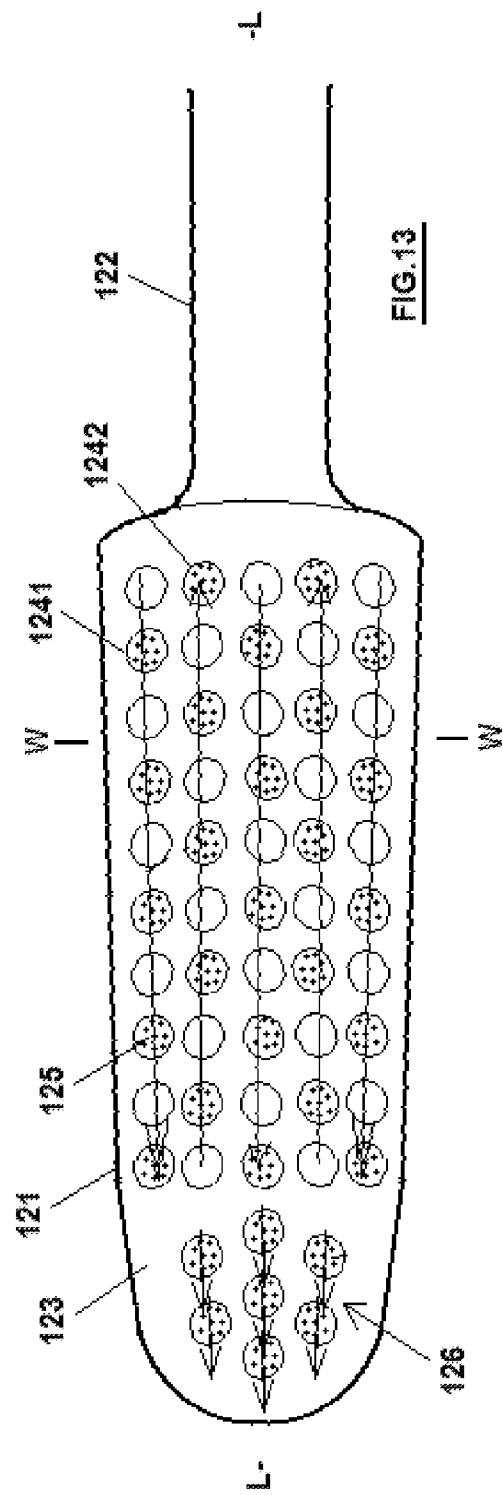
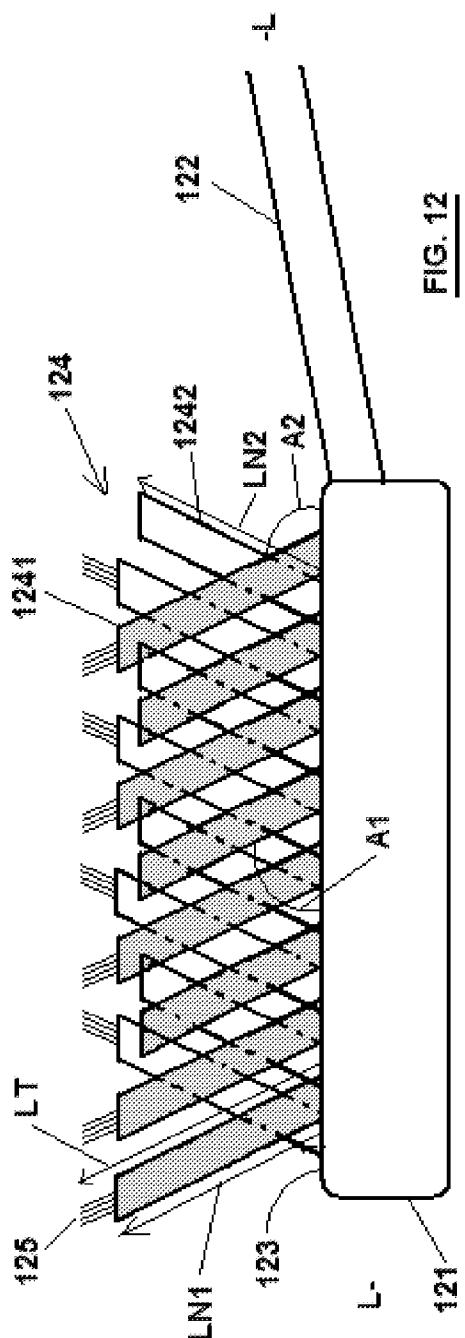
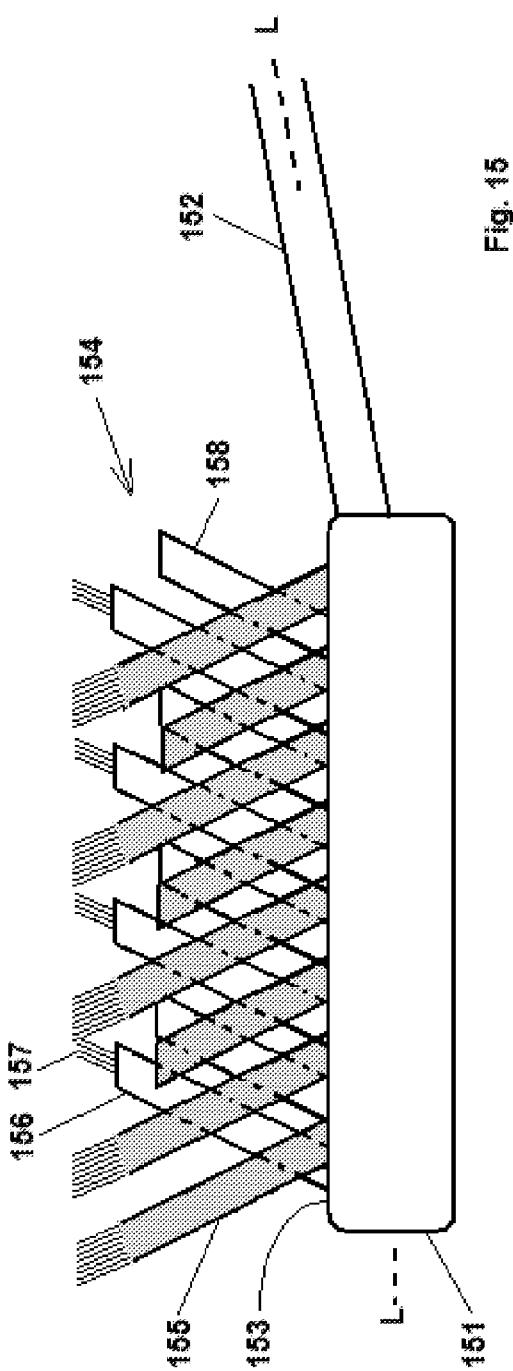
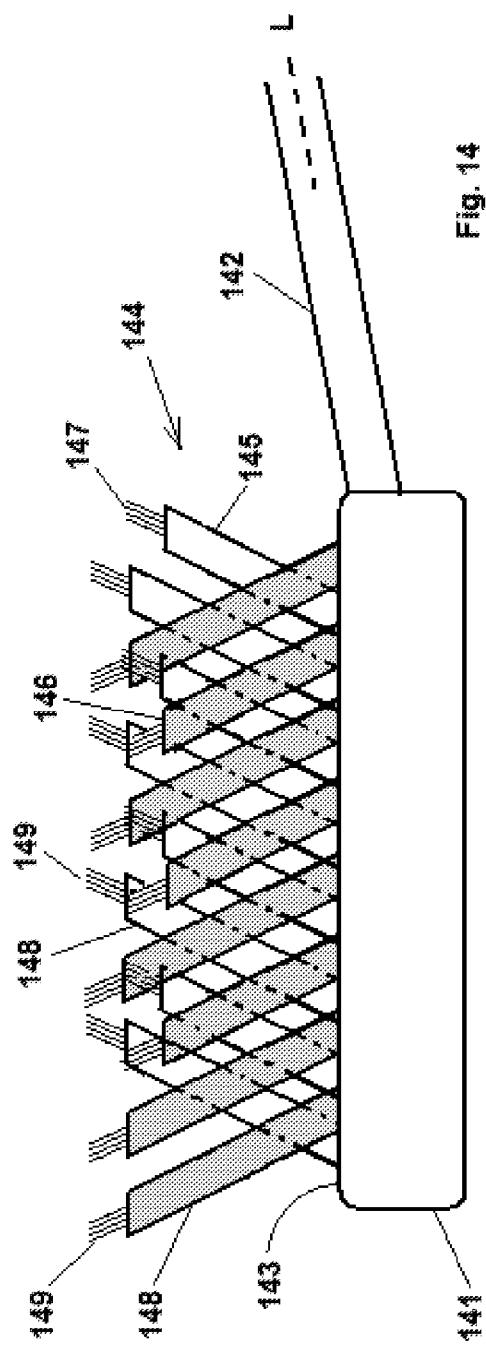
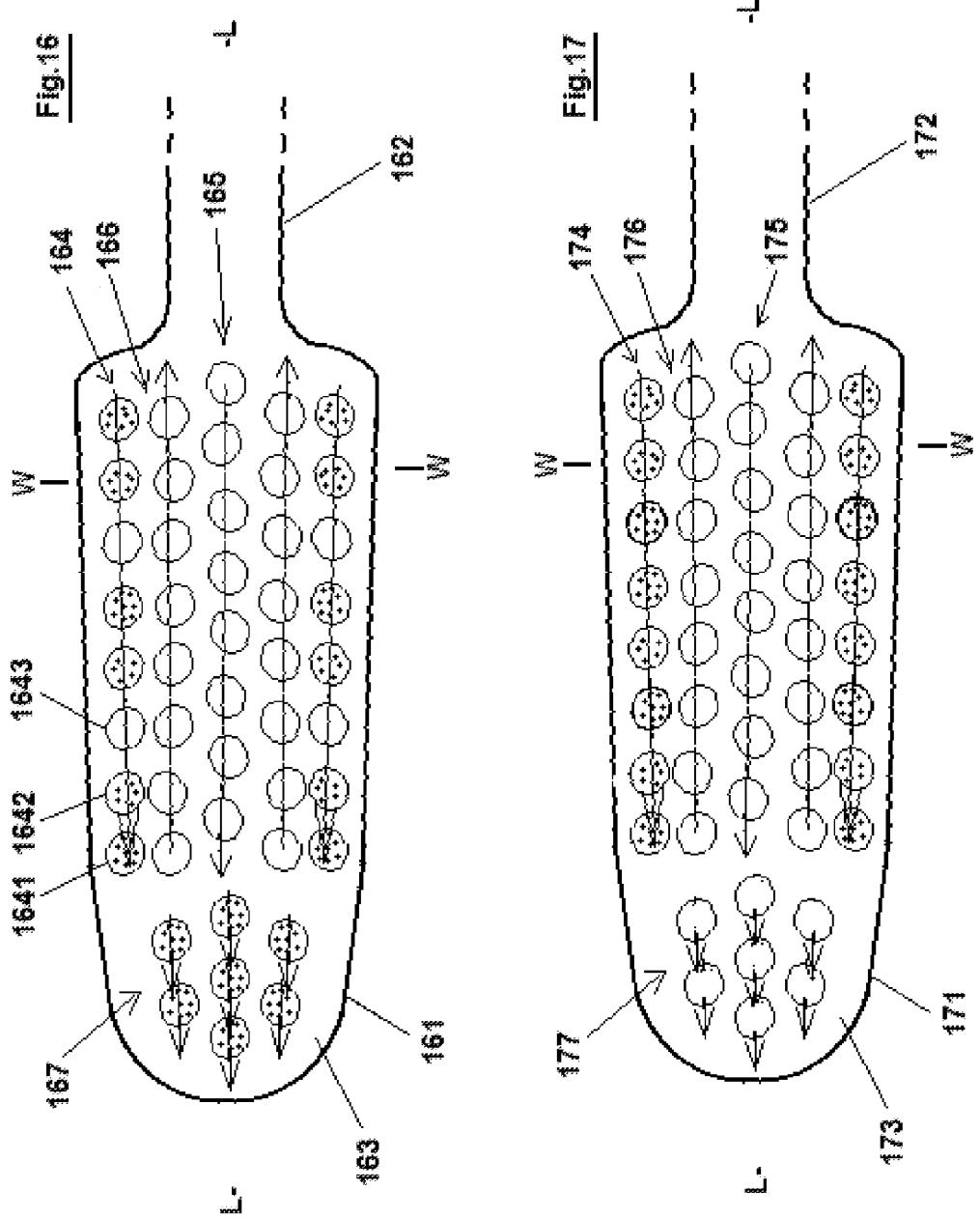


Fig. 10







# INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2009/067076

A. CLASSIFICATION OF SUBJECT MATTER	INV. A46B9/04	A46B9/02	A46B9/06
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A46D1/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
A46B A46D

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

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

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/271276 A1 (GARBERG CHRISTINE [DE] ET AL) 6 November 2008 (2008-11-06) paragraphs [0013], [0040]; figures 1-3	1-2,8-9, 11-12,37 21,28
X	US 2006/236478 A1 (HOHLBEIN DOUGLAS J [US] ET AL) 26 October 2006 (2006-10-26) paragraphs [0028], [0035]; figures 1-6	1-20,37
X	US 2008/184511 A1 (BROWN WILLIAM RALPH [US] ET AL) 7 August 2008 (2008-08-07) paragraphs [0097], [0158], [0166], [0172], [0173]; figures 1A-G,15E,16A-C	21-27,37
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Further documents are listed in the continuation of Box C.

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Name and mailing address of the ISA/  
European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040,  
Fax: (+31-70) 340-3016

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**INTERNATIONAL SEARCH REPORT**

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**C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

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