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(54) **Title**: TOOTHBRUSH AND METHOD OF MANUFACTURING IT

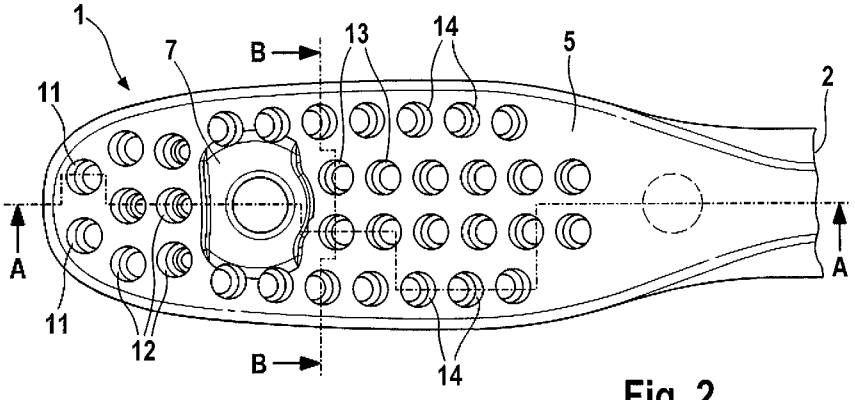

Fig. 2

(57) **Abstract**: The present invention is directed to a toothbrush having a handle portion, a neck portion and a head, said head being provided with bristle tufts arranged in a complex internal geometry by means of the stapling technique. To enable a visually flawless molding to be produced, material cross-sections in the head, in particular in the area of the blind-end holes provided for tufting, are taken into consideration.

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TOOTHBRUSH AND METHOD OF MANUFACTURING IT

This invention relates to a toothbrush having a handle portion and a neck portion connecting the handle portion with a head, said head having a brushing side and a rear side opposite thereto, said brushing side including a plurality of bristle tufts for cleaning the teeth, said tufts being attachable in the head through tufting apertures using an anchor, with each tufting aperture being assigned a blind-end hole having sidewalls and a bottom. The present invention relates furthermore to a method of manufacturing such a toothbrush.

From WO 2006/050039 A1 there is known a toothbrush head in which the blind-end holes extend at different depths into the head from the brushing side of the head. Given bristle tufts of equal length for the respective blind-end holes, it is suggested in this manner to produce a topography of the bristle ends on the brushing side.

From DE 102 21 786 A1 it is also known to insert bristle tufts of equal length into blind-end tufting holes in the head, likewise with the aim to obtain a different topography of the bristle ends by providing the brushing side of the head with an inclination.

From WO 2008/059435 there is known a toothbrush having in the toothbrush bristle zone an LED, partly in the head and partly protruding therefrom.

The aim is to keep the thickness of the toothbrush head as small as possible in order to enable a comfortable use in the mouth. This stands, however, in contrast to the increasing functional demands placed on a toothbrush head, making it necessary to provide head geometries which, owing to their complex inner structure, make it difficult to produce a visually faultless hard plastic injection molding. During the injection molding process the plastic material flowing into the die for molding the head is exposed to turbulence between the various blind-end tufting holes and other recesses or cavities of the molding and therefore flows very unevenly, particularly to undercuts or more complex structures lying farther away from the injection point. This problem is aggravated as soon as plastic materials are used for the head which exhibit greater shrinkage on cooling subsequent to the injection molding process. Depending on the inner structure of the head, visual faults or sunk spots, in particular also on the rear side of the head, are the undesired consequence.

It is therefore an object of the present invention to provide a toothbrush which has a complex inner structure within the head while yet affording a visually flawless manufacture, in particular also with regard to the rear side of the head. It is another object of the present invention to provide a suitable method.

This object is accomplished by a toothbrush with the features of claim 1 and by a method with the features of claim 14.

An advantageous aspect of the invention has revealed that a minimum distance x or y of between 0.5 and 2.5 mm between a bottom of a blind-end hole provided for the insertion of bristle tufts and the rear side of the head enables a thinner toothbrush head to be provided which affords more comfortable handling in the mouth. If, in addition, the cross-sectional areas within the head between the bottoms and the rear side differ significantly from blind-end hole to blind-end hole, thus resulting in a more complex structure, it is of importance that in the transition area between the bottom of the blind-end hole and the sidewalls of the blind-end hole a chamfer or radius is provided, because this enables the injection molding to reach a higher level of perfection. In this arrangement, there are no restrictions to the small size of the bottom provided that the chamfered or radiused area rendering the blind-end hole smaller becomes correspondingly larger to form nearly a bottom. Considered as cross-sectional area between bottom and rear side of the head is in particular a section through the head which cuts across the blind-end hole and forms a plane arranged at right angles to the toothbrush longitudinal axis. Conventionally, the toothbrush longitudinal axis extends from the head end to the handle end of the toothbrush or, depending on the overall geometry, at least from the beginning of the head adjacent to the neck portion to the end of the head. Differences in the cross-sectional area or in the wall thicknesses of the injection molding may be attributable to recesses and cavities in the injection molding, undercuts or different configurations of the blind-end holes relative to each other. Of course, similar problems for the sides of the head or the brushing side or other portions of the toothbrush should be remedied in a similar way.

In a further advantageous aspect, the minimum distance x and y between the bottom and the rear side of the head is fixed to between 0.8 and 2 mm. Particularly when the length of the blind-end holes and thus the depth of the bottom or the distance to the rear side are fitted to suit each other in such a way that in a complex head structure wall thicknesses of approximately uniform magnitude result, uniform cooling in the molding after the injection-molding process and with it uniform shrinkage are ensured. Sunk spots at locations where major amounts of material have accumulated can thus be avoided. In particular when this minimum distance x and y is in the range of between 0.5 and 2.5 mm or 0.8 and 2 mm between the bottom and the rear side for all or the majority of the blind-end holes of the head, it is ensured that, depending on how the inner structure of the head is otherwise designed, the material thicknesses in the head are still sufficiently uniform, in spite of an inhomogeneous inner structure, in order to be able to obtain a flawless injection-molded product.

In a further advantageous aspect, provision is made for third and fourth blind-end holes which can be tufted with bristles to the same depth, with the third and fourth blind-end holes being constructed such that their bottoms extend to different depths. This makes it

possible for the tufting depth of the tufts to be alike in the third and fourth blind-end holes while yet providing, due to different levels of depth, compensating chambers to compensate for material accumulations and the attendant material shrinkage problems.

In another advantageous aspect, the chamfer or radius in the fourth blind-end hole is followed by a constriction (opposite the sidewall lying above) and an adjoining further radius or chamfer and only then by the closing bottom. This enables the constriction to remain devoid of bristle tufts which affords, as set forth in the foregoing, a largely uniform tufting depth and hence a simplified manufacturing process.

In another advantageous aspect, the head has a first interior region and a second interior region, with the first interior region being made of hard plastic and the second interior region including an electrically operable function element or part thereof. The head is thus characterized by an inhomogeneous, rugged inner structure, with the second interior region requiring the provision of cavities in the molding of the first interior region. These cavities to be provided in the head in addition to the blind-end hole geometries result in added complexity, causing the flow areas of the liquid plastic to be severely narrowed, with many angles and boundaries and undercuts during the injection-molding operation in the die. Furthermore, the second interior region defines maximum material thicknesses which prescribe a certain cooling period for the plastic molding.

In another advantageous aspect, an injection point for the hard plastic of the head is provided on the neck or on the handle portion, and the blind-end holes are spaced at different relative axial distances to the injection point on the head, with provision being made in the hard plastic of the head for a free space for the function element between these blind-end holes spaced at different relative distances. Preferably, blind-end holes are hence provided both in the injection direction before, and in the injection direction after, the free space or cavity for the function element. In addition, blind-end holes may also be provided laterally or above the cavity, causing the complexity of the inner structure to be enhanced still further and making it necessary to take into account the material thicknesses or measures against undesired shrinkage effects closely.

In another advantageous aspect, the head includes at least one fifth blind-end hole which is arranged adjacent to and above the function element or above the free space or above the second interior region and is shorter than the third and fourth blind-end holes. Hence it is proposed shortening the blind-end hole depth at those locations in the head where the free space is correspondingly limited by other cavities for the formation of blind-end holes. In an alternative embodiment, all the blind-end holes are reduced to this dimension at a uniform depth from the brushing side of the head into the head interior.

In another advantageous aspect, the rear side of the head is made of the same hard plastic as the brushing side. This does not preclude injection molding the head at other locations using the two-component or multi-component injection molding technique, for example, when it is desired to have elastomer elements molded on in the brushing area. However, the rear side remains preferably at least in part devoid of a second plastic component which, while it may conceal visual defects on the molding on the one hand, adds to the thickness of the head on the other hand.

In another advantageous aspect, the head is formed of a hard plastic material which exhibits more than 1% material shrinkage after the actual injection-molding operation. Rather than selecting a different hard plastic, which is likewise conventional for the injection molding of toothbrush bodies but entails other disadvantages, for solving the material shrinkage problems which may produce visual defects already from 1% material shrinkage, it is accordingly preferred to match the inner structure of the head to the demands of material shrinkage.

In another advantageous aspect, the head is formed of polypropylene (PP hard plastic). Polypropylene usually has 2% material shrinkage after the injection-molding process.

In another advantageous aspect, the head is formed of polyethylene, POM, SAN or copolyester hard plastic.

In another advantageous aspect, the head includes first and second bristle tufts of different lengths from the bottom of the blind-end hole to the bristle end spaced from the brushing area of the head, with the first and second bristle tufts being of approximately equal length from the brushing side to the bristle end. Alternatively, the first and second bristle tufts are of different lengths from the brushing side to the bristle end.

In another advantageous aspect, provision is made in the head for at least one blind-end hole having its central axis arranged at an angle to the perpendicular on the brushing side. Hence the head includes blind-end holes or tufting holes which extend at an inclination therein and are thus able to receive bristle tufts emerging from the head angularly. Angled bristle tufts enhance the cleaning performance of the bristles on the tooth, in which case however the angled blind-end holes may lead to increased turbulence of the liquid plastic in the die of the molding to be produced, in particular on staggered angled arrangements.

The present invention relates also to a method of manufacturing a toothbrush exhibiting the features of claim 1.

Further objects, advantages and application possibilities of the present invention will become apparent from the subsequent description of embodiments with reference to the accompanying drawing. It will be appreciated that any feature described and/or represented by illustration, when used singularly or in any meaningful combination, forms the subject matter of the present invention, irrespective of their summary in the claims or their back-reference.

In the drawing,

FIG. 1 is a perspective view of a bristled head of a toothbrush according to the invention;

FIG. 2 is a top plan view of the head of FIG. 1, shown devoid of bristles;

FIG. 3 is a longitudinal sectional view taken along the line A-A of FIG. 2; and

FIG. 4 is a cross-sectional view taken along the line B-B of FIG. 2, but with the bristles shown attached to the head.

FIG. 1 shows in a perspective representation the head of a manual or electric toothbrush. The neck portion of the toothbrush adjoins the breakaway line 2 and is not shown in the Figures. Arranged in longitudinal continuation of the neck portion along the longitudinal axis 3 is a handle portion of the toothbrush in which electrical components are received according to the present embodiment in order to supply an electrically operable function element in the head with energy and the corresponding electrical components. For this purpose, the handle portion and the neck portion are provided preferably with cavities in the interior. In the present case, the electrically operable function element is preferably an LED arranged in protruding fashion on the brushing side 5 of the head within the bristle tufts 6. According to the present embodiment, the brushing side 5 is preferably of planar construction. Arranged on the brushing side are front cleaning bristles 6a positioned adjacent to the distal end of the head 1. The front cleaning bristles 6a are aligned forwardly at an angle to the longitudinal axis 3 so that the posterior wisdom teeth can be reached particularly well. The bristle zone includes furthermore two outer rows of bristle tufts 6b which according to the present embodiment are arranged at an inclination to the handle portion. Provided between these outer rows of bristle tufts 6b are two center bristle rows having bristle tufts 6c arranged at an inclination towards the distal end of the head 1. It will be understood that the toothbrush may include any other bristle configurations or oral care elements in combination with bristle tufts 6.

FIG. 2 shows a top plan view of the head and hence the brushing side 5 of the toothbrush. FIG. 3 shows a longitudinal section along the line A-A of FIG. 2, and FIG. 4

shows a cross-section along the line B-B of FIG. 2. The bristle tufts 6 are not shown in FIGS. 3 and 2. In FIG. 4 the bristle tufts have been added. Provided in the front half of the head 1 is a ramp 7 or, alternatively, for example, an elastomer element (not shown) which surrounds the LED 4. The associated cable connections are not shown in FIGS. 2, 3 and 4. The LED is inserted into the mounting hole 8 within the ramp 7 or the elastomer element. Adjoining in the interior of the head is a free space 9 or cavity 9 for the electrical leads to be provided for the electrically operable function element (here LED). The molding of the head 1 includes corresponding recesses for this free space.

As becomes apparent in particular from FIG. 3, blind-end holes 11, 12, 13 and 14 are provided for receiving the bristle tufts 6a through tufting apertures 10. The blind-end holes are tufted with bristle tufts, which in turn are comprised of a multiplicity of bristles or filaments, using the method referred to as anchor tufting (also called stapling technique). In this process, an anchor 15 (see FIG. 4) is driven centrally into a bristle tuft in a manner known in the art, said anchor seating itself in the hard plastic of the head to thereby ensure a secure fastening of the bristle tufts 6 in the head. The blind-end holes 11, 12, 13 and 14 have respective sidewalls 16 which form the lateral boundary surfaces for the bristle tufts in the blind-end holes. In combination with the sidewalls 16, the blind-end holes thus define as a rule a cylindrical body. Bottoms 17 and 18 are provided to limit the blind-end holes in downward direction in the interior of the head 1. The sidewalls 16 are connected with the bottoms 17 through chamfers or radiuses which ultimately form a conically tapering or frusto-conical section in the blind-end hole. According to this embodiment, the head 1 has blind-end holes 11, 13 and 14 which have their sides bounded exclusively by the sidewalls 16, the adjoining chamfers or radiuses 19 and the bottoms 17. The tufting depth of the bristle tufts within the blind-end holes 11, 13 and 14 extends to roughly the bottoms 17. Unlike the other blind-end holes, the blind-end holes 12 are provided with constrictions 20, so that the following structure results for these blind-end holes. Adjoining the tufting apertures 10 of the blind-end holes 12, sidewalls 16 begin to extend into the depth of the head 1, which sidewalls continue downwardly in a chamfer or radius 19 which, similar to the other blind-end holes, is of a conically or frusto-conically tapering configuration. Adjoining the chamfer or radius 19 further into the depth is a constricted portion 20 which in this case is likewise hollow, cylindrical, but of a smaller diameter than that defined by the sidewall 16. This constricted portion continues in a further chamfer or radius which connects the constriction with the bottom 18 of the blind-end holes 12. The constriction may also be formed by other geometries, as, for example, the frustum of a cone, a cone, a taper or curved surfaces. Unlike the other blind-end holes, the blind-end holes 12 are not tufted down to the bottom but only as far as the first chamfer or radius 19 which is located at approximately the same level of depth as the chamfer or radius 19 of the adjacent blind-end holes 11. In consequence, the front group of bristle tufts 6a of the head 1 extends to a

uniform tufting depth in the head 1, which simplifies the manufacturing process. The purpose of the constriction 20 is to prevent sunk spots from developing due to material shrinkage which would occur in the absence of such a constriction on material accumulation in the area of cross-section of the head on the rear side, because shrinkage is reduced owing to the lower amount of material accumulation and a shortened cooling period of the plastic material subsequent to the injection-molding operation. The vertical extension of the lowermost point of the bottom of the blind-end holes to the outer surface of the rear side 21 of the head defines the minimum distances x and y, respectively (see FIG. 3). According to the present embodiment, the minimum distance x between the lowermost point of the blind-end hole 12 and the rear side 21 is 1 mm, approximately. A minimum distance of between 1.2 and 1.6 mm, approximately, is predetermined at y between the lowermost point of the blind-end hole 11 and the rear side 21 directly thereunder. Advantageously, this distance varies for all the blind-end holes of the head between 0.5 and 2.5 mm or preferably between 0.8 and 2 mm. Because these areas can be at different distances from the injection point, it may be appropriate to provide different distances between the lowermost bottoms of the blind-end holes and the rear side of the head.

The blind-end holes 14 have likewise the same tufting depth for the bristle tufts as the blind-end holes 11 and 12. The blind-end holes 14 are arranged laterally next to the cavity or free space 9. The blind-end holes 13 extend into the head less deeply than the other blind-end holes. Extending further deeply adjacent to the blind-end holes 13 is the cavity 9 (see in particular FIGS. 3 and 4).

As becomes apparent particularly from FIG. 1, the length of the bristle tufts from the bottom of the blind-end holes to the bristle ends in the cleaning area is not predetermined by the depth of the blind-end holes. The topography nevertheless identifiable from FIG. 1 with height differences in the bristle tuft ends is determined after insertion of the bristle tufts in the blind-end holes by cutting the bristle ends to length and endrounding them subsequently. Thus, as illustrated in FIG. 4, bristle tufts 6b and 6c are provided in the head which are of equal length between the brushing side 5 and the bristle ends but extend to different depths in the blind-end holes of the head, so that the overall lengths of the bristle tufts differ in spite of like end height.

As becomes apparent in particular from FIG. 4, the cavity 9 is closed tight by an end cover 22. The end cover 22 is not shown in FIG. 3. The subject-matter of this application can be used to advantage regardless of the construction of an end cover 22 or cavities 9 in the head. The provision of a cavity 9 in addition to the blind-end holes increases however the inner complexity of the head 1 so that material shrinkage and visual flawlessness in the injection-molding process are not achievable with the known approaches. As becomes additionally apparent from FIGS. 3 and 4, sections are provided in vertical extension below

the bristle tufts on the rear side 21 of the head 1 which are not in alignment with the cavity 9 or the cover 22, so that particularly at these locations sunk spots due to material shrinkage could develop in the absence of the measures herein described.

According to this embodiment, the head is injection-molded from a plastic component made of hard plastic, namely polypropylene. The injection point for the molding in the die is preferably located in the neck or handle portion of the toothbrush. Alternatively, the injection point is provided in the head. In the absence of a further plastic component or in particular soft plastic component on the rear side 21 of the head 1, this embodiment provides likewise no possibility of concealing visual flaws in the injection-molding process by a soft plastic. Depending on the type of visual flaw, concealing it by over-coating the visually objectionable areas is not always possible either.

The method of manufacturing the toothbrush is composed of the following process steps: Injection-molding of at least the plastic head, where applicable, together with the neck or handle portions, using in particular polypropylene or other materials. Then bristle tufts 6 are inserted in the head and anchors are driven into the head to secure the bristle tufts. Finally, the end sections of the bristle tufts 6 are finished by cutting the bristle tufts 6 to the proper length or topography, by endrounding them and applying further finishing steps, where appropriate. In cases where the electrically operable function element (here LED) is not cast integrally with the head in the prior injection-molding process, mounting of this element in the head takes place subsequent to the above tufting steps.

CLAIMS

What is to be claimed is:

1. A toothbrush having a handle portion and a neck portion connecting the handle portion with a head (1), said head (1) having a brushing side (5) and a rear side (21) opposite thereto, said brushing side (5) including a plurality of bristle tufts (6) for cleaning the teeth, said tufts being attachable in the head (1) through tufting apertures (10) using an anchor (15), with each tufting aperture being (10) assigned a blind-end hole (11, 12, 13, 14) having sidewalls (16) and a bottom (17, 18), wherein provision is made for a chamfer or radius (19) in the transition area between the bottom (17, 18) and the sidewalls (16), with a cross-sectional area of the head (1) between a first bottom (17, 18) and the rear side (21) differing from a cross-sectional area of the head between a second bottom (17, 18) and the rear side (21), and said first bottom and said second bottom (17, 18) being arranged in the head in such a way that the minimum distance y between the first bottom (17, 18) and the rear side (21) as well as the minimum distance x between the second bottom (17, 18) and the rear side (21) are each in the range of between 0.5 and 2.5 mm.

2. The toothbrush according to claim 1, characterized in that the first and the second bottom (17, 18) are arranged in the head (1) in such a way that the minimum distance x and y amounts to between 0.8 and 2 mm each.

3. The toothbrush according to claim 1 or 2, characterized in that the head (1) includes third and fourth blind-end holes (11, 12) which can be tufted with bristle tufts (6a) to the same depth, said third and fourth blind-end holes (11, 12) being constructed such that their bottoms (17, 18) extend to different depths.

4. The toothbrush according to claim 3, characterized in that in the fourth blind-end hole (12) the chamfer or radius (19) is followed by a constriction (20) and an adjoining further radius or chamfer (19) and thereafter by the adjoining bottom (18).

5. The toothbrush according to at least one of the preceding claims, characterized in that the head (1) has a first interior region and a second interior region, said first interior region (9) being made of hard plastic and said second interior region including an electrically operable function element (4) or part thereof.

6. The toothbrush according to claim 5, characterized in that provision is made for an injection point for the hard plastic of the head (1) on the neck or on the handle portion and that the blind-end holes (11, 12, 13, 14) are spaced at different relative axial distances to the injection point on the head (1), and that in the hard plastic of the head (1) a free space is provided for the function element (4) between said blind-end holes (11, 12, 13, 14) spaced at different relative distances.

7. The toothbrush according to at least one of the preceding claims, characterized in that the head includes at least one fifth blind-end hole (13) which is arranged adjacent to and above the function element (4) and is shorter than the third and fourth blind-end holes (11, 12, 14).

8. The toothbrush according to at least one of the preceding claims, characterized in that the rear side of the head (1) is made at least in part of the same hard plastic as the brushing side (5).

9. The toothbrush according to at least one of the preceding claims, characterized in that the head is formed of a hard plastic material which exhibits more than 1% material shrinkage after an injection-molding operation.

10. The toothbrush according to at least one of the preceding claims, characterized in that the head is formed of polypropylene hard plastic.

11. The toothbrush according to at least one of the claims 1 to 9, characterized in that the head is formed of polyethylene, POM, SAN or copolyester hard plastic.

12. The toothbrush according to at least one of the preceding claims, characterized in that the head (1) includes first and second bristle tufts (6a, 6b, 6c) of different lengths from the bottom (17) of the blind-end hole to the bristle end, said first and second bristle tufts (6a, 6b, 6c) being of approximately equal length from the brushing side (5) to the bristle end.

13. The toothbrush according to at least one of the preceding claims, characterized in that provision is made in the head for at least one blind-end hole having its central axis arranged at an angle to the perpendicular on the brushing side.

14. A method of manufacturing a toothbrush according to claim 1.

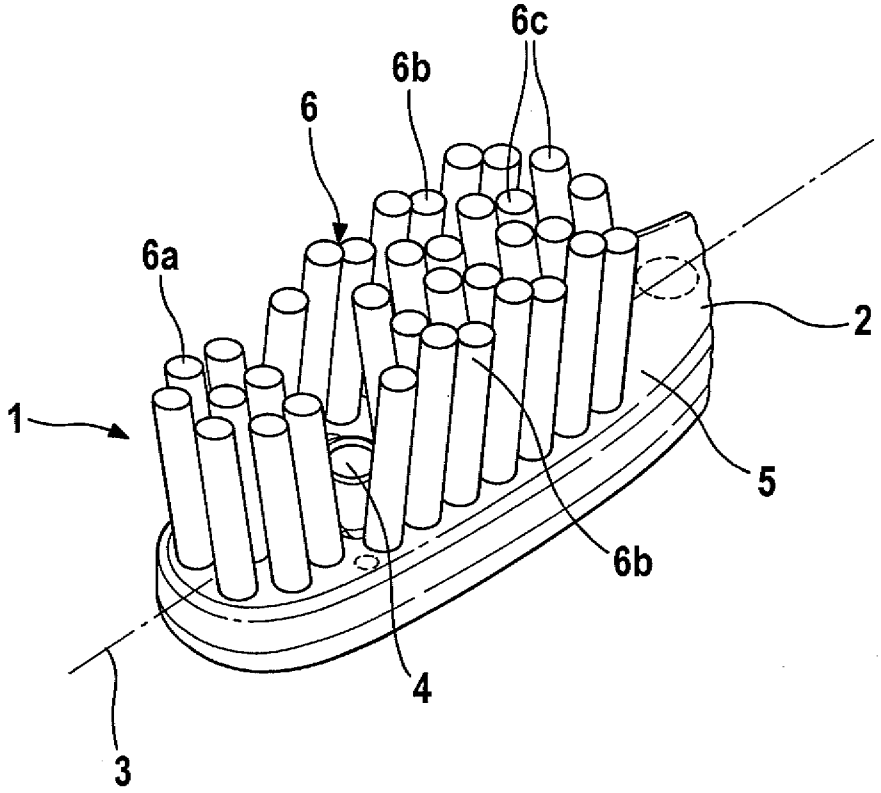

Fig. 1

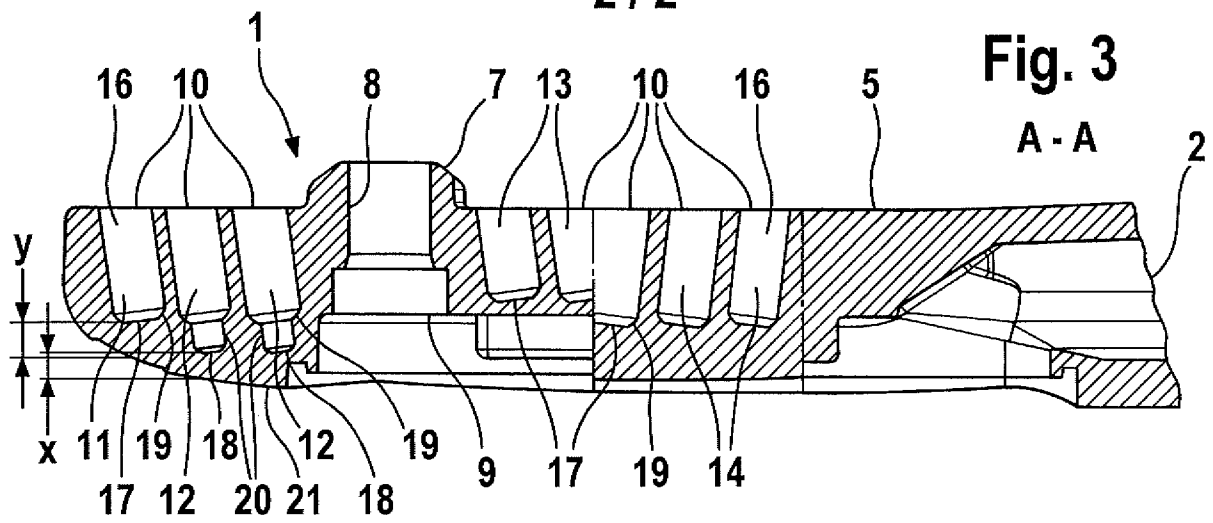

Fig. 3

A - A

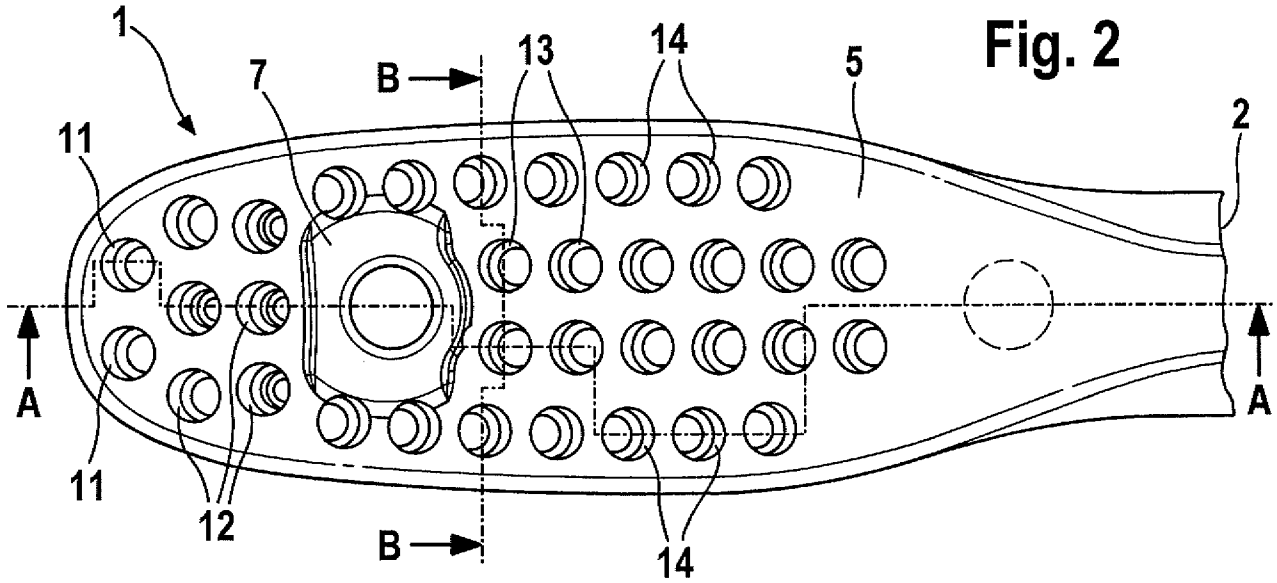

Fig. 2

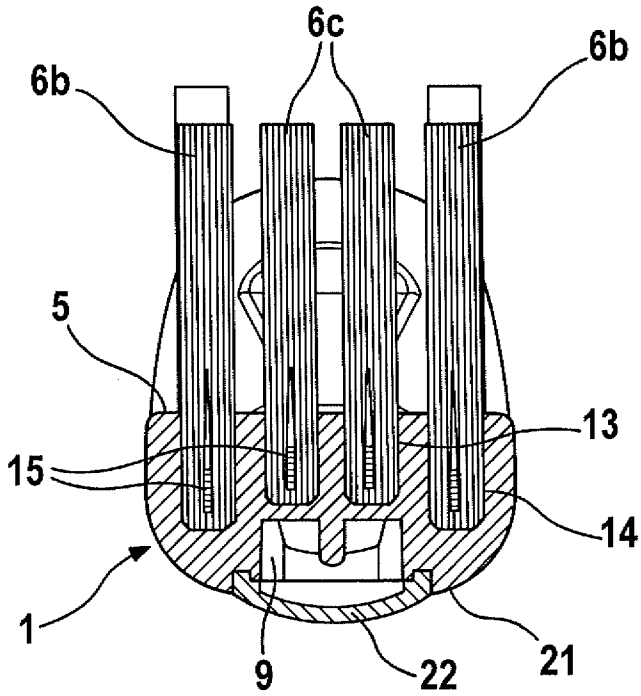

Fig. 4

B - B

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2008/053813

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01N15/06 G01N33/543 G01R33/12 G01N15/10

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)
G01N G01R

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	WO 03/102546 A (UNIV CALIFORNIA [US]; AYTUR TURGUT [US]; BEATTY P ROBERT [US]; BOSER B) 11 December 2003 (2003-12-11) abstract page 17, paragraph 57 - paragraph 59; figures 9A,9B,10 -----	1-15
X	MOISS PIEDADE ET AL: "A New Hand-Held Microsystem Architecture for Biological Analysis" IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS PART I: REGULAR PAPERS, IEEE SERVICE CENTER, NEW YORK, NY, US, vol. 53, no. 11, 1 November 2006 (2006-11-01), pages 2384-2395, XP011150246 ISSN: 1057-7122 the whole document ----- -/--	1-15

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

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Date of the actual completion of the international search	Date of mailing of the international search report
21 October 2009	28/10/2009

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

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International application No
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