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EARLIEST PRIORITY CLAIMED

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TITLE OF INVENTION

54	METHOD FOR PRODUCING BRISTLE PRODUCTS

57	ABSTRACT (NOT MORE THAT 150 WORDS)	NUMBER OF SHEETS	31

If no classification is finished, Form P.9 should accompany this form.
The figure of the drawing to which the abstract refers is attached.

Abstract

The invention relates to a method for producing bristle products. Individual bristles or groups of bristles consisting of synthetic material are fixed to a carrier in a predetermined arrangement, forming the desired bristle area. At least one part of the bristles in the predetermined arrangement or in the fixed bristle area is structured by means of laser beams in a contactless and preferably regular manner. Furthermore, the bristles are shortened in a contactless manner at the free ends thereof by means of laser beams. In this way, structures are produced in a reproducible form on the outer and upper side of the bristle area, said structures assisting the cleaning action.

The invention concerns a method for producing brushware by mounting individual bristles or bristles combined into groups, in a predetermined arrangement, on a support thereby forming the desired bristle stock, wherein at least the envelope of part of the bristles of the bristle stock is processed to receive a structure.

The invention also concerns a method for producing brushware by mounting individual bristles or bristles combined into groups, in a predetermined arrangement, on a support thereby forming the desired bristle stock, wherein the free ends of at least part of the bristles are shortened.

Brushware usually consists of a more or less regular bristle stock, wherein the bristles forming same have a smooth envelope surface with the free bristle ends being disposed in a flat, continuously, or discontinuously curved envelope surface. The bristle ends have the primary purpose of cleaning, grinding or polishing through mechanical action on the surface while the envelope of the bristles primarily has a wiping effect. A plurality of bristles must be provided within a bristle stock to substantially ensure effective and principally planar cleaning. Only the envelopes of the outer bristles of the bristle stock should be substantially effective during

brushing, with the inward bristles merely supporting the bristles among themselves and serving the additional function of retaining application media or media required for the brushing effect in the narrow capillaries between the bristles.

Many attempts have been made to also include the bristle envelope in the cleaning, polishing or grinding process effected during brushing by e.g. structuring the outer bristles of the bristle stock through mechanical material abrasion after manufacture of the brushware (US 5,678,275). This type of treatment does not provide satisfactory results. In particular, uniquely localized and geometrically predetermined structures cannot be produced, since the bristles deflect due to their flexibility which, in turn, differs in dependence on the position within the bristle stock and on the separation from the mounting point on the support.

The applicant has also suggested (WO99/66111) structuring the extruded monofilaments used for producing bristles through laser treatment of the monofilament envelope. The monofilaments are subsequently combined into strands and the bristles of the strand are cut to the desired length. Since the monofilaments are axially displaced with respect to one another when combining into the strand, a locally defined structure cannot be generated on the combined bristles of the bristle stock. In addition, the somewhat rough, structured bristles cause problems during conventional sorting into groups, e.g. bundles. This leads to large fluctuations in the number of bristles in a

bundle. This method also fails to facilitate arrangement of the structured bristles in the outer region of a bristle stock only, where they are most effective. The inwardly disposed, structured bristles are less effective or even ineffective relative thereto. Therefore, an unnecessary excessive amount of material is structured and possibly also weakened by the monofilament treatment. Moreover, the production process during manufacture of the monofilaments is slowed down by the laser treatment.

It has been known for some time that a planar bristle surface (envelope surface of the free bristle ends) does not facilitate sufficient cleaning in many applications, in particular with tooth brushes. The bristles of such a tooth brush bristle stock cannot properly follow the irregular curvatures of the teeth. The interdental spaces also remain largely untreated. For this reason, tooth brushes having greatly differing bristle stock "topographies" have been proposed. These topographies are usually generated through subsequent mechanical abrasion of the plastic material on the bristle ends, e.g. through cutting of the bristles (US 2,227,126, DE 198 32 436, EP 0 736 270) and therefore involve a relatively demanding mechanical grinding or cutting treatment. Only limited variations are possible. Mutual axial displacement of the bristles before mounting on the support (EP 0 346 646) has led to better results and, theoretically, any "topography" can be produced. This method requires an additional treatment step before mounting the bristles on the support. The topographical bristles must then

be held in position and subsequently connected to the bristle support.

It is the underlying purpose of the present invention to propose a method for producing brushware which permits structuring of the bristle envelopes before or after mounting on the bristle support and in any reproducible fashion. The bristle ends should be shortened to form any desired, reproducible bristle end envelope surface.

The first part of the inventive object is achieved in that, in the predetermined arrangement or on the mounted bristle stock, at least one part of the bristles is structured without contact using laser radiation.

Conventionally (DE 198 29 943), a finished bristle stock has been marked using laser radiation to serve as an indication of wear. Structuring is not involved since the bristle material itself is not removed.

Modern laser technology permits accurate localization of the action of the laser radiation and concentration of the effect on the smallest of surfaces, such as individual points or lines. It can moreover be adapted to the material to be treated and permits exact adjustment of the depth in dependence on the material. The inventive use of laser energy therefore permits generation of defined and regular structures of preferably geometrical arrangement on the envelope of the bristles of a

bristle stock, wherein the mechanical effect of the structures can also be influenced through exact control of the depth of the laser radiation. Since the method is carried out in a contact-free fashion, reproducible structures can be generated irrespective of the flexibility of the bristles. This is, in particular, the case with plastic bristles even though the invention is not limited to this material. Laser technology also permits adjustment of the type and arrangement of the structures to the application at hand. The structures improve the reception capacity for cleaning or application media, which are delivered without complications due to the smooth surfaces of the structures and which can be easily rinsed out.

These structures also increase the massaging effect of tooth and body brushes as well as the abrasive effect of the structured edges of technical brushes, whose bristles contain abrasive materials.

The inventive method can be used for forming bristle stock "topographies" through contact-free cutting of the free ends of the bristles using laser radiation.

This method in accordance with the invention permits generation of the finest of structures, e.g. punctiform or linear depressions in the surface of the bristle arrangement or of the bristle stock, with the consequence that the envelope surface has steps of any desired type to provide additional scraping or scratching effects during brushing.

In a preferred embodiment, the laser source is controlled to round the free ends of the bristles through thermal loading caused by the laser treatment. While structuring is produced substantially through evaporation or gasification of the plastic material by the introduced laser energy, it has surprisingly turned out that, when cutting the bristles at the free bristle end, the bristle end is also advantageously rounded, like a dome. The reason therefor may be that the molecules in the bristles, having a linear orientation due to the monofilament production, are thermally loaded at the location of action of the laser radiation thereby re-orientating the molecules into their disordered, tangled state.

The laser source is also designed in dependence on the respective material, preferably a plastic material, such that the bristle envelopes are profiled through material removal in response to thermal decomposition of the plastic material. Evaporation and gasification processes also cause material removal. This has the advantage, compared to all mechanical treatment methods, that the structures do not fray. Fraying causes loss of material during use of the brushware, which can cause problems, in particular for hygiene brushes, especially tooth brushes. For the case of application brushes, such fraying can lead to inclusions of foreign matter resulting in irregularities in the application layer. During mechanical treatment, removed material residues will always remain on the bristles which require subsequent cleaning processes without

guaranteeing 100% success. The inventive method also obviates the need for such cleaning.

In accordance with a further embodiment of the inventive method, the bristle envelopes are structured through foaming of the plastic material. Practical experiments have shown that the plastic material bubbles in response to the laser treatment to form an uneven bristle envelope surface. This foaming can be controlled through fillers, laser guidance etc.

Two or multiple component brushes are known which consist of a core and an envelope. They are used, in particular, for wear indication, wherein the core and envelope have different colors. The bristles, which initially have only one color, show a different color with increasing wear at the bristle end to indicate the degree of wear. One embodiment of the invention provides that, in brushware having such bristles, only the envelope is structured by the laser radiation. This permits structuring of the envelope up to the core, through local removal of envelope material.

To prevent unfavorable changes in the properties defined by the bristle cross-section and the selected plastic material in consequence of subsequent structuring, the invention provides that the envelope structure of the bristles extends to a depth of not more than 10% of the bristle cross-section. The depth and local arrangement of the structures within the bristle stock can be selected such that the static properties of the

individual bristle and of the entire bristle stock are maintained to the desired degree.

During production of the "topographies", the free ends of the bristles can be shortened in a substantially linear pattern. This linear pattern can be adapted to the directions of motion which are normal for the respective brushware to obtain optimum effects for the "topography".

The free ends of neighboring bristles can also be shortened, thereby forming a stepped envelope surface.

The free ends of only individual groups of bristles can be shortened by the laser radiation. The free ends of the bristles in one individual bristle group can be shortened to thereby form a non-planar envelope surface, e.g. conify the ends of a bundle.

As mentioned above, the inventive method can be carried out on the prepared bristle arrangement or on the mounted bristle stock. In this event, only the envelope of outwardly disposed bristles can be structured. Instead or additionally, inwardly disposed bristles can also be exposed through separation and lateral deflection of bristles (DE 198 32 436, EP 0 763 270) to permit structuring of their envelopes.

Although laser radiation can be used for controlled structuring of the plurality of plastic materials which can be used for

bristles, it may be advantageous to use bristles with fillers which absorb laser radiation, thereby providing easier and more precise control of the structuring. The fillers may be provided only in certain cross-sectional regions of the bristles, e.g. close to the envelope, or, for bristles having a profiled cross-section, in the outward profiled regions. This leads to particularly intensive mechanical action during brushing, in particular, in connection with the inventive structuring in the region of polygonal edges of polygonal cross sections.

Finally, the structuring produced during laser treatment can be visualized through simultaneous coloring of the plastic material. Instead of or additionally, the structure produced during the laser treatment can be visualized through fillers contained in the plastic material of the bristles, which change their color in response to the laser radiation.

The invention is described below with respect to some embodiments shown in the drawing.

Figs. 1 through 6 show a side view of a tooth brush head with different structures on the bristle envelope;

Figs. 7 and 8 show a side view of a tooth brush head with structures on the bristle envelope and bristle end topography;

Figs. 9 through 11 show a top view onto a tooth brush head with different linear topographies;

Figs. 12 through 14 show perspective views of a tooth brush head with different structures or "topographies";

Figs. 15 through 17 show a top view onto the bristle stock of an exchangeable head for electric tooth brushes with different "topographies";

Fig. 18 shows a representation of another embodiment corresponding to Figs. 13 and 14;

Figs. 19 through 21 each show a representation of modifications of the embodiments of Figs. 1 through 8;

Figs. 22 through 24 each show a view of a structured individual bristle; and

Fig. 25 shows perspective views of a round bristle.

The head 2 of the tooth brush 1, which is shown in sections in the drawing, forms a support for bristles 3 which, in the embodiments of Figs. 1 through 12, are all mounted individually, standing on the support 2, such that the bristle stock 4 consists of a relatively dense bristle package defining intermediate, narrow capillaries. In the embodiment of Fig. 1, structures 5 in the shape of parallel lines have been formed via laser radiation through removal of material from the bristle envelope. The structuring according to Fig. 1 gives

particularly good effects for the so-called red-white cleaning method.

In the embodiment of Fig. 2, which also illustrates a bristle stock 4 of individually, standing bristles 3, structures 5 in the form of wavy lines are provided through laser radiation, which are narrower than those of Fig. 1.

In the embodiment of Fig. 3, the structures 5 at the outer bristles of the bristle stock 4 are provided in the form of slanted hatching and in the embodiment of Fig. 4 in the form of cross-hatching. The embodiments of Figs. 2 through 4 are suitable for any tooth cleaning method.

The embodiment of Fig. 5 shows structures 5 on the outer bristles in the form of circular, planar depressions, whereas Fig. 6 shows structures 5 of circular lines.

In the embodiment of Fig. 7, the bristles 3 of the bristle stock 4 have differing lengths, i.e. they are longer in the region of the front end of the brush head 2 than in the remaining region of the bristle stock, thereby forming a "topography" with one step in the front region. In a similar fashion as in Fig. 1, structures 5 are provided in the envelope of the outer bristles in this front region only.

In the embodiment of Fig. 8, the bristle stock 4 has a "topography", wherein the ends of a portion of the bristles 3

lie in one plane, and the ends of the other portion of the bristles are subdivided into individual groups 6 and lie in a higher plane, relative to the bristle support 2. In this embodiment, only the protruding bristles of the group 6 have linear structures.

Figs. 9 through 11 each show a top view of a tooth brush head 2 with bristle stock 4, viewing onto the free ends of the bristles 3. The outer contour of the bristle stock 4 approximately follows the contour of the tooth brush head 2. In the embodiment of Fig. 9, the bristles are shortened only in the region of the front end of the bristle head through laser radiation, i.e. along concentric lines 7 of a polygon. In the embodiment of Fig. 10, the bristles 3 are shortened in a regular cross-hatched pattern, while in the embodiment according to Fig. 11 they are shortened along the line 9.

Fig. 12 shows a perspective view of a tooth brush head 2, wherein the envelope of the external bristles has a structure 5 of parallel lines. The bristles are also shortened in the region of the front end of the head in a cross-hatched fashion.

In the embodiment of Fig. 13, the bristle stock 4 consists of groups 9 of bristles formed as round bundles. The front region of the bristle head 2 has groups 10 and 11, wherein the free bristle ends have been cut to different lengths using laser radiation such that the free ends of the groups 10 and 11 have

different conical taperings. It is also possible to structure the envelope of the bristles disposed on the conical surface.

In the embodiment of Fig. 14, the bristle stock 1 again consists of groups 9 of bristles in the form of cylindrical bundles, while a group 12 of individually standing bristles is disposed in the front region of the bristle head. In this embodiment, only the bristles 3 of this group 12 have linear structures 5 which extend parallel to one another.

Figs. 15 through 17 show a top view onto the bristle stock 4 of brushes having a rounded head which are used, in particular, in electrical tooth brushes. In accordance with Fig. 15, the bristles 3 are shortened along concentric rings 13, while in the embodiment in accordance with Fig. 16, the bristles 3 are shortened to produce a spiral topography. In the embodiment in accordance with Fig. 17, the bristles are cut in a co-radial 15 fashion. The embodiments of Figs. 16 and 17 particularly enhance the action of the free bristle ends when the bristle head rotates about its central axis.

Fig. 18 shows a tooth brush head 2 similar to that of Figs. 13 and 14, whose bristle stock 4 comprises groups 9 of bristles formed as round bundles, and with a bristle group 12 disposed at the front end. The front bristle group 12 consists of individual bristle strips which are disposed like a star, wherein the individual strips have parallel structures 5 disposed substantially perpendicular to the bristle axis.

In the embodiments according to Figs. 19 through 21, the individual structures 5 produced on the envelope of the outer bristles of the bristle stock 4 by the laser radiation, are irregular, but have a regularly disposed statistical distribution across the entire side surface of the bristle stock.

The envelope of individually standing bristles, in particular of those having a larger diameter, can be structured in the same fashion as described above in connection with an entire bristle stock or bristle groups of such a stock. In the embodiment of Fig. 22, the envelope of the bristle 3 has inclined structures 5 whereas the embodiment of Fig. 23 has a zig-zag-shaped line structure 5. The bristle 3 can be structured with cross-hatching as shown in Fig. 24.

Fig. 25 shows a round brush having a cylindrical carrier 1 which can be e.g. the head of a hair brush, a technical brush or the like. Ray-shaped, cylindrical bristle groups 16 are mounted on the support 1 whose free ends have parallel structures 5.

CLAIMS

1. Method for producing brushware through mounting individual bristles or bristles combined into groups in a predetermined arrangement on a support, thereby forming the desired bristle stock, wherein at least a part of the bristles of the bristle stock is treated with laser radiation characterized in that, in the predetermined arrangement or on the mounted bristle stock, the envelope of at least part of the bristles is structured in a contact-free fashion using laser radiation.

2. Method according to claim 1, characterized in that the bristles have a regular structure.

3. Method according to claim 1 or 2, characterized in that the free ends of at least part of the bristles, in a predetermined arrangement thereof or on the mounted bristle stock, are shortened by removing material at the free ends of the bristles in a contact-free fashion using laser radiation.

4. Method according to claim 3, characterized in that the free ends of the bristles are rounded through thermal loading via the laser treatment.

5. Method according to any one of the claims 1 through 4, characterized in that the envelope of the bristles is profiled or

the free ends thereof are shortened through material abrasion due to thermal decomposition of the plastic material.

6. Method according to any one of the claims 1 through 5, characterized in that the envelope of the bristles is structured through foaming of the plastic material.

7. Method according to any one of the claims 1 through 6, characterized in that, with two-component bristles having at least one core and an envelope concentrically surrounding same, only the envelope is structured via the laser radiation.

8. Method according to claim 7, characterized in that the envelope is structured down to the core through local removal of the envelope material.

9. Method according to any one of the claims 1 through 8, characterized in that the structure of the bristle envelope extends to a depth of approximately 10% of the bristle cross-section.

10. Method according to any one of the claims 1 through 9, characterized by shortening the free ends of bristles disposed substantially along lines in the surface of the predetermined arrangement or of the mounted bristle stock.

11. Method according to any one of the claims 1 through 10, characterized in that the free ends of neighboring bristles are

shortened thereby forming a stepped envelope surface of the bristle ends.

12. Method according to any one of the claims 1 through 11, characterized in that the free ends of individual groups of bristles are shortened.

13. Method according to any one of the claims 1 through 12, characterized in that the free ends of the bristles of an individual group of bristles are shortened thereby forming a non-planar envelope surface.

14. Method according to any one of the claims 1 through 13, characterized in that only the envelope of the outer bristles of the predetermined arrangement or of the mounted bristle stock is structured.

15. Method according to any one of the claims 1 through 14, characterized in that inwardly disposed bristles of the predetermined arrangement or of the mounted bristle stock are exposed by separating and laterally deflecting the bristles, and the envelope of these bristles is structured.

16. Method according to any one of the claims 1 through 15, characterized in that bristles having fillers which absorb laser radiation are used for producing brushware.

17. Method according to any one of the claims 1 through 16, characterized in that the structure produced during laser treatment is visualized through coloring of the plastic material.

18. Method according to any one of the claims 1 through 16, characterized in that the structure produced during laser treatment is visualized through fillers in the plastic material of the bristles which change color in response to laser radiation.

19. Method for producing brushware substantially as herein described and illustrated.

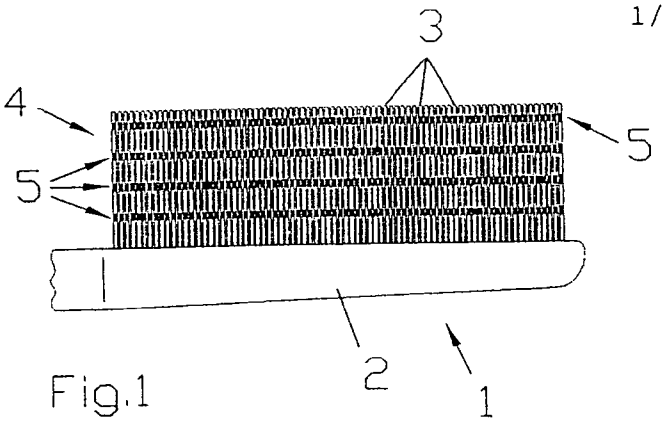


Fig.1

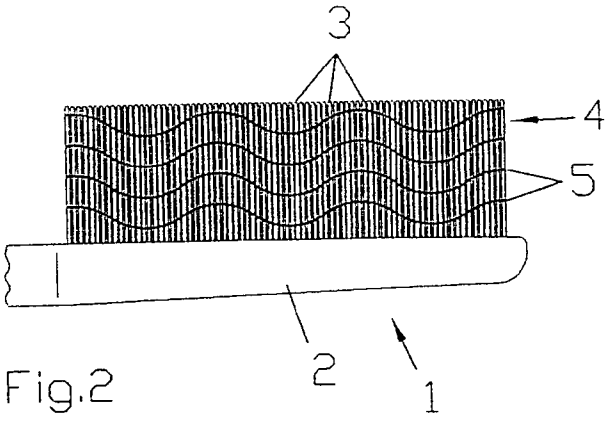


Fig.2

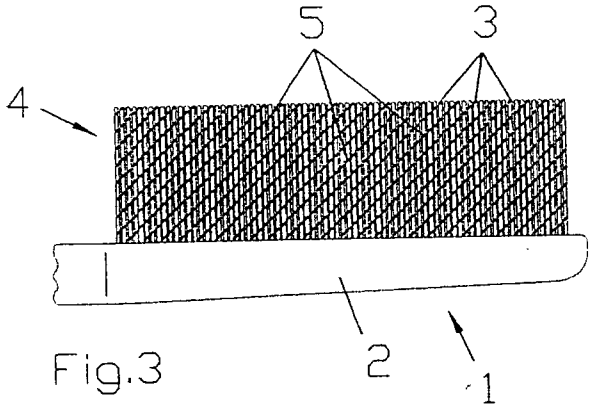


Fig.3

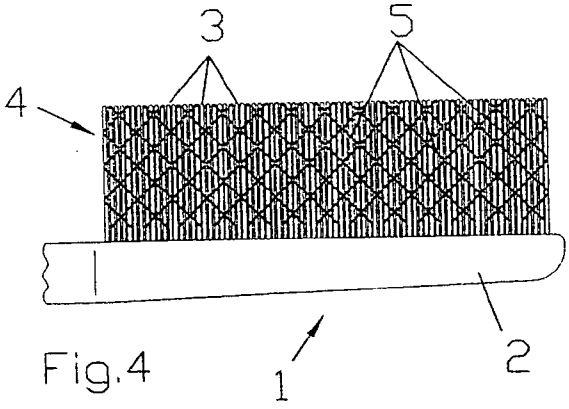


Fig.4

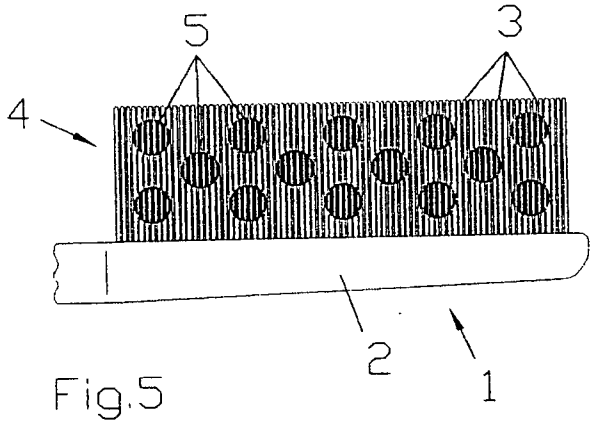


Fig.5

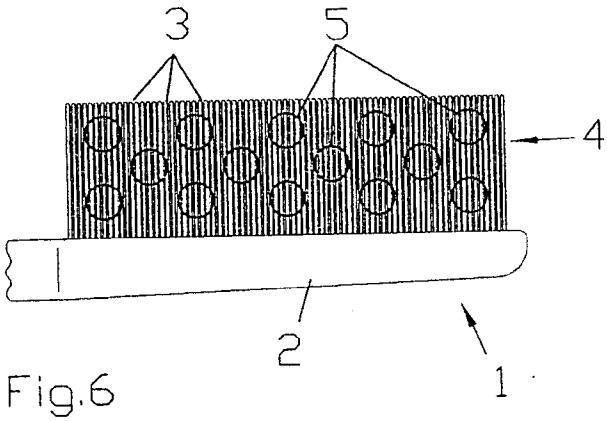


Fig.6

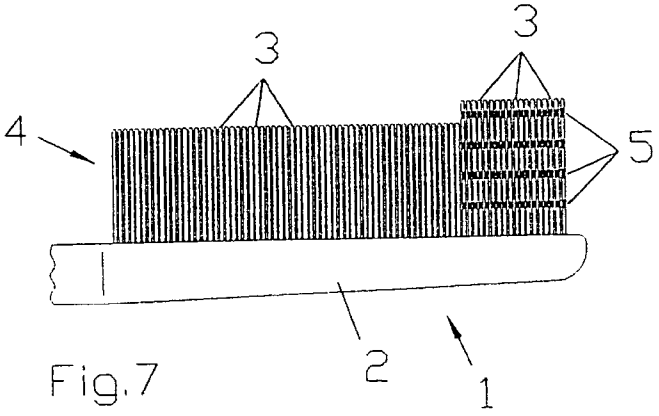


Fig.7

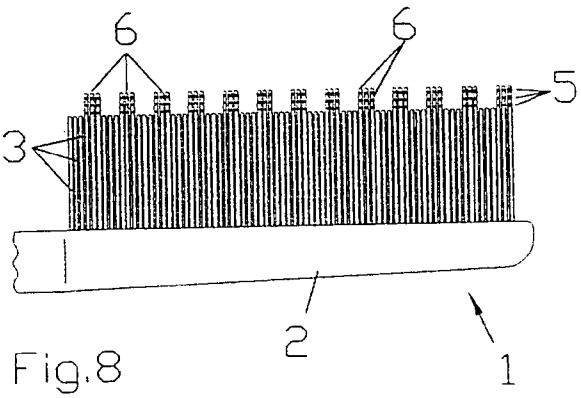


Fig.8

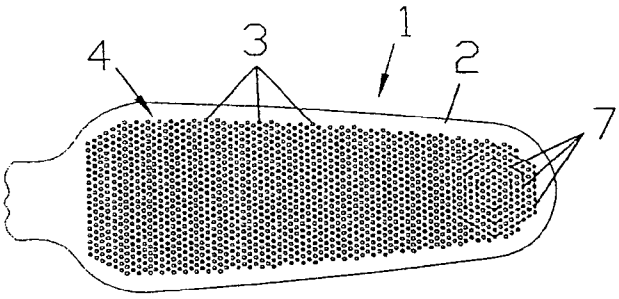


Fig.9

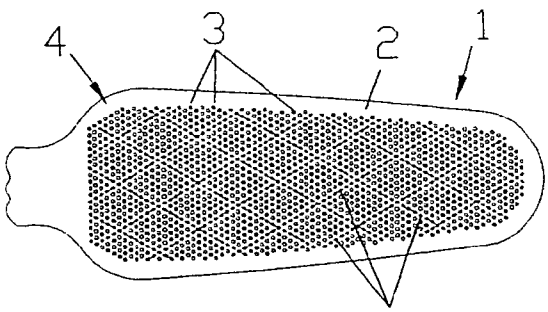


Fig.10

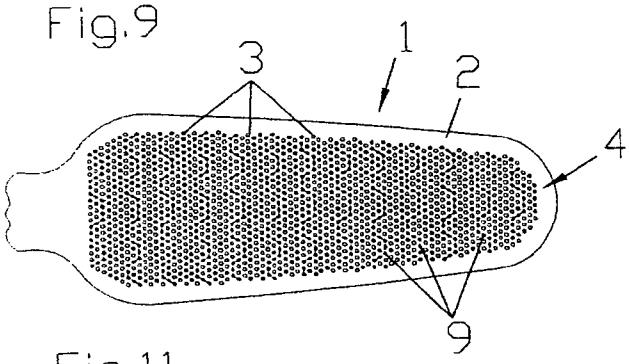


Fig.11

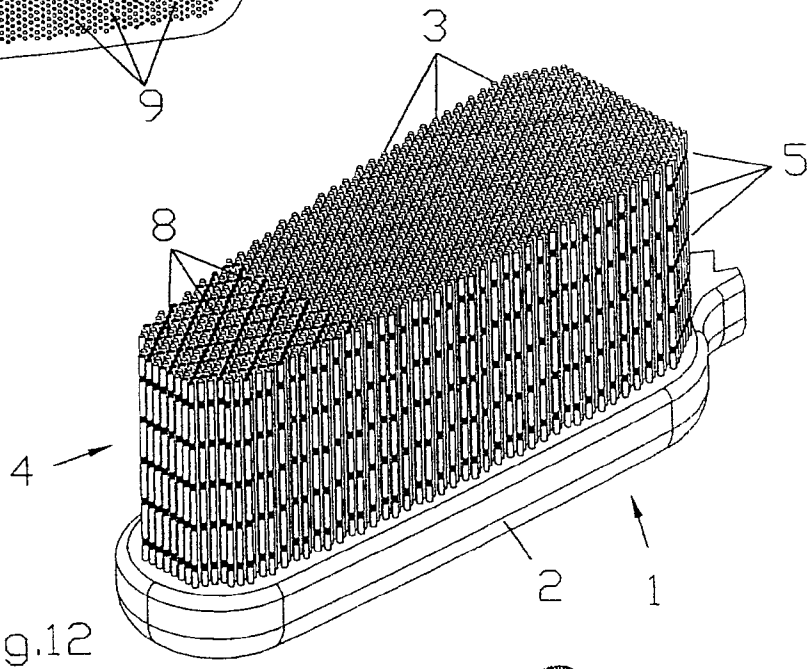


Fig.12

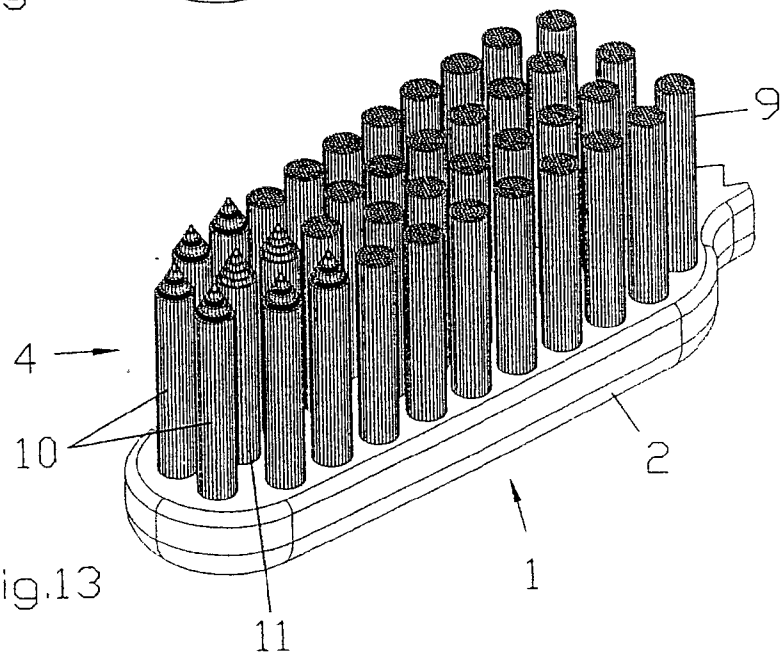


Fig.13

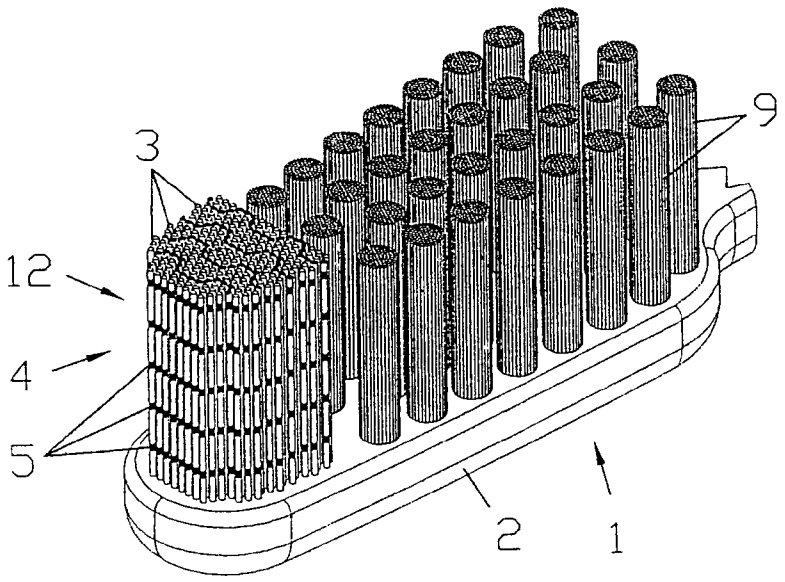


Fig.14

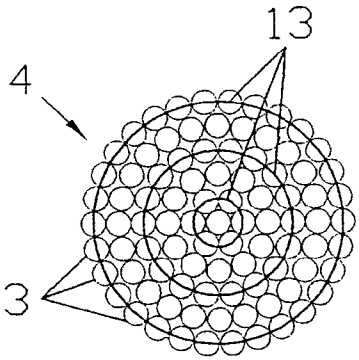


Fig.15

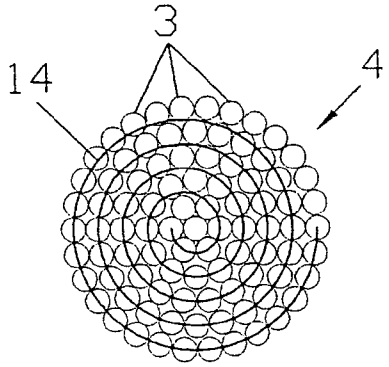


Fig.16

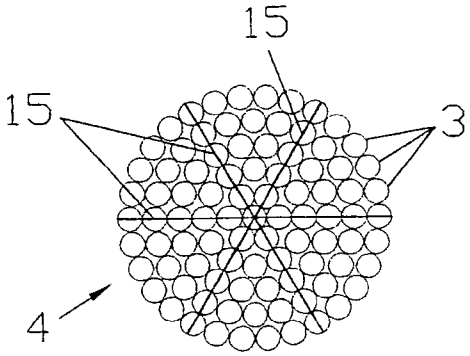


Fig.17

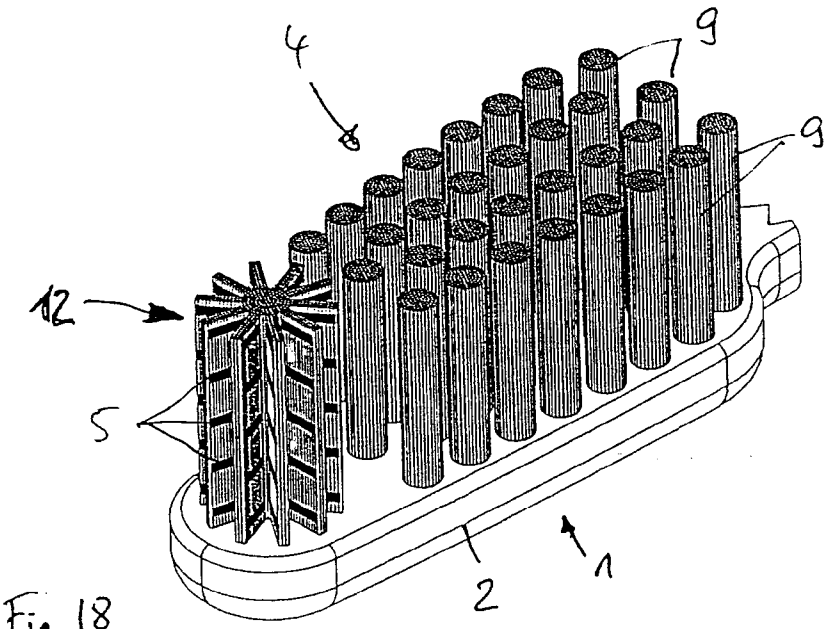


Fig. 18

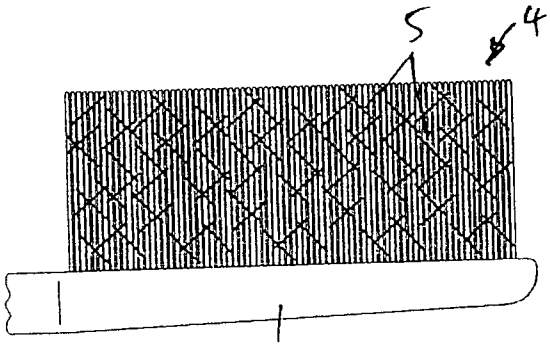


Fig. 19

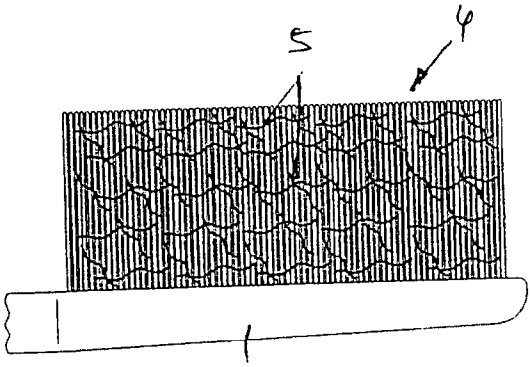


Fig. 20

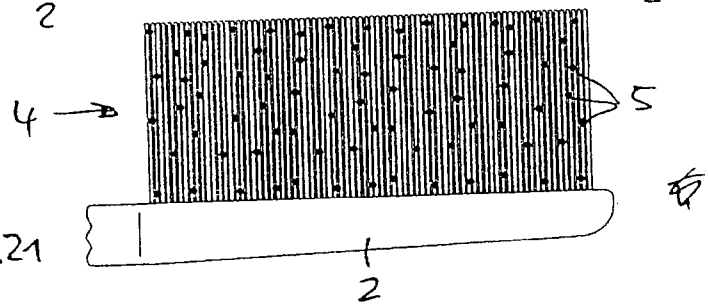


Fig. 21

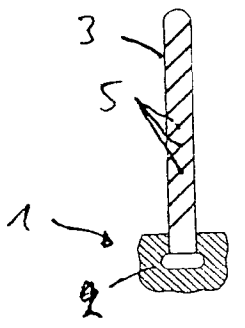


Fig. 22

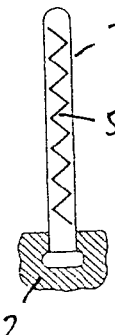


Fig. 23

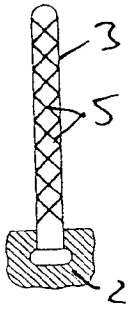


Fig. 24

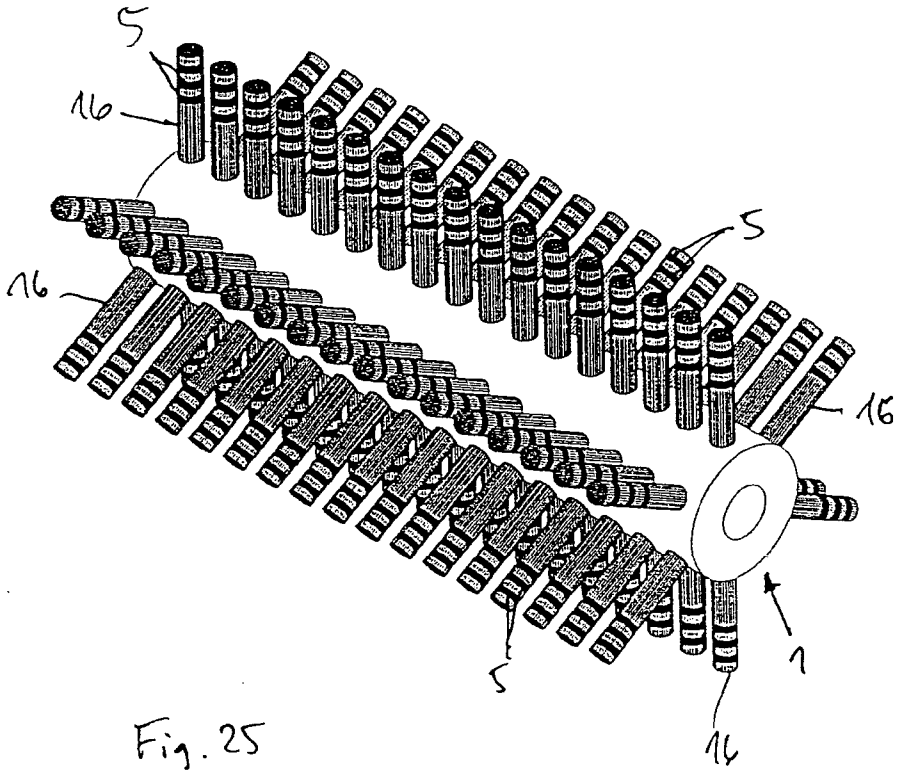


Fig. 25