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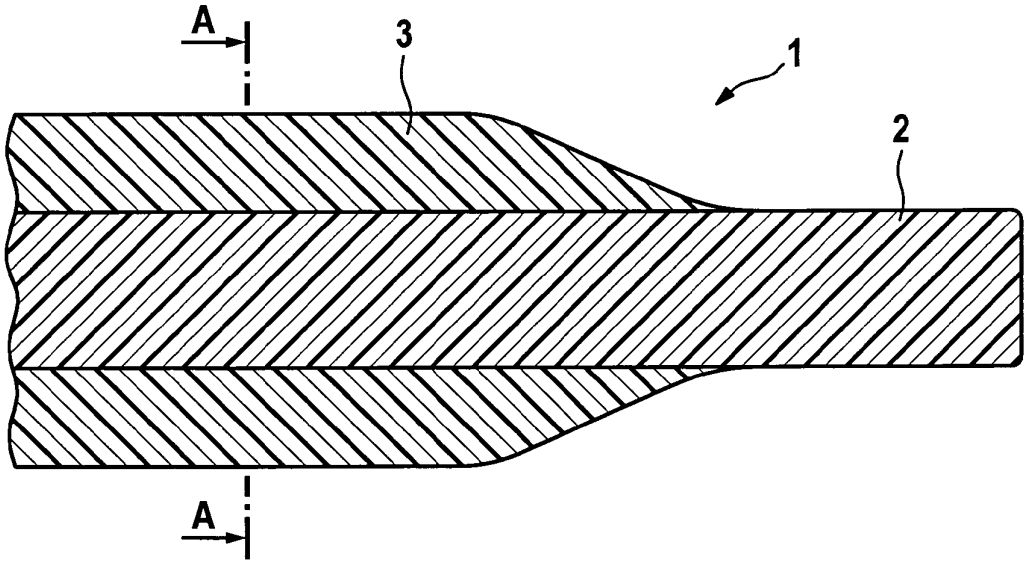
[Fortsetzung auf der nächsten Seite]

(54) **Title:** MULTI-FILAMENT BRISTLES FOR TOOTHBRUSHES

(54) **Bezeichnung:** MEHRFILAMENTIGE BORSTEN FÜR ZAHNBÜRSTEN



(57) **Abstract:** The invention relates to a bristle (1; 4; 7; 10; 13), in particular for toothbrushes, and to a corresponding production method, wherein the bristle, in the longitudinal direction, has at least two jointly extruded filaments (2, 3; 5, 6; 8, 9; 11, 12; 14, 15) made of different materials, wherein the cross-sectional area of at least one of the filaments (3; 5; 9; 11) decreases toward the free end of the bristle.

(57) **Zusammenfassung:** Die Erfindung betrifft eine Borste (1; 4; 7; 10; 13), insbesondere für Zahnbürsten sowie ein entsprechendes Herstellungsverfahren, wobei die Borste in Längsrichtung zumindest zwei gemeinsam extrudierte Filamente (2, 3; 5, 6; 8, 9; 11, 12; 14, 15) aus unterschiedlichen Materialien aufweist, wobei die Querschnittsfläche zumindest eines der Filamente (3; 5; 9; 11) zum freien Ende der Borste hin abnimmt.

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Zur Erklärung der Zweibuchstaben-Codes und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

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(2) Priority Application
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CERTIFICATION OF TRANSLATION

"multifilament bristles for toothbrushes"
(PCT/EP 2007/000664)

I, Peggy Fallin Wright,

am the translator of the documents attached and certify that the following is a true translation to the best of my knowledge and belief.

Peggy Fallin Wright

Signature of translator dated this 20th day of Aug. 2008

TITLE: MULTIFILAMENT BRISTLES FOR TOOTHBRUSHES

Description

The invention relates to bristles, in particular for toothbrushes, the manufacturing method for same and the corresponding bristle material, such that the bristles comprise at least two coextruded filaments of different materials running in the longitudinal direction.

State of the Art

Bristles for toothbrushes typically consist of polyester monofilaments or nylon monofilaments, i.e., plastic fibers that are extruded, drawn and fixed. Nylon bristles are flexible, easily deformable and are especially water-absorbent. They must therefore be designed to be relatively thick, so that predefined flexibility requirements are met. This requires rounding of the bristle ends to prevent injury to the gingiva.

In contrast with that, polyester bristles, which are made of polybutylene terephthalate (PBT) and/or polyethylene terephthalate (PET), for example, have a low water absorbency and have good stability properties. However, these bristles mostly do not meet the requirements of elasticity or flexural rigidity. They are typically too stiff and inflexible and may thus cause injury to the gingiva.

EP 1 234 525 B1 describes a method for manufacturing toothbrushes with highly conical bristles to increase the flexibility of polyester bristles. Polyester monofilament bristles are immersed here in corrosive chemicals until the immersed part of the monofilaments

is completely eroded. This ultimately leads to a conically tapering bristle end.

It is a disadvantage here that the chemically tapered ends of the bristles are attacked and are subject to massive damage due to the etching process to some extent. Reject production is therefore high due to the etching process, which has a negative effect on production costs. The conically tapered bristles produced from monofilament therefore have a low stability because of the eroded lateral surface and their flexural rigidity is already too low. In addition, shaping of the conically tapered bristles is determined essentially only by the etching process and cannot be designed to conform to predefined requirements.

In addition, it is known from the state of the art, for example, EP 1 030 937 B1, that bristles or interdental cleaning devices may be made of a monofilament comprising at least two coextruded polymers. For example, two polymers are coextruded here to form a monofilament, and after successful drawing and optionally stabilizing through the action of mechanical forces across the monofilament axis, the bristles are slotted along the interfacial layers between the polymers for a locally limited length. This allows fissure-like slots to be formed on the sheath of the monofilament, so the slots can be used to receive media, in particular dental care agents or dental medical preparations and/or antibacterial preparations.

To form fissure-like slots in a coextruded monofilament comprising two polymers, the action of mechanical forces is always provided for splitting the monofilament along the boundary layers between the at least two polymers. The mechanical creation of slots,

gaps and flags is complicated on the one hand and on the other hand is also relatively inaccurate because the formation of such gaps depends significantly on the amplitude and direction of the applied force and on the binding forces between the polymers. Slots that can be produced in this way therefore often have different lengths, different irregular shapes and frayed lateral surfaces that are difficult to monitor.

Object

The object of the present invention is therefore to make available tapering bristles, in particular for tooth-brushes, having a freely selectable geometry as well as improved elasticity properties. In addition, the object of the invention is to optimize a production process and/or machining process for such bristles from the standpoints of an economical production process.

Invention and Advantageous Effects

The object on which the present invention is based is achieved by means of a bristle according to Patent Claim 1 as well as a method for manufacturing or processing such bristles according to Patent Claim 11 using bristle material according to Patent Claim 17. Other advantageous embodiments of the invention are characterized in the respective dependent claims.

The inventive bristle has at least two coextruded filaments of different materials in the longitudinal direction and is characterized in that the cross-sectional area of at least one of the two filaments decreases toward the free end of the bristle. Thus, at least one of the at least two coextruded filaments changes its geometry in the area of the bristle end. The deciding factor here is that the two coextruded

filaments are made of different materials, e.g., polyester and polyamide, which may be subjected to a material-selective processing operation to form the inventive bristle.

Through the choice and arrangement of the different materials for the coextruded filaments of the bristles, the flexural elastic properties of the bristle as well as their geometric design can be shaped in virtually any manner, in particular in the area of the bristle ends.

According to a first embodiment, the cross-sectional area of the at least one filament decreases steadily toward the free end of the bristle. A steady decrease in the cross-sectional area is associated with a steadily decreasing lateral surface and a steadily declining diameter of this bristle filament. This prevents sharp corners or edges, which are characteristics of surfaces and/or lateral surfaces having an irregular profile in an advantageous manner. The risk of injury for sensitive areas in the oral cavity, e.g., the gingiva can thus be reduced in an advantageous manner.

According to another aspect, the cross-sectional area of the free end of the bristle is determined essentially by the at least one other filament. In a preferred embodiment, its cross-sectional area is essentially constant in the longitudinal direction of the bristles. In particular, it is provided that at least one filament has a cross-sectional area of zero on the free end of the bristle, so that the total cross section of the bristle on the free end of the bristle is determined essentially by the remaining at least one other filament.

Due to the effect of reduction in the cross-sectional area of the bristle ends, the entire bristle may conform better to the given requirements in terms of elasticity and/or flexural rigidity. In contrast with a conically tapering monofilament produced by chemical etching, the inventive bristle is not pointed chemically at its filament end and thus is also not attacked or otherwise damaged.

According to a particularly advantageous embodiment of the present invention, the at least one other filament is surrounded radially by the at least one filament in at least some regions. It is provided in particular here that the at least one other filament forms a core section of the bristle which is on the interior radially, while the at least one filament surrounds this internal core filament as a sheathing. Finally, this core sheathing tapers toward the end of the bristle until only the other filament forming the core of the bristle remains at the free end of the bristle and forms a tapered bristle cross section.

In particular, it is provided here that the at least one other filament, e.g., the core filament, extends in the axial direction farther than the one filament, e.g., the lateral surface filament. The free end of the bristle is thus formed only by the filament whose cross-sectional area does not change significantly.

It may also be provided that multiple filaments which do not change in cross section are distributed regularly over the cross section of the bristle and are surrounded in at least some areas in the radial direction by the at least one filament whose cross-sectional area has a change toward the end of the bristle. Due to the taper in the cross-sectional area of the at least one filament toward the free end of the

bristle, ultimately a configuration may be formed at the end of the bristle by a plurality of individual filaments separated from one another by interspaces. Such filament configurations are advantageous for holding dental care agents or dental medical preparations and/or antibacterial preparations, for example.

According to another embodiment, it is provided that the at least one other filament is rounded or chamfered on its free end. The filaments forming the free end of the bristle thus essentially no longer have any edges that could cause injury in the oral cavity.

According to another embodiment of the invention, the at least two filaments have a different elasticity and/or a different flexural rigidity. Depending on the amount of filaments comprising different materials in the total material of the bristle, the elasticity properties and/or the flexural rigidity properties of the bristle can be adjusted to a predetermined extent in a targeted manner.

In addition, it is provided that the at least one filament can be eroded by means of an etchant, in particular a chemical etchant, such as sodium hydroxide solution, sulfuric acid or formic acid, whereby the at least one other filament is essentially resistant to the respective chemical etchant. With the help of a chemical etching process, the free end of the bristle can be processed in a material-selective manner through the choice of different materials for the at least one filament and the at least one other filament and a suitable choice of a chemical etchant. Furthermore, through any arrangement and geometry of individual filaments, almost any elasticity properties of the

bristle ends and corresponding versatile bristle end geometries can be implemented.

According to another embodiment, polyamide and/or polyester is provided as the material for the filaments. These materials have different elasticity and rigidity properties. Furthermore, only one of these materials is attacked by the chemicals provided for a chemical etching process, such as sodium hydroxide solution, sulfuric acid or formic acid, whereas the respective other material is essentially resistant to these chemicals. The polyamide may be in particular nylon, PA 6.6, PA 6.10 and PA 6.12, while the polyester may be essential PET and/or PBT.

According to another independent aspect, the invention relates to a method for manufacturing or processing bristles, in particular toothbrush bristles which have at least two coextruded filaments comprising different materials in the longitudinal direction. This method is characterized in that at least one of the filaments is eroded in at least some areas by means of a chemical etching process in the area of the free end of the bristles. The at least one other filament is essentially resistant to the chemicals used in the chemical etching process and it becomes corroded to a negligible extent at most in the chemical etching process.

According to a preferred embodiment of the inventive method, at least one filament that is essentially resistant to the etchant is exposed by means of the etching process in at least some areas, preferably in the area of the free end. The parameters of the etching process such as the depth of immersion of the bristle ends in the chemicals and their dwell time in the chemicals are preferably adapted to the shape and

geometry of the filaments, in particular the radial dimensions of the filaments. In this manner, the etching process can be optimized so that the at least one filament is completely eroded in the area of the free end of the bristle so that the at least one other filament can be essentially exposed there.

This is important in particular when the core of the bristle is formed by a filament that is resistant to the chemicals used and is surrounded radially by the filaments that are corroded in the etching process as sheathing. Therefore, the lateral surfaces of the multifilament bristle surrounding the internal bristle core is eroded by the chemical etching process to the extent that it tapers conically toward the end of the bristle. Consequently, only the lateral surface of the bristle tapers, while a bristle core that is not damaged chemically protrudes beyond the end of the lateral surface of the bristle.

In addition, the etching process is universally applicable to a number of different configurations of different filaments. For example, the free ends of several filaments, preferably arranged regularly and a distance apart from one another, can be determined by means of the etching process. Ultimately this even allows inexpensive chemical production of slots which may be used to hold media. Furthermore, production of bristles with a split use end comprising multiple individual filaments is also possible by chemical methods which are therefore inexpensive.

According to another aspect, the ends of the bristles are chamfered or rounded by grinding after the etching process.

According to another aspect of the invention which is especially advantageous, the bristles are secured on a bristle carrier provided for the bristles, in particular on a toothbrush head, before the etching process. Thus the bristles are already on their predetermined position on the bristle head even before the etching and grinding process which processes the ends of the bristles, and need not be attached to this bristle carrier after the etching process, which would be associated with a disproportionately greater effort because the bristles which are designed with a taper at their ends would have to be treated with greater care.

Attaching the bristles to the bristle head before processing the ends of the bristles allows in particular a simplified production of complex cluster geometries of bristles on the bristle carrier.

According to another independent aspect, the invention therefore relates to bristle materials of any type, but in particular toothbrushes having a bristle carrier on which the inventive tapered multifilament bristles are arranged.

Exemplary Embodiments

Additional goals, advantages, features and advantageous properties of the present invention are derived from the following description of exemplary embodiments on the basis of the drawings. All the features described and/or illustrated here in any reasonable combination constitute the subject matter of the present invention, even independently of the patent claims or their reference back to previous claims.

In the drawing:

Figure 1 shows a cross section through a two-filament bristle in cross section A-A,

Figure 2 shows the two-filament bristle according to Figure 1 in a longitudinal section,

Figure 3 shows a multifilament bristle in cross section,

Figure 4 shows a bristle having filaments arranged in segments,

Figure 5 shows a bristle having filaments on the outside, and

Figure 6 shows a bristle end having several exposed filaments.

Figures 1 and 2 show a bristle 1, in particular the bristle of a toothbrush, shown schematically in cross section. The bristle 1 here consists of two filaments 2, 3 of different materials which are extruded, drawn and secured together. The one filament 2 forms an internal core of the bristle 1 while the other filament 3 surrounds the internal filament 2 as sheathing. The other filament, for example, is made of polyamide, e.g., nylon, while the outer filament 3 is made of polyester.

By immersing the free end of the bristle 1 into a chemical that is corrosive for the lateral surface 3 of the bristle, e.g., sodium hydroxide solution or sulfuric acid, the originally cylindrical lateral surface 3 is eroded in a material-selected manner, while the bristle core 2 which is resistant to chemicals retains an unchanged geometry in comparison with its basic state (not shown). The polyester

filament 3 forming the bristle material is etched away by immersion into the chemicals, so that the lateral surface 3 of the bristle, before reaching the free end of the bristle, tapers conically with a cross-sectional area that decreases steadily toward the end of the bristle.

In comparison with a known etching process with monofilaments, this material-selective etching process has the advantage that the internal core 2 of the bristle is not damaged in at all by the etching process. This still has the required flexural rigidity and can easily be pointed or rounded mechanically in the following process steps. In addition, because of the material-selective etching of the bristle end, this ensures that the thickness cannot drop below the predefined minimum of the bristle end, so that this reliably counteracts the risk of a bristle breaking out or breaking off in an uncontrolled manner.

In addition, such a material-selective etching process is associated with a reduction in the amount of material to be eroded so that on the whole a higher yield of the etching process can be achieved with corresponding cost advantages.

Figure 3 shows another exemplary embodiment of a multifilament bristle 4. Several filaments 6 comprising the same material are arranged here distributed regularly over the cross section of the bristle 4 and at a distance from one another. The interspaces between the filaments 6 are filled here with the filament 5, which is eroded by the chemicals used in the etching process. By immersing such a bristle end into the etching chemical, here again the filament 5 can be removed completely at the free bristle end, so that the individual filaments 6 remain standing with a smaller

diameter and are suitable for accommodating material in the filament interspaces and for penetrating into extremely small dental interspaces.

Finally, Figure 4 illustrates another exemplary embodiment of the bristle 7, showing in cross section the arrangement of segments of different filaments 8, 9 in radial symmetry. In contrast with the exemplary embodiment according to Figure 3, all the filaments 8, 9 run from the midpoint of the bristle to the edge of the bristle. Here again individual filaments 8 or 9 can be removed in a targeted manner at the free end of the bristle through a suitable etching process.

Figure 5 shows another example of a bristle end, in which individual filaments 12 made of one material are arranged with a distance between them but adjacent to the bristle circumference, while the other filament 11 fills up the core area of the bristle. In this exemplary embodiment, it is provided in particular that the filament 11 is partially removed by the etching process, so that the individual bristle filaments 12 are exposed in at least some areas and thus form a spread end of the bristle 10.

Finally, Figure 6 shows a schematic side view of another bristle end 13, which has different filaments 14, 15, which are preferably dissolved away by means of a chemical etching process, thus forming a bristle end that fans out. For example, it is possible to provide here that the filaments 14, 15, which are made of different materials, are initially held together by means of another filament, which is not shown explicitly here, e.g., in the manner of the filament 11 shown in Figure 5, which is ultimately removed in the etching process, so that finally the fan-like structure

illustrated in Figure 6 is formed at the end of the bristle.

PATENT CLAIMS

1. A bristle (1; 4; 7; 10; 13), in particular for toothbrushes having at least two coextruded filaments (2, 3; 5, 6; 8, 9; 11, 12; 14, 15) of different materials in the longitudinal direction,

   characterized in that

   the cross-sectional area of at least one filament (3; 5; 9; 11) decreases toward the free end of the bristle.

2. The bristle according to Claim 1,

   characterized in that

   the cross-sectional area of the at least one filament (3; 5; 9; 11) decreases steadily toward the free end of the bristle 1; 4; 7; 10; 13).

3. The bristle according to Claim 1 or 2,

   characterized in that

   the cross-sectional area of the at least one other filament (2; 6; 8; 12) is essentially constant in the longitudinal direction of the bristle.

4. The bristle according to any one of the preceding claims,

   characterized in that

   the bristle (1; 3; 7; 10; 13) tapers toward its free end, in particular with a conical or pointed taper.

5. The bristle according to any one or more of the preceding claims,

characterized in that

the at least one other filament (2; 6; 8; 12) is surrounded radially in at least some areas by the at least one filament (3; 5; 9; 11).

6. The bristle according to any one or more of the preceding claims,

characterized in that

the at least one other filament (2; 6; 8; 12) extends further in the axial direction than the at least one filament (3; 5; 9; 11).

7. The bristle according to any one or more of the preceding claims,

characterized in that

the at least one other filament (2; 6; 8; 12) is rounded or chamfered at its free end.

8. The bristle according to any one or more of the preceding claims,

characterized in that

the at least two filaments (2, 3; 5, 6; 8, 9; 11, 12; 14, 15) have a different elasticity and/or a different flexural rigidity.

9. The bristle according to any one or more of the preceding claims,

characterized in that

the at least one filament (3; 5; 9; 11) is erodable by means of an etchant against which the at least one other filament (2; 6; 8; 12) is essentially resistant.

10. The bristle according to any one or more of the preceding claims,

characterized in that

the material provided for the filaments (2, 3; 5, 6; 8, 9; 11, 12; 14, 15) is polyamide, in particular nylon, PA6.6, PA6.10, PA6.12 and/or polyester, in particular polyethylene terephthalate (PET), polybutylene terephthalate (PBT).

11. The method for producing or processing bristles (1; 4; 7; 10; 13), in particular toothbrush bristles which have at least two coextruded filaments ((2, 3; 5, 6; 8, 9; 11, 12; 14, 15) of different materials in the longitudinal direction,

characterized in that

at least one of the filaments (3; 5; 9; 11) is eroded in at least some areas by means of a chemical etching process in the area of the free end of the bristles (1; 4; 7; 10; 13).

12. The method according to Claim 11,

characterized in that

at least one filament (2; 6; 8; 12) which is essentially resistant to the etchant is exposed in at least some areas by means of the etching process.

13. The method according to any one of the preceding Claims 11 or 12,

characterized in that

a sheath of filaments (3; 5; 9; 11) surrounding the core of the bristle (1; 4; 7; 10) is eroded in at least some areas by means of the etching process.

14. The method according to any one or more of the preceding Claims 11 to 13,

characterized in that

the free ends of several regularly arranged filaments (6; 8; 12; 14, 15) are exposed by means of the etching process.

15. The method according to any one or more of the preceding Claims 11 to 14,

characterized in that

the bristle ends are chamfered or rounded by grinding after the etching process.

16. The method according to any one or more of the preceding Claims 11 to 15,

characterized in that

the bristles (1; 4; 7; 10; 13) are secured on a bristle carrier provided for the bristles (1; 4; 7; 10; 13) before the etching process.

17. Bristle material, in particular toothbrush, having a bristle carrier on which the bristles (1; 4; 7; 10; 13) are arranged according to any one or more of the preceding Claims 1 to 10.

Fig. 1

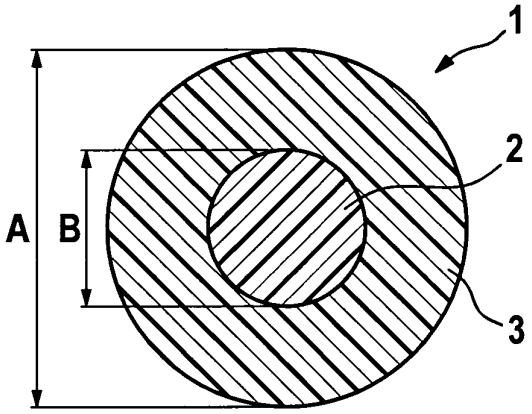

Fig. 2

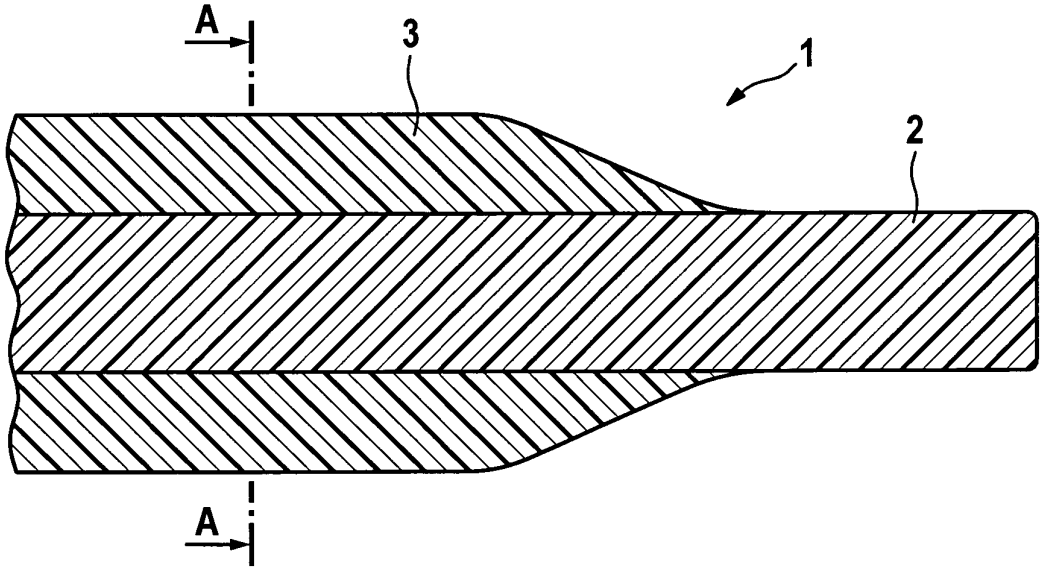

Fig. 3

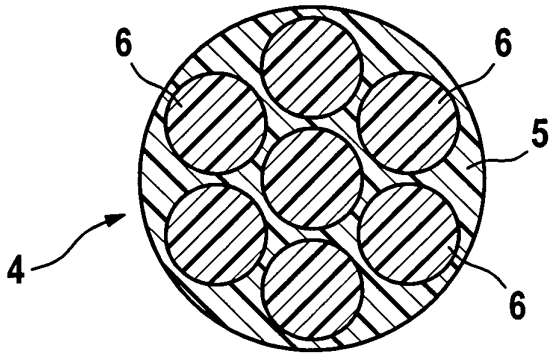

Fig. 4

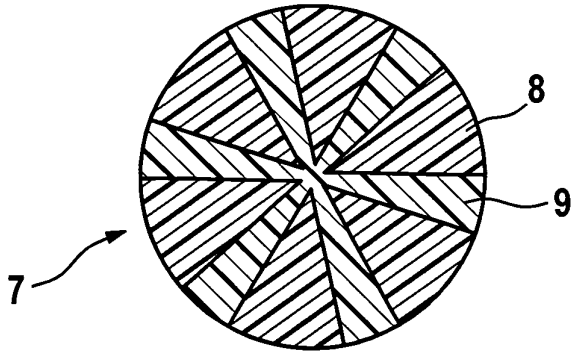

Fig. 5

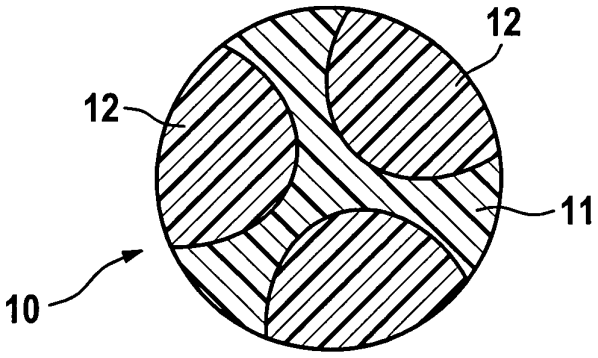

Fig. 6