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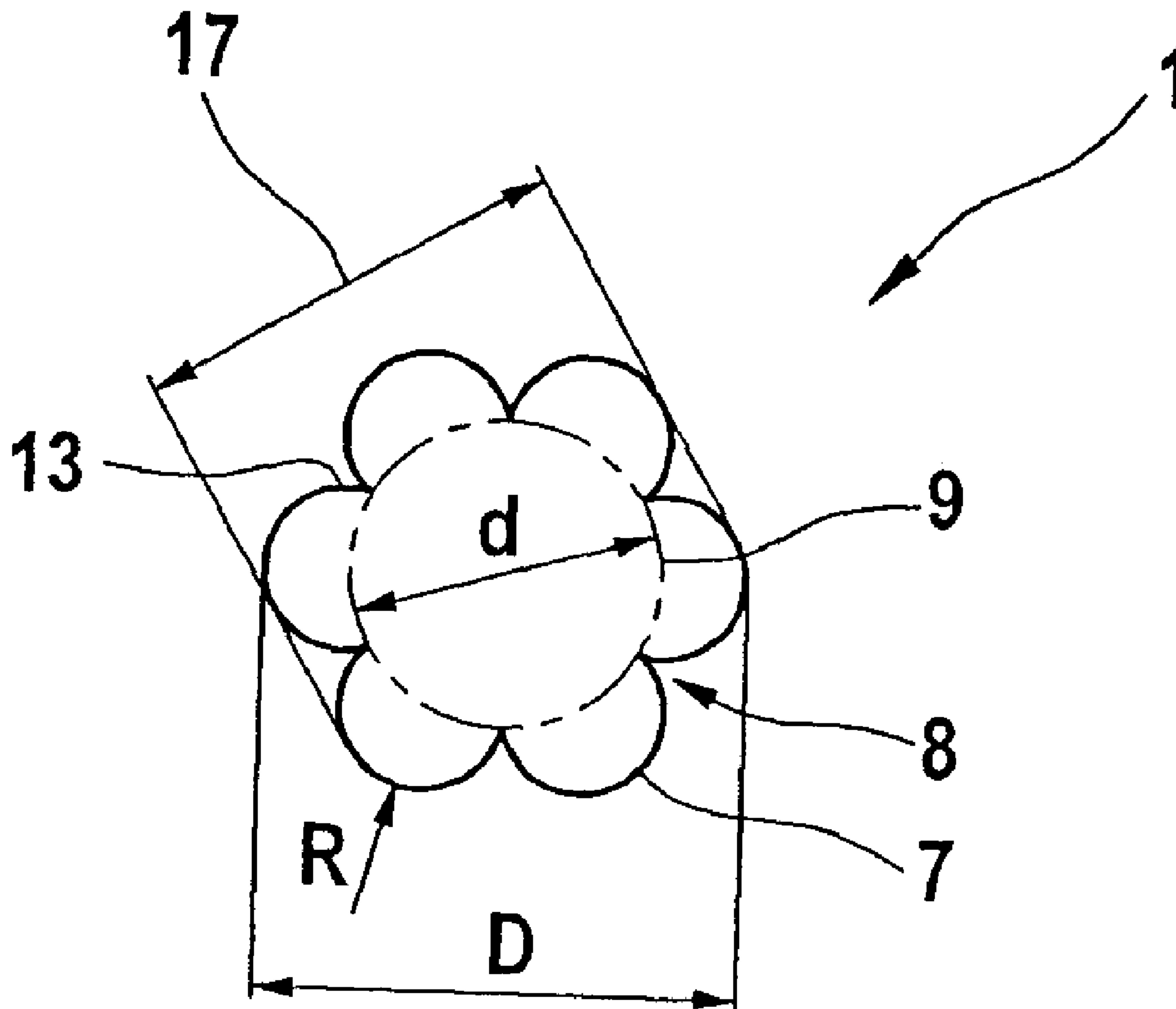
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(54) **Titre : BROSSE A DENTS ET TETE DE BROSSE A DENTS AINSI QUE SOIE DE NETTOYAGE DENTAIRE POUR CELLE-CI**
(54) **Title: TOOTHBRUSH, AS WELL AS TOOTHBRUSH HEAD AND TOOTH CLEANING BRISTLE FOR THE SAME**



(57) **Abrégé/Abstract:**

The present invention relates to a tooth cleaning bristle which is formed as a monofilament and has a generated surface with a structured profile, preferably shaped like a longitudinal groove which, in the circumferential direction, has alternate projections and



(57) Abrégé(suite)/Abstract(continued):

depressions. The invention also relates to a toothbrush head with a bristle support to which at least one such tooth cleaning bristle is attached and, finally, to a preferably electric toothbrush with such a toothbrush head. In order to be able simultaneously to satisfy the diverse requirements of a tooth cleaning bristle, the present invention envisages a special profile of the generated surface of the tooth cleaning bristles which makes it possible to fill the bristle support easily, and which prevents the bristles which are brought together in a bunch from interlocking and yet ensures an intensive cleaning action on the generated surface side. Thanks to the profile, the circumference of the tooth cleaning bristle has a specific relationship to the cross section surface of the bristle. According to the invention, the tooth cleaning bristle which is formed as a monofilament has a profile on the generated surface side which is designed such that the relationship of the circumference of the generated surface to the cross section surface of the tooth cleaning bristle is in the range of 30 mm^{-1} to 50 mm^{-1} . The generated surface of the tooth cleaning bristle is thus significantly larger compared to a circular cylindrical bristle with a comparable cross section surface, and so the cleaning action on the generated surface side improves accordingly, and toothpaste can better stick to and come off the tooth cleaning bristles on the generated surface side. Nevertheless, despite the profile on the generated surface side, the tooth cleaning bristle is still able to be attached to a suitable bristle support in the anchor connection method.

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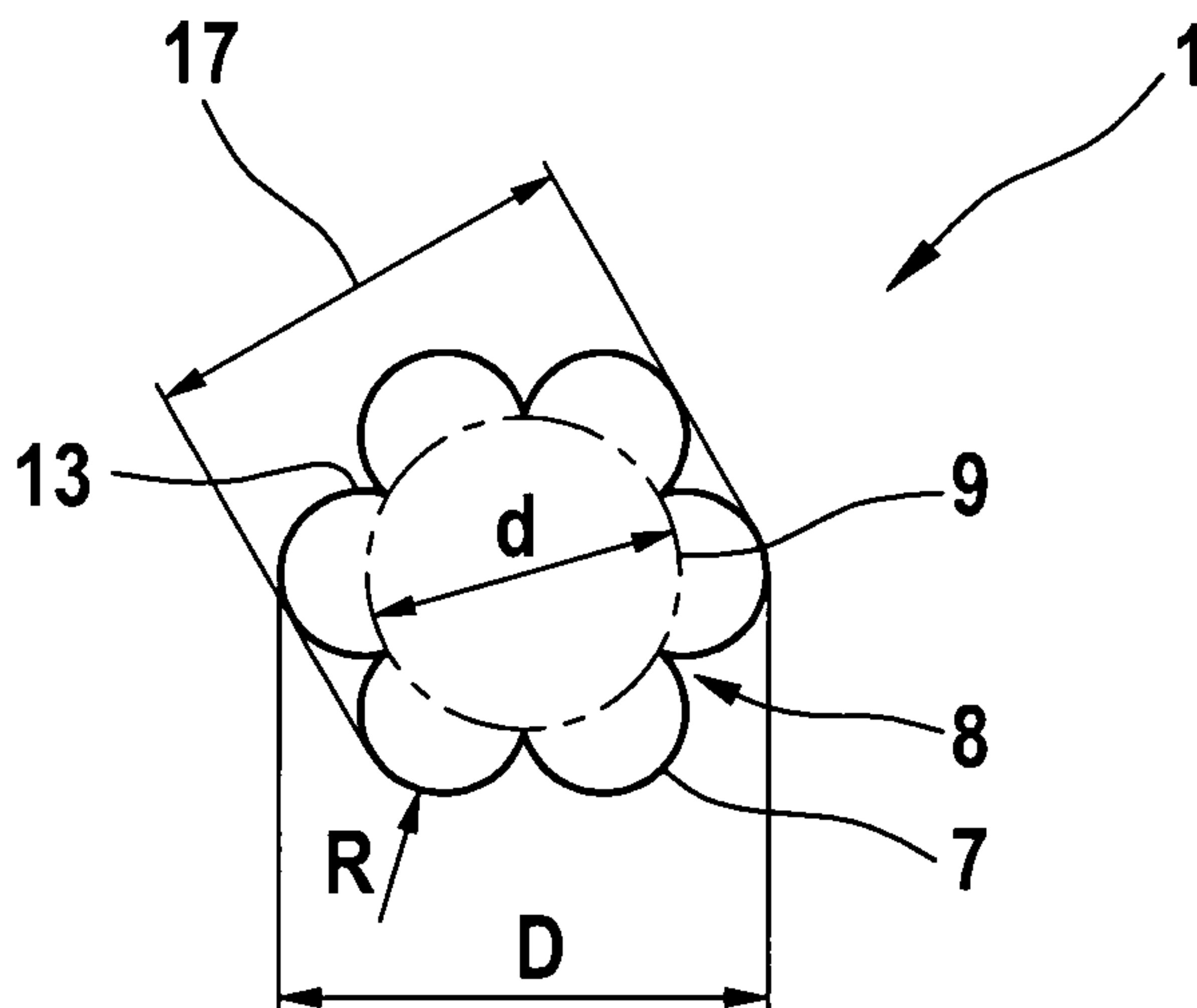
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(54) Title: TOOTHBRUSH AND TOOTHBRUSH HEAD AND A TOOTH CLEANING BRISTLE FOR SAME

(54) Bezeichnung: ZAHNBÜRSTE SOWIE ZAHNBÜRSTENKOPF UND ZAHNPUTZBORSTE HIERFÜR

(57) Abstract: The present invention relates to a tooth clean-
ing bristle which is formed as a monofilament and has a gen-
erated surface with a structured profile, preferably shaped like
a longitudinal groove which, in the circumferential direction,
has alternate projections and depressions. The invention also
relates to a toothbrush head with a bristle support to which at
least one such tooth cleaning bristle is attached and, finally, to a
preferably electric toothbrush with such a toothbrush head. In
order to be able simultaneously to satisfy the diverse require-
ments of a tooth cleaning bristle, the present invention envis-
ages a special profile of the generated surface of the tooth clean-
ing bristles which makes it possible to fill the bristle support
easily, and which prevents the bristles which are brought to-
gether in a bunch from interlocking and yet ensures an inten-
sive cleaning action on the generated surface side. Thanks to
the profile, the circumference of the tooth cleaning bristle has
a specific relationship to the cross section surface of the bristle.
According to the invention, the tooth cleaning bristle which is
formed as a monofilament has a profile on the generated sur-face side which is designed such that the relationship of the circumference of the generated surface to the cross section surface of the
tooth cleaning bristle is in the range of 30 mm^{-1} to 50 mm^{-1} . The generated surface of the tooth cleaning bristle is thus significantly
larger compared to a circular cylindrical bristle with a comparable cross section surface, and so the cleaning action on the generated
surface side improves accordingly, and toothpaste can better stick to and come off the tooth cleaning bristles on the generated surface
side. Nevertheless, despite the profile on the generated surface side, the tooth cleaning bristle is still able to be attached to a suitable
bristle support in the anchor connection method.(57) Zusammenfassung: Die vorliegende Erfindung betrifft eine Zahnputzborste, die als Monofilament ausgebildet ist und eine
Mantelfläche mit einer vorzugsweise längsriefenförmig strukturierten Profilierung aufweist, die in Umfangsrichtung abwechselnd
Vorsprünge und Senken besitzt. Die Erfindung betrifft weiterhin einen Zahnbürstenkopf mit einem Borstenträger, an dem zumindest
eine solche Zahnputzborste befestigt ist, sowie schließlich eine vorzugsweise elektrische Zahnbürste mit einem solchen Zahnbürs-
tenkopf. Um die an sich auseinander laufenden Anforderungen an eine Zahnputzborste gleichermaßen erfüllen zu können, sieht die
vorliegende Erfindung eine spezielle Profilierung der Mantelfläche der Zahnputzborsten vor, die eine einfache Bestopfbarkeit des
Borstenträgers ermöglicht, ein Verhaken der zu einem Büschel zusammengefassten Borsten

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verhindert und dennoch eine intensive mantelflächenseitige Putzwirkung sicherstellt. Durch die Profilierung steht die Umfangslänge der Zahnputzborste in einem bestimmten Verhältnis zu der Querschnittsfläche der Borste. Erfindungsgemäß besitzt die als Monofilament ausgebildete Zahnputzborste eine mantelflächenseitige Profilierung, welche derart ausgebildet ist, dass das Verhältnis der Umfangslänge der Mantelfläche zu der Querschnittsfläche der Zahnputzborste im Bereich von 30 mm^{-1} bis 50 mm^{-1} liegt. Hierdurch ist die Mantelfläche der Zahnputzborste gegenüber einer kreiszylindrischen Borste mit vergleichbarer Querschnittsfläche deutlich vergrößert, so dass sich die mantelflächenseitige Putzwirkung entsprechend verbessert und Zahnpasta an der Zahnputzborste mantelflächenseitig besser anhaftet und abgegeben wird. Nichtsdestotrotz bleibt die Zahnputzborste trotz der mantelflächenseitigen Profilierung geeignet, im Ankerstopfverfahren an einem entsprechenden Borstenträger befestigt zu werden.

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Toothbrush, as well as toothbrush head and tooth cleaning bristle for the same

The present invention relates to a tooth cleaning
5 bristle, which is configured as a monofilament and has
a shell surface having a profiling that is structured
preferably in the shape of a longitudinal flute and
that possesses projections and depressions, alternating
in the peripheral direction. The invention further
10 relates to a toothbrush head having a bristle carrier
to which at least one such tooth cleaning bristle is
fastened, and finally to a preferably electric
toothbrush having a toothbrush head of this kind.

15 Traditionally, for the bristle cluster of a toothbrush,
substantially cylindrical tooth cleaning bristles are
used, circular cylindrical bristles, in particular, but
also cylindrical shapes having bases which are
different from the circular shape, being known. Besides
20 cylindrical tooth cleaning bristles of triangular,
square or polygonal cross sections, tooth cleaning
bristles having complicated profilings on the shell
surface have also recently been proposed, e.g. tooth
cleaning bristles of star-shaped or cruciform cross
25 sections. Such tooth cleaning bristles, which are
profiled on the shell surface, have been proposed from
various aspects.

Thus US 3,302,230 shows a toothbrush having bristles
30 which taper in the longitudinal direction and which are
designed to be of triangular, star-shaped or rhombic
configuration in cross section in order to obtain a
scraping effect with the shell-surface-side contoured
edges and to achieve an improved adhesion of the
35 toothpaste compared to circular cross sections. JP 6-
233709 A also proposes such angular cross-sectional
profiles for the tooth cleaning bristles of a
toothbrush in order to effect a better plaque removal

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by virtue of the shell-surface-side edges and their scraping effect. DE 195 33 815 A1 proposes, on the other hand, a toothbrush whose bristles, on their shell surface, are designed to have a single-turn or multi-
5 turn helix as profile in order to obtain an enhanced massaging effect. Such helically twisted profilings have the drawback, however, that the bristles can easily catch amongst themselves and, moreover, that penetration into interdental spaces is made more
10 difficult, since the bristles would need to twist for this purpose.

From DE 198 18 345 A1, multilayered tooth cleaning bristles of non-homogeneous material cross section are
15 known, in which a relatively hard plastics core is designed to be encased in an elastomeric plastics layer profiled by stamping against the core, longitudinal ribs which are distributed over the periphery and which give the bristle an altogether approximately flower-
20 shaped cross section, or hole-shaped recesses in the shell surface, being proposed as the profiling. Such multilayered bristles are, however, complicated to produce and correspondingly expensive and, moreover, are only conditionally suited to fastening by the so-
25 called anchor-plugging method. In order to increase the flexural rigidity of even long, very narrow bristles, DE 1 997 717 proposes constructing a bristle from a plurality of filaments which are bonded together along their longitudinally running contact surfaces,
30 whereupon convexly curved longitudinal ribs are formed on the shell surface in the style of a flower stem bunch. Between the filaments forming the bristle, storage pockets are obtained, in which moisture collects. Self-evidently, this bristle, too, which is
35 bonded together from a plurality of filaments, can only be produced by complex means. In US 5,533,227, a toothbrush is additionally described, the bristles of which are sharpened to a point at the bristle ends.

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Apart from these sharpenings, the bristles are, however, of circular cylindrical configuration.

Further bristles having shell-surface-side profilings
5 for other purposes, however, are shown by the
publications EP 0 329 505 B1, DE 11 40 901, US
5,725,954, US 2,434,533 and GB 1,137,407.

The previously proposed tooth cleaning bristles having
10 shell-surface-side profilings have so far managed only
inadequately to meet the, in part, diametrically
divergent requirements which apply to toothbrushes and
tooth cleaning. Although tooth cleaning bristles of
cruciform or star-shaped cross sections can effect a
15 good plaque removal by virtue of the scraping effect of
their shell-surface-side edges, they do however possess
a very specific, direction-dependent flexural rigidity.
In addition, bristles of such cross section, which are
combined into a cluster, can easily catch. Also, tooth
20 cleaning bristles which are profiled in this way are
fastenable to the bristle carrier of the toothbrush
head only with difficulty. In particular, the tooth
cleaning bristles can no longer readily be turned over
in a U-shape, so that a fastening by the anchor-
25 plugging method is difficult. Tooth cleaning bristles
which in this regard are easier to handle, having
polygonal, in particular square or hexagonal cross
sections without concavities on the shell surface, are
disadvantageous, on the other hand, in terms of the
30 reception of toothpaste on the shell surface of the
bristles. Roughly the same is true of cylindrical tooth
cleaning bristles having wholly unprofiled shell
surfaces, which, moreover, offer little advantage in
terms of the bristling density. If the tooth cleaning
35 bristles are too round, space between the individual
bristles in a bristle cluster is always sacrificed, so
that, given a set size of the bristle carrier and a set
number of pluggable holes, only a limited number of

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bristles can be provided.

Starting from the above, the object of the present invention is to provide an improved tooth cleaning
5 bristle, an improved toothbrush head and a correspondingly improved toothbrush, to eliminate the drawbacks of the prior art and to advantageously refine the latter. In particular, the aim is to provide tooth
10 cleaning bristles which, in production engineering terms, can be easily combined by the anchor-plugging method into a bristle cluster with high bristle density and which nevertheless boast a high cleaning performance.

15 In order to be able equally to meet the intrinsically divergent requirements demanded of a tooth cleaning bristle, the present invention provides a specific profiling of the shell surface of the tooth cleaning
20 bristles, which profiling allows a simple pluggability of the bristle carrier with a high bristle density, prevents catching of the bristles combined into a cluster, and yet ensures an intensive cleaning action on the shell surface side. As a result of the
25 profiling, the peripheral length of the tooth cleaning bristle stands in a specific ratio to the cross-sectional area of the bristle. According to the invention, the tooth cleaning bristle configured as a monofilament possesses a shell-surface-side profiling which is configured such that the ratio of the
30 peripheral length of the shell surface to the cross-sectional area of the tooth cleaning bristle lies

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within the range from 30 mm^{-1} to 50 mm^{-1} . The shell surface of the tooth cleaning bristle is hence significantly enlarged in relation to a circular cylindrical bristle of comparable cross-sectional area, so that the cleaning action on the shell surface side is correspondingly improved and toothpaste adheres better to the tooth cleaning bristle on the shell surface side and is delivered better. In the shell-surface-side depressions of the profiling, toothpaste can be received and, upon cleaning contact with the tooth flanks, directly delivered, whereby a greater polishing effect is achieved, which is desirable, in particular, in the removal of tooth color. As a result of the enlarged shell surface, which is obtained despite the small cross-sectional area compared to round bristles, more cleaning area is engaged with the teeth to be cleaned, thereby resulting in an enhanced cleaning performance. Moreover, a thus configured profiling of the shell surface of the tooth cleaning bristle allows a high bristling density given a constant bristle arrangement in a cluster, without sacrificing space between the bristles. Nonetheless, in spite of the shell-surface-side profiling, the tooth cleaning bristle remains suitable for fastening to a corresponding bristle carrier by anchor-plugging methods. A multiplicity of tooth cleaning bristles with essentially double the cluster length can here be banded together in a U-shape to form a cluster and anchored in a cluster-receiving recess in the bristle carrier by means of an anchor lying over the bend in the bristles. An anchorless plugging, using, for example, the so-called AFT or IAP method, are likewise conceivable with these bristles.

Preferably, the shell-surface-side profiling of the tooth cleaning bristle is configured such that said peripheral length/cross-sectional area ratio amounts to between 30 mm^{-1} and 40 mm^{-1} , in particular about 32 mm^{-1}

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to 36 mm^{-1} . As a result, still better allowance is made for the aforesaid divergent requirements.

In a refinement of the invention, the peripheral length
5 of the profiled shell surface, measured therefore running along the projections and depressions which are provided there, amounts to between 0.5 mm and 1 mm, the profiling advantageously being configured such that the peripheral length amounts to between 0.6 mm and 0.8 mm.
10 Despite this relatively high peripheral length, the cross-sectional area can advantageously be kept small, the cross-sectional area preferably amounting to just 0.01 mm^2 to 0.03 mm^2 , in particular about 0.015 mm^2 to 0.020 mm^2 . By virtue of the small cross-sectional area
15 of the individual tooth cleaning bristles, a high packing density with a large number of bristles per unit of area of the bristle carrier is able to be achieved. Moreover, the tooth cleaning bristles can be easily turned over in a U-shape in the desired manner
20 in order to be fastened to the bristle carrier by anchor-plugging methods.

The depressions and projections of the profiling can here be configured and arranged fundamentally
25 differently. According to an advantageous embodiment of the invention, the projections and depressions are evenly distributed over the periphery of the shell surface of the tooth cleaning bristle. The depressions and projections can here be arranged in particular such
30 that an inner envelope circle is defined by the depressions and an outer envelope circle is defined by the projections, i.e. the radially deepest points of the depressions lie on a circle, just as the radially outermost points of the projections lie on a circle.
35 Oval, elliptical or generally non-circular envelope curves may also basically be considered. Preference is given, however, to the aforesaid configuration comprising an arrangement of depressions and

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projections which defines envelope circles, with which arrangement the aforesaid divergent requirements regarding the nature of a tooth cleaning bristle cluster can best be met.

5

In a refinement of the invention, the depth of the depressions and the height of the projections is chosen such that the ratio of the diameter of the outer envelope circle defined by the projections to the
10 diameter of the inner envelope circle defined by the depressions lies within the range from 1.1 to 1.6, preference being given to different values of the diameter ratio, depending on the geometry of the depressions and projections.

15

The number of depressions and projections of the shell-surface-side profiling which are distributed over the periphery can be chosen fundamentally different, at least four depressions and four projections being
20 distributed over the periphery in order to achieve a sufficient enlargement of the peripheral length without cross-sectional incisions of too great a depth. In a refinement of the invention, at least six depressions and at least six projections are provided on the shell
25 surface of the tooth cleaning bristle.

According to a preferred embodiment of the invention, the tooth cleaning bristle configured as a monofilament can be provided with a cross section which is
30 substantially flower-shaped or has the shape of a multilobed clover leaf. The projections can here, viewed in cross section, possess an arc-shaped, in particular circular-arc-shaped contour, while the depressions, likewise viewed in cross section, can
35 possess a V-shaped or pointed contour, formed by the converging side flanks of two respectively adjacent projections. The depressions here have, so to speak, a bottomless configuration, in the form of convergent

columns, the side flanks of the adjacent projections converging to a point or such that they are rounded off with just a small radius. Depending on the strength of convexity of the projections, the side flanks can
5 converge in the depressions at different angles, the contour preferably being configured such that the side flanks of two adjacent projections converge at an acute angle, advantageously at an angle of less than 60°.

10 In particular in such a configuration of the shell-surface-side profiling having depressions converging inwards to a point, the aforesaid diameter ratio of outer envelope circle to inner envelope circle can lie within the range from 1.4 to 1.6 and, according to an
15 advantageous embodiment of the invention, can amount to about 1.5.

In such an altogether flower-shaped or clover-leaf-shaped configuration of the cross section of the tooth
20 cleaning bristle, it proves particularly advantageous if, on the shell surface, six projections and six depressions are provided, which extend in the form, respectively, of longitudinal ribs and longitudinal depressions, advantageously parallel to the
25 longitudinal axis of the tooth cleaning bristle.

By virtue of the longitudinal ribs of arc-shaped marginal contour, an efficient and nonetheless gentle tooth cleaning can be achieved also with the shell
30 surfaces of the tooth cleaning bristles.

In order to achieve a stronger abrasive effect with the shell surface of the tooth cleaning bristles, the tooth cleaning bristle, according to an alternative, likewise
35 preferred embodiment of the invention, can possess a cross section which, all in all, is roughly like a splined shaft and in which, on the shell surface of the tooth cleaning bristle, in the peripheral direction,

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crenelated projections alternate with approximately U-shaped depressions or grooves. The crenelated contour of the projections can here advantageously possess slightly inclined side flanks, so that the crenelated
5 projections slightly taper radially outwards. The connecting portion of the crenelated contour, connecting the preferably straight side flanks, can have a basically flat configuration, yet, in a refinement of the invention, is slightly convexly
10 curved, an angular transition of the top-side-forming connecting portion into the side flanks being advantageously provided. The depressions provided between the crenelated projections are delimited by said side flanks of the crenelated contours, which,
15 however, in contrast to the previously described embodiment, are spaced apart, so that a blunt base is formed between the side flanks and the depression acquires, all in all, a U-shaped cross section. In particular, the profiling can be configured such that
20 the shell surface of the tooth cleaning bristle corresponds to a circular cylindrical shaft, into the periphery of which longitudinal grooves are milled.

In such a configuration of the tooth cleaning bristle
25 with U-shaped depressions, which configuration - roughly speaking - is all in all like a splined shaft, said depressions advantageously have a very flat configuration. In a refinement of the invention, the diameter ratio of the aforesaid outer envelope circle
30 to the inner envelope circle amounts to about 1.1 to 1.2. Preferably, on the shell surface, eight projections are provided, which alternate with eight U-shaped depressions.

35 Preferably, the tooth cleaning bristles possess a cross section which is essentially constant over the length of the tooth cleaning bristles, so that the projections and depressions of the profiling have a fairing pattern

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and extend substantially over the entire length of the
bristle. Where necessary, the tooth cleaning bristle
can be rounded or otherwise taper toward its bristle
end, so that a constant cross section is no longer
5 given in this bristle end portion.

In a refinement of the invention, the profiling of the
shell surface is not twisted per se. The tooth cleaning
bristle, in particular in the region of the profiled
10 shell surface, can, where necessary, apart from a
bristle end portion, have an altogether cylindrical
configuration, in which case the base, due to the
profiling, is not of course circular, but is
correspondingly profiled.

15 Further aims, advantages, features and possible
applications of the present invention emerge from the
following description of preferred illustrative
embodiments with reference to the drawings. Here, all
20 described and/or pictorially represented features per
se, or in any chosen sensible combination or sub-
combination, form the subject of the present invention,
including independently of their amalgamation in the
claims or the relations thereof. In the drawings,

25 fig. 1: shows a perspective view of an electric
toothbrush according to a preferred
embodiment of the invention, which has a
brush head having a rotary drivable bristle
30 field,

fig. 2: shows a schematic representation of a bristle
cluster comprising filaments turned over in a
U-shape, which bristle cluster is
35 accommodated in a cluster-receiving recess
and is fastened with an anchor lying over the
bend in the filaments,

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fig. 3: shows a schematic, perspective representation of a tooth cleaning bristle of the toothbrush from fig. 1 according to a first preferred embodiment,

5

fig. 4: shows a cross section through the tooth cleaning bristle from fig. 3, and

fig. 5: shows a cross section through a tooth cleaning bristle according to an alternative embodiment of the invention.

10

The toothbrush 13 shown in figure 1 comprises a hand part 14 and a toothbrush head 2 which is seated on a brush tube 25 forming a front end of the hand part 14 or connected to the latter. The hand part 14 is formed by a toothbrush housing 26, in which, in a manner which is known per se, a battery compartment and a drive motor 27 are disposed axially one behind the other. The drive motor 27 can be switched on and off by means of a switch 18. Via a drive train (not specifically represented), comprising a gear mechanism and a transducer extending through the brush tube 25, the disk-shaped bristle carrier 3 of the toothbrush head 2 can be driven in a rotationally oscillating manner. In the illustrated embodiment, a bristle field 19 is here seated on the bristle carrier 3, which bristle field has a substantially circular cylindrical configuration and can comprise a multiplicity of bristle clusters 4, as shown by figure 2.

25

30

The bristle cluster 4 shown in figure 2 is advantageously fastened to the bristle carrier 3 by so-called anchor-plugging methods. The bristle carrier 3 has for this purpose a substantially cylindrical, blindhole-shaped cluster-receiving recess 12, in which the bristle cluster 4 is rammed. The bristle cluster 4 here comprises a multiplicity of tooth cleaning

35

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bristles 1 turned over in a U-shape, which essentially have double the length of the bristle cluster 4, so that each tooth cleaning bristle 1 sits in the shape of a loop in the receiving recess 12 and forms with its two side pieces in fact two bristles in the bristle cluster 4. As shown by figure 2, over the bend of the turned-over tooth cleaning bristle 1 there is placed an anchor 11, with the aid of which the bristle cluster 4 is anchored in the cluster-receiving recess 12. The anchor 11 here extends transversely over the receiving recess 12 and can be driven in the wall thereof.

According to a first advantageous embodiment of the invention, the tooth cleaning bristles 1 here advantageously possess the contour shown in figure 3. Each tooth cleaning bristle 1 is here configured as a monofilament and is produced from a polymer material, in particular polyamide, PBT (polybutylene terephthalate) or a thermoplastic elastomer, other materials, too, in principle being usable. By virtue of the monofil configuration, the tooth cleaning bristle 1 possesses a substantially homogeneous material cross section.

As shown by figure 3, the tooth cleaning bristle 1 advantageously possesses an altogether cylindrical shape, in the illustrated embodiment a cross section being provided which is constant over the length of the tooth cleaning bristle 1. On the shell surface 5 of the tooth cleaning bristle 1 there is provided a profiling 6, which in the illustrated embodiment has a course running axially parallel to the longitudinal axis of the tooth cleaning bristle 1.

As jointly shown by figures 3 and 4, the profiling 6 of the shell surface 5 substantially corresponds to a splined shaft profile, which in the illustrated embodiment has an eight-grooved configuration. In the

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peripheral direction, dentate or crenelated projections 7 alternate with depressions 8 of U-shaped cross section, the depressions 8 forming all in all axially parallel grooves in the shell surface 5 and the
5 projections 7 forming axially parallel ribs.

As shown by figure 4, the projections 7 possess in the peripheral direction a somewhat greater width than the depressions 8. The crenelated projections 7 are
10 laterally delimited by straight side flanks 13, while the raised top side of the projections 7, which forms a connecting portion 14 between the side flanks 13 of the respective projection 7, has a slightly convex configuration. Said top sides of the projections 7 here
15 respectively possess the shape of a circular cylindrical segment and lie on a joint outer envelope circle 10 or an outer envelope cylinder, the diameter of which is labeled in figure 3 with the reference symbol D. The depressions 8 provided between the
20 projections 7 form axially parallel grooves of U-shaped cross section, having a planar or, alternatively, slightly convex bottom 15, the bottoms 15 of all the depressions 8 lying together on an inner envelope circle 9 or an inner envelope cylinder, the diameter of
25 which is labeled in figure 4 with the letter d.

As shown by figure 4, the depressions 8 widen slightly radially outwards. The side flanks 13 of the projections 7, which side flanks laterally delimit the
30 depressions 8, are slightly inclined one to the other at an acute angle, preferably at an angle 16a of about 10° to 30° , preferably about 15° . While the angle 16a describes the "apex angle" directly between the inner points of intersection of the side flank 13 and the
35 surface line of the depression, the greater angle 16b (= about 20°) indicates the apex angle between the outer points of intersection of the side flank and the surface line of the projections.

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The angle α (= 16a) in fig. 4, which describes the angular range of the depressions in terms of their angular extent, is in any event less than the angle β , which describes the angular range of the angular extent of the projections. Preferably, α stands in relation to β in the ratio 1 to 2.

In the illustrated embodiment, the depth of the depressions 8 is chosen such that the ratio of the aforesaid diameter D of the outer envelope circle 10 to the diameter d of the inner envelope circle 9 in the illustrated embodiment amounts to about 1.15.

In the illustrated embodiment, eight depressions 8 and eight projections 7 are here provided, the depressions 8 and the projections 7 being evenly distributed over the periphery of the shell surface 5 respectively at a dividing angle of 45°.

In concrete terms, the diameter D of the outer envelope curve 10 in the illustrated embodiment amounts to about 6.25 mil, equivalent to about 0.1587 mm, while the diameter d of the inner envelope curve 9 amounts to 5.5 mil, equivalent to about 0.1397 mm.

For the illustrated embodiment, this produces a peripheral length of about 0.60 mm to 0.65 mm and a cross-sectional area of about 0.015 mm² to 0.20 mm², so that the ratio of the peripheral length to the cross-sectional area amounts to about 34 mm⁻¹ to 35 mm⁻¹.

Alternatively to the cross-sectional area shown in figure 4, the tooth cleaning bristle can also possess an altogether approximately flower-shaped cross section or a cross section which approximately corresponds to the contour of a multilobed clover leaf, as shown by figure 5. The likewise axially parallel projections 7

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possess in cross section a circular-arc-shaped outer contour, which is dimensioned and arranged such that, all in all, say, respectively semicircular arc segments are placed adjacent to each other around the periphery, cf. figure 5. In this embodiment, the depressions 8 are formed by the pointedly converging side flanks 13, so that the depressions 8 - roughly speaking - possess an approximately V-shaped contour, while the flanks possess a curvature. In the illustrated embodiment, the side flanks 13 of two adjacent projections 7 meet at an angle of about 45° .

As shown by figure 5, six such projections 7 of circular-segment-shaped cross section are evenly distributed over the periphery at a dividing angle of 60° , the projections 7 being evenly arranged also in the radial direction, so that with their respectively maximum radial extent they define an outer envelope circle 10, the diameter of which, in figure 5, is once again labeled with the reference symbol D. The depressions 8 define the inner envelope circle 9, the diameter of which is labeled in figure 5 with the reference symbol d.

The outer contour of the projections 7, which is rounded in cross section in the shape of a circular arc, is rounded with a radius of curvature of about 0.02 mm to 0.03 mm, in the illustrated embodiment a rounding radius R of about 0.026 mm being provided. Together with the even distribution of the, in total, 6 projections 7, this produces a diameter D of the outer envelope circle 10 of about 6.58 mil, equivalent to about 0.167 mm. The diameter d of the inner envelope circle 9, which is defined by the depressions 8, amounts in the illustrated embodiment to about 4.34 mil, equivalent to about 0.11 mm. The minimum outer diameter 17, which is obtained by a measurement in the manner shown in figure 5, amounts to about 5.5 mil to

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6.5 mil, in particular about 6 mil, equivalent to about 0.152 +/- 0.013 mm.

5 The diameter ratio of the outer envelope circle 10 to the inner envelope circle 9 amounts in the illustrated embodiment to about 1.5.

10 By virtue of the arc-shaped projections 7 of the profiling 6, the peripheral length is significantly enlarged relative to a circular cross section with the same cross-sectional area. For a flower-shaped cross sectional contour of this kind, the peripheral length advantageously amounts to about 0.575 mm to 0.675 mm combined with a cross-sectional area of about 0.013 mm² 15 to 0.023 mm². In concrete terms, in the illustrated embodiment, a peripheral length of 0.625 mm is obtained with a cross-sectional area of about 0.018 mm². The ratio of the peripheral length to the cross-sectional area thus amounts to about 34 mm⁻¹ to 35 mm⁻¹.

20

The tooth cleaning bristle can be used in manual toothbrushes and electric toothbrushes with sonic drive, oscillation drive or with eccentric balance drive.

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THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A tooth cleaning bristle comprising a monofilament with a solid cross-sectional area with an outer surface having a contour along at least a portion of a length of the monofilament, wherein the contour defines alternating projections and depressions about a periphery of the monofilament, each of the projections are laterally delimited by a pair of straight side walls while a raised top side of each projection between the respective side walls has a slightly convex configuration, each of the depressions being U-shaped and being defined by the side walls of adjacent projection and a bottom extending between the respective side walls, each of the projections further have in the peripheral direction a somewhat greater width than the depressions, wherein a ratio of a circumference of the outer surface of the monofilament to a cross-sectional area of the monofilament is in a range from about 34 mm^{-1} to about 35 mm^{-1} and further wherein an inner envelope circle is defined by the depressions and an outer envelope circle is defined by the projections, and wherein a ratio of a diameter of the outer envelope circle to a diameter of the inner envelope circle is in a range from about 1.1 to about 1.2.

2. The tooth cleaning bristle of claim 1, wherein the contour defines at least four depressions and at least four projections distributed over the periphery of the outer surface of the monofilament.

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3. The tooth cleaning bristle of claim 1, wherein the contour defines at least six depressions and at least six projections distributed over the periphery of the outer surface of the monofilament.

4. The tooth cleaning bristle of claim 1, wherein the contour defines at least eight depressions and at least eight projections distributed over the periphery of the outer surface of the monofilament.

5. The tooth cleaning bristle of claim 1, wherein the projections when viewed in cross-section have a crenelated contour.

6. The tooth cleaning bristle of claim 1, wherein the projections when viewed in cross-section have a convexly curved top connecting the side walls.

7. The tooth cleaning bristle of claim 1, wherein the depressions have substantially the same shape and dimensions.

8. The tooth cleaning bristle of claim 1, wherein the depressions and the projections are substantially parallel to a longitudinal axis of the tooth cleaning bristle.

9. The tooth cleaning bristle of claim 1, wherein the contour of the outer surface of the monofilament is fluted.

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10. A toothbrush head, comprising:

a bristle holder; and

at least one toothbrush bristle fastened to the bristle holder wherein the toothbrush bristle comprises a monofilament with a solid cross-sectional area with an outer surface having a contour along at least a portion of a length of the monofilament, wherein the contour defines alternating projections and depressions about a periphery of the monofilament, each of the projections are laterally delimited by a pair of straight side walls while a raised top side of each projection between the respective side walls has a slightly convex configuration, each of the depressions being U-shaped and being defined by the side walls of adjacent projection and a bottom extending between the respective side walls, each of the projections further have in the peripheral direction a somewhat greater width than the depressions, wherein a ratio of a circumference of the outer surface of the monofilament to a cross-sectional area of the monofilament is in a range from about 34 mm^{-1} to about 35 mm^{-1} and further wherein an inner envelope circle is defined by the depressions and an outer envelope circle is defined by the projections, and wherein a ratio of a diameter of the outer envelope circle to a diameter of the inner envelope circle is in a range from about 1.1 to about 1.2.

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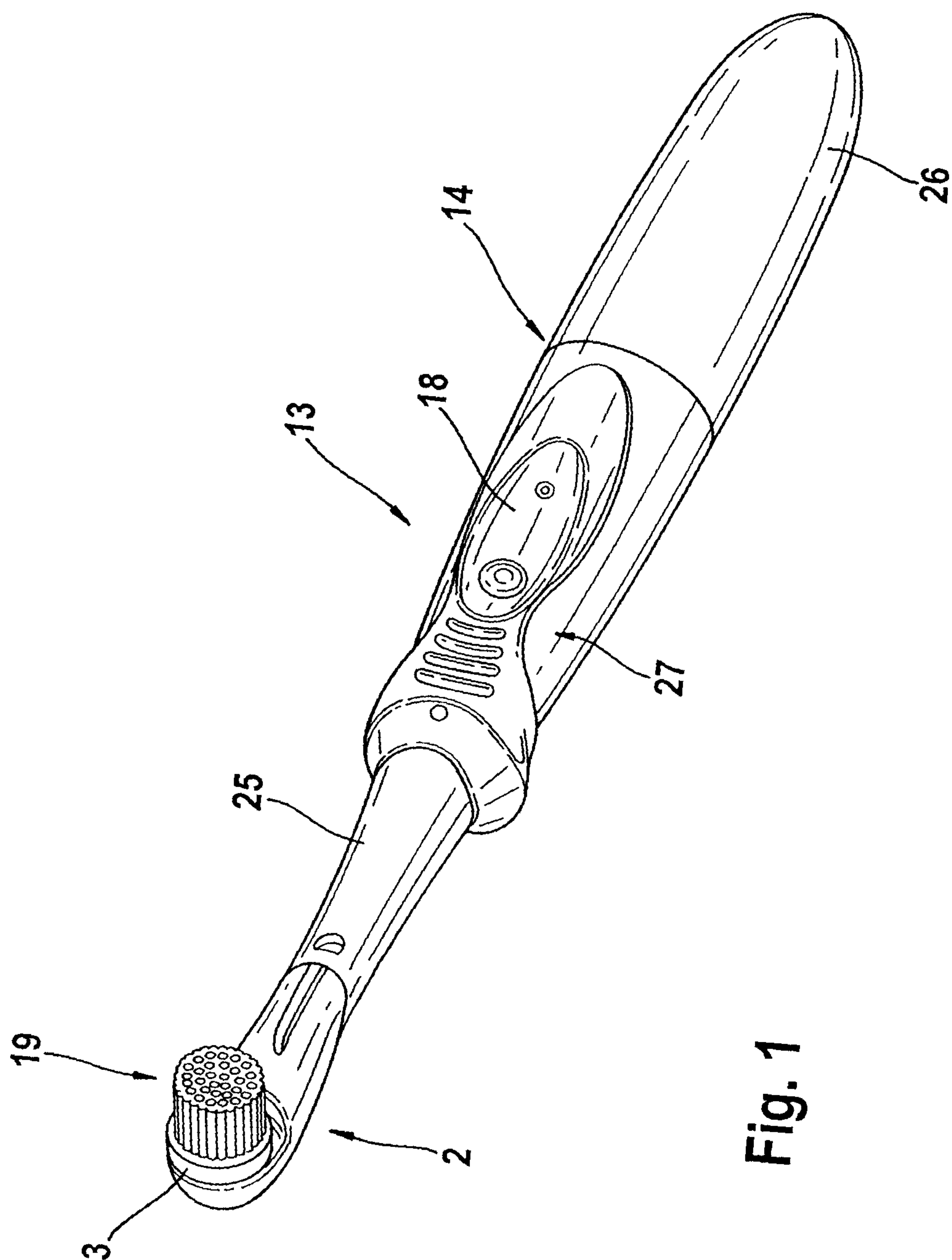


Fig. 1

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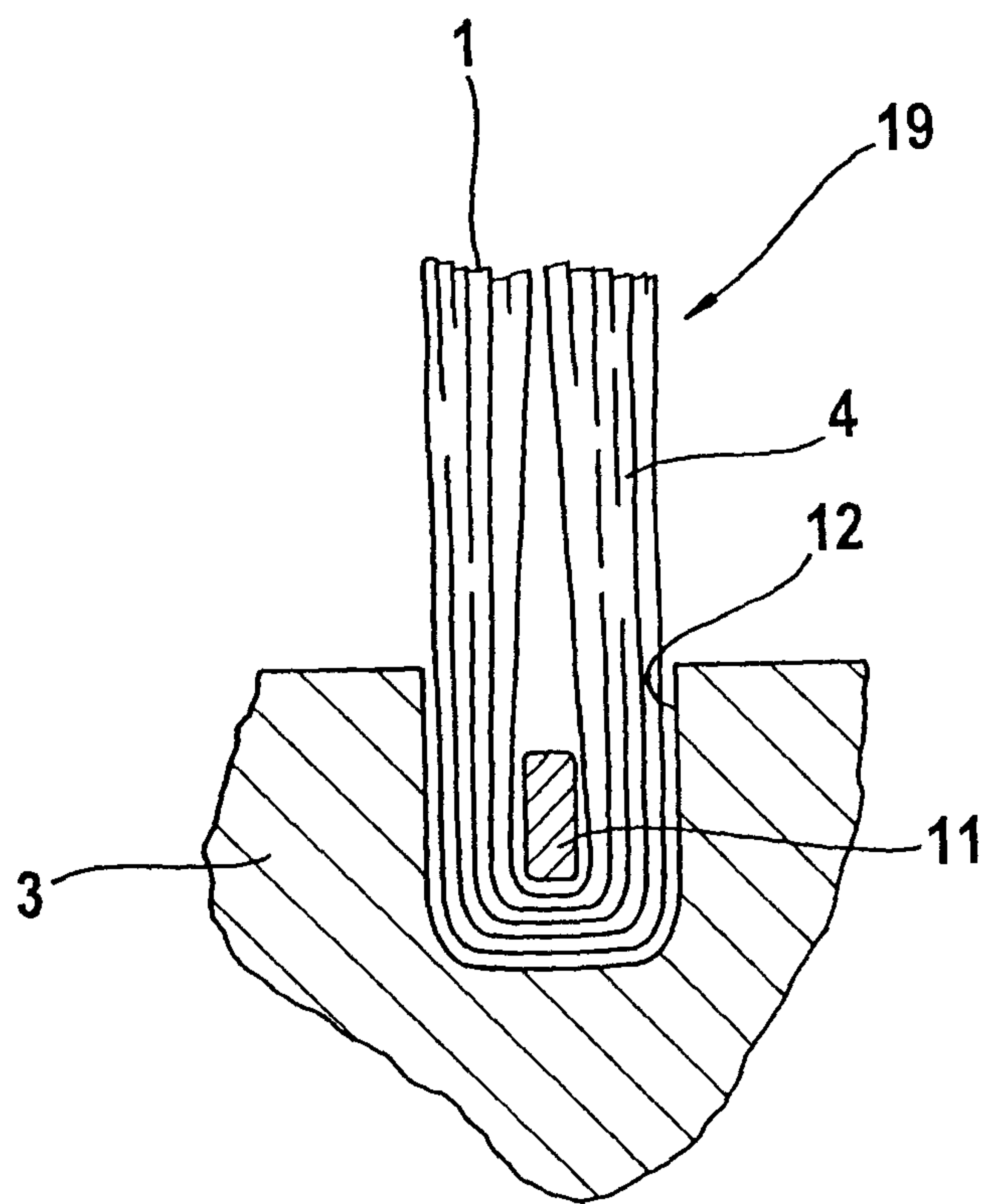


Fig. 2

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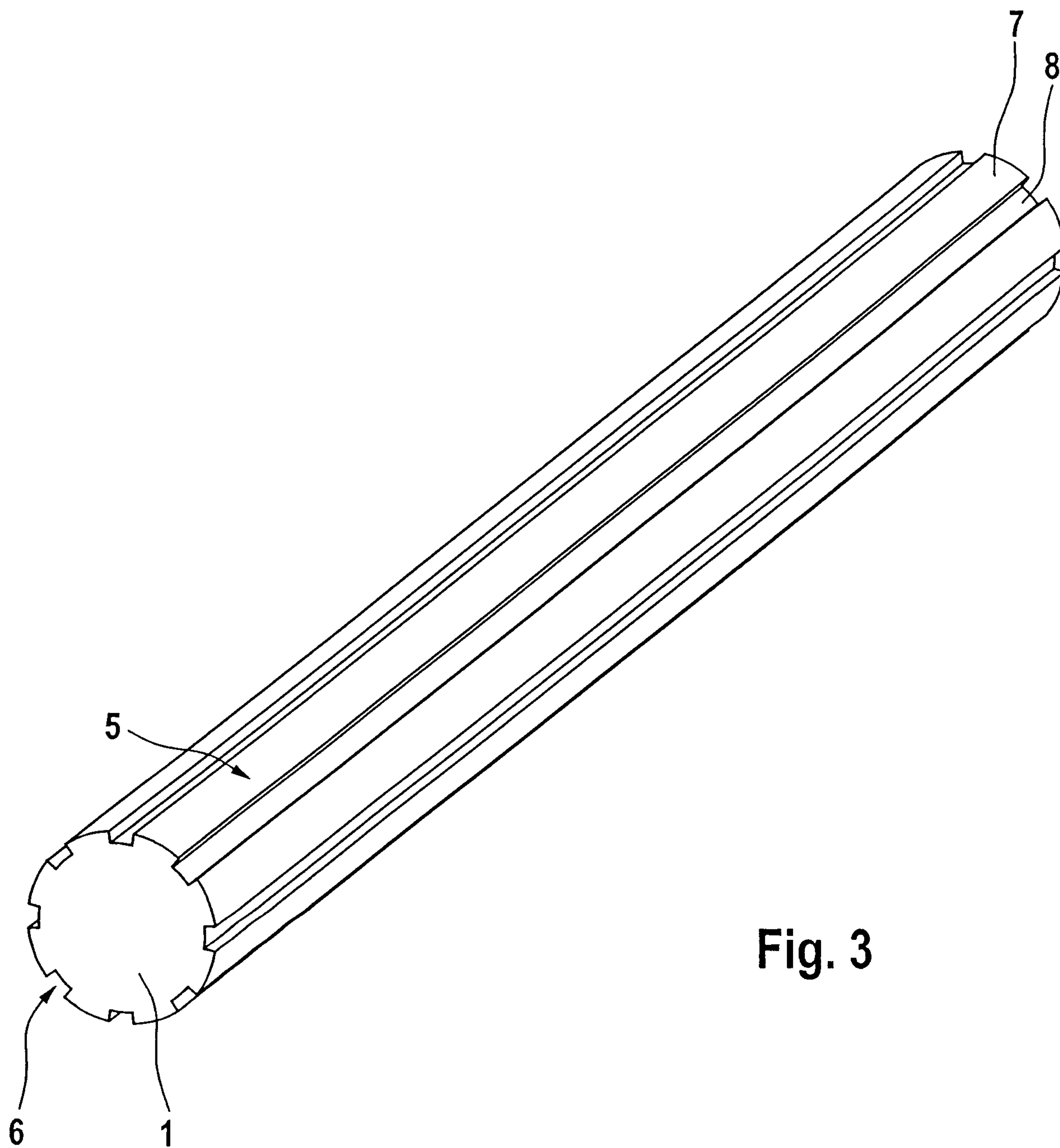


Fig. 3

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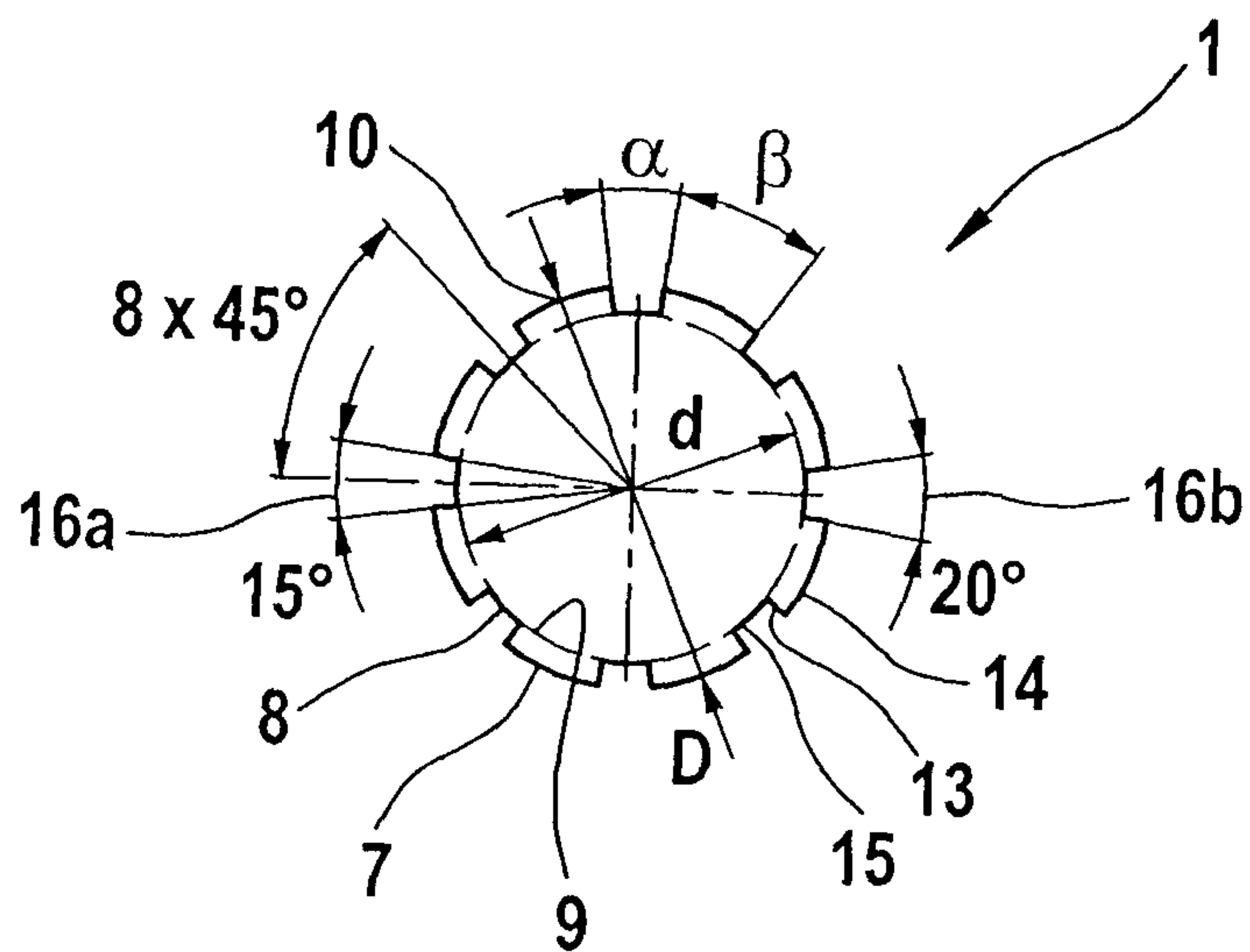


Fig. 4

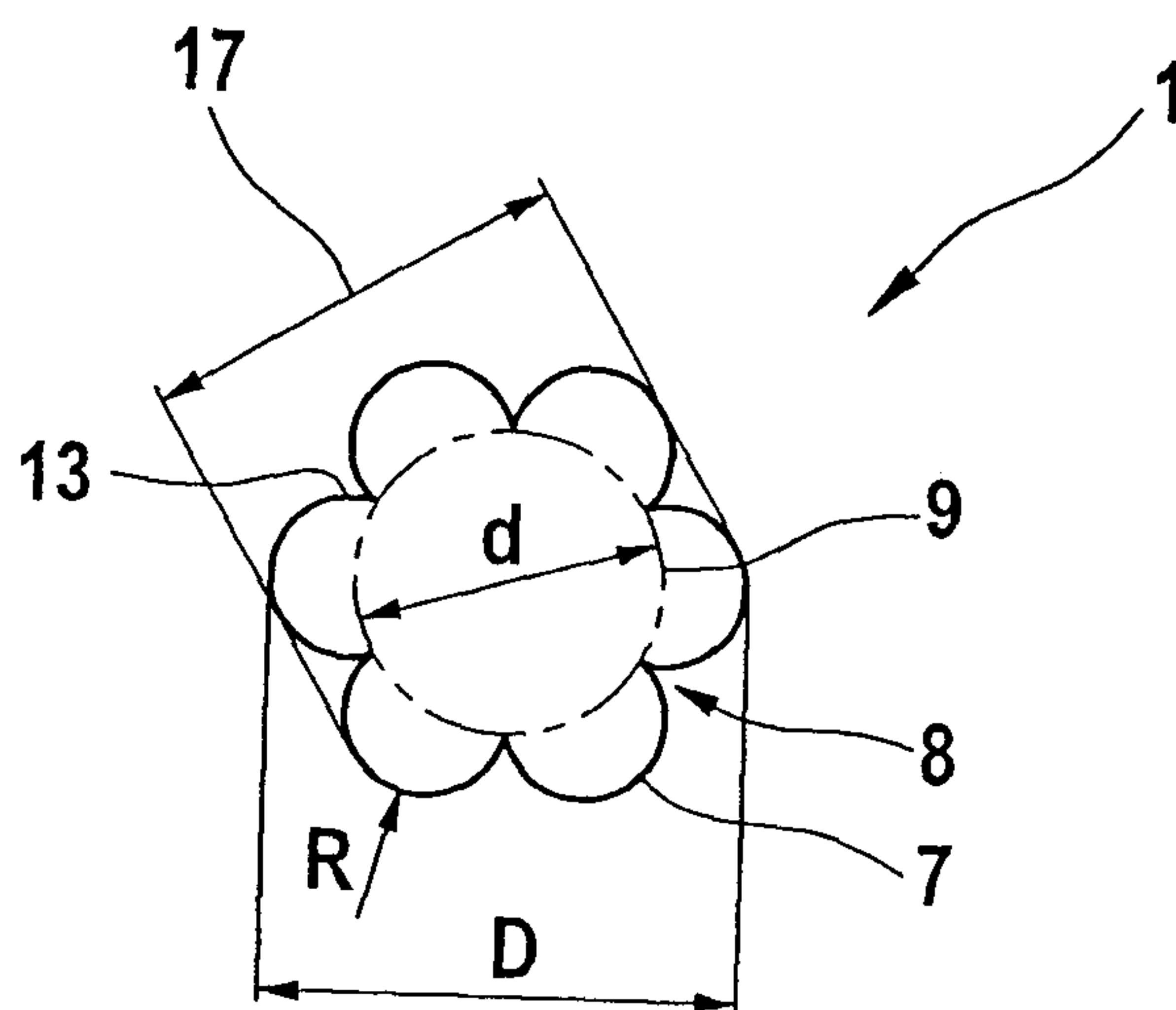


Fig. 5

