Description

# Toothbrush with Eccentric Drive

The invention relates to a toothbrush with a brush head according to the preamble of claim 1.

Various designs of toothbrushes of this type are widely commercially available. The toothbrushes typically include an interchangeable brush head having a rotationally symmetric brush body that receives the bristles or bundles of bristles. The brush body is rotatably supported in a housing section which is coupled with the housing of the toothbrush for rotation about a rotation axis and is a driven by an electric motor. Such drive is described, for example, in WO 91/07116.

In this context, eccentric drives are widely used which reversibly drive the brush body. The brush body performs an alternating rotation motion in both rotation directions with a rotation angle of, for example, 130°. Eccentric drives of this type are known, for example, from U.S. 4,845,795, U.S. 5,504,959 or U.S. 5,617,601.

WO 96/37 164 discloses another modification of an eccentric drive for a toothbrush. In this modification, the revolving rotation motion of the drive motor is directly transmitted to a drive shaft which extends through the brush body and has an angled end. The angled end meshes with a corresponding guide channel disposed on the bristle carrier, thereby causing the bristle carrier to perform a reversing rotation motion. This drive is mechanically simple and wear-resistant. The drive has also a small footprint, allowing the housing to be narrow and compact.

Although such toothbrushes have operated satisfactorily in practice, new progress in dental care calls for additional improvements. In particular, the simple rotation motion of the brush body is considered to be inadequate to reliably clean the tooth surfaces.

This prompted the superposition of a different pivoting motion on the rotation

motion. Such designs, which are based on eccentric drives, are described, for example, in DE 44 33 914 A1 or WO 96/31171.

The cleaning action of such toothbrushes, however, was still not considered to be optimal. Moreover, such toothbrushes are quite complex and hence difficult to manufacture.

It is therefore an object of the present invention to provide a toothbrush of the aforedescribed type that has a simple design and provides an improved cleaning action in comparison to the conventional toothbrushes with a rotating drive.

The problem is solved by a toothbrush having the characterizing features of claim 1.

Advantageous embodiments of the invention are described in the dependent claims.

The invention is based on the concept of superimposing an additional pivoting motion on the reversing rotation motion. In this way, the bristles held in the brush body are pressed against the tooth surface in a high-frequency pulsating mode. This induces a vibration effect acting essentially perpendicular to the tooth surface, which helps to dislodge deposits, approximately comparable to an ultrasound treatment.

This is achieved by supporting the brush body on a housing section not only for rotation, but also for a pivoting motion.

In a first preferred embodiment, the pivoting motion that is superimposed on the rotation motion can be produced by engagement of a drive pin of the eccentric drive with the brush body in a circumferential and axial direction.

Alternatively, according to a second embodiment of the invention, the pivoting motion that is superimposed on the rotation motion can be produced by operatively connecting a bearing journal attached to a section of the toothbrush housing with the brush body in the circumferential and axial direction.

The superimposed motion can be easily implemented through these simple measures.

According to a third preferred embodiment, the eccentric drive has an eccentric shaft that rotates in one direction and is oriented perpendicular to the rotation axis of the bristle carrier and extends through the center of the brush body. The drive pin is supported by an end face of the rotating eccentric shaft. This design makes the device mechanically simple and wear-resistant. The drive also takes up little space, making the housing narrow and compact.

In according to a fourth preferred embodiment, the brush body executes a tilting motion that revolves with the rotation motion. In this case, the brush body can be supported by a bearing journal that is axially offset and attached to a housing section of the housing. The end face of the brush body facing away from the bristles has a corresponding conical recess extending in the axial direction and pointing inwardly. The bearing journal hence supports the brush body in the axial direction. The conical shape of the recess enables the pivoting or tilting motion produced by the eccentric drive. The cone angle has to be designed to be large enough to allow an unobstructed pivoting motion. The bearing journal is then able to absorb the produced axial forces in any angular position of the brush body.

The rotating motion of the eccentric shaft can be readily transferred to the brush head if the brush body has a radially inwardly extending conical recess, in which the drive pin of the eccentric shaft is directly inserted. In this case, the rotation axis of the brush body and eccentric shaft intersect each other perpendicularly.

According to a fifth embodiment, the pivoting or tilting motion of the brush body does not revolve, but is performed about a defined axis. With this arrangement, for example, an oscillating linear motion can be combined with the reversing rotation motion.

The brush body preferably has a guide channel extending in the axial direction

for guiding the drive pin of the eccentric shaft. The pivoting motion is produced by having the guide pin traverse a guide channel, making contact at the end of the guide channel and thereby entraining the brush body in the axial direction. Unlike the fourth embodiment, the brush body is engaged during the rotation motion of the drive pin only along predetermined angular sectors. The length of the guide channel therefore determines the excursion of the brush body in the axial direction.

The guide channel can also be formed directly in the region of the peripheral surface of the brush body. This can be accomplished in a number of ways, which will now be described with reference to certain examples.

Preferably, the guide channel is formed directly in the bristle carrier. The drive pin hereby engages directly in the guide channel, moving back and forth between a front reversing point and a rear reversing point. The force to reversibly drive the bristle carrier is transmitted by the sides of the guide channel that extend in the axial direction.

This design requires only a small number of movable components, runs therefore very quiet and is suitable in particular for high-frequency applications, also referred to as fast-running toothbrushes.

Preferably, the guide channel forms a part of a sliding block that is inserted in the brush body. The sliding block can be inserted in an axially extending recess in the brush body either directly or through a support, which simplifies assembly and reduces the cost. The sliding block has the advantage over a directly built-in channel that it can be exchanged when worn. In particular, the material can be selected independently of the material of the brush body, so that the design can be optimally adapted to the wear characteristics.

According to another embodiment, a sliding block is axially displaceable in the guide channel, with the sliding block having a drive-pin bore adapted to engage with the guide pin. Advantageously, with a support of this type the brush head

does not follow the entire motion of the eccentric pin in the axial direction during a revolution of the eccentric pin, but for example, is engaged only immediately before the respective reversing points. The axial component responsible for the pivoting motion can thereby be arbitrarily "apportioned."

With all the latter embodiments described above, the design of the sliding block and the corresponding recess and/or guide channel disposed on the bristle carrier enable a rotation and/or pivoting motion of the sliding block in a direction that opposes the rotation motion performed by the bristle body. The drive pin engaging in the sliding block is then not subjected to bending stress.

The sliding blocks typically have a cylindrical shape to provide a reliable support in the recess and/or guide channel. In another preferred embodiment, the sliding block has a spherical shape. This arrangement advantageously minimizes the friction forces produced between the sliding block and the recess and/or guide channel.

The aforedescribed pivoting or tilting axis is defined, for example, by two bearing journals that project radially outwardly and are disposed on the housing section of the brush head. The bearing journals engage with corresponding bearing channels which are disposed along the circumference of the brush body. To simplify manufacture, the bearing channel can extend around the circumference; alternatively, bearing channels can be provided that are associated with a respective bearing journal and have a limited extent along the circumference. The length along the circumference should be great enough so as not to obstruct the rotation motion of the brush body.

According to a particularly simple design of the invention, a pivoting motion can be produced by providing the brush body with a V- or U-shaped bearing channel disposed opposite the eccentric shaft, wherein the bearing channel is attached to the brush body in the axial direction along a circumferential section, essentially mirror-symmetrically to the symmetry plane of the brush body. Moreover, at least one bearing journal is disposed on the housing section and is guided by this

bearing channel.

According to the invention, the cleaning power of a toothbrush of this type can also be further enhanced by having the brush head perform an up-and-down motion in addition to the reversing rotation motion and the positively guided pivoting motion. Such a motion is akin a nutating or wobble motion.

According to the invention, the up-and-down motion of the brush head that is part of the nutating motion, is produced by supporting the bristle carrier for axial displacement on the housing section and providing on the bristle carrier at least one bearing channel that is disposed on the bristle carrier along a circumferential section and exhibits a pitch in the axial direction. At least one bearing journal is disposed on the housing section and engages in the bearing channel. The positively coupled bristle carrier follows the corresponding motion of the drive pin between the two reversing points in the axial direction and hereby produces the axial displacement of the bristle carrier.

It should be noted, that the placement of a drive pin/bearing journal with respect to the guide/bearing channels can be reversed. In other words, the bearing journals can also be placed on the brush head, and the corresponding channels placed on the housing section. Without diminishing the performance, the guide pin can also be placed on the brush head and a corresponding bore can be provided on the eccentric shaft.

Although the aforedescribed concepts can be applied to toothbrushes in general, they are suited in particular for fast-running toothbrushes, which are also referred to as ultrasonic toothbrushes. The eccentric shaft of these toothbrushes rotates with a rotation speed in the range between approximately 15,000 and 25,000 rpm. Such a high rotation speed places a high load on the components, in particular due to the continuing reversal of the rotation direction of the brush body. For these reasons, the drive should be constructed as simply as possible, which is optimally achieved by the aforedescribed measures.

The invention will now be described with reference to the embodiments illustrated in the drawings. There is shown in:

Fig. 1 an axial cross-section of a brush head according to a first embodiment, with the brush body in a first position,

Fig. 2 the brush head according to Fig. 1, with the brush body in a second position,

Fig. 3 a top view of the brush head according to Fig. 1, with the brush body in a third position,

Fig. 4 an axial cross-section of a brush head according to a second embodiment,

Fig. 5 a top view of the brush head according to Fig. 4,

Fig. 6 a brush head according to a third embodiment ("nutating head toothbrush"),

a) view from below,

b) view from the right,

c) front view,

d) cross-sectional view of along A-A

Fig. 7 a brush head according to a fourth embodiment ("nutating head toothbrush"),

a) view from below,

b) view from the right,

c) front view,

d) cross-sectional view of along A-A

Fig. 8 a perspective view of the brush head according to Fig. 6,

Fig. 9 an exploded view of a toothbrush with the brush head of Fig. 6,

Fig. 10 a longitudinal cross-section of the toothbrush with the brush head of Fig. 6 - sectional plane = mirror-symmetry plane,

Fig. 11 an axial bearing journal for the brush head of Fig. 6 and Fig. 7,

Fig. 12 a cross-sectional view of a drive according to a fifth embodiment,

Fig. 13 a cross-sectional view of a drive according to a sixth embodiment,

Fig. 14 a cross-sectional view of a drive according to a seventh embodiment.

A first embodiment of a toothbrush according to the invention is illustrated in Fig. 1 to Fig. 3.

The brush head 1 has a brush body 10, with a bristle carrier 20 having bristles 22 attached to one end face of the brush body 10. A conical recess 14 extending in the axial direction and projecting inwardly is machined in the end face facing away from the bristles 22.

A corresponding bearing journal 34 projecting perpendicularly thereto and engaging with the conical recess 14 is disposed on a housing section 30. The brush body 10 also has a conical recess 18 which extends inwardly in a radial direction r, with a drive pin 52 of an eccentric shaft 50 inserted into the recess 18. This results in the subsequently described mechanical movement of the brush body 10.

The eccentric shaft 50 is driven for continuous rotation by a drive motor (not shown). The eccentric pin 52 executes a circular rotation motion U, whereby the brush body 10 simultaneously performs a reversing rotation motion R and a pivoting motion with respect to the stationary axis G. In the position illustrated in

Fig. 1, the eccentric pin 52 is at the left reversal point, so that the brush body 10 is tilted upwardly by the tilt angle K. Fig. 2 shows the opposite position, in which the brush body 10 is tilted downwardly by the tilt angle K. During a complete revolution U of a eccentric shaft 50, the brush body 10 executes a pivoting motion, starting from the position illustrated in Fig. 1 and continuing to the position illustrated in Fig. 2, finally returning to the initial position of Fig. 1. The entire tilt angle is therefore equal to 2K.

As seen with particularity from Fig. 3, the tilt motion is positively coupled with the rotation motion, so that the brush body 10 is always tilted by the tilt angle K with respect to the stationary axis G, thereby performing a sort of nutating motion.

The mechanical movement of the second embodiment depicted in Fig. 4 and Fig. 5 is different from that of the first embodiment. A brush head 100 with a brush body 110 is again provided. A bristle carrier 120 receiving bristles 122 is attached to the end face of the brush body 110. A conical axial recess 114 is located on the opposite side. The brush body 110 is supported by the axial recess 114 on a bearing journal 34 which is disposed on a housing section 30 and projects perpendicularly therefrom.

Also provided is an eccentric shaft 50 with a drive pin 52 that can be rotatably driven. So far, this embodiment is identical to the previously described embodiment.

Unlike the previously described embodiment, however, two bearing journals 38 are provided that project outwardly in a radial direction and engage in a bearing channel 118 extending around the peripheral surface 116.

Also provided on the brush body 110 is a receiving opening 124 in which a siding block 130 is inserted that is secured to a support 134. The siding block 130 is provided with a guide channel 132 in which the guide pin 52 engages. This results in the following motion:

The bearing journals 38 allow a pivoting motion of the brush body 110 about the

stationary axis G only in the plane depicted in Fig. 4, but not in the bisecting plane depicted in Fig. 5.

During a complete revolution U of the eccentric shaft 50, the brush body 110 is moved, starting from the position illustrated in Fig. 4 that is tilted downwardly by the tilt angle K, to a position (not shown) that is tilted upwardly by the tilt angle K, and finally returns to the initial position of Fig. 4. Accordingly, only a tilting motion about an axis perpendicular to the drawing plane is executed. The brush body 110 is moved alternatingly, through contact of the guide pin 52 with the respective end of the guide channel 132, so that the maximum displacement path and therefore the tilt angle K is determined by the length of the guide channel 132 in conjunction with the position of the guide pin 52 relative to the eccentric shaft.

As seen from the foregoing, a combined rotating and tilting motion can be implemented by using a simple design, which produces an optimal cleaning effect.

The third embodiment of the toothbrush according to the invention is illustrated in Fig. 6 as well as in Figs. 8 to 11.

As seen from Fig. 6, a brush head 200 of this type has a brush body 210, to which a bristle carrier 220 with bristles is attached. The bristles are not shown in the drawing for sake of clarity.

The end face 212 of the brush body 210 has an inwardly pointing recess 214 extending in the axial direction. The recess 214 merges into a cone 215, which is followed by a cavity 213 extending inwardly in the axial direction.

Bearing channels, which in the present example are referred to as a bearing channel of the second type 217 and bearing channel of the third type 219, are formed in the peripheral surface 216 of the brush body 210. The bearing channel of the second type 217 is located opposite to a guide channel 232. Two opposing bearing channels of the third type 219 are located relative to an

imaginary mirror-symmetry plane extending through the bearing channel of the second type 217 and the guide channel 232.

The bearing channel of the second type 217 is essentially U-shaped in the direction of the channel, wherein the two legs of the U-shape are arranged mirror-symmetrically with respect to the aforedescribed mirror symmetry plane. The bearing channels of the third type 219 also extend along a circumferential segment and are formed with a pitch in relation to the axial direction on the bristle carrier.

Fig. 7 shows a brush head according to a fourth embodiment, with the Figs. 8, 9, 10 and 11, like the illustrations of the third embodiment, depicting embodiments of the toothbrush of the invention.

The brush head 300 according to Fig. 7 has the following characteristic features which are similar to those of the brush head 200 depicted in Fig. 6:

The brush head 300 has a brush body 310, with an axial recess 314 disposed on the end face 312 of the brush body 310. The axial recess 314 merges into a cone 315, which terminates in a cavity 313. Like the brush head 220 of the previous embodiment, the peripheral surface 316 of the brush body 310 has a bearing channel of the second type 317 and two bearing channels of the third type 319. The bearing channels of the third type 319 are again attached opposite to one another, whereas the bearing channel of the second type 317 is located opposite a guide channel 332. As in the previous embodiment, for sake of clarity, the bristle carrier 320 attached to the brush body 310 is shown without the bristles.

As in the previous embodiment, the bearing channel of the second type 317 is U-shaped and extends on the peripheral surface 316 of the brush body 310. As in the previous example, the bearing channels of the third type 309 have pitch in the axial direction; unlike the previous example, however, the angle of pitch changes along the circumference.

Fig. 8 shows a perspective view of the brush head according to a third

embodiment. The following features can be seen in Fig. 8:

The brush head 400 is based on a brush body 410 and a bristle carrier 420 with bristles 422, the bristle carrier being disposed on the brush body 410. The brush body 410 has an essentially cylindrical form with an approximately elliptical base. The end face 412 of the brush body 410 has a recess 414 in the axial direction, which in the illustrated example is cylindrical. The cylindrical axial recess 414 has an inwardly pointing conical taper. The cone has the reference numeral 415. The cone 415 is merges into a cavity 413.

The "narrow sides" of the cylindrical brush body 410 having an elliptical base have a guide channel 432 and a bearing channel of the second type 417 (only hinted at in the figure) located opposite of each other. The guide channel 432 is formed as a receiving opening 424 which is conically tapered to the inside and an inwardly expanding cavity 426 subsequent to the receiving opening 424.

The "longitudinal sides" of the cylindrical brush body 410 also have two opposing bearing channels of the third type 419 which are constructed in a manner described above. In the present example, the bearing channels of the second and third type 417 and 419 are formed in the cylindrical brush body so as to project into the cavity 413 which follows the cone 415 and hence the axial recess 414.

Fig. 9 shows an exploded view of such a toothbrush with a brush head to demonstrate the insertion of the brush head according to Fig. 6 and Fig. 7 into the housing of a toothbrush.

The toothbrush is based on a housing 560 shaped as a truncated cone, with a pointed end of the housing 560 forming a housing section 562 adapted to receive the brush head. The exemplary housing section 562 is cylindrical and placed on the housing in such a way that the cylinder axis of the housing section 562 is essentially perpendicular to the axis of the housing 560 that is shaped as a truncated cone.

The cylindrical housing section 562 has a recess (not shown) adapted to receive the brush body 510. An axial bearing journal 568 can be inserted centrally on the bottom of this recess. The circumference of the cylindrical housing section 562 has three bores adapted for insertion in the radial direction of two bearing journals 566 and a bearing journal 564. These bearing journals 564 and 566 and the bearing journals 568 are adapted to engage with the respective bearing channels 217, 317, 417 and 219, 319, 419, as well as with the axial recess 214, 314, 414.

The housing 560 of the toothbrush forms a cavity extending in the axial direction. Also depicted in Fig. 9 is the eccentric shaft 550 that can be inserted in this cavity. A drive pin 552 oriented in the axial direction of the eccentric shaft 550 is disposed on the end face of the eccentric shaft 550. When the eccentric shaft 550 - as intended - is inserted in the cavity of the housing 560, the drive pin 552 engages directly with the guide channel 532 of the brush body 510.

Fig. 10 illustrates the engagement of the respective bearing pins 664, 668/ guide pins 652 with the respective bearing/guide channels of the brush head 600. Fig. 10 shows a longitudinal cross-section of the toothbrush, with the brush head 600 and the eccentric shaft 650 of Fig. 6 inserted. The mirror-symmetry plane of the toothbrush 601 is selected to be the sectional plane.

Illustrated is a brush body 610 with a rotation axis oriented essentially perpendicular to the longitudinal axis of the housing 660 of the toothbrush 601. Also illustrated are the guide pins 652 that engage with the guide channel, the axial bearing journals 668 that engage with the axial recess, and the radial bearing journals 664 that are secured on the housing section 662 and engage with the bearing channel of the second type.

The mechanical movement of the third embodiment and the mechanical movement of the fourth embodiment, as illustrated in Figs. 6 to 10, are essentially identical. The following three motions are superimposed to produce a nutating motion of a brush head of the electric toothbrush:

1. a reversing rotation motion,
2. a pivoting motion,
3. an up-and-down motion.

The reversing rotation motion is produced by the rotation motion of the eccentric shaft 550 and 650, respectively, which moves the drive pin 552 and 652 that is in engagement with the recess 214, 314, 414, back and forth between two reversal points. The axial recess 214, 314, 414 is so dimensioned in the axial direction that the rotation motion of the eccentric shaft 550, 650 transmits only one force, which produces a reversing rotation motion perpendicular to the rotation axis.

The pivoting motion of the brush body 210, 310, 410, 510, 610 is produced by the fact that the reversing rotation motion is positively guided by the engagement of the radially disposed bearing journal 564 and 664, respectively, with the bearing channel of the second type 217, 317, 417. The radial bearing journal 564 and 664, respectively, that moves in a bearing channel of the second type 217, 317, 417 causes the brush head to perform a tilting motion about an axis located in the mirror-symmetry plane of the brush head.

Two bearing journals which are arranged mirror-symmetrically to the aforedescribed mirror-symmetry plane and extend in the radial direction, engage during the reversing rotation motion with respective bearing channels of the third type 219, 319 and 419 which are arranged in the brush body 210, 310, 410 and with axial pitch in the circumferential direction, to thereby produce an up-and-down motion of the brush body 210, 310, 410, 510, 610.

The stroke or the up-and-down motion of the brush head is more less pronounced, depending on the angle of inclination of the bearing channels of the third type 219, 319 and 419, respectively. With the brush head of the third embodiment illustrated in Figs. 6, the up-and-down motion is independent of the rotation angle. With the brush head of the fourth embodiment (Fig. 7), the stroke during the reversing motion is dependent on the rotation angle bacause the angle

of inclination increases in one direction. In the present example, for a left-hand rotation, the brush body initially moves strongly upward starting from the right limit stop, whereas the second half of the rotation executes only a very small lifting stroke. Starting from the left limit stop and for a right-hand rotation of the brush head, the speed of the downward motion of the brush head is exactly the opposite. Such a stroke motion with a different up-and-down velocity of the brush causes variations in the pressure exerted by the toothbrush on the tooth during the cleaning operation. This feature further improves the cleaning effect as compared to an embodiment relying on a brush body that executes a reversing pivoting motion. The superposition of these three motions necessitates a sturdy design as well as an ability of the axial bearing journal 568 and 668, respectively, to absorb the mechanical stress load, since the bearing journal must not only enable the brush head to move in all the above-described directions, must also be able to absorb the produced forces.

These different motions are made possible by an axial bearing journal 768 illustrated in Fig. 11. The bearing journal 768 consists essentially of a cylindrical body 774, a cylindrical neck 772 that is positioned on the cylindrical body 774 and has a smaller cross-sectional area than the body 774, and an essentially spherical head 770 disposed on the cylindrical neck 772.

The body 774 is adapted to be inserted in a bore disposed on the housing section 662 and 562, respectively. The dimensions of the head 770 are selected so that the head 770 requires very little clearance for insertion in the cavity 213, 313, 413 of the axial recess 214, 314 and 414, respectively. The lengths of the neck 772 and the axial bearing journal 768 are selected so that the up-and-down motion of the brush body 210, 310, 410, 510, 610 produced by the guiding of the radial bearing journal 566 that engages with the bearing channels of the third type 219, 319 and 419, respectively, does not produce a mechanical bending stress in the bearing journal 768. The cone 215, 315 and 415, respectively, of the axial recess 214, 314, 414 in the brush body 210, 310 and 410, respectively, of the brush body 210, 310, 410, 510, 610 then moves between the spherical

head 770 and the upper edge of the body 774 along the neck 772 of the axial bearing journal 768.

Figs. 12 to 14 show in cross-section different drives according to additional embodiments. In particular, these figures are intended to show how a revolving rotation motion of the eccentric shaft can be transformed into a reversing rotation motion.

The embodiment of the toothbrush depicted in Fig. 12 illustrates how a reversing rotation motion can be produced with the help of a sliding block that is inserted in a guide channel disposed on the brush body.

The toothbrush consists of a handle portion 880 to which a housing 860 with a brush body 810 can be connected. A motor 890 is disposed in the handle portion 880, with the motor being connected via a respective gear with an eccentric shaft 850 which is guided inside the housing 860. The front section of the housing 860 includes a housing section 862 into which the brush head 800 can be inserted.

The brush body 810 is movably supported in the housing section 862 through an axial bearing journal 868 and a radial bearing journal 864 in a manner described above.

The bristle carrier 820 has a guide channel 832 adapted to receive a sliding block 830 that can move axially. A drive pin 852 of the eccentric shaft 850 engages in a drive-pin bore 836 disposed on the sliding block 830. In this way, the sliding block 830 is positively coupled with the drive pin 852 and can move freely in the guide channel 832 back and forth between two reversing points.

The drive-pin bore 836 receives the drive pin 852 essentially without play. The relative motion of the drive pin 852 in the height direction and in the rotation direction is substantially unobstructed to minimize friction losses.

As seen with particularity from the enlarged schematic diagram X, the drive pin 852 in the selected cross-sectional view is located at the left reversal point.

When the rotation begins, the position of the drive pin shifts to the right until the drive pin reaches its right reversal point. The brush body 810 executes a rotation motion. Later during the rotation motion, the drive pin 852 returns to its initial position, whereby the brush carrier 820 moves in the opposite direction.

A reliable motion requires that the eccentric pin 852, on one hand, can move freely in the guide channel 832 between the two reversing points, and on the other hand, is guided laterally with a relatively small clearance, so that the reversing motion can be converted essentially without play. In addition, the sliding block 830 has to be supported in the guide channel 832 for rotation about its longitudinal axis. The sliding block 830 can then execute a compensating motion in a direction opposing the rotation direction of the bristle carrier 820, thereby eliminating bending stress of the engaging drive pin 852. The sliding block 830 and the guide channel 832 have a matching circular cross-section which allows a compensating motion essentially without play and with reduced friction. Lastly, the eccentric pin 852 should be long enough to always maintain contact when following the changing height position of sliding block 830.

The brush head 900 depicted in Fig. 13 is essentially identical to the aforedescribed embodiment.

Once more, a brush head 900 having a bearing journal 968 is provided. The bristle carrier 920 is supported by an axial recess 914 for (in particular) longitudinal displacement.

The bristle carrier 920 has an axial guide channel 932 in which a sliding block 930 is supported for axial displacement. The sliding block 930 has a drive-pin bore 936 in which a drive pin 952 engages on the eccentric shaft 950.

The basic design is so far identical to the embodiment described with reference to Fig. 12. The difference is, however, that the sliding block 930 has the spherical shape.

The embodiment of a toothbrush with a brush head 1000 illustrated in Fig. 14 is

essentially identical to the embodiments described with reference to Figs. 12 and 13.

Once more, a brush body 1010 with a bristle carrier 1020 is illustrated which together form a brush head 1000. The bristle carrier 1020 with bristles 1022 is, as in the aforedescribed embodiments, rotatably (and longitudinally displaceably) supported by the bearing journal that cooperates with the axial recess 1014. The axial recess 1014 consists, as described in detail above, of a cone 1015 and the following cavity 1013. The radial bearing journal 1064 that engages with a bearing channel 1017 positively guides the brush body 1010 in the housing section 1060.

So far, the basic design is essential to the embodiments described with reference to Figs. 12 and 13. The difference is, however, that the guide pin 1052 which can be rotated by a motor operating on the eccentric shaft 1050, engages directly with a guide channel 1032.

This results in the following to mechanical movement:

The eccentric pin 1052 moves - driven by the motor-driven eccentric shaft 1050 - freely back and forth in the guide channel 1032 between front and rear reversal points. A force is transmitted from the drive pin 1052 to the bristle carrier 1020 via the sides of the guide channel 1032 which extend in the axial direction of the brush body 1010. To eliminate bending stress on the guide pin 1052 that engages with the guide channel 1032, the guide channel 1032 has a cavity 1022 which extends inwardly in the radial direction. The cavity 1026 receives the free end of the drive pin 1052 while maintaining a gap from the inner wall of the cavity 1026. In addition, the receiving opening 1024 of the guide channel 1032 expands conically outwardly in the radial direction.

This embodiment advantageously requires only a small number of moveable parts, and hence operates quietly and is particularly appropriate for high frequency applications, so-called fast-running toothbrushes. These toothbrushes

have an eccentric shaft rotating with a rotation speed in the range between 15,000 and 25,000 rpm. At these high rotation speeds, the components experience a particularly high stress which is caused mainly by the continuing reversal in the direction of the bristle body. It is therefore desirable to design a simple toothbrush that can be easily operated, which is optimally provided by the aforedescribed measures.

List of reference numerals

| | |
|---|---|
| 1 | brush head |
| 10 | brush body |
| 12 | end face |
| 14 | axial recess |
| 16 | peripheral surface |
| 18 | radial recess |
| 20 | bristle carrier |
| 22 | bristles |
| 30 | housing section |
| 34 | axial bearing journal |
| 38 | radial bearing journal |
| 50 | eccentric shaft |
| 52 | drive pin |
| | |
| 100 | brush head |
| 110 | brush body |
| 112 | end face |
| 114 | axial recess |
| 116 | peripheral surface |
| 118 | bearing channel of the first type |
| 120 | bristle carrier |
| 122 | bristles |
| 124 | receiving opening |
| 130 | sliding block |
| 132 | guide channel |
| 134 | support |
| | |
| 210 | brush body |
| 212 | end face |
| 213 | cavity |
| 214 | axial recess |
| 215 | cone |
| 216 | peripheral surface |
| 217 | bearing channel of the second type |
| 219 | bearing channel of the third type |

220 bristle carrier
232 guide channel

310 brush body
312 end face
313 cavity
314 axial recess
315 cone
316 peripheral surface
318 bearing channel of the second type
319 bearing channel of the third type
320 bristle carrier
332 guide channel

410 brush body
412 end face
413 cavity
414 axial recess
415 cone
416 peripheral surface
417 bearing channel of the second type
419 bearing channel of the third type
420 bristle carrier
422 bristles
424 receiving opening
426 cavity
432 guide channel

510 brush body
550 eccentric shaft
552 drive pin
560 housing
562 housing section receiving the brush head
564 radial bearing journal
566 radial bearing journal
568 axial bearing journal

610 brush body
601 toothbrush
650 eccentric shaft
652 drive pin
660 housing
662 housing section
664 radial bearing journal
668 axial bearing journal

768 axial bearing journal
770 head
772 neck
774 body

810 brush body
820 bristle carrier
830 sliding block
832 guide channel
836 drive-pin bore
850 eccentric shaft
852 drive pin
860 housing
862 housing section
864 radial bearing journal
868 axial bearing journal
880 handle portion
890 motor

900 brush head
910 brush body
914 axial recess
920 bristle carrier
922 bristles
930 sliding block
932 guide channel
936 drive-pin bore
950 eccentric shaft

952 drive pin
960 housing
962 housing section
964 radial bearing journal
968 axial bearing journal

1000 brush head
1010 brush body
1013 cavity
1014 axial recess
1015 cone
1017 bearing channel of the second type
1020 bristle carrier
1022 bristles
1024 receiving opening
1026 cavity
1032 guide channel
1050 eccentric shaft
1052 drive pin
1060 housing
1062 housing section
1064 radial bearing journal
1068 axial bearing journal

ax axial direction
r radial direction
u circumferential direction
K tilt angle
R rotation motion
brush body
U rotation motion
eccentric shaft
G rotation axis

Claims

1. Toothbrush with a brush head (1,100,200, 300, 400, 500, 600, 800, 900, 1000) supported by a brush body (10,110, 210, 310, 410, 910, 1010), the brush body having a bristle carrier (20, 120, 220, 320, 420, 820, 920, 1020) adapted to receive bristles (22, 122, 422, 922, 1022) and rotatably supported on a housing section (30, 562, 662, 862, 962, 1062) for rotation about a rotation axis (G) and reversibly driveable by an eccentric drive (50, 52; 550, 552; 650, 652; 850, 852; 950, 952; 1050, 1052),

characterized in

that the brush body (10,110, 210, 310, 410, 910, 1010) is also pivotally supported on the housing section (30, 562, 662, 862, 962, 1062).

2. Toothbrush according to claim 1,

characterized in

that for producing a pivoting motion that is superimposed to the rotation motion (R), a drive pin (52) of the eccentric drive (50, 52) is operatively connected with the brush body (10,110, 210, 310, 410, 910, 1010) in the circumferential direction (U) and in the axial direction (ax).

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3. Toothbrush according to claim 1 or 2,

characterized in

that for producing a pivoting motion that is superimposed to the rotation motion (R), a bearing journal (564, 664, 964, 1064) disposed on a housing section (562, 662, 862, 962, 1062) is operatively connected with the brush body (10,110, 210, 310, 410, 910, 1010) in the circumferential direction (U) and in the axial direction (ax).

4. Toothbrush according to one of the claims 1 to 3,

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characterized in

that the eccentric drive (50, 52; 550, 552; 650, 652; 850, 852; 950, 952; 1050, 1052) has an eccentric shaft (50, 550, 650, 850, 950, 1050) that rotates in one direction, with the eccentric shaft arranged so as to be perpendicular to the rotation axis (G) of the bristle carrier (20, 120, 220, 320, 420, 820, 920, 1020) and extending through the center of the brush body (10,110, 210, 310, 410, 910, 1010) and supporting on its end face the drive pin (52, 552, 652, 852, 952, 1052).

5. Toothbrush according to one of the claims 1 to 4,

characterized in

that the brush body (10,110, 210, 310, 410, 910, 1010) has a conical recess (14, 114, 214, 314, 414, 914, 1014) that is oriented axially inwardly and disposed on the end face (12, 112, 212, 312, 412) that faces away from the bristles (22, 122, 422, 922, 1022), said recess cooperating with a bearing journal (34, 568, 668, 768, 868, 968, 1068) which is attached to a housing section (30, 562, 662, 862, 962, 1062) and projects axially therefrom.

6. Toothbrush according to one of the claims 1 to 5,

characterized in

that the brush body (10) has a radially inwardly extending conical recess (18) in which the guide pin (52) is inserted.

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7. Toothbrush according to one of the claims 1 to 6,

characterized in

that the brush body (110) has a guide channel (132) extending in the axial direction (ax), in which the drive pin (52) is guided.

8. Toothbrush according to claim 7,

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characterized in

that the guide channel (232, 332, 432, 1032) is formed directly in the brush body (210, 310, 410, 1010).

9. Toothbrush according to claim 7 or 8,

characterized in

that the guide channel (132) is - alternatively or in addition - a component of a sliding block (130) which is inserted in the brush body (110).

10. Toothbrush according to claim 9,

characterized in

that the sliding block (130) is fixed on the brush body (110) in the axial direction.

11. Toothbrush according to claim 9,

characterized in

- that a sliding block (830, 930) is supported in the guide channel (832, 932) for axial displacement, and

- that the sliding block (830, 930) has a drive-pin bore (836, 936) adapter for engagement with the drive pin (852, 852, 952).

12. Toothbrush according to one of the claims 9 to 11,

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characterized in

that the sliding block (830, 930) is shaped as a sphere or a cylinder.

13. Toothbrush according to one of the claims 1 to 12,

characterized in



that the brush body (110) has two opposing bearing channels of a first type extending in the circumferential direction (U) or a bearing channel (118) of the first type that extends at least over most of the circumference, wherein the bearing channels cooperate with corresponding bearing journals (38) which are attached to the housing section (30) and project radially therefrom.

14. Toothbrush according to one of the claims 1 to 13,

characterized in

- that the brush body (210, 310, 410, 510, 1010) has a bearing channel of the second type (217, 317, 417) facing the eccentric shaft (850, 950, 1050), with the bearing channel (217, 317, 417) attached to the brush body (210, 310, 410, 910, 1010) along a circumferential section and formed in the shape of a V or U in the axial direction essentially mirror-symmetrically to the symmetry plane of the brush body, and

- that at least one bearing journal (564, 664, 964, 1064) which is guided in the bearing channel of the second type (217, 317, 417), is disposed on the housing section (562, 662, 862, 962, 1062).

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15. Toothbrush according to one of the claims 1 to 14,

characterized in

- that the bristle carrier (220, 320, 420, 820, 920, 1020) is supported for axial displacement on the housing section (560, 660, 860, 960, 1060) and has at least the bearing channel of the third type (219, 319, 419) which is disposed on the bristle carrier (220, 320, 420, 820, 920, 1020) along a circumferential section and having pitch in the axial direction, and

- that at least one bearing journal (566) which is guided in the bearing channel of the third type (219, 319, 419), is disposed on the a housing section (562, 662, 862, 962, 1062).

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16. Toothbrush according to one of the preceding claims,

characterized in

that an end face of the guide pin (52) is secured on a drive shaft (50) that can be driven with a rotation speed is a range of 15,000 to 25,000 rpm.

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