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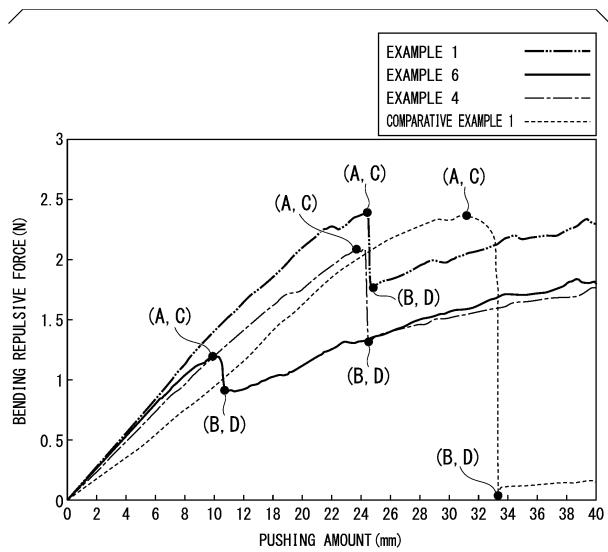
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(54) **TOOTHBRUSH**

(57) An object of the present invention is to provide a toothbrush that enables an appropriate brushing pressure to be recognized with high versatility and good usability. A sensing portion for sensing that an external force in a first direction orthogonal to the bristle tufting surface exceeds a predetermined value is provided on a rear end side from the bristle tufting surface. The sensing portion changes a relationship between a displacement amount of the head portion when a load is applied to the head portion in the first direction toward a back surface side opposite to the bristle tufting surface and a repulsive force

generated according to the displacement amount from an increase to a decrease in the repulsive force at a first threshold value according to an increase in the displacement amount, and stops the decrease in the repulsive force at a second threshold value where the displacement amount is larger than the first threshold value, and when the repulsive force when the displacement amount is at the first threshold value is A, and the repulsive force when the displacement amount is at the second threshold value is B, a value represented by B/A is 0.3 or more and 0.9 or less.

FIG. 8



**Description**

[Technical Field]

5 [0001] The present invention relates to a toothbrush.

[0002] Priority is claimed on Japanese Patent Application No. 2018-246150 filed on December 27, 2018, the content of which is incorporated herein by reference.

10 [Background Art]

15 [0003] While the proportion of people at the age of 80 who have 20 teeth is approximately 50%, the proportion of elderly caries (root surface caries) has increased. Root caries is caries of dentin exposed due to gingival recession, and since dentin has a higher composition ratio of organic components than enamel, caries progresses faster. One example of a causes of gingival recession is over-brushing, in which brushing is performed at a brushing pressure larger than that of an appropriate value.

20 [0004] Since the brushing pressure is defined by a load/bristle tufting area, reducing the brushing pressure can be achieved by at least one of reducing the load and increasing the bristle tufting area. To reduce the load, a toothbrush having a specification designed to incline a neck portion above a bristle tufting surface in advance, to bend the neck portion when brushing, and to be brushed with a force straightening the neck portion when brushing, a soft toothbrush having a specification that uses bristles with a small diameter, a toothbrush having a specification in which the center of gravity of a grip portion is disposed closer to a rear end portion of a handle so that force is not easily applied to a bristle tufting portion, or the like is commercially available. In addition, for increasing the bristle tufting area, a toothbrush having a wide head width and the like are commercially available. Incidentally, in these specifications, although it is possible to reduce the brushing pressure, it is difficult to make all users recognize the appropriate brushing pressure at the same level and control the brushing pressure.

25 [0005] In addition, although users are taught appropriate brushing methods at dentists' offices, since it is difficult to deal with the brushing method by oneself because it is not clear how much force is applied, it is found that there are many users who are aware of over-brushing yet continue to over-brush.

30 [0006] Therefore, examples of means for causing a user to recognize an appropriate brushing pressure include a toothbrush disclosed in Patent Document 1. The toothbrush disclosed in Patent Document 1 has a two-beam structure disposed between a head portion and a grip portion, and including a rear side beam to which compressive stress is applied and a facial side beam to which tensile stress is applied during normal use.

35 [0007] In this toothbrush, in a state where the user grips the grip portion, the rear side beam elastically buckles and reverses from an arc protruding upward to an arc protruding downward when a compressive force exceeding the determined force is applied thereto. As described above, the toothbrush disclosed in Patent Document 1 can cause the user to recognize that the appropriate brushing pressure is exceeded by reversing the rear side beam.

[Citation List]

40 [Patent Document]

[Patent Document 1]

45 [0008] Published Japanese Translation No. H 6-504937 of the PCT International Publication

[Summary of Invention]

[Technical Problem]

50 [0009] However, since the toothbrush disclosed in Patent Document 1 described above deforms in the direction where the rear side beam approaches the facial side beam when an excessive brushing load is applied, there is a limit to the amount of deformation of the rear side beam, and it cannot be said that versatility is sufficient. In addition, if the rear side beam comes into contact with the facial side beam when an excessive brushing load is applied, usability deteriorates.

55 [0010] The present invention has been made in consideration of the above points, and an object thereof is to provide a toothbrush that enables an appropriate brushing pressure to be recognized with high versatility and good usability.

[Solution to Problem]

**[0011]** According to a first aspect of the present invention, there is provided a toothbrush including: a head portion provided on a tip end side in a long axis direction and having a bristle tufting surface; a grip portion disposed on a rear end side from the head portion; and a neck portion disposed between the bristle tufting surface and the grip portion; in which a sensing portion for sensing that an external force in a first direction orthogonal to the bristle tufting surface exceeds a predetermined value is provided on a rear end side from the bristle tufting surface, the sensing portion changes a relationship between a displacement amount of the head portion when a load is applied to the head portion in the first direction toward a back surface side opposite to the bristle tufting surface and a repulsive force generated according to the displacement amount from an increase to a decrease in the repulsive force at a first threshold value according to an increase in the displacement amount, and stops the decrease in the repulsive force at a second threshold value where the displacement amount is larger than the first threshold value, and when the repulsive force when the displacement amount is at the first threshold value is A, and the repulsive force when the displacement amount is at the second threshold value is B, a value represented by B/A is 0.3 or more and 0.9 or less.

**[0012]** In addition, in the toothbrush according to one aspect of the present invention, the repulsive force A is 1.0 N or more and 5.0 N or less.

**[0013]** In addition, in the toothbrush according to one aspect of the present invention, when the displacement amount at the first threshold value is C and the displacement amount at the second threshold value is D, a value represented by D - C is 0 mm or more and 1.5 mm or less.

**[0014]** In addition, in the toothbrush according to one aspect of the present invention, the displacement amount C is 28 mm or less.

**[0015]** In addition, in the toothbrush according to one aspect of the present invention, when the displacement amount exceeds the second threshold value, the sensing portion causes the repulsive force to increase according to the increase in the displacement amount.

**[0016]** In addition, in the toothbrush according to one aspect of the present invention, starting from the displacement amount at the second threshold value, a rate of increase in the repulsive force until the displacement amount of the head portion reaches 4 mm is 0.015 or more.

**[0017]** In addition, in the toothbrush according to one aspect of the present invention, in the sensing portion, when a load is applied to the back surface side to stop at least the decrease in the repulsive force and thereafter the load is released, a relationship between the displacement amount and the repulsive force after the release remains the same as before the load is applied.

**[0018]** In addition, in the toothbrush according to one aspect of the present invention, the sensing portion includes a reversal portion that connects a first region on the tip end side from the sensing portion and a second region on the rear end side from the sensing portion, and that snaps, buckles, and reverses as the head portion is displaced to the back surface side opposite to the bristle tufting surface in the first direction due to the external force exceeding the threshold value, and an elastic deformation portion that is disposed with a gap from the reversal portion, connects the first region and the second region, and elastically deforms at least up to the external force at which the reversal portion snaps, buckles, and reverses, and the reversal portion is located between an outer contour on the bristle tufting surface side and an outer contour on the back surface side in the elastic deformation portion in a side view viewed in a direction orthogonal to the long axis direction and the first direction.

**[0019]** In addition, in the toothbrush according to one aspect of the present invention, a path where the elastic deformation portion is deformed due to the external force in the first direction and a path where the reversal portion is deformed due to the external force in the first direction are provided in a non-interfering manner.

**[0020]** In addition, in the toothbrush according to one aspect of the present invention, the elastic deformation portion and the reversal portion are disposed with a gap in a second direction orthogonal to the first direction and the long axis direction.

**[0021]** In addition, in the toothbrush according to one aspect of the present invention, the reversal portion has a protrusion shape toward the back surface side when the external force in the first direction is equal to or less than the predetermined value, and is reversed in the protrusion shape toward the bristle tufting surface side when the external force in the first direction exceeds the predetermined value.

**[0022]** In addition, in the toothbrush according to one aspect of the present invention, the reversal portion includes a groove portion extending in the second direction on at least one of the bristle tufting surface side and the back surface side in a region including an apex of the protrusion shape.

**[0023]** In addition, in the toothbrush according to one aspect of the present invention, the reversal portion is made of a hard resin, and a portion of the elastic deformation portion is made of a resin having a hardness different from that of the hard resin.

**[0024]** In addition, in the toothbrush according to one aspect of the present invention, the gap is a through-hole extending in the first direction.

## [Advantageous Effects of Invention]

[0025] The present invention can provide a toothbrush that enables an appropriate brushing pressure to be recognized with high versatility and good usability.

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## [Brief Description of Drawings]

## [0026]

10 Fig. 1 is a view illustrating an embodiment of the present invention and is a front view of a toothbrush 1.  
 Fig. 2 is a cross-sectional view of the toothbrush 1 along a plane including a center in a width direction.  
 Fig. 3 is a cross-sectional view of a sensing portion 70 along a plane parallel to a thickness direction and the width direction.  
 15 Fig. 4 is a cross-sectional view of the sensing portion 70 along a plane parallel to the thickness direction and a long axis direction.  
 Fig. 5 is a partial front view in a vicinity of the sensing portion 70 in a hard portion 70H.  
 Fig. 6 is a partial side view in the vicinity of the sensing portion 70 in the hard portion 70H.  
 Fig. 7 is a cross-sectional view of the sensing portion 70 along a plane parallel to the thickness direction and the long axis direction for describing reversal of a reversal portion.  
 20 Fig. 8 is a graph illustrating a relationship between a pushing amount (mm) measured by an autograph tester and a bending repulsive force (N).  
 Fig. 9 is a perspective view illustrating the sensing portion 70 of the toothbrush 1.

## [Description of Embodiments]

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[0027] Hereinafter, embodiments of a toothbrush of the present invention will be described with reference to Figs. 1 to 9.

[0028] The following embodiments illustrate one aspect of the present invention, do not limit the present invention, and can be randomly changed within the scope of the technical idea of the present invention. In addition, in the following drawings, in order to make each configuration easy to understand, the scale and number of each structure are different from those of the actual structure. In addition, in the following description, a direction orthogonal to a bristle tufting surface in a side view will be described as a vertical direction, a bristle tufting surface side will be described as an upper side, and a back surface side opposite to the bristle tufting surface will be described as a lower side as appropriate. The vertical direction, the upper side, and the lower side are names used only for description, and do not limit the actual positional relationship and direction in the present invention.

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[0029] Fig. 1 is a front view of a toothbrush 1. Fig. 2 is a cross-sectional view of the toothbrush 1 along a plane including a center in a width direction (vertical direction in Fig. 1).

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[0030] The toothbrush 1 of the present embodiment is provided with a head portion 10 disposed on a tip end side in the long axis direction (hereinafter, simply referred to as a tip end side) and on which a bristle bundle (not illustrated) of bristles is tufted, a neck portion 20 extending on a rear end side of the head portion 10 in the long axis direction (hereinafter, simply referred to as a rear end side), a sensing portion 70 extending to a rear end side of the neck portion 20, and a grip portion 30 extending to a rear end side of the sensing portion 70 (hereinafter, the head portion 10, the neck portion 20, the grip portion 30, and the sensing portion 70 are collectively referred to as a handle body 2).

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[0031] The toothbrush 1 of the present embodiment is a molded body in which a hard portion H made of a hard resin and a soft portion E made of a soft resin are integrally molded. The hard portion H constitutes at least a portion of each of the head portion 10, the neck portion 20, the grip portion 30, and the sensing portion 70. The soft portion E constitutes a portion of each of the grip portion 30 and the sensing portion 70 (details will be described later).

## [Head portion 10]

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[0032] The head portion 10 includes a bristle tufting surface 11 on one side in the thickness direction (direction orthogonal to a paper surface in Fig. 1). Hereinafter, the bristle tufting surface 11 side in the thickness direction is defined as a front surface side in a front surface direction, the side opposite to the bristle tufting surface is defined as a back surface side, and a direction orthogonal to the thickness direction and the long axis direction is defined as a width direction (or as appropriate, a side surface direction). A plurality of bristle tufting holes 12 are formed on the bristle tufting surface 11. A bristle bundle of bristles (not illustrated) is tufted in the bristle tufting hole 12.

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[0033] A width of the head portion 10, that is, a length in the width direction parallel to the bristle tufting surface 11 on the front surface side and orthogonal to the long axis direction (hereinafter, simply referred to as a width), is not particularly limited, and is preferably 7 mm or more and 13 mm or less, for example. When the width is the above lower limit value

or more, a sufficient area for tufting the bristle bundle can be secured, and when the width is the above upper limit value or less, the operability in the oral cavity is further enhanced.

**[0034]** The length of the head portion 10 in the long axis direction (hereinafter, simply referred to as a length) is not particularly limited, and is preferably 10 mm or more and 33 mm or less, for example. When the length of the head portion 10 is the above lower limit value or more, a sufficient area for tufting the bristle bundle can be secured, and when the length is the above upper limit value or less, the operability in the oral cavity is further enhanced. A boundary between the neck portion 20 and the head portion 10 in the long axis direction in the present embodiment is a position where the width of the neck portion 20 is a minimum value from the neck portion 20 toward the head portion 10.

**[0035]** The length of the head portion 10 in the thickness direction (hereinafter, simply referred to as a thickness) can be determined in consideration of the material and the like, and is preferably 2.0 mm or more and 4.0 mm or less. When the thickness of the head portion 10 is the above lower limit value or more, the strength of the head portion 10 is further enhanced. When the thickness of the head portion 10 is the above upper limit value or less, the reachability to the rear of the molars can be enhanced and the operability in the oral cavity is further enhanced.

**[0036]** The bristle bundle is a bundle of a plurality of bristles. The length (bristle length) from the bristle tufting surface 11 to the tip end of the bristle bundle can be determined in consideration of a bristle waist and the like required for the bristle bundle, and is, for example, 6 to 13 mm. All the bristle bundles may have the same bristle length or may be different from each other.

**[0037]** A thickness of the bristle bundle (bristle bundle diameter) can be determined in consideration of the bristle waist and the like required for the bristle bundle, and is set to, for example, 1 to 3 mm. All the bristle bundles may have the same bristle bundle diameter or may be different from each other.

**[0038]** Examples of the bristles constituting the bristle bundle include bristles in which diameters gradually decrease toward a tip of the bristle and have sharpened tips of the bristles (tapered bristles), and bristles in which diameters from the bristle tufting surface 11 toward a tip of the bristle are substantially the same as each other (straight bristles). Examples of a straight bristle include a bristle in which a tip of the bristle is a plane substantially parallel to the bristle tufting surface 11, and a bristle in which a tip of the bristle is hemispherically rounded.

**[0039]** Examples of the material of the bristle include polyamides such as 6-12 nylon (6-12NY), 6-10 nylon (6-10NY), polyesters such as polyethylene terephthalate (PET), polybutylene terephthalate (PBT), polytrimethylene terephthalate (PTT), polyethylene naphthalate (PEN), polybutylene naphthalate (PBN), polyolefins such as polypropylene (PP), elastomer resins such as polyolefin-based elastomers and styrene-based elastomers, and the like. These resin materials can be used alone or in a combination of two or more. In addition, examples of the bristle include a polyester bristle with a multi-core structure having a core portion and at least one or more layers of sheath portions provided on the outside of the core portion.

**[0040]** The cross-sectional shape of the bristle is not particularly limited, and may be a circular shape such as a perfect circle or an ellipse, a polygonal shape, a star shape, a three-leaf clover shape, a four-leaf clover shape, or the like. The cross-sectional shapes of all the bristles may be the same as each other or different from each other.

**[0041]** The thickness of the bristle can be determined in consideration of the material and the like, and in a case where the cross section is circular, the thickness is, for example, 6 to 9 mil (1 mil = 1/1000 inch = 0.025 mm). In addition, a plurality of bristles having different thicknesses may be used in any combination in consideration of usability, brushing feeling, cleaning effect, durability, and the like.

40 [Neck portion 20]

**[0042]** The length of the neck portion 20 is preferably 40 mm or more and 70 mm or less in terms of operability.

**[0043]** As an example, the width of the neck portion 20 is formed to gradually increase from a position where the minimum value is obtained toward the rear end side. The neck portion 20 in the present embodiment is formed to gradually increase from a position where the width has a minimum value toward the rear end side. In addition, the neck portion 20 is formed to gradually increase from a position where the thickness has a minimum value toward the rear end side.

**[0044]** The width and thickness of the neck portion 20 at the minimum position are preferably 3.0 mm or more and 4.5 mm or less. When the width and thickness of the neck portion 20 at the minimum position are the above lower limit value or more, the strength of the neck portion 20 is further enhanced. When the width and thickness are the above upper limit value or less, the lips are likely to be closed, the reachability to the molars is enhanced, and the operability in the oral cavity is further enhanced. The width and thickness of the neck portion 20 formed to gradually increase from the position where the minimum value is obtained toward the rear end side can be appropriately determined in consideration of the material and the like.

**[0045]** The front surface side of the neck portion 20 in the side view is inclined toward the front surface side and toward the rear end side. The back surface side of the neck portion 20 in the side view is inclined toward the back surface side and toward the rear end side. The neck portion 20 is inclined in a direction where a distance from the center in the width

direction increases toward the rear end side in a front view.

**[0046]** The boundary between the neck portion 20 and the sensing portion 70 in the present embodiment is the position of the tip end on the neck side 20 where an elastic deformation portion 90 that will be described later is provided. Here, the width is expanded from the neck portion 20 toward the grip portion 30 with an arcuate contour in both a front view and a side view, and a position of the center of curvature of the arc coincides with a changed position in the long axis direction. More specifically, the boundary between the neck portion 20 and the sensing portion 70 coincides with a position in the long axis direction where the center of curvature changes from the outside of the arcuate contour to the center side in the width direction in the front view illustrated in Fig. 1. In addition, the boundary between the neck portion 20 and the sensing portion 70 coincides with a position in the long axis direction where the center of curvature changes from the outside of the arcuate contour to the center side in the thickness direction in a side view illustrated in Fig. 2.

[Grip portion 30]

**[0047]** The grip portion 30 is disposed in the long axis direction. As illustrated in Fig. 1, a length of the grip portion 30 in the width direction gradually narrows from the boundary with the sensing portion 70 toward the rear end side, and then extends at a substantially constant length. As illustrated in Fig. 2, a length of the grip portion 30 in the thickness direction gradually narrows from the boundary with the sensing portion 70 toward the rear end side, and then extends at a substantially constant length.

**[0048]** The boundary between the sensing portion 70 and the grip portion 30 in the present embodiment is the position of the tip end on the grip portion side 30 where the elastic deformation portion 90 that will be described later is provided. Here, the width is reduced from the sensing portion 70 toward the grip portion side 30 with an arcuate contour in both a front view and a side view, and a position of the center of curvature of the arc coincides with a changed position in the long axis direction. More specifically, the boundary between the sensing portion 70 and the grip portion 30 coincides with a position in the long axis direction where the center of curvature changes from the center side in the width direction to the outside of the arcuate contour in the front view illustrated in Fig. 1. In addition, the boundary between the sensing portion 70 and the grip portion 30 coincides with a position in the long axis direction where the center of curvature changes from the center side in the thickness direction to the outside of the arcuate contour in the side view illustrated in Fig. 2.

**[0049]** The position in the long axis direction where the length of the grip portion 30 in the width direction gradually narrows from the boundary with the sensing portion 70 toward the rear end side and then is a substantially constant length, and the position in the long axis direction where the length of the grip portion 30 in the thickness direction gradually narrows from the boundary with the sensing portion 70 toward the rear end side and then is a substantially constant length are the same as each other.

**[0050]** The grip portion 30 includes a soft portion 31E at the center in the width direction on the front surface side. The soft portion 31E constitutes a portion of the soft portion E. The soft portion 31E gradually narrows from the boundary with the sensing portion 70 toward the rear end side in the front view, and then extends at a substantially constant length. A side edge of the soft portion 31E and a side edge of the grip portion 30 on the outside in the width direction are formed at a substantially constant distance in the front view.

**[0051]** The grip portion 30 includes a hard portion 30H. The hard portion 30H constitutes a portion of the hard portion H. The hard portion 30H includes a hollow 31H in which a portion of the soft portion 31E is embedded on the front surface side. The hollow 31H gradually narrows from the boundary with the sensing portion 70 toward the rear end side in the front view, and then extends at a substantially constant length.

**[0052]** A portion of the soft portion 31E protrudes from the hard portion 30H exposed on the front surface side. The other soft portion 31E is substantially flush with the hard portion 30H exposed on the front surface side.

**[0053]** The grip portion 30 includes a soft portion 32E at the center in the width direction on the back surface side (refer to Figs. 1 and 2). The soft portion 32E constitutes a portion of the soft portion E. The soft portion 32E has substantially the same outer contour as the outer contour of the soft portion 31E in the front view. That is, the soft portion 32E gradually narrows from the boundary with the sensing portion 70 toward the rear end side, and then extends at a substantially constant length. In a rear view, a side edge of the soft portion 32E and a side edge of the grip portion 30 on the outside in the width direction are formed at a substantially constant distance.

**[0054]** The hard portion 30H includes a hollow 32H (refer to Fig. 2) in which a portion of the soft portion 32E is embedded on the back surface side. The hollow 32H gradually narrows from the boundary with the sensing portion 70 toward the rear end side in the rear view, and then extends at a substantially constant length.

**[0055]** A portion of the soft portion 32E protrudes from the hard portion 30H exposed on the back surface side. The other soft portion 32E is substantially flush with the hard portion 30H exposed on the front surface side.

**[0056]** Since the soft portion 31E is provided on the front surface side of the grip portion 30 and the soft portion 32E is provided on the back surface side, the grip property when the grip portion 30 is gripped is improved.

[Sensing portion 70]

**[0057]** The sensing portion 70 senses that the external force in the first direction orthogonal to the bristle tufting surface 11 exceeds a predetermined value (hereinafter, external force threshold value). The sensing portion 70 changes a relationship between the displacement amount of the head portion 10 when a load is applied to the head portion 10 in the thickness direction on the back surface side and a repulsive force generated according to the displacement amount from an increase to a decrease in the repulsive force at a first threshold value according to the increase in the displacement amount, and stops the decrease in the repulsive force at a second threshold value where the displacement amount is larger than the first threshold value (details will be described later).

**[0058]** As illustrated in Fig. 1, the sensing portion 70 includes a reversal portion 80 and an elastic deformation portion 90 which connect the neck portion 20 on the tip end side from the sensing portion 70 and the grip portion 30 on the rear end side from the sensing portion 70.

**[0059]** Fig. 3 is a cross-sectional view of the sensing portion 70 along a plane parallel to a thickness direction and the width direction. Fig. 4 is a cross-sectional view of the sensing portion 70 along a plane parallel to the thickness direction and a long axis direction.

**[0060]** As illustrated in Fig. 3, of the elastic deformation portions 90 are each provided with gaps S on both sides of the reversal portion 80 in the width direction. The gaps S include a through-hole K penetrating in the thickness direction. As illustrated in Fig. 1, the through-hole K is formed in a rectangular shape in a plan view extending in the long axis direction.

**[0061]** By providing the gaps S, the reversal portion 80 can be reversed (easily reversed) without interfering with the periphery structure. In addition, since the deformation of the reversal portion 80 does not follow the deformation of the elastic deformation portion (because there is no interference), the functional roles (to be described later) of the reversal portion 80 and the elastic deformation portion 90 can be made independent. As a result, for example, the degree of freedom in design for obtaining the following effects can be enhanced. For example, vibration or sound when the reversal portion 80 that will be described later is reversed can be clearly generated. In addition, when the gaps S are communicated with both sides of the reversal portion 80 in the thickness direction so as not to interfere with the reversing behavior of the reversal portion 80, the above effect is further improved. By widening the gaps S in the thickness direction, the vector of the load applied to a brush portion (bristle) during brushing, the direction where the gaps open, and the direction where the reversal portion 80 and the elastic deformation portion 90 are deformed are made parallel to each other (refer to Fig. 7), and for example, it is easy to link the generation of vibration or sound due to reversing with the brushing load. In addition, when the gaps S are passed through the front surface side and the back surface side by the through-hole K, for example, the movable region of the elastic deformation portion 90 which is responsible for the bending function of the toothbrush skeleton with respect to the load during brushing can be further expanded (the tensile behavior on the front surface and the compression behavior on the back surface due to bending are unlikely to be hindered). In a case where there is no through-hole K between the elastic deformation portion 90 and the reversal portion 80, the movable region of the elastic deformation portion 90 is narrow. In this case, the reversal portion 80 is not assigned an opportunity to reverse in an appropriate load range, and it is assumed that the reversal portion 80 is reversed before reaching the appropriate load range, or is not reversed even within the appropriate load range. On the other hand, by providing the through-hole K between the elastic deformation portion 90 and the reversal portion 80, the "external force threshold value" at which the reversal portion 80 that will be described later reverses can be controlled in a fine range. The gaps S may not penetrate in the thickness direction, and may be formed inside the elastic deformation portion 90 by a closed cavity extending in the long axis direction. In addition, the gap S may include hollows (to be described later) that open on the front surface side or the back surface side.

**[0062]** Each elastic deformation portion 90 includes a hard portion 90H and a soft portion 90E. As illustrated in Fig. 1, the hard portion 90H and the soft portion 90E connect a rear end of the neck portion 20 and a front end of the grip portion 30. As illustrated in Figs. 3 and 4, a hollow (recessed portion) 71 that opens on the front surface side and a hollow (recessed portion) 72 that opens on the back surface side are provided between the pair of elastic deformation portions 90. The bottom portions of the hollow 71 and the hollow 72 on both end sides in the width direction are connected to the through-holes K. The reversal portion 80 is exposed and provided at the bottom portions of the hollow 71 and the hollow 72 at the center in the width direction. By providing the hollows 71 and 72, for example, the movable region of the elastic deformation portion that bears the bending function of the toothbrush skeleton with respect to the load during brushing can be further expanded, and the bending anisotropy in the thickness direction can be improved. The hollows between the pair of elastic deformation portions 90 may not penetrate in the thickness direction, or may open in only one of the thickness directions. In addition, for example, a closed cavity extending in the long axis direction may be formed inside the elastic deformation portion 90, and the cavity may be interposed in the center to form a pair of elastic deformation portions in the width direction.

**[0063]** In the pair of elastic deformation portions 90, the end portions of the soft portions 90E in the long axis direction are connected to each other in the width direction on both the front surface side and the back surface side. The soft portions 90E of the pair of elastic deformation portions 90 are provided at the periphery of the oval hollows 71 and 72

in the front view. The rear end side of the soft portion 90E is connected to the soft portion 31E of the grip portion 30.

**[0064]** Since the soft portion 90E is connected in the width direction on both the tip end side and the rear end side of the elastic deformation portion 90, stress is unlikely to be concentrated on the end of the reversal portion 80 even when the reversing is repeated, and the bending is unlikely to occur. In addition, since the soft portion 90E is connected in the width direction, the amount of heat possessed by the soft resin (elastomer) during injection molding increases, which enhances the adhesiveness between the neck portion 20 and the sensing portion 70 (neck portion 20 and elastic deformation portion 90). Furthermore, the anisotropy in the sensing portion 70 is increased by connecting the soft portions 90E in the width direction on both the tip end side and the rear end side of the elastic deformation portion 90. For example, the pair of elastic deformation portions 90 can be bent without twisting in the thickness direction with respect to the movement during brushing.

**[0065]** Fig. 5 is a partial front view in a vicinity of a hard portion 70H in the sensing portion 70. Fig. 6 is a partial side view in the vicinity of the hard portion 70H in the sensing portion 70.

**[0066]** As illustrated in Fig. 5, the hard portion 70H is formed in a rectangular shape in a plan view connecting the hard portion 20H which is the neck portion 20 and the hard portion 30H of the grip portion 30 in the long axis direction.

**[0067]** As illustrated in Fig. 6, the tip end side of the hard portion 70H on the front surface side is connected to the hard portion 20H by a curved surface 73H having an arc shape in the side view. The rear end side of the hard portion 70H on the front surface side is connected to the hard portion 30H by a curved surface 74H having an arc shape in the side view. The arc centers of the curved surfaces 73H and 74H are located on the front surface side from the hard portion 70H in the side view. The tip end side of the hard portion 70H on the back surface side is connected to the hard portion 20H by a curved surface 75H having an arc shape in the side view. The rear end side of the hard portion 70H on the back surface side is connected to the hard portion 30H by a curved surface 76H having an arc shape in the side view. The arc centers of the curved surfaces 75H and 76H are located on the back surface side from the hard portion 70H in the side view.

**[0068]** In a case where the curved surfaces 73H to 76H do not exist, stress may be concentrated on the boundary between the tip end side of the hard portion 70H and the hard portion 20H and the boundary between the rear end side of the hard portion 70H and the hard portion 30H. On the other hand, since the curved surfaces 73H to 76H exist, the concentrated stress can be relaxed. Furthermore, since the curved surfaces 73H to 76H exist, both the elastic deformation portion 90 and the tip end side and the rear end side of the reversal portion 80 can be flexibly deformed (the degree of deformation of the elastic deformation portion 90 that triggers reversing can be sensed more finely).

**[0069]** The hard portion 70H includes through-holes 73 provided on both sides of the reversal portion 80 in the width direction. The through-holes 73 extend in the long axis direction. The length of the through-hole 73 in the long axis direction is a length at which a tip end side end portion of the through-hole 73 is separated from the hard portion 20H and a rear end side end portion of the through-hole 73 is separated from the hard portion 30H. As illustrated in Fig. 3, of the through-holes 73, the soft portion 90E is provided near the hard portion 90H in the width direction, and the through-hole K is formed near the reversal portion 80 in the width direction.

**[0070]** In the hard portion 70H, since the hard portion 90H is disposed on both sides in the width direction with the reversal portion 80 as the center through the through-hole 73, even when a load is applied and the elastic deformation portion 90 is deformed, the shape of the reversal portion 80 can be maintained. When the hard portion H constituting the toothbrush 1 over the entire length is bent, the reversal portion 80 of the sensing portion 70 is reversed in an attempt to release the accumulated strain energy. For example, in a case where the hard portion 70H is connected to the neck portion 20 and the grip portion 30 only by the reversal portion 80, since the energy cannot be accumulated, the hard portion 70H is immediately reversed. When the reversal portion 80 is integrally injection-molded with a first region A1 and a second region A2 that will be described later, the neck portion 20, the grip portion 30, and the hard portion 70H, the accumulated strain energy can be efficiently transferred to the reversal portion.

**[0071]** The hard portion 90H is formed on the outside of the hard portion 70H in the width direction from the through-hole 73. As illustrated in Fig. 3, the hard portion 90H has a substantially rectangular cross-sectional shape. The hard portion 90H is embedded in the soft portion 90E. Since the hard portion 90H is embedded in the soft portion 90E, the stress applied to the hard portion 90H can be relaxed from the viewpoint of strength. In addition, from the viewpoint of the degree of bending of the toothbrush 1 with respect to the load, it is possible to control the elastic behavior of the elastic deformation portion 90. In addition, the bending anisotropy of a sensing portion 70 is increased, and for example, the elastic deformation portion 90 can be bent without twisting in the thickness direction with respect to the movement during brushing.

**[0072]** Examples of the material of the hard portion H include a resin having a flexural modulus (JIS7171) of 1500 MPa or more and 3500 MPa or less, and for example, include a polyacetal resin (POM). The flexural modulus of the hard portion H is more preferably 2000 MPa or more and 3500 MPa or less. By using a material having a high elastic modulus (for example, POM), even when the shape is made narrow or thin, when an excessive load is applied, snap buckling occurs and vibration is developed. In addition, by using a material having a high elastic modulus, it is possible to rapidly return to an initial state (state where the bending of the elastic deformation portion 90 is released) after the

snap buckling occurs.

[0073] As an example, the material of the soft portion E preferably has a shore hardness A of 90 or less, and more preferably a shore hardness A of 50 to 80, so that the load when the snap buckling occurs is close to a recommended brushing load value. Examples of the soft resin include elastomers (for example, olefin-based elastomers, styrene-based elastomers, polyester-based elastomers, and polyurethane-based thermoplastic elastomers) and silicones. A styrene-based elastomer is preferable because styrene-based elastomers have excellent miscibility with polyacetal resins.

[0074] As illustrated in Fig. 5, the reversal portion 80 extends in the long axis direction in the front view, and connects the first region A1 on the tip end side of the through-hole 73 and the second region A2 on the rear end side of the through-hole 73 in the hard portion 70H. The reversal portion 80 is formed in substantially a V shape in the side view which gradually inclines toward the back surface side from both end portions in the long axis direction toward the center, in a first stable state (hereinafter referred to as a first state) illustrated in Fig. 4 in which no external force is applied to the back surface side of the head portion 10 (or an external force equal to or less than a predetermined external force threshold value that will be described later is applied). That is, in the first state, the reversal portion 80 is formed in a protrusion shape on the back surface side where the center in the long axis direction is the apex.

[0075] For example, when an external force to the back surface side is applied to the head portion 10 while the grip portion 30 is gripped, in a case where the magnitude of the external force is in the first state equal to or less than a predetermined external force threshold value, the elastic deformation portion 90 and the reversal portion 80 are elastically deformed according to the magnitude of the external force in the sensing portion 70.

[0076] That is, when an external force is applied to the back surface side of the head portion 10, the sensing portion 70 changes a relationship between the displacement amount of the head portion 10 according to the magnitude of the external force and a repulsive force (bending repulsive force) generated according to the displacement amount from increasing to decreasing the repulsive force at a first threshold value according to the increase in the displacement amount of the head portion 10, and stops the decrease in the repulsive force at a second threshold value where the displacement amount of the head portion 10 is larger than the first threshold value.

[0077] In a case where the magnitude of the external force exceeds a predetermined external force threshold value and the displacement amount of the head portion 10 exceeds the first threshold value, the elastic deformation portion 90 elastically deforms according to the magnitude of the external force exceeding the external force threshold value. On the other hand, in a case where the magnitude of the external force exceeds a predetermined external force threshold value and the displacement amount of the head portion 10 exceeds the first threshold value, as illustrated by a two dot chain line in Fig. 7, the reversal portion 80 snaps, buckles, and reverses to a second stable state (hereinafter referred to as a second state) when the neck portion 20 is deformed. In the second state, the reversal portion 80 is reversed in a direction that is substantially a reversed V shape in the side view which gradually inclines toward the front surface side toward the center. In the second state, the reversal portion 80 is formed in a protrusion shape on the front surface side where the center in the long axis direction is the apex.

[0078] When the reversal portion 80 shifts from the first state to the second state, since the energy accumulated in the reversal portion 80 is released until the reversal portion 80 reaches the second state, the displacement amount of the head portion 10 increases, but the repulsive force decreases. In addition, since the reversal portion 80 is in a stable state when the reversal portion 80 is in the second state, the decrease in the repulsive force is stopped.

[0079] That is, in a case where the magnitude of the external force exceeds a predetermined external force threshold value, since the elastic deformation portion 90 elastically deforms, the reversal portion 80 snaps, buckles, and reverses from the first state to the second state, in a state where the bending strength of the sensing portion 70 is ensured. In addition, since the through-hole K is provided between the reversal portion 80 and the elastic deformation portion 90, the reversal portion 80 and the elastic deformation portion 90 can be deformed independently of each other, and the reversal portion 80 can be easily reversed. That is, since the through-hole K is provided when a brushing load is applied, the reversal portion 80 can be bent after only the elastic deformation portion 90 is first bent without either hindering the deformation behavior of the other. The space between the reversal portion 80 and the elastic deformation portion 90 does not necessarily penetrate, and a gap S may be formed.

[0080] Due to the vibration and the decrease in the repulsive force when the reversal portion 80 snaps, buckles, and reverses, and shifts from the first state to the second state, the user who grips the grip portion 30 can sense an over-brushing state in which the external force applied to the head portion 10 on the back surface side exceeds the external force threshold value.

[0081] Even after the reversal portion 80 snaps, buckles, and reverses from the first state to the second state, when an external force is applied to the head portion 10 and the increased displacement amount of the head portion 10 exceeds the second threshold value larger than the first threshold value, the repulsive force increases in a state where the reversal portion 80 in which the decrease in the repulsive force is stopped at the second threshold value is formed in a protrusion shape on the front surface side in the second state. Since the repulsive force increases in the state where the reversal portion 80 is formed in the protrusion shape on the front surface side in the second state, a series of brushing pressure behavior is rapidly restored even when the external force applied to the head portion 10 decreases, so that it is possible

to suppress the occurrence of operational problems. Therefore, the user who grips the grip portion 30 senses the change in the repulsive force in two stages of a repulsive force that is decreased when the displacement amount of the head portion 10 exceeds the first threshold value, and a repulsive force in which the decrease is stopped when the displacement amount of the head portion 10 is at the second threshold value, and can more accurately sense the over-brushing state.

5 When an external force (load) is applied on the back surface side, and the load is released at least after stopping the decrease in the repulsive force, the sensing portion 70 maintains the same relationship between the displacement amount of the head portion 10 after release and the repulsive force as before the load is applied.

[0082] Here, when the repulsive force when the displacement amount of the head portion 10 is at the first threshold value is A (N) and the repulsive force when the displacement amount is at the second threshold value is B (N), the values represented by B/A are preferably 0.3 or more and 0.9, and more preferably 0.65 or more and 0.85 or less. In a case where the value represented by B/A is less than 0.3, the attenuation from the repulsive force A to the repulsive force B is large, which may impair the usability. In addition, when the displacement amount of the head portion 10 exceeds the second threshold value and increases, the increase in the repulsive force is large, which may impair the usability. In a case where the value represented by B/A exceeds 0.9, the attenuation from the repulsive force A to the repulsive force B is small, and the over-brushing state may not be recognized. Therefore, by setting the value represented by B/A to 0.3 or more and 0.9 or less, it is possible for the repulsive force in which the displacement amount of the head portion 10 exceeds the second threshold value and increases to be fully recognized so that the over-brushing state is perceived without impairing the usability.

[0083] The repulsive force A is preferably 1.0 N or more and 5.0 N or less, more preferably 1.5 N or more and 4.0 N or less, and even more preferably 1.5 N or more and 3.0 N or less. In a case where the repulsive force A is less than 1.0 N, sufficient cleaning power may not be obtained. When the repulsive force A exceeds 5.0 N (approximately 500 g), it may cause harm to the gingiva. Therefore, by setting the repulsive force A to 1.0 N or more and 5.0 N or less, a sufficient cleaning power can be secured and the harmful effect on the gingiva can be suppressed. In addition, the value of the repulsive force A is set to a value within the above preferable range and not exceeding a recommended brushing pressure that will be described later.

[0084] When the displacement amount of the first threshold value is C (mm) and the displacement amount of the second threshold value is D (mm), the value represented by D - C is preferably 0 mm or more and 1.5 mm or less, more preferably 0 mm or more and 1.0 mm or less, and even more preferably 0 mm or more and 0.5 mm or less. When the value represented by D - C exceeds 1.5 mm, the displacement amount of the head portion 10 exceeds the first threshold value and the repulsive force decreases, and thereafter the displacement amount increases until the displacement amount of the head portion 10 exceeds the second threshold value and the repulsive force increases. Therefore, the synergistic effect of recognizing the change in the repulsive force in two steps may decrease. That is, there is a possibility that the sharp change in the repulsive force when the first threshold value is exceeded may feel dull. Therefore, by setting the value represented by D - C to 0 mm or more and 1.5 mm or less, it is possible to allow the over-brushing state to be accurately perceived by causing a change in the repulsive force in two stages at a short distance without impairing the usability.

[0085] The displacement amount C of the first threshold value is preferably 28 mm or less. When the displacement amount C exceeds 28 mm, the bending amount during brushing increases, and it is difficult for the user to perform the oral cleaning. Therefore, by setting the displacement amount C to 28 mm or less, it is possible to secure the role of oral cleaning. The displacement amount C of the first threshold value is more preferably 24 mm or less. In addition, the lower limit value of the displacement amount C is more preferably 10 mm or more. By setting the lower limit value of the displacement amount C to 10 mm or more, the brushing load applied to the gingiva can be relaxed. In addition, the repulsive force up to the displacement amount C preferably increases in proportion to the displacement amount, and more preferably the proportional relationship does not change (the degree of increase in the repulsive force is not relaxed) even when the displacement amount C is approached. Specifically, a rate of increase in the repulsive force for each displacement amount of 1 mm up to the displacement amount C is preferably 0.05 or more, more preferably 0.08 or more, and even more preferably 0.09 or more. As a result, the pressure assumed by the user is directly reflected in the repulsive force in a region up to the displacement amount C reaching the upper limit pressure, so that the brushing load can be appropriately controlled. In a case where the degree of increase in the repulsive force is gradually relaxed in the vicinity of the displacement amount C, the user may unintentionally continue brushing at a pressure near the upper limit.

[0086] Starting from the displacement amount D of the second threshold value, a rate of increase in the repulsive force until the displacement amount of the head portion 10 reaches 4 mm is preferably 0.015 or more. In a case where the rate of increase in the repulsive force from the displacement amount D of the second threshold value to the displacement amount of the head portion 10 of 4 mm is less than 0.015, the increase in the repulsive force after the reversal portion 80 is reversed is poor and the usability may be impaired. Therefore, by setting the rate of increase in the repulsive force from the displacement amount D of the second threshold value to the displacement amount of the head portion 10 of 4 mm to 0.015 or more, even after the reversal portion 80 is reversed, brushing can be continued without impairing the usability.

**[0087]** The reversal portion 80 includes a groove portion 81 at the center in the long axis direction on the front surface side, that is, in a region including an apex of the protrusion shape. The reversal portion 80 includes a groove portion 82 at the center in the long axis direction on the back surface side, that is, in a region including the apex of the protrusion shape. The groove portions 81 and 82 extend in the width direction. The groove portion 81 is formed in an arc shape in the side view in which the center of the arc is disposed on the front surface side. The groove portion 82 is formed in an arc shape in the side view in which the center of the arc is disposed on the back surface side. In a case where the reversal portion 80 is not provided with the groove portions 81 and 82, stress is uniformly generated in the entire reversal portion 80, and snap buckling is unlikely to occur. On the other hand, when the groove portions 81 and 82 are provided in the reversal portion 80, stress is intensively generated in the groove portions 81 and 82, and snap buckling is likely to occur.

**[0088]** The radius of the arc-shaped groove portions 81 and 82 in the side view is preferably 1 mm or more and 2 mm or less. In a case where the radius of the groove portions 81 and 82 is less than 1 mm, the reversal portion 80 may not be reversed. In a case where the radius of the groove portions 81 and 82 exceeds 2 mm, the vibration of the reversal portion 80 at the time of reversing is decreased, and it may be difficult to sense that the reversal portion 80 is in the over-brushing state.

**[0089]** As for the depth of the groove portions 81 and 82, it is preferable that the groove portion 81 is deeper than the groove portion 82. In a case where the groove portion 82 is deeper than the groove portion 81, the reversal portion 80 is unlikely to be reversed even in a case where the magnitude of the external force exceeds a predetermined external force threshold value. In addition, in a case where the groove portion 81 is deeper than the groove portion 82, the reversal portion 80 can be guided to be more likely to snap and buckle on the front surface side.

**[0090]** Configurations in which neither of the groove portions 81 and 82 is provided and in which the groove portion 82 is not provided and only the groove portion 81 is provided are also possible.

**[0091]** Since the reversal portion 80 is provided with the groove portions 81 and 82 in the region including the apex of the protrusion shape, the region including the apex of the protrusion shape is thinner than the other regions. Therefore, the strain energy accumulated by the deformation of the reversal portion 80 due to the external force exceeding the external force threshold value can be instantly released starting from the groove portions 81 and 82, and the reversal portion 80 can be reversed. In addition, the positions of the groove portions 81 and 82 in the thickness direction can be adjusted to adjust the position where the reversal portion 80 reverses from the first state to the second state.

**[0092]** In addition, since the groove portions 81 and 82 are formed in an arc shape in the side view, for example, as compared with the case where the groove portions 81 and 82 are formed in a V shape on two intersecting planes, even when the apex of the reversal portion 80 including the groove portions 81 and 82 moves in the thickness direction, the stress concentration at the apex can be relaxed.

**[0093]** The external force threshold value of the external force applied to the head portion 10 on the back surface side is, for example, an upper limit value of an appropriate brushing pressure. The external force threshold value corresponds to the first threshold value in the displacement amount of the head portion 10 described above.

**[0094]** As illustrated in Fig. 4, the angle  $\theta$  at which the reversal portion 80 is inclined to the plane parallel to the long axis direction and the width direction is preferably 5 degrees or more and 11 degrees or less, and more preferably 7 degrees or more and 11 degrees or less. In a case where the inclination angle  $\theta$  is less than 5 degrees, since the reversal portion 80 is deformed without snap buckling, it may be difficult to sense that it is in the over-brushing state. In a case where the inclination angle  $\theta$  exceeds 11 degrees, it may be difficult for the reversal portion 80 to snap, buckle, and reverse due to the over-brushing pressure, or when the reversal portion 80 snaps, buckles, and reverses, the reversal portion 80 may break and lose reversibility.

**[0095]** The thickness of the reversal portion 80 is preferably 1 mm or more and 2 mm or less, excluding the groove portions 81 and 82. In a case where the thickness of the reversal portion 80 is less than 1 mm, the reversal portion 80 does not snap and buckle when deformed, and it may be difficult to sense that it is in an over-brushing state. When the thickness of the reversal portion 80 exceeds 2 mm, it may be difficult for the reversal portion 80 to snap, buckle, and reverse due to the over-brushing pressure, or when the reversal portion 80 snaps, buckles, and reverses, the reversal portion 80 may break and lose reversibility.

**[0096]** Assuming that the maximum thickness of the reversal portion 80 is  $T$  (mm) and the maximum thickness of the sensing portion 70 is  $t$  (mm), by defining a value represented by  $T/t$ , it is possible to control the ease of reversing of the reversal portion 80 and the timing (external force threshold value) thereof when an excessive brushing load is applied. The value represented by  $T/t$  is preferably 0.05 or more and 0.35 or less, and more preferably 0.10 or more and 0.35 or less. In a case where the value represented by  $T/t$  is less than 0.05, although the reversal portion 80 also deforms in a form that follows the bending of the sensing portion 70 (elastic deformation portion 90), the reversal portion 80 does not snap and buckle, and therefore it can be difficult to sense an over-brushing state. When the value represented by  $T/t$  exceeds 0.35, it may be difficult for the reversal portion 80 to snap, buckle, and reverse due to the over-brushing pressure, or when the reversal portion 80 snaps, buckles, and reverses, the reversal portion 80 may break and lose reversibility.

**[0097]** That is, by setting  $T/t$  within the above ranges, the bending strength of the reversal portion 80 is flexible at a constant ratio for the elastic deformation portion 90, and the reversal portion 80 can be operated with a slight delay for the bending of the elastic deformation portion 90 that bears the handle skeleton. As a result, even when an excessive brushing load is applied, it is possible to control the ease of reversing of the reversal portion 80 and the timing (external force threshold value) that triggers the reversal portion 80 to reverse.

**[0098]** As illustrated in Fig. 3, assuming that the maximum width of the reversal portion 80 is  $L$  (mm) and the maximum width of the sensing portion 70 is  $W$  (mm), by defining a value represented by  $L/W$ , for example, it is possible to control the ease of reversing of the reversal portion 80 and the timing (external force threshold value) thereof when an excessive brushing load is applied. The value represented by  $L/W$  is preferably 0.05 or more and 0.35 or less, and more preferably 0.10 or more and 0.35 or less. In a case where the value represented by  $L/W$  is less than 0.05, although the reversal portion 80 also deforms in a form that follows the bending of the sensing portion 70 (elastic deformation portion 90), the reversal portion 80 is unlikely to snap and buckle, and therefore it can be difficult to sense an over-brushing state. When the value represented by  $L/W$  exceeds 0.35, the reversal portion 80 is unlikely to be deformed and reversed due to the bending of the handle body 2 that occurs in the range of normal brushing. Therefore, it may be difficult for the reversal portion 80 to snap, buckle, and reverse due to the over-brushing pressure, or when the reversal portion 80 snaps, buckles, and reverses, the reversal portion 80 may break and lose reversibility. That is, by setting  $L/W$  within the above ranges, the bending strength of the reversal portion 80 is made flexible at a constant ratio for the elastic deformation portion 90, and the reversal portion 80 can be operated with a slight delay for the bending of the elastic deformation portion 90 that bears the handle skeleton. Therefore, even when an excessive brushing load is applied, it is possible to control the ease of reversing of the reversal portion 80 and the timing (external force threshold value) that triggers the reversal portion 80 to reverse.

**[0099]** The length of the reversal portion 80 in the long axis direction is preferably 15 mm or more and 30 mm or less, more preferably 15 mm or more and 25 mm or less, and even more preferably 15 mm or more and 20 mm or less. The position of the tip end side end portion of the reversal portion 80 is the position of the tip end side end portion of the through-hole 73. The position of the rear end side end portion of the reversal portion 80 is the position of the rear end side end portion of the through-hole 73. In a case where the length of the reversal portion 80 in the long axis direction is less than 15 mm, it may be difficult for the reversal portion 80 to snap, buckle, and reverse due to the normal brushing pressure, and the deformation required for snap buckling to develop may not be generated. In a case where the length of the reversal portion 80 in the long axis direction exceeds 30 mm, the displacement required for snap buckling is significantly increased, which significantly reduces the usability, and the deformation behavior of the reversal portion 80 may be the same as that of the elastic deformation portion 90.

**[0100]** The reversal portion 80 is located between the outer contour of the bristle tufting surface side 11 and the outer contour of the back surface side of the elastic deformation portion 90 in the side view. More specifically, the position of the reversal portion 80 in the thickness direction is set so as not to protrude from the thickness of the elastic deformation portion 90 in the side view so that the reversal portion 80 does not form the outermost contour of the toothbrush. Therefore, for example, it is possible to prevent the reversal portion from coming into contact with the user during use. Specifically, it is preferable that the elastic deformation portion 90 be on the back surface side of the position where the thickness is halved. In a case where the position of the reversal portion 80 in the thickness direction is on the back surface side of the position where the thickness of the sensing portion 70 is halved, when the reversal portion 80 is reversed to be in the second state, the possibility of the apex of the reversal portion 80 protruding from the front surface on the front surface side of the elastic deformation portion 90 and coming into contact with the user's finger can be reduced. In addition, since the reversal portion 80 is disposed on the back surface side of the position where the thickness of the elastic deformation portion 90 is halved, when the reversal portion 80 is bent, the back surface side is compressed rather than the front surface side, and therefore energy that triggers the reversing easily accumulates, and the strain energy can be efficiently transferred to the reversal portion 80.

**[0101]** By setting the flexural modulus to 1500 MPa or more, the reversal portion 80 forming a portion of the hard portion H can snap and buckle so that the over-brushing state can be perceived. In addition, by setting the flexural modulus of the reversal portion 80 to 3500 MPa or less, it is possible to prevent the reversal portion 80 from losing the reversibility due to breakage when the reversal portion 80 snaps, buckles, and reverses. In addition, by using a material having a defined flexural modulus, vibrations associated with snap buckling are intensively generated in a short time and are sensitive (sharp, large). As a result, the user can easily sense the over-brushing.

**[0102]** When the reversal portion 80 snaps and buckles, the moving distance of the apex of the protrusion shape in the thickness direction is preferably 0.2 mm or more and 5.0 mm or less. In a case where the moving distance of the apex in the thickness direction is less than 0.2 mm, the vibration at the time of snap buckling is decreased, and it may be difficult to sense the over-brushing state. In a case where the moving distance of the apex in the thickness direction exceeds 5.0 mm, it may be difficult for the reversal portion 80 to snap, buckle, and reverse due to the over-brushing pressure, or when the reversal portion 80 snaps, buckles, and reverses, the reversal portion 80 may break and lose reversibility. When the moving distance of the reversal portion 80 is within the above range when the snap buckling

occurs, the vibration generated by the snap buckling is intensively generated in a short time and is sensitive (sharp, large). As a result, the user can easily sense the over-brushing.

**[0103]** The thickness of the hard portion 90H in the elastic deformation portion 90 is preferably 2.0 mm or less, and the width is preferably larger than the thickness. In a case where the thickness of the hard portion 90H is 2.0 mm or less, the hard portion 90H is in a plane stress state, and the hard portion 90H is unlikely to generate internal stress. As a result, the elastic deformation portion 90 is unlikely to break even when deformed, and the energy required for reversing the reversal portion 80 can be sufficiently accumulated.

**[0104]** In addition, in the toothbrush 1 of the present embodiment, since the reversal portion 80 and the elastic deformation portion 90 are disposed with a gap in the width direction, the sensing portion 70 can be more easily deformed on the front surface side and the back surface side, and can be in a plane stress state where the sensing portion 70 is substantially not deformed in the long axis direction and the width direction. That is, in the toothbrush 1 of the present embodiment, the directions where the reversal portion 80 and the elastic deformation portion 90 are deformed are the thickness directions separated from each other in the width direction, and are not present on the same plane. In other words, a path where the elastic deformation portion 90 is deformed due to the external force in the thickness direction and a path where the reversal portion 80 is deformed due to the external force in the thickness direction are provided in a non-interfering manner. Therefore, in the toothbrush 1 of the present embodiment, since the elastic deformation portion 90 and the reversal portion 80 are unlikely to be constrained by each other and can be deformed, it is possible to more sufficiently accumulate the energy required for the reversing of the reversal portion 80, stress is intensively generated in the reversal portion 80 (particularly the groove portions 81 and 82), and a sharp snap buckling is developed.

**[0105]** In addition, since the toothbrush 1 of the embodiment is suppressed from being shaken in the width direction, the bending in the thickness direction due to brushing can be transmitted to the reversal portion 80 without loss. In addition, by disposing the reversal portion 80 and the elastic deformation portion 90 in the width direction, the bending of the elastic deformation portion 90 and the reversing of the reversal portion 80 can be made independent and the timing can be shifted. In a case where the elastic deformation portion 90 and the reversal portion 80 are disposed in the thickness direction, the roles of the bending of the elastic deformation portion 90 and the reversing of the reversal portion 80 may be hindered from each other.

**[0106]** As described above, in the toothbrush 1 of the present embodiment, the sensing portion 70 is provided so that the relationship between the displacement amount of the head portion 10 when a load is applied to the head portion 10 on the back surface side in the thickness direction and the repulsive force generated according to the displacement amount increases the repulsive force according to the increase in the displacement amount in a case where the displacement amount is equal to or less than the first threshold value, and decreases the repulsive force according to the increase in the displacement amount in a case where the displacement amount is equal to or less than the second threshold value larger than the first threshold value, and the value represented by B/A is 0.3 or more and 0.9 or less. Therefore, it is possible to fully recognize the repulsive force with high versatility and good usability and sense the over-brushing state.

[Modification example of sensing portion 70]

**[0107]** In the above embodiment, the configuration in which the sensing portion 70 includes the elastic deformation portion 90 and the reversal portion 80 is exemplified, but the present invention is not limited to this configuration. For example, the configuration may have both a function of elastically deforming due to an external force in the thickness direction and a function of snapping and buckling.

**[0108]** Fig. 9(a) is a front view illustrating a modification example of the sensing portion 70. Fig. 9(b) is a side view illustrating the modification example of the sensing portion 70. Fig. 9(c) is a right side view of Fig. 9(a). In Figs. 9(a) to 9(c), the neck portion 20 and the grip portion 30 are not illustrated.

**[0109]** As illustrated in Fig. 9(a), the sensing portion 70 of the modification example is formed in a rectangular shape in a front view. The sensing portion 70 includes a hollow 70a that opens on the front surface side. As illustrated in Fig. 9(b), the sensing portion 70 includes an arcuate curved surface 70b having a protrusion shape on the back surface side in the side view. The center of curvature of the curved surface 70b in the side view is further located on the front surface side in the thickness direction from the end portion of the curved surface 70b in the long axis direction. The center of curvature of the curved surface 70b in the side view is located at the center of the sensing portion 70 in the long axis direction. An intersection angle (intersection angle of a small value) between the tangent of the curved surface 70b and a straight line parallel to the long axis direction in the side view is 0° (that is, parallel) at the center in the long axis direction. The intersection angle between the tangent of the curved surface 70b and the straight line parallel to the long axis direction in the side view gradually increases from the center toward the end portion in the long axis direction. Since the center of curvature of the curved surface 70b is located on the front surface side in the thickness direction from the end portion of the curved surface 70b in the long axis direction in the side view, the intersection angle between the tangent line of the curved surface 70b and the straight line parallel to the long axis direction in the side view is an acute

angle or 0°. The bottom surface of the hollow 70a in the side view is a curved surface 70b and a curved surface 70d disposed on the front surface side with a constant width.

[0110] As illustrated in Fig. 9(c), the sensing portion 70 includes an arcuate curved surface 70c having a protrusion shape on the back surface side in the right side view. The center of curvature of the curved surface 70c in the right side view is located on the front surface side in the thickness direction from the end portion of the curved surface 70c in the width direction. The center of curvature of the curved surface 70c in the right side view is located at the center of the sensing portion 70 in the width direction. An intersection angle (intersection angle of a small value) between the tangent of the curved surface 70c and a straight line parallel to the width direction in the right side view is 0° (that is, parallel) at the center of the width direction. The intersection angle between the tangent of the curved surface 70c and the straight line parallel to the width direction in the right side view gradually increases from the center toward the end portion in the width direction. Since the center of curvature of the curved surface 70c is located on the front surface side in the thickness direction from the end portion of the curved surface 70c in the width direction in the right side view, the intersection angle between the tangent line of the curved surface 70c and the straight line parallel to the width direction in the right side view is an acute angle or 0°. The bottom surface of the hollow 70a in the right side view is a curved surface 70c and a curved surface 70e disposed on the front surface side with a constant width.

[0111] As the material of the sensing portion 70 of the modification example, the above-described hard resin, soft resin, metal, or the like can be used. In the above-described sensing portion 70, there is no limitation on the length and width in the long axis direction, and the maximum thickness is 5 mm or less. In addition, in order to easily cause snap buckling, it is preferable to provide a through groove 70f indicated by a two dot chain line extending in the long axis direction at the center position of the sensing portion 70 in the width direction and penetrating in the thickness direction.

[0112] In the sensing portion 70 having the above configuration, when an external force is transmitted through the neck portion 20 and deforms on the back surface side, the curved surface 70b having a protrusion shape on the back surface side in the side view and the curved surface 70c having a protrusion shape on the back surface side in the right side view are provided, and the bending strength on the back surface side in the thickness direction is large. Therefore, the back surface side is elastically deformed as an elastic deformation portion by an external force equal to or less than the external force threshold value. On the other hand, since the sensing portion 70 has a maximum thickness of 5 mm or less and is thin, when an external force exceeding the external force threshold value is transmitted, the sensing portion 70 snaps and buckles as a reversal portion and reverses to an arc shape of the protrusion shape on the front surface side. As described above, the sensing portion 70 of the modification example can have both a function of elastically deforming by an external force in the thickness direction and a function of snapping and buckling without separately providing each of the elastic deformation portion and the reversal portion.

[Examples]

[0113] Hereinafter, the present invention will be described in detail with reference to examples, but the present invention is not limited to the following examples, and can be appropriately modified and performed without departing from the gist thereof.

(Examples 1 to 9, Comparative Examples 1 to 4)

[0114] Samples of Examples 1 to 9 and Comparative Examples 1 to 4 were prepared according to the specifications illustrated in [Table 1]. Example 4 is a sample of a toothbrush that does not include a soft portion of a sensing portion with respect to the sample of Example 1. With respect to the sample of Example 1, Example 6 is a sample that does not include a reversal portion and includes a first engaging portion having a base end located in a second region on the rear end side of the sensing portion and extending in the long axis direction toward a first region on the tip end side of the sensing portion, in which a second engaging portion having a base end is located in the first region and extending in the long axis direction toward the second region, is separated in the first direction when the external force in the first direction is equal to or less than the threshold value, and engages with the displacement of the head portion toward the back surface side opposite to the bristle tufting surface in the first direction due to the external force exceeding the threshold value, and in which the relative positional relationship in the first direction is reversed. Example 7 is a toothbrush sample in which the radius of the groove portions 81 and 82 of the reversal portion is changed from 1.5 mm to 2 mm with respect to the sample of Example 1. Example 9 is a toothbrush sample that includes a sensing portion of the modification example illustrated in Fig. 9 with respect to the sample of Example 1. In Comparative Example 1, "Tekiatsukun" manufactured by Wada Precision Dental Research Co., Ltd. was used as a sample. In Comparative Example 3, a toothbrush in which a gap S was filled with a soft resin was used as a sample with respect to the sample of Example 1. The bristle tufting portions of the samples other than Comparative Example 1 had the same specifications as that of a Clinica Advantage toothbrush manufactured by Lion Corporation.

## [Test method]

[0115] For each sample, the grip portion 30 side was fixed from the boundary between the sensing portion 70 and the grip portion 30 so that the bristle tufting surface of the head portion was horizontal. A test was performed in which a load was applied to the bristle tufting surface of the head portion on the back surface side in the thickness direction. For each test, an autograph tester (AGS-H, manufactured by SHIMADZU Corporation) was used as an evaluation device. In the test, a finger contact portion on the most tip end side of the grip portion of the toothbrush was chucked, the center of the bristle tufting surface in the head portion in the front view was pushed by the presser at a test speed of 100 mm/min, and the pushing amount (displacement amount of the head portion) and the load (repulsive force) when the reversal portion was reversed were measured. The test was performed three times for each sample, and the average value was used.

## [Evaluation method]

[0116] A questionnaire was performed after each sample was used for one week. The survey was performed by 10 panelists. There were five questionnaire items of "awareness of vibration", "usability immediately after vibration", "harmfulness to gums", "feeling that plaque in mouth is removed", and "operability in mouth", and each was evaluated on a 7-point scale. The average score obtained in each sample was used as the evaluation result and is illustrated in [Table 1]. In each evaluation, a case where the average score exceeded 4.0 was regarded as passing (OK), and a case of 4.0 or less was regarded as failure (NG). Details of each evaluation item are described below.

- Awareness of vibration

[0117] This is an evaluation axis for whether or not the user is aware of the vibration of the sensing portion that occurs when the repulsive force A is attenuated to the repulsive force B. The vibration referred to here is a short and sensitive (sharp, large) vibration generated by the snap buckling.

[0118] The vibration was evaluated on a 7-point scale of significantly hard to feel (1 point), very hard to feel (2 points), slightly hard to feel (3 points), neither hard nor easy to feel (4 points), slightly easy to feel (5 points), very easy to feel (6 points), and significantly easy to feel (7 points).

- Usability immediately after vibration

[0119] This is an evaluation axis of usability immediately after the vibration generated from the sensing portion. When the attenuation from the repulsive force A to the repulsive force B does not interfere with the series of tooth brushing behaviors, the usability is good, and when the attenuation is a large obstacle, the usability is bad.

[0120] The usability was evaluated on a 7-point scale of significantly bad (1 point), very bad (2 points), slightly bad (3 points), neither bad nor good (4 points), slightly good (5 points), very good (6 points), and significantly good (7 points).

- Harmfulness to gums

[0121] This is an evaluation axis of whether or not harmfulness to the gums is present due to the tooth brushing behavior immediately before the vibration generated from the sensing portion and in the process up to that point (up to the first threshold value).

[0122] The harmfulness was evaluated on a 7-point scale of present and significant (1 point), present (2 points), present but slight (3 points), unclear (4 points), almost absent (5 points), substantially absent (6 points), and entirely absent (7 points).

- Feeling that plaque in mouth is removed

[0123] This is an evaluation axis of whether or not the plaque in the mouth is removed due to the tooth brushing behavior immediately before the vibration generated from the sensing portion and in the process up to that point (up to the first threshold value).

[0124] The feeling that the plaque is removed was evaluated on a 7-point scale of the feeling is significantly lacking (1 point), the feeling is lacking (2 points), the feeling is slightly lacking (3 points), unclear (4 points), the feeling is slightly present (5 points), the feeling is present (6 points), and the feeling is significantly present (7 points) for the usability.

- Operability in mouth

**[0125]** This is an evaluation axis regarding the quality of operability in the mouth due to the tooth brushing behavior immediately before the vibration generated from the sensing portion and in the process up to that point (up to the first threshold value).

**[0126]** The operability was evaluated on a 7-point scale of significantly bad (1 point), very bad (2 points), slightly bad (3 points), neither bad nor good (4 points), slightly good (5 points), very good (6 points), and significantly good (7 points).

**[0127]** Fig. 8 is a graph illustrating the relationship between the pushing amount (mm) and the bending repulsive force (N) in the samples of Example 1, Example 4, Example 6, and Comparative Example 1 measured by the autograph tester.

In addition, in [Table 1], in the samples of Examples 1 to 9 and Comparative Examples 1 to 4, the repulsive force A (N) at the pushing amount of the first threshold value, the repulsive force B (N) at the pushing amount of the second threshold value, the pushing amount (displacement amount) C (mm) at the first threshold value, the pushing amount (displacement amount) D (mm) at the second threshold value, B/A, and D - C (mm) are illustrated.

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[Table 1]

|  | Example 1 | Example 2 | Example 3 | Example 4 | Example 5 | Example 6 | Example 7 | Example 8 | Example 9 | Comparative Example 1 | Comparative Example 2 | Comparative Example 3 | Comparative Example 4 |
|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------------------|-----------------------|-----------------------|-----------------------|
| Flexural modulus (MPa)                                       | 2500      | 2000      | 2500      | 2500      | 3200      | 2500      | 2500      | 2500      | 2500      | -                     | 4500                  | 2500                  | 4500                  |
| Inclination angle $\theta$ of reversal portions 80 (degrees) | 8         | 8         | 11        | 8         | 8         | 8         | 8         | 8         | 8         | -                     | 8                     | 8                     | 3                     |
| Length of reversal portions 80 in long axis direction (mm)   | 21        | 21        | 21        | 21        | 21        | 21        | 30        | 21        | -         | 21                    | 21                    | 21                    | 21                    |
| B/A  | 0.73      | 0.88      | 0.31      | 0.62      | 0.70      | 0.76      | 0.66      | 0.72      | 0.80      | 0.01                  | 0.27                  | 0.92                  | 0.28                  |
| A(N)   | 2.4       | 2.2       | 3.0       | 2.1       | 4.9       | 1.2       | 1.6       | 1.5       | 1.6       | 2.4                   | 4.9                   | 5.4                   | 1.9                   |
| D - C (mm)   | 0.25      | 0.41      | 0.49      | 0.33      | 0.49      | 1.00      | 1.46      | 0.45      | 0.48      | 2.01                  | 0.32                  | 0.46                  | 1.60                  |
| C (mm)   | 22.8      | 24.0      | 24.8      | 22.5      | 23.0      | 11.5      | 10.3      | 27.5      | 27.2      | 30.6                  | 20.0                  | 21.5                  | 19.5                  |
| Awareness of vibration                                       | 6.4       | 4.6       | 6.9       | 6.4       | 6.2       | 5.0       | 4.5       | 6.2       | 6.0       | 4.5                   | 6.8                   | 3.0                   | 3.4                   |
| Usability immediately after vibration                        | 6.3       | 6.7       | 4.2       | 5.8       | 6.2       | 6.4       | 6.0       | 6.2       | 6.6       | 1.8                   | 3.7                   | 6.8                   | 2.8                   |
| Harmfulness to gums  | 6.4       | 6.7       | 6.0       | 6.7       | 4.1       | 6.9       | 6.9       | 6.9       | 6.8       | 6.4                   | 4.1                   | 2.2                   | 6.7                   |
| Feeling that plaque in mouth is removed                      | 6.3       | 6.2       | 6.5       | 6.2       | 6.8       | 4.5       | 6.0       | 6.0       | 6.2       | 6.6                   | 6.6                   | 6.9                   | 6.1                   |
| Operability in mouth   | 6.1       | 6.0       | 5.8       | 6.1       | 6.1       | 6.8       | 4.2       | 4.3       | 3.1       | 6.4                   | 6.4                   | 6.3                   | 6.5                   |

[0128] As illustrated in [Table 1], it was confirmed that the value represented by B/A was in the range of 0.3 or more and 0.9 or less in the samples of Examples 1 to 9, and that the value represented by B/A was out of the range of 0.3 or more and 0.9 or less in the samples of Comparative Examples 1 to 4. When the value represented by B/A increases, the vibration generated from the sensing portion is unlikely to be noticeable. In addition, when the value represented by B/A decreases, the vibration is likely to be noticeable, but the attenuation of the repulsive force significantly increases, and therefore the usability deteriorates. Therefore, the samples of Comparative Examples 1, 2, and 6 in which the value represented by B/A was less than 0.3 failed the evaluation of "usability immediately after vibration". In addition, the sample of Comparative Example 3 in which the value represented by B/A exceeded 0.9 failed the evaluation of "awareness of vibration". On the other hand, the samples of Examples 1 to 9 in which the value represented by B/A is in the range of 0.3 or more and 0.9 or less passed both of the evaluations "awareness of vibration" and "usability immediately after vibration".

[0129] Therefore, in the toothbrushes according to Examples 1 to 9, it is possible to fully recognize the repulsive force that is decreased when the displacement amount of the head portion 10 exceeds the first threshold value, and the stop of the decrease in the repulsive force when the displacement amount of the head portion 10 is at the second threshold value, and to sense the over-brushing state, without impairing the usability.

[0130] In addition, it was confirmed that the value of the repulsive force A was within the range of 1.0 N or more and 5.0 N or less in the samples of Examples 1 to 9, and the value of the repulsive force A was outside of the range of 1.0 N or more and 5.0 N or less in the sample of Comparative Example 3. The larger the value of the repulsive force A, the greater the harmfulness to the gingiva. When the value of the repulsive force A decreases, the irritation to the gingiva disappears, but the plaque removing force decreases. The sample of Comparative Example 5 in which the value of the repulsive force A exceeded 5.0 N failed the evaluation of the harmfulness to the gums.

[0131] On the other hand, the samples of Examples 1 to 9 in which the value of the repulsive force A was in the range of 1.0 N or more and 5.0 N or less passed both of the evaluation of "feeling that plaque in mouth is removed" and the evaluation of "harmfulness to gums". Therefore, the toothbrushes according to Examples 1 to 9 can develop sufficient plaque removing force while suppressing irritation to the gingiva.

[0132] In addition, it was confirmed that the value of D - C was within the range of 0 mm or more and 1.5 mm or less in the samples of Examples 1 to 9, and the value of D - C was outside of the range of 0 mm or more and 1.5 mm or less in the samples of Comparative Examples 1 and 4. The smaller the value of D - C, the greater the slope of the decrease in the repulsive forces A and B, which makes the vibration easier to feel. On the other hand, a larger value of D - C is considered to slow the decrease in the repulsive force, making the vibration harder to feel. Therefore, the sample of Comparative Example 4 in which the value of D - C exceeded 1.5 mm failed the evaluation of "awareness of vibration".

[0133] On the other hand, the samples of Examples 1 to 9 in which the value of D - C was within the range of 0 mm or more and 1.5 mm or less passed the evaluation of "awareness of vibration". Therefore, in the toothbrushes according to Examples 1 to 9, it is possible to fully recognize the repulsive force that is decreased when the displacement amount of the head portion 10 exceeds the first threshold value, and the stop of the decrease in the repulsive force when the displacement amount of the head portion 10 is at the second threshold value, and to sense the over-brushing state.

[0134] In addition, it was confirmed that the C value was within the range of 28 mm or less in the samples of Examples 1 to 9, and the C value was outside of the range of 28 mm or less in the sample of Comparative Example 1. The larger the value of C, the larger the bending until vibration occurs, which causes the usability to deteriorate. Therefore, the sample of Comparative Example 1 in which the value of C exceeded 28 mm failed the evaluation of "operability in mouth".

[0135] On the other hand, the samples of Examples 1 to 9 in which the value of C was within the range of 28 mm or less passed the evaluation of "operability in mouth". Therefore, in the toothbrushes according to Examples 1 to 9, good operability in the mouth can be ensured until vibration occurs.

[0136] Although the preferred embodiments according to the present invention are described above with reference to the accompanying drawings, it goes without saying that the present invention is not limited to the above examples. The various shapes and combinations of the constituent members described in the above-described examples are examples, and can be variously changed based on design requirements and the like without departing from the gist of the present invention.

[0137] For example, in the above embodiment, the configuration in which the sensing portion 70 is provided between the neck portion 20 and the grip portion 30 is illustrated, but the invention is not limited to this configuration. The sensing portion 70 may have a configuration provided in the neck portion 20 or a configuration provided in the grip portion 30.

[0138] In addition, although the configuration in which one reversal portion 80 is provided in the sensing portion 70 is illustrated in the above embodiment, the invention is not limited to this configuration, and a configuration in which a plurality of reversal portions 80 are provided may be provided.

[0139] For example, in a case where two reversal portions 80 are provided, one is formed to have a thickness and inclination angle  $\theta$  that are reversed at the upper limit value of the appropriate brushing load, and the other is formed to have a thickness and inclination angle  $\theta$  that are reversed at the lower limit value of the appropriate brushing load. Therefore, it is possible to easily define both the upper limit value and the lower limit value of the brushing load.

[0140] In addition, although the configuration in which the reversal portion 80 is reversed in the thickness direction is illustrated in the above embodiment, the invention is not limited to this configuration. For example, the reversal portion 80 may be configured to be reversed in the width direction, or in a diagonal direction orthogonal to the long axis direction and intersecting the width direction and the thickness direction. By adopting a configuration in which the reversal portion 80 is reversed in the diagonal direction, it is possible to sense over-brushing during brushing by a rolling method.

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[Industrial Applicability]

[0141] The present invention can be applied to a toothbrush.

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[Reference Signs List]

[0142]

15 1: Toothbrush  
2: Handle body  
10: Head portion  
11: Bristle tufting surface  
20: Neck portion  
20 30: Grip portion  
70: Sensing portion  
80: Reversal portion  
81, 82: Groove portion  
E, 31E, 32E: Soft portion  
25 H: Hard portion  
K: Through-hole  
S: Gap

30 **Claims**

1. A toothbrush comprising:

35 a head portion provided on a tip end side in a long axis direction and having a bristle tufting surface;  
a grip portion disposed on a rear end side from the head portion; and  
a neck portion disposed between the bristle tufting surface and the grip portion,  
wherein a sensing portion for sensing that an external force in a first direction orthogonal to the bristle tufting surface exceeds a predetermined value is provided on a rear end side from the bristle tufting surface,  
the sensing portion  
40 changes a relationship between a displacement amount of the head portion when a load is applied to the head portion in the first direction toward a back surface side opposite to the bristle tufting surface and a repulsive force generated according to the displacement amount from an increase to a decrease in the repulsive force at a first threshold value according to an increase in the displacement amount, and  
stops the decrease in the repulsive force at a second threshold value where the displacement amount is larger  
45 than the first threshold value, and  
when the repulsive force when the displacement amount is at the first threshold value is A, and the repulsive force when the displacement amount is at the second threshold value is B,  
a value represented by  $B/A$  is 0.3 or more and 0.9 or less.

50 2. The toothbrush according to Claim 1,

wherein the repulsive force A is 1.0 N or more and 5.0 N or less.

3. The toothbrush according to Claim 1 or 2,

55 wherein, when the displacement amount at the first threshold value is C and the displacement amount at the second threshold value is D,  
a value represented by  $D - C$  is 0 mm or more and 1.5 mm or less.

4. The toothbrush according to Claim 3,  
wherein the displacement amount C is 28 mm or less.

5. The toothbrush according to any one of Claims 1 to 4, wherein, when the displacement amount exceeds the second threshold value, the sensing portion causes the repulsive force to increase according to the increase in the displacement amount.

6. The toothbrush according to Claim 5,  
wherein, starting from the displacement amount at the second threshold value, a rate of increase in the repulsive force until the displacement amount of the head portion reaches 4 mm is 0.015 or more.

10. The toothbrush according to any one of Claims 1 to 6,  
wherein, in the sensing portion,  
when a load is applied to the back surface side to stop at least the decrease in the repulsive force and thereafter the load is released, a relationship between the displacement amount and the repulsive force after the release remains the same as before the load is applied.

15. The toothbrush according to any one of Claims 1 to 7,  
wherein the sensing portion includes  
a reversal portion that connects a first region on the tip end side from the sensing portion and a second region on the rear end side from the sensing portion, and that snaps, buckles, and reverses as the head portion is displaced to the back surface side opposite to the bristle tufting surface in the first direction due to the external force exceeding the threshold value, and  
20. an elastic deformation portion that is disposed with a gap from the reversal portion, connects the first region and the second region, and elastically deforms at least up to the external force at which the reversal portion snaps, buckles, and reverses, and  
25. the reversal portion is located between an outer contour on the bristle tufting surface side and an outer contour on the back surface side in the elastic deformation portion in a side view viewed in a direction orthogonal to the long axis direction and the first direction.

30. The toothbrush according to Claim 8,  
wherein a path where the elastic deformation portion is deformed due to the external force in the first direction and a path where the reversal portion is deformed due to the external force in the first direction are provided in a non-interfering manner.

35. The toothbrush according to Claim 8 or 9,  
wherein the elastic deformation portion and the reversal portion are disposed with a gap in a second direction orthogonal to the first direction and the long axis direction.

40. The toothbrush according to Claim 10,  
wherein the gap is a through-hole extending in the first direction.

45. The toothbrush according to Claim 10 or 11,  
wherein the reversal portion has a protrusion shape toward the back surface side when the external force in the first direction is equal to or less than the predetermined value, and is reversed in a protrusion shape toward the bristle tufting surface side when the external force in the first direction exceeds the predetermined value.

50. The toothbrush according to Claim 12,  
wherein the reversal portion includes a groove portion extending in the second direction on at least one of the bristle tufting surface side and the back surface side in a region including an apex of the protrusion shape.

55. The toothbrush according to any one of Claims 8 to 13,  
wherein the reversal portion is made of a hard resin, and  
a portion of the elastic deformation portion is made of a resin having a hardness different from that of the hard resin.

FIG. 1

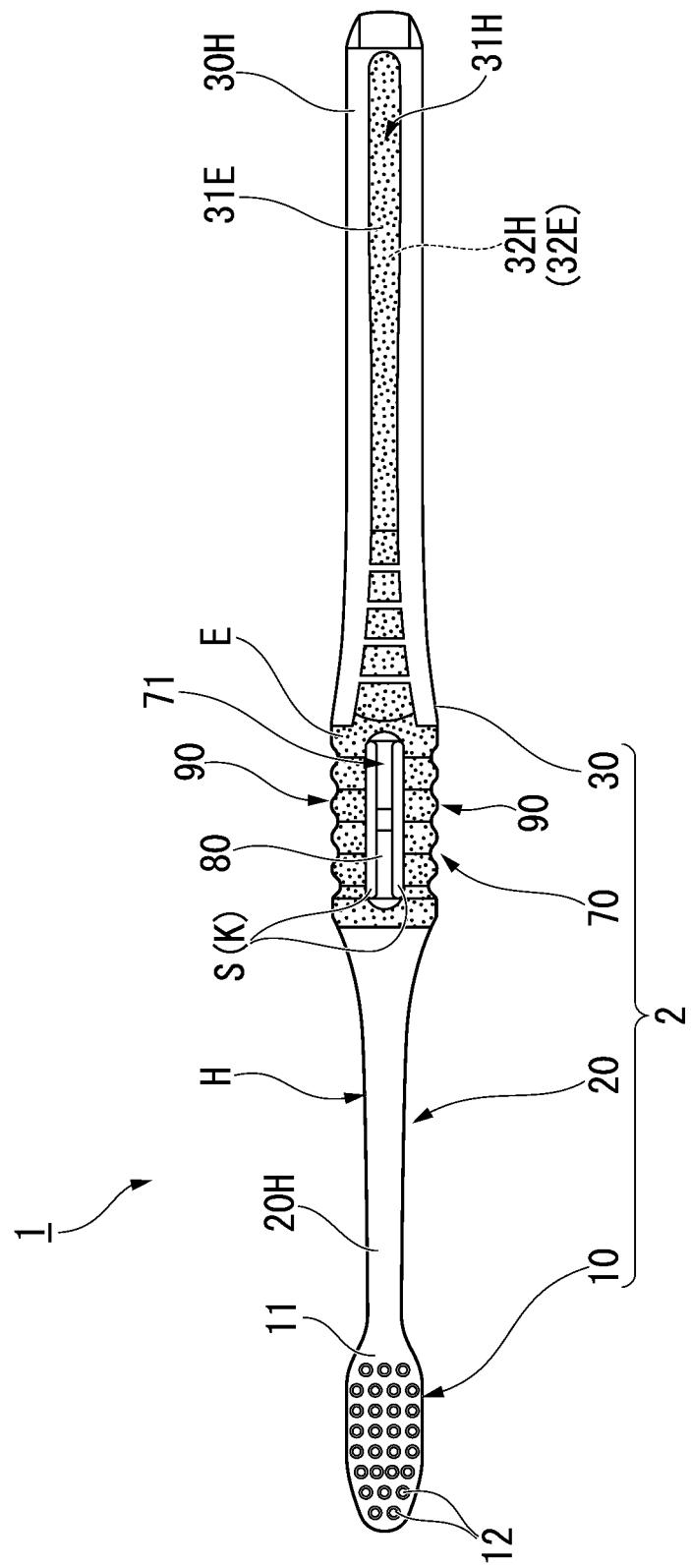


FIG. 2  
1

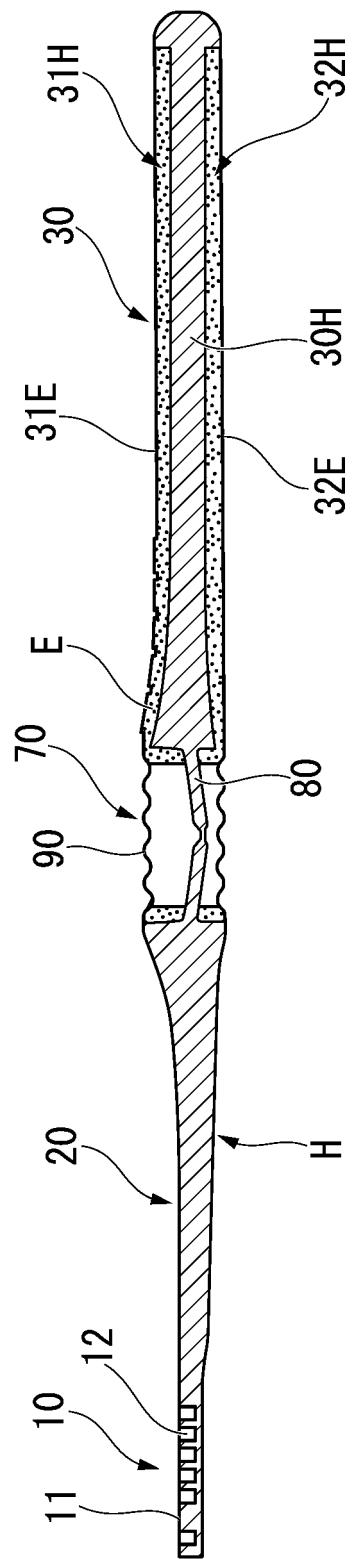


FIG. 3

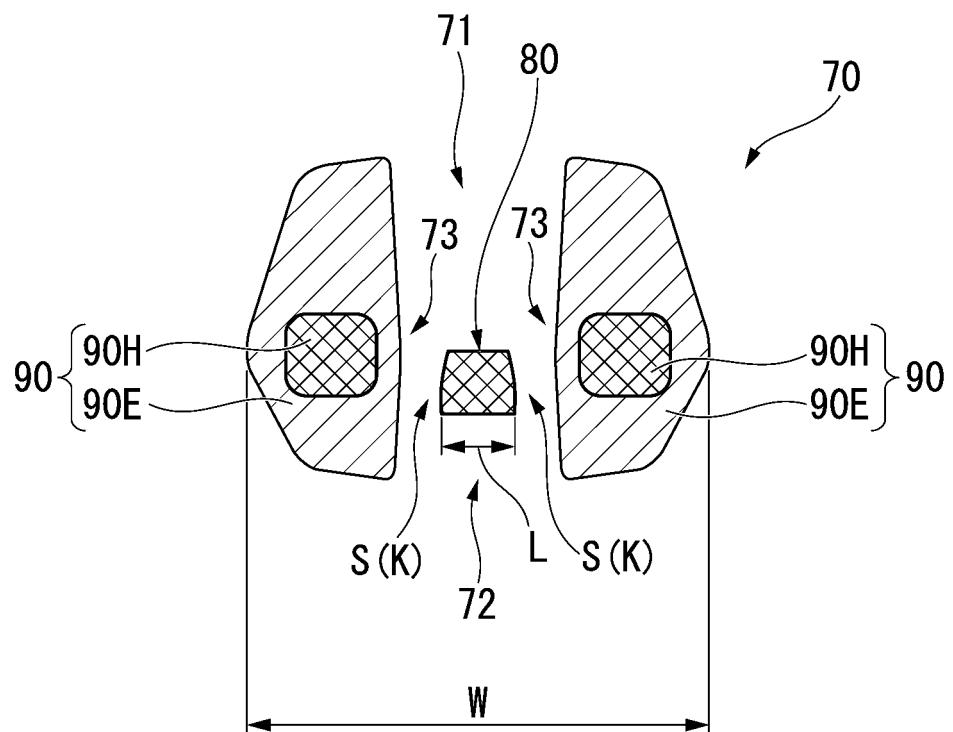


FIG. 4

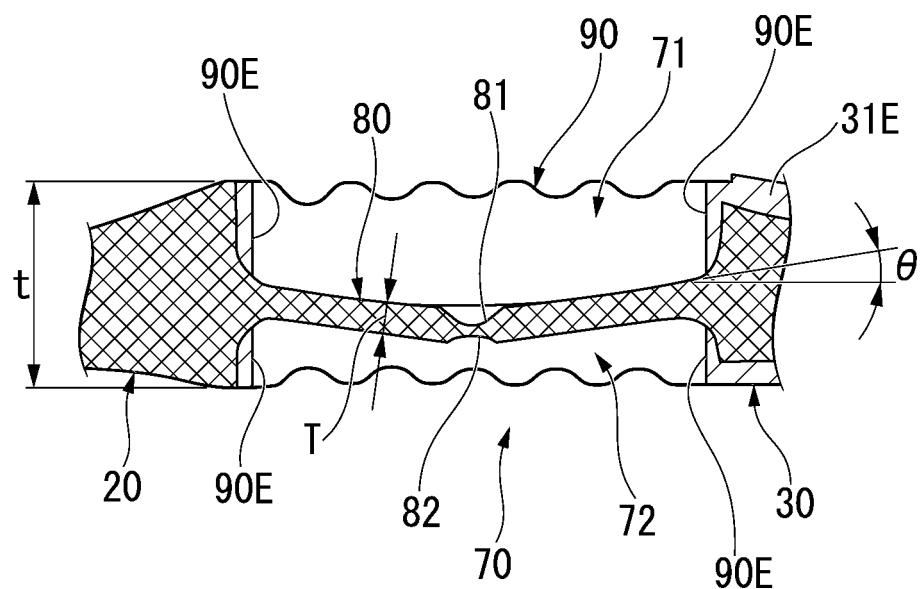


FIG. 5

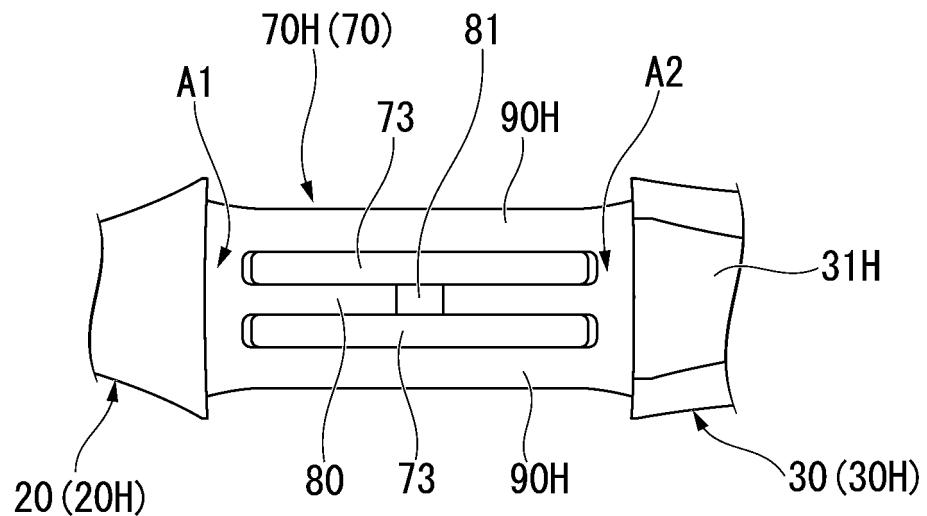


FIG. 6

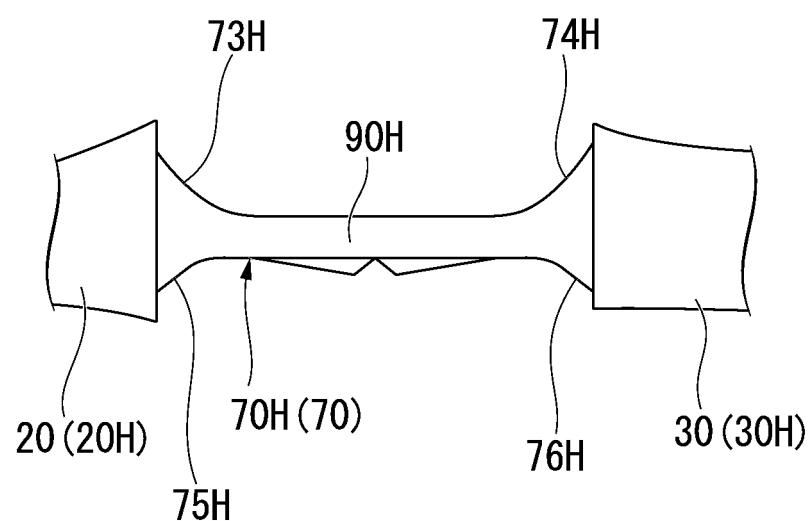


FIG. 7

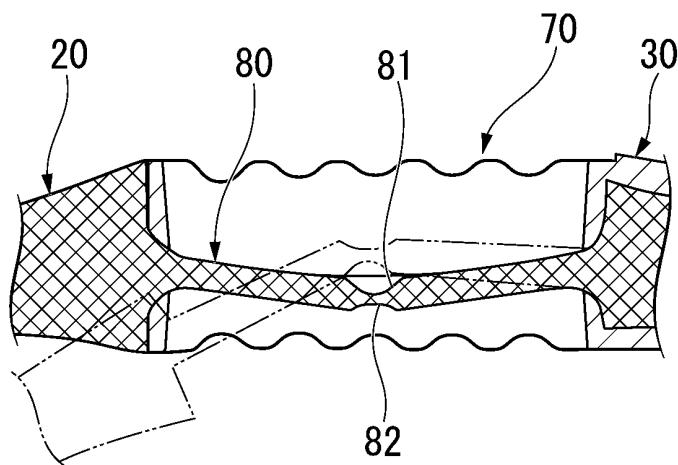


FIG. 8

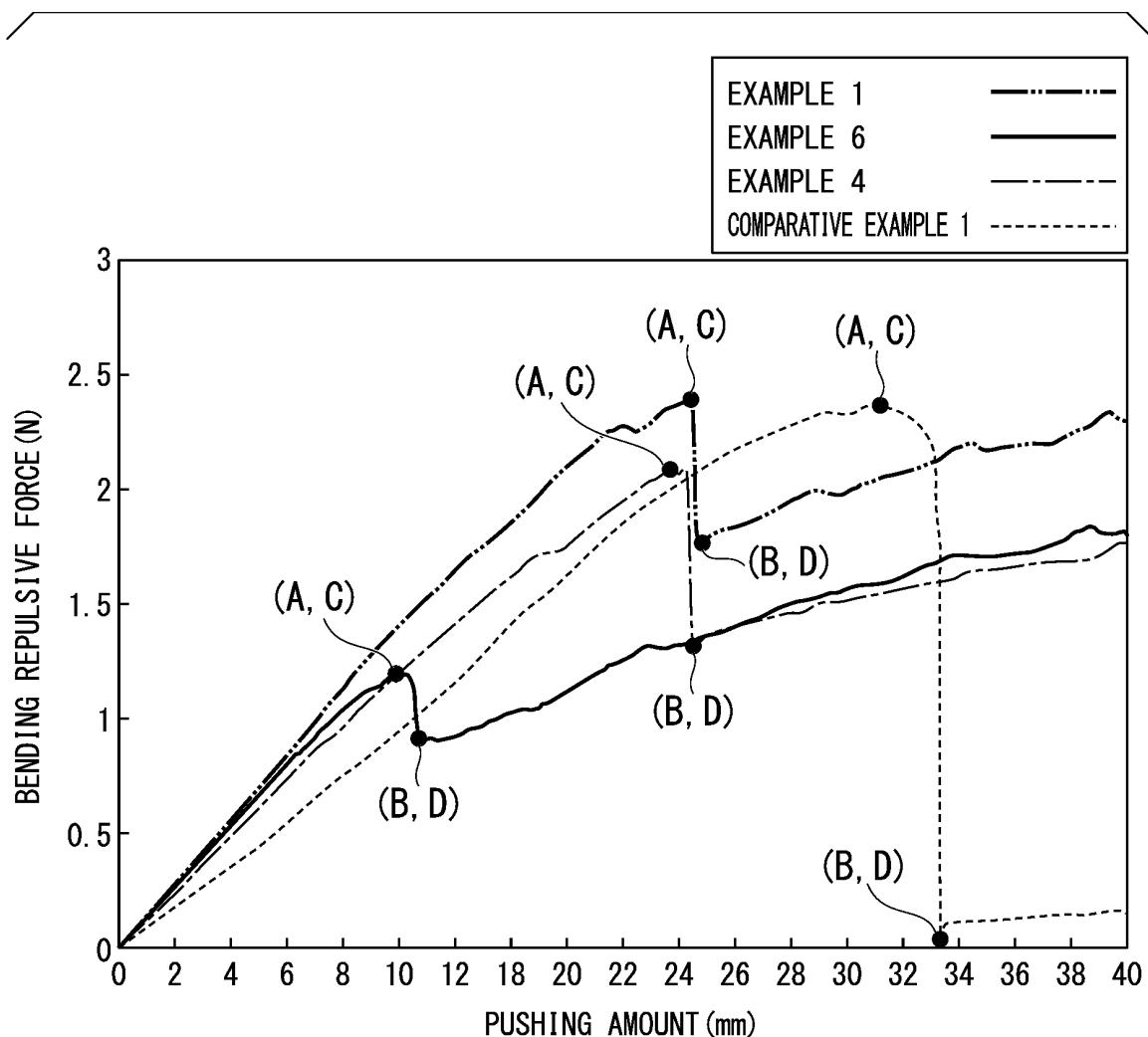
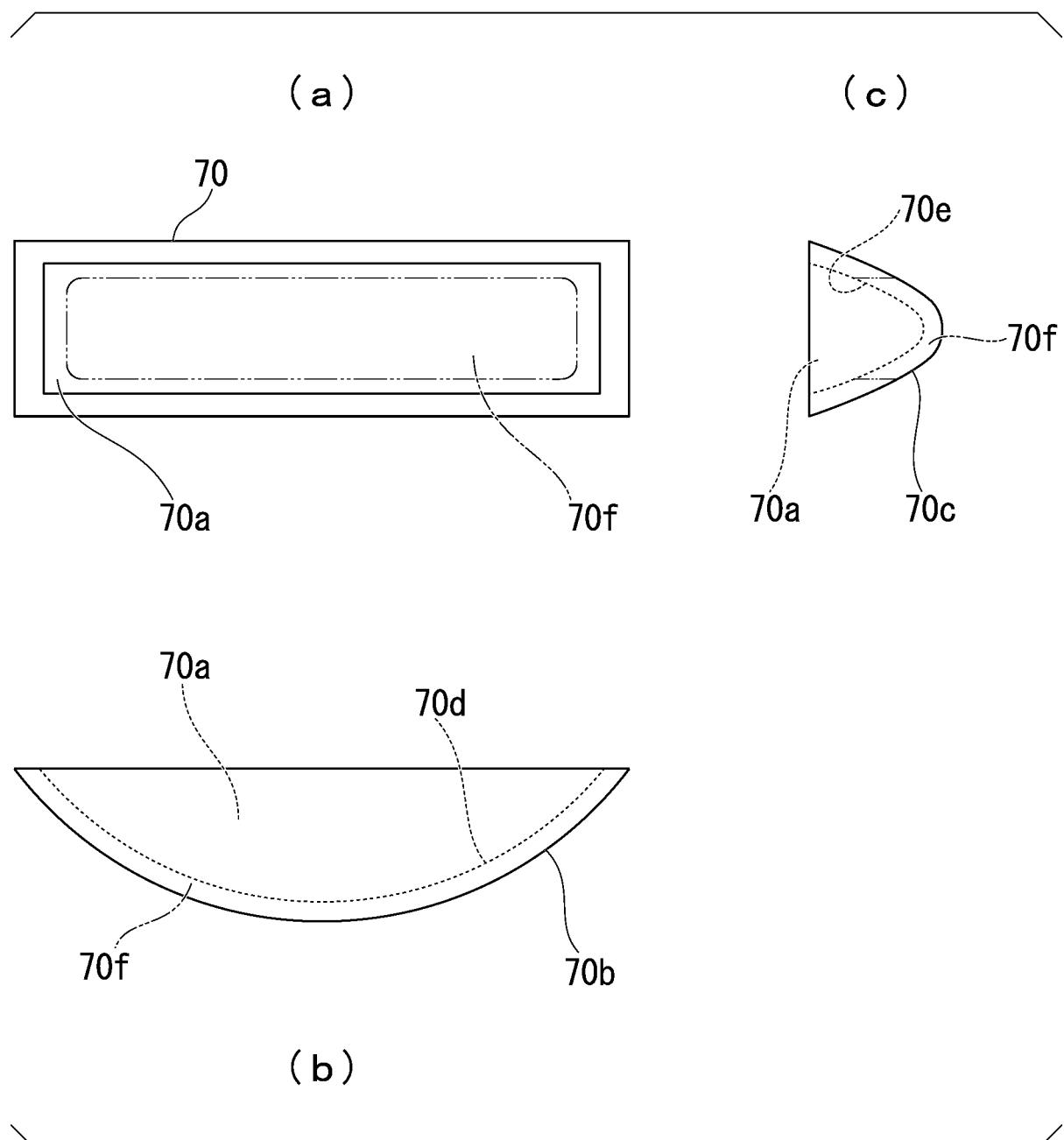


FIG. 9



| INTERNATIONAL SEARCH REPORT |   | International application No.<br>PCT/JP2019/051103                               |           |  |                       |   |  |         |   |                    |              |   |   |              |   |  |      |
|-----------------------------|---|--|-----------|--|-----------------------|---|--|---------|---|--------------------|--------------|---|---|--------------|---|--|------|
| 5                           | <b>A. CLASSIFICATION OF SUBJECT MATTER</b><br>A46B 5/00 (2006.01)i; A46B 7/06 (2006.01)i<br>FI: A46B5/00 C; A46B7/06  |  |           |  |                       |   |  |         |   |                    |              |   |   |              |   |  |      |
| 10                          | According to International Patent Classification (IPC) or to both national classification and IPC   |  |           |  |                       |   |  |         |   |                    |              |   |   |              |   |  |      |
| 15                          | <b>B. FIELDS SEARCHED</b><br>Minimum documentation searched (classification system followed by classification symbols)<br>A46B5/00; A46B7/06  |  |           |  |                       |   |  |         |   |                    |              |   |   |              |   |  |      |
| 20                          | Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched<br>Published examined utility model applications of Japan 1922-1996<br>Published unexamined utility model applications of Japan 1971-2020<br>Registered utility model specifications of Japan 1996-2020<br>Published registered utility model applications of Japan 1994-2020   |  |           |  |                       |   |  |         |   |                    |              |   |   |              |   |  |      |
| 25                          | Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  |  |           |  |                       |   |  |         |   |                    |              |   |   |              |   |  |      |
| 30                          | <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; padding: 2px;">Category*</th> <th style="text-align: left; padding: 2px;">Citation of document, with indication, where appropriate, of the relevant passages</th> <th style="text-align: left; padding: 2px;">Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; padding: 2px;">X</td> <td style="padding: 2px;">JP 6-504937 A (THE PROCTER &amp; GAMBLE CO.)<br/>09.06.1994 (1994-06-09) pp. 4-7, fig. 1-12</td> <td style="text-align: center; padding: 2px;">1, 5, 7</td> </tr> <tr> <td style="text-align: center; padding: 2px;">Y</td> <td style="padding: 2px;">pp. 4-7, fig. 1-12</td> <td style="text-align: center; padding: 2px;">2-4, 6, 8-14</td> </tr> <tr> <td style="text-align: center; padding: 2px;">Y</td> <td style="padding: 2px;">US 2014/0020198 A1 (SLOCUM, T. Jonathan)<br/>23.01.2014 (2014-01-23) paragraphs [0026], [0029], fig. 1-2</td> <td style="text-align: center; padding: 2px;">2-4, 6, 8-14</td> </tr> <tr> <td style="text-align: center; padding: 2px;">Y</td> <td style="padding: 2px;">WO 01/21035 A1 (PLACONTROL, INC.) 29.03.2001<br/>(2001-03-29) pp. 5, 8, 13-14, 22-23, fig. 1-4, 42-43</td> <td style="text-align: center; padding: 2px;">8-14</td> </tr> </tbody> </table> |  | Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. | X | JP 6-504937 A (THE PROCTER & GAMBLE CO.)<br>09.06.1994 (1994-06-09) pp. 4-7, fig. 1-12 | 1, 5, 7 | Y | pp. 4-7, fig. 1-12 | 2-4, 6, 8-14 | Y | US 2014/0020198 A1 (SLOCUM, T. Jonathan)<br>23.01.2014 (2014-01-23) paragraphs [0026], [0029], fig. 1-2 | 2-4, 6, 8-14 | Y | WO 01/21035 A1 (PLACONTROL, INC.) 29.03.2001<br>(2001-03-29) pp. 5, 8, 13-14, 22-23, fig. 1-4, 42-43 | 8-14 |
| Category*                   | Citation of document, with indication, where appropriate, of the relevant passages  | Relevant to claim No.  |           |  |                       |   |  |         |   |                    |              |   |   |              |   |  |      |
| X                           | JP 6-504937 A (THE PROCTER & GAMBLE CO.)<br>09.06.1994 (1994-06-09) pp. 4-7, fig. 1-12  | 1, 5, 7  |           |  |                       |   |  |         |   |                    |              |   |   |              |   |  |      |
| Y                           | pp. 4-7, fig. 1-12  | 2-4, 6, 8-14   |           |  |                       |   |  |         |   |                    |              |   |   |              |   |  |      |
| Y                           | US 2014/0020198 A1 (SLOCUM, T. Jonathan)<br>23.01.2014 (2014-01-23) paragraphs [0026], [0029], fig. 1-2   | 2-4, 6, 8-14   |           |  |                       |   |  |         |   |                    |              |   |   |              |   |  |      |
| Y                           | WO 01/21035 A1 (PLACONTROL, INC.) 29.03.2001<br>(2001-03-29) pp. 5, 8, 13-14, 22-23, fig. 1-4, 42-43  | 8-14   |           |  |                       |   |  |         |   |                    |              |   |   |              |   |  |      |
| 35                          |   |  |           |  |                       |   |  |         |   |                    |              |   |   |              |   |  |      |
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| 50                          | Date of the actual completion of the international search<br>11 March 2020 (11.03.2020)   | Date of mailing of the international search report<br>24 March 2020 (24.03.2020) |           |  |                       |   |  |         |   |                    |              |   |   |              |   |  |      |
| 55                          | Name and mailing address of the ISA/<br>Japan Patent Office<br>3-4-3, Kasumigaseki, Chiyoda-ku,<br>Tokyo 100-8915, Japan  | Authorized officer<br><br>Telephone No.  |           |  |                       |   |  |         |   |                    |              |   |   |              |   |  |      |

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