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(54) **TOOTHBRUSH**

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(57) **ABSTRACT**

A toothbrush comprises bristle supporting elements in the head region thereof. The bristle supporting elements are arranged in an elastic manner relative to the neck region and in a bendable and twistable manner relative to one another by a foil-type hard film. Preferably, the foil-type hard film externally extends in a flush fashion around a top opening of the bristle supporting element.

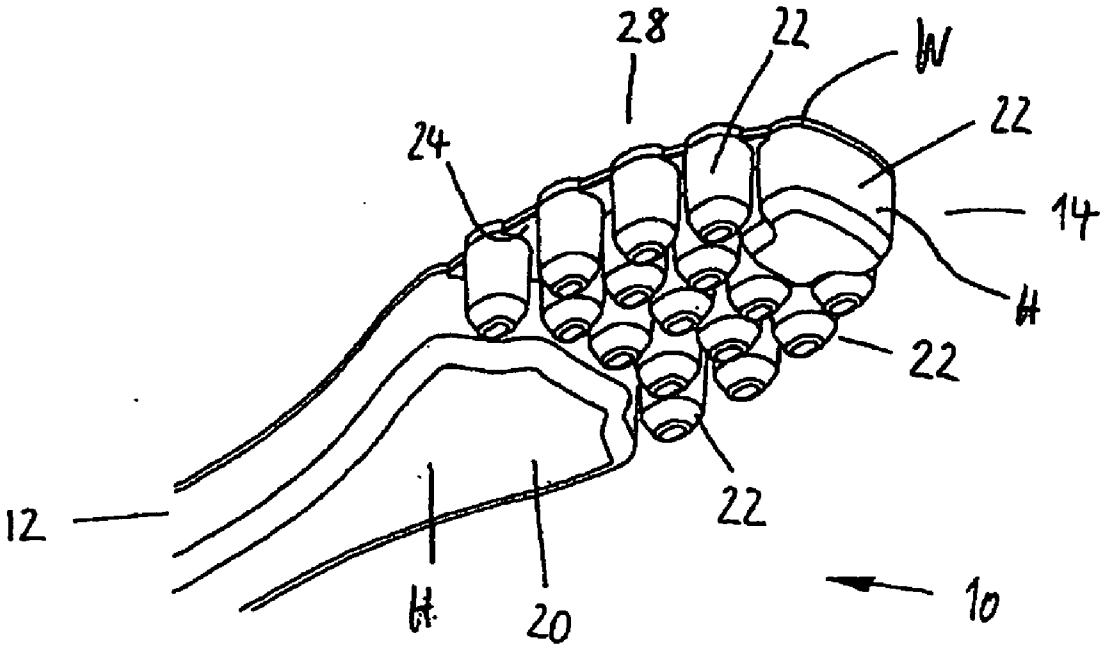


Fig. 1

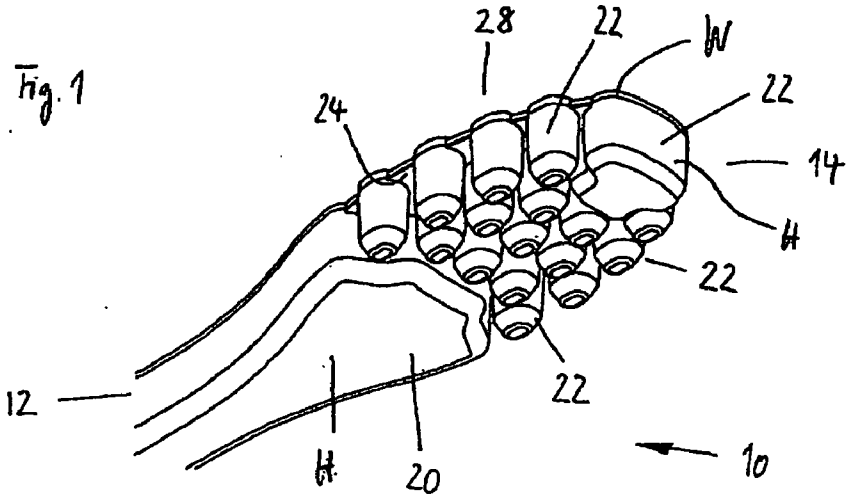


Fig. 2

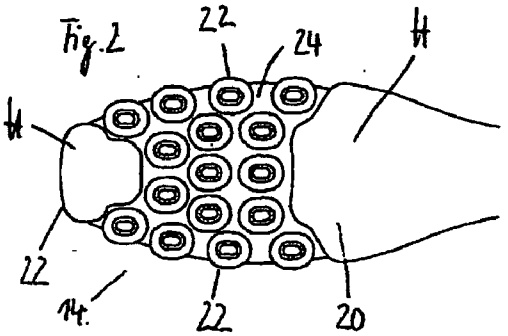
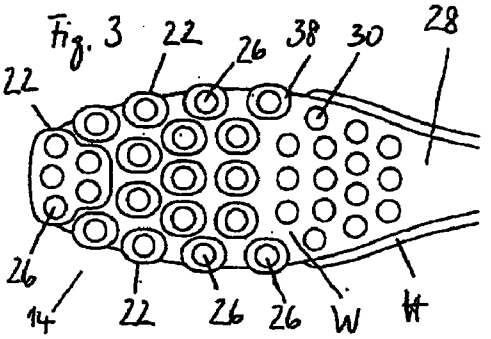


Fig. 3



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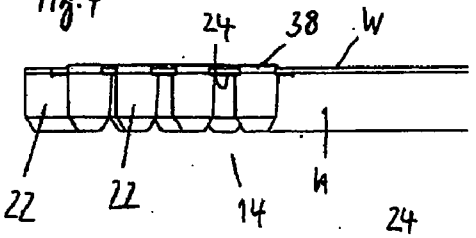
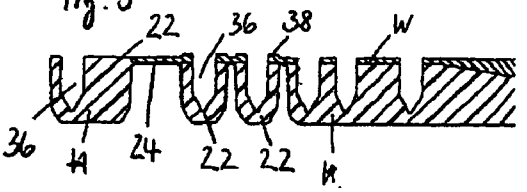


Fig. 5



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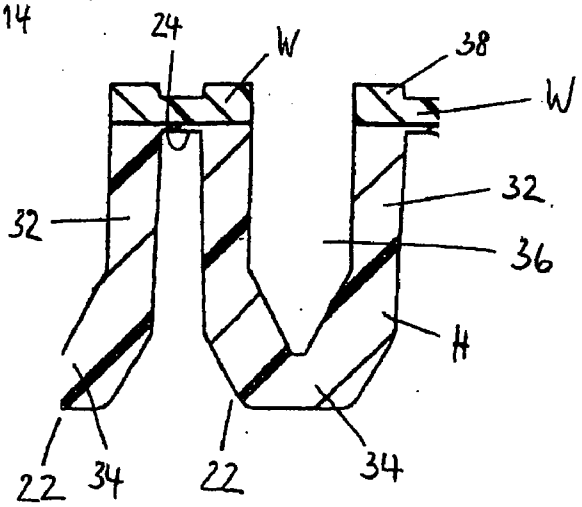

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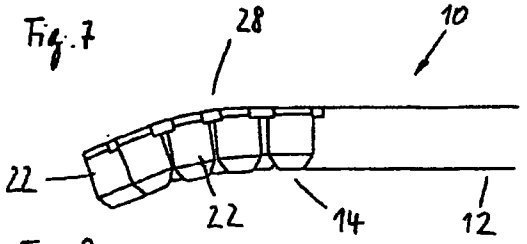

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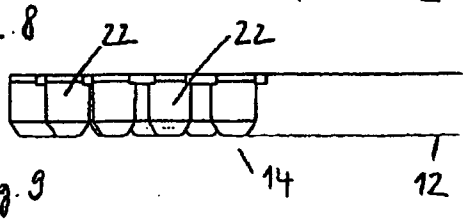

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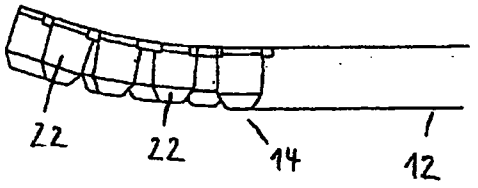

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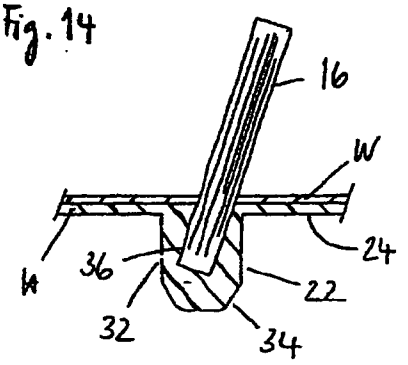

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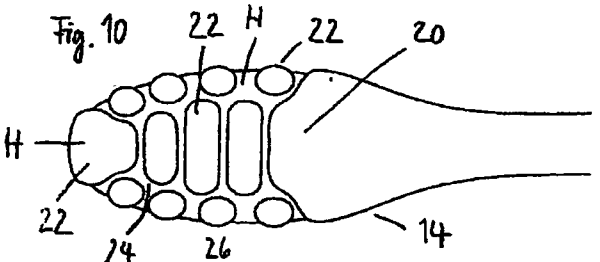

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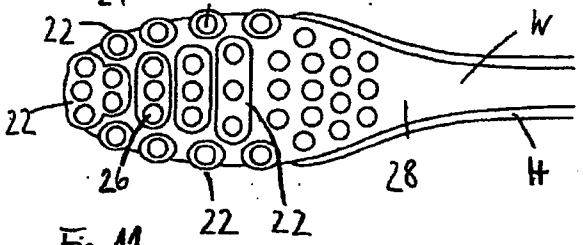

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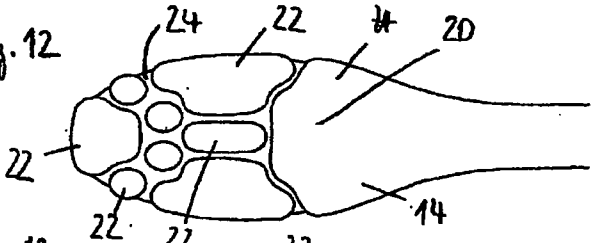

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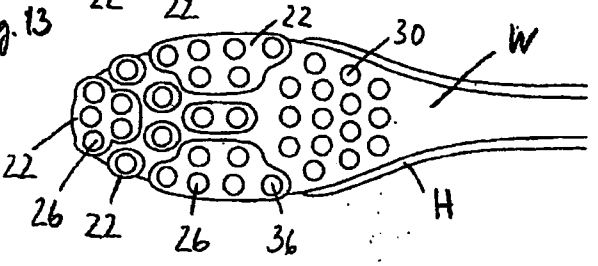

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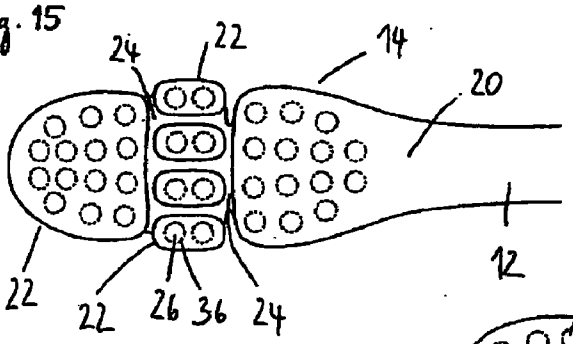

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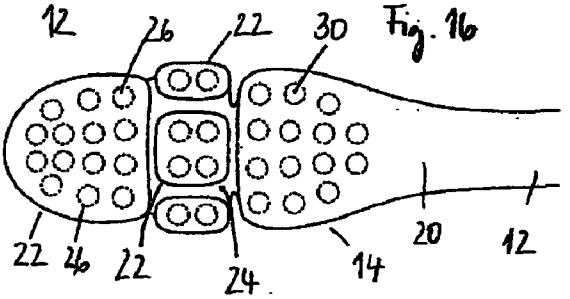

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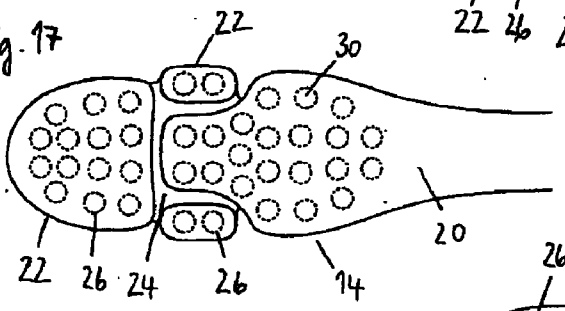

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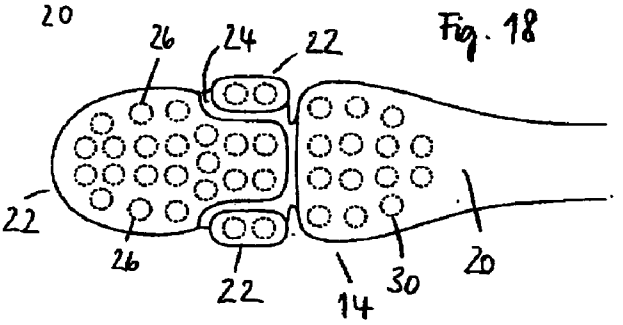

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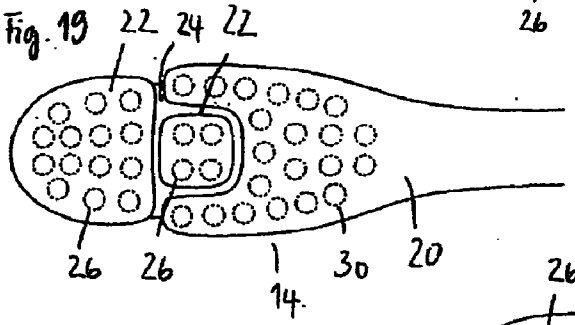

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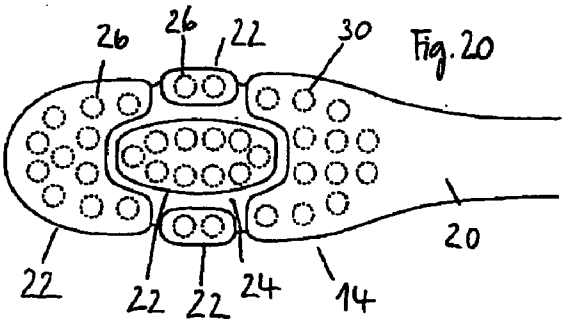

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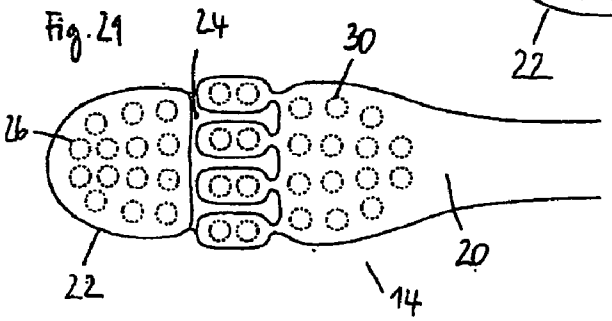

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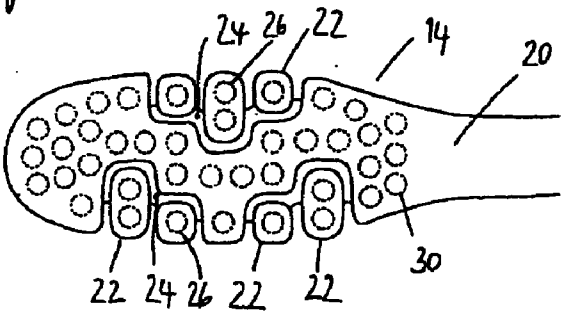

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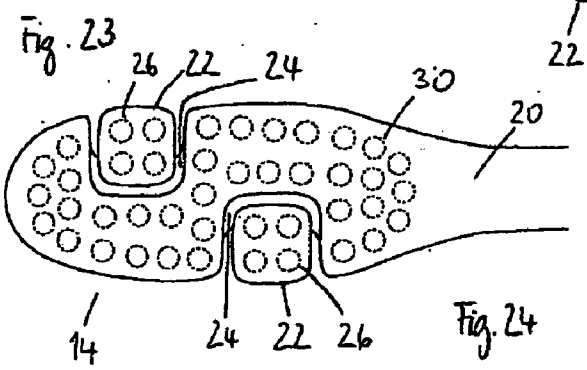

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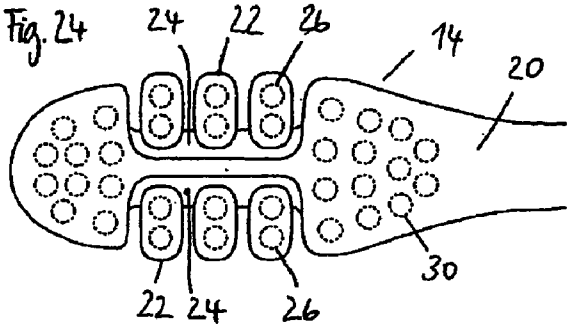

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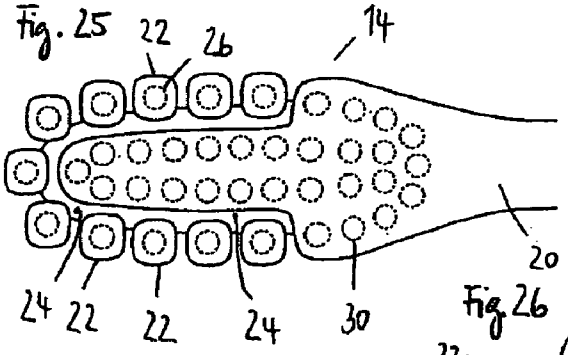

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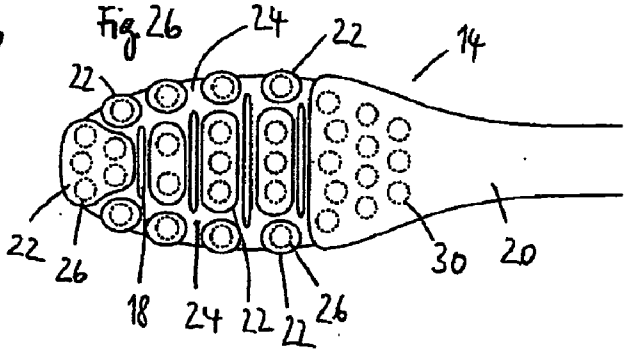

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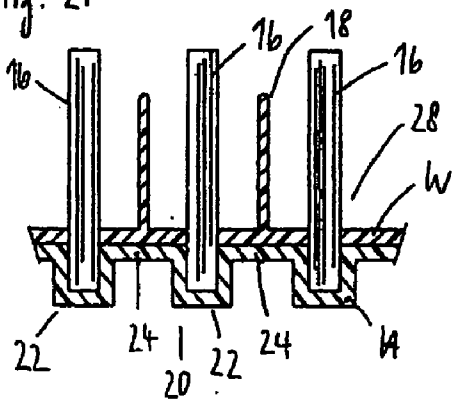

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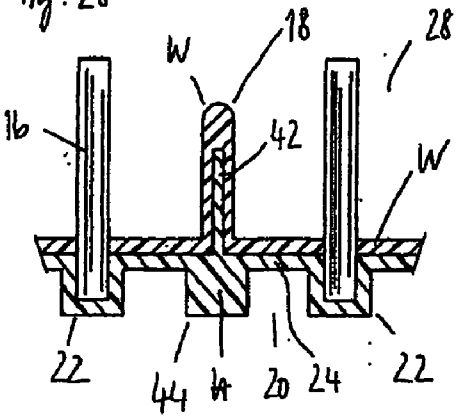

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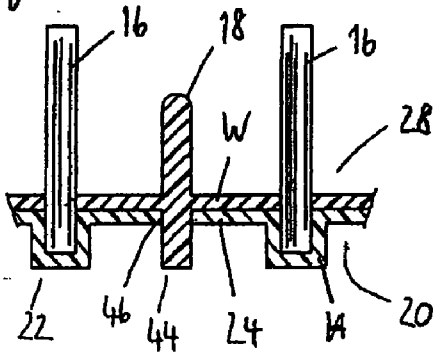

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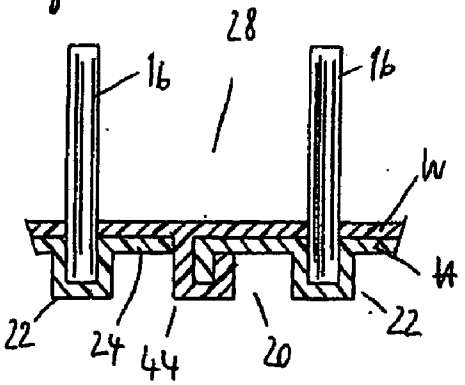

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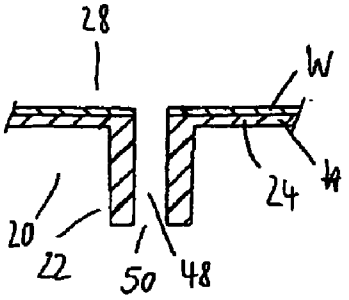

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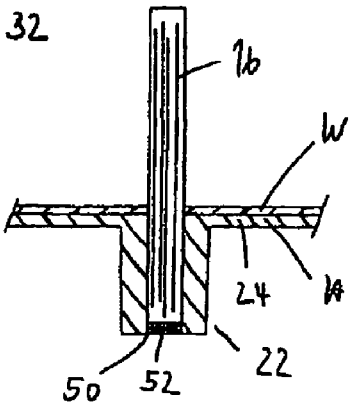

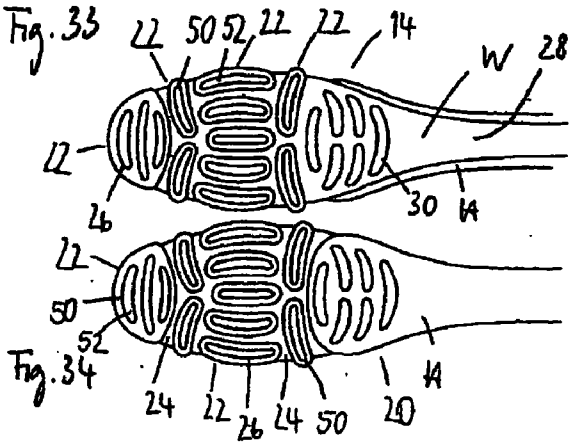
Fig. 33
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Fig. 34
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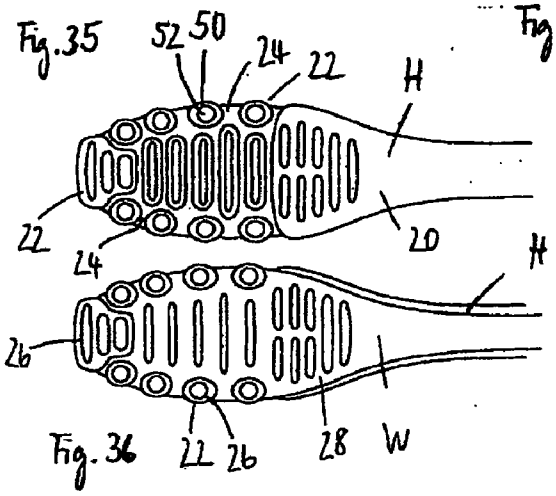
Fig. 35
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Fig. 36
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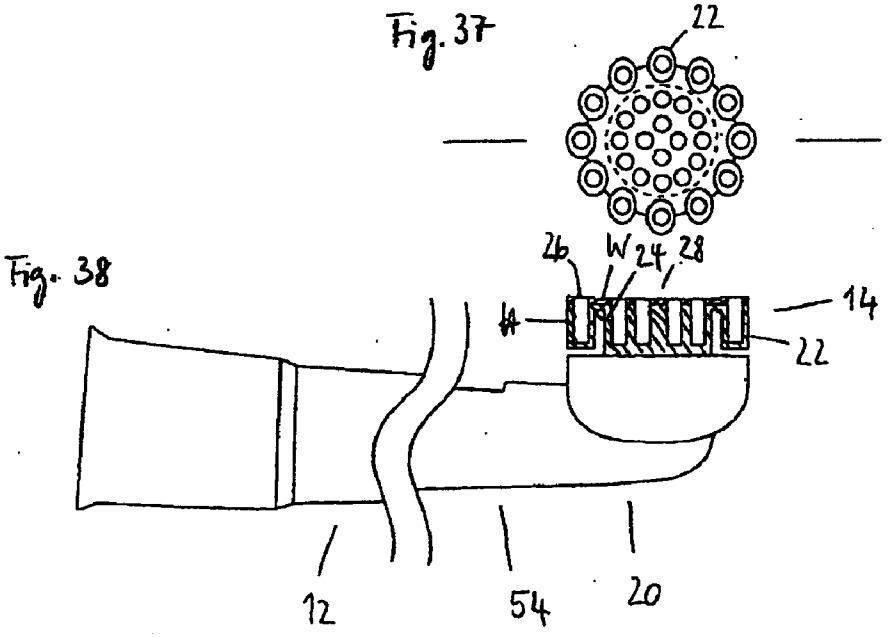
Fig. 37
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Fig. 38
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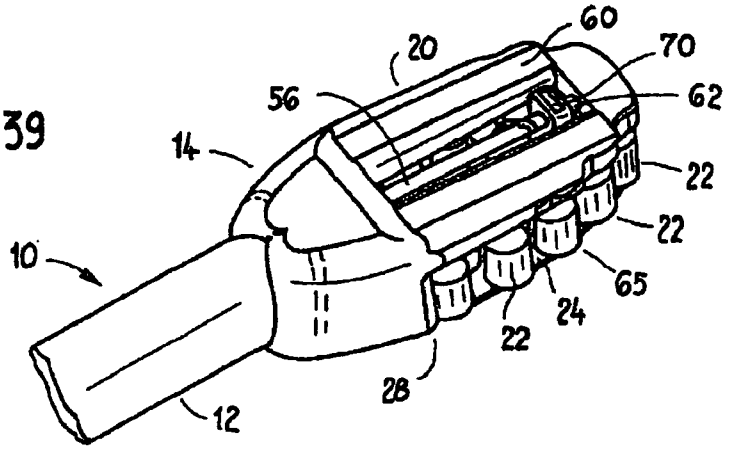
Fig.39



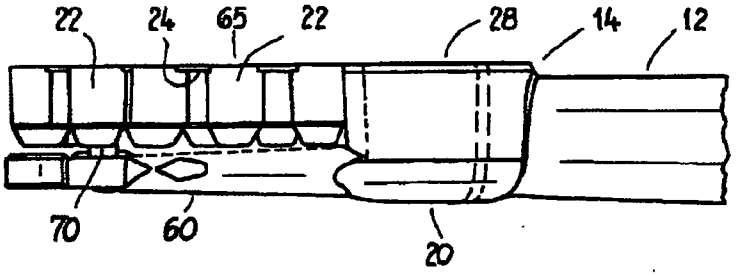
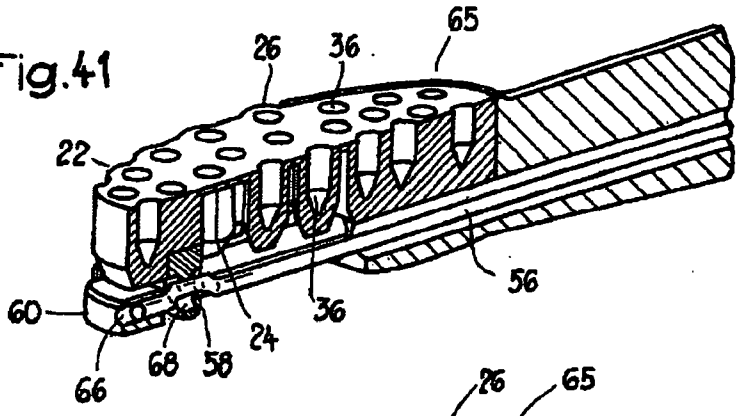


Fig.40

Fig.41



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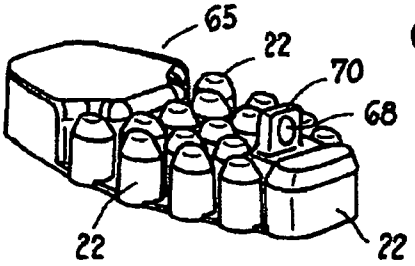


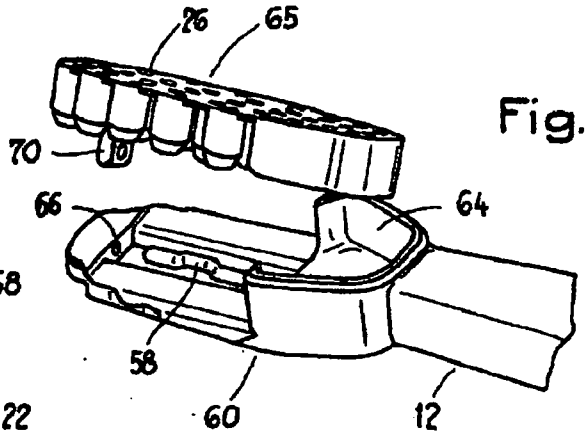


Fig.43

Fig. 44

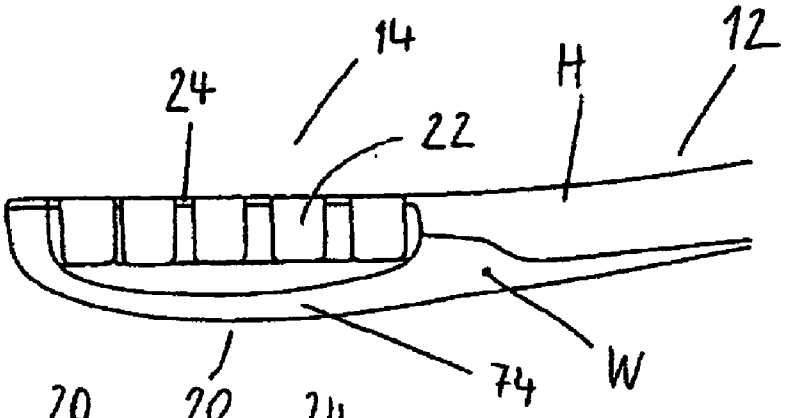
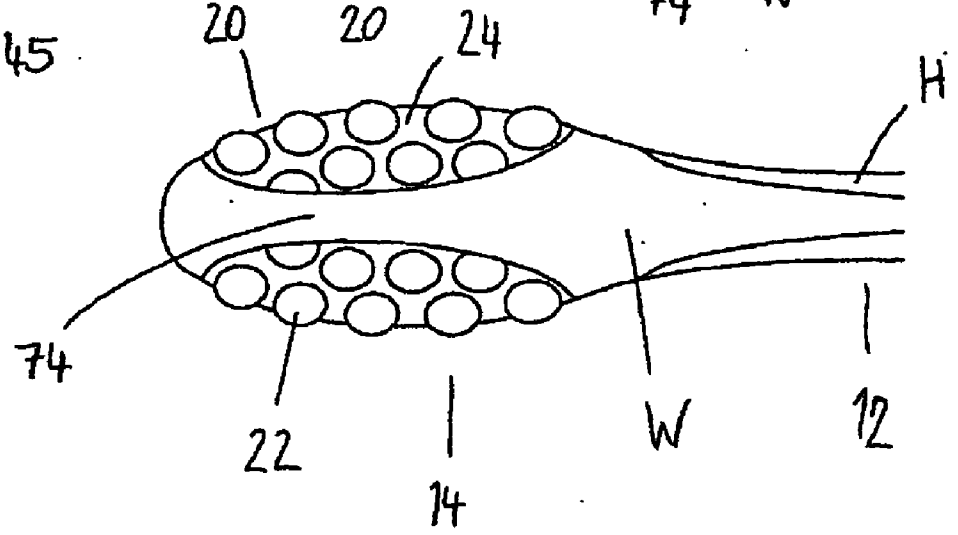


Fig. 45



TOOTHBRUSH

[0001] The present invention relates to a toothbrush according to the preamble of claim **1** and to a method for producing it according to claim **27**.

[0002] Toothbrushes are instruments, generally known in oral hygiene, for the cleaning and care of teeth and also further surfaces of the oral cavity. A toothbrush is disclosed, for example, in FR 2652245. This toothbrush has in its head region bristle carrier elements which are intended for the reception of bristles and which are connected to one another on a bristle-tufted top side at portions which are in each case contiguous to one another. The connection of the individual bristle carrier elements in the toothbrush head region leads to the formation of a bending line which extends rectilinearly over the entire width of its head region and about which the bristle carrier elements can be angled elastically.

[0003] A further toothbrush is described in DE-U-200 13 862. In this, bristles of the toothbrush are fastened in blind-hole-like recesses of a head basic body. The head basic body itself is injection-molded around it completely on a bristle-remote underside with an elastic material as supporting body.

[0004] A brush in which bristles combined into bristle bundles can be angled or deflected elastically with respect to one another is described in U.S. Pat. No. 3,000,030. The bristle bundles arranged rectilinearly one behind the other in a row form comb-like brush segments which are connected to one another via elastic webs. On account of the elastic webs, it is possible to angle the brush segments elastically with respect to one another.

[0005] A further toothbrush is disclosed, for example, in EP-B-0 857 026. The head of the toothbrush in this case forms a bristle carrier for receiving the bristles which are likewise combined into bristle bundles. The fastening-side ends of the bristle bundles have head-like thickenings which are obtained by the melting of the bristle ends. The fastened ends of the bristle bundles are seated with these head-like thickenings in elastic bearings which are mounted in holes of a hole plate and project beyond the rear side of the latter. By means of a rotary knob, an adjusting plate arranged behind the elastic bearings can be varied in its position, such that an elastic deflection of the elastic bearings is restricted to a greater or lesser extent, depending on the set position of said adjusting plate.

[0006] The object of the present invention is to provide a toothbrush with a head region which can be adapted elastically to specific surface shapes in the oral cavity, to different cleaning positions of the toothbrush and also to different actions of force by a user upon the toothbrush and which at the same time allows a particularly cost-effective manufacture of the toothbrush.

[0007] This object is achieved by means of a toothbrush according to patent claim **1** and a production method for the toothbrush according to claim **27**. Particularly preferred embodiments are furnished with the features listed in the dependent claims.

[0008] The toothbrush according to the invention has a grip region and a neck region which is contiguous to the grip region and which carries, opposite the grip region, a head region. In the head region, at least one bristle carrier element is arranged, to which bristles or bristles combined into bristle bundles are fastened. In this case, the bristles or bristle bundles emerge from at least one upper carrier element orifice on the top side of the bristle carrier element.

[0009] According to the invention, the bristle carrier element is connected elastically to the neck region by means of a sheet-like hard film consisting of a hard material and can thereby be deflected elastically with respect to said neck region. The sheet-like hard film extends at least in portions, flush on the outside, around the upper carrier element orifice. By the bristle carrier element thereby being incorporated elastically into the head region, the latter is fastened so as to be capable of being angled in virtually any direction or of being rotated about at least virtually any axis.

[0010] It is, of course, possible to arrange a plurality of carrier elements elastically in the head region via the sheet-like hard film. Preferably, the sheet-like hard film has a very low thickness, in particular a thickness which is very much lower than a length and also substantially lower than the wall thickness of the bristle carrier element. What is thereby achieved, on the one hand, is that the bristle carrier elements have sufficient rigidity and toughness for bristle anchoring, and on the other hand, that the bristle carrier elements can be moved elastically with respect to one another.

[0011] In a particularly preferred embodiment the bristle carrier element and the sheet-like hard film are produced from one and the same hard material in one operation and starting from the same injection-molding point. Furthermore, it is particularly advantageous if the sheet-like hard film is covered on its top side with a layer consisting of a soft material. As a result, the elasticity properties or the return of the sheet-like hard film can be improved or set. The risk of a local weakening of the sheet-like hard film along a bending line, even after a large number of actions involving the angling of the bristle carrier elements, is greatly reduced. Preferably, the layer consisting of soft material is applied by means of injection molding after the formation of the sheet-like hard film and of the bristle carrier elements.

[0012] In an alternative design variant, the elasticity properties or the return of the brush head is improved or set by means of a material bridge which, for example, runs from the free end region of said brush head to the neck region and consists of soft material and which is spaced apart from the bristle carrier elements.

[0013] When the toothbrush according to the invention is produced in an injection-molding method, a very high injection-molding pressure of more than 800 bar, preferably of between 1000 and 1500 bar, is used, in order to ensure a full and correct formation of the sheet-like hard film and of the bristle carrier elements. Normally, for toothbrushes with corresponding cross sections, polypropylene is processed at an injection-molding pressure of 500 bar to 750 bar. The relatively high injection-molding pressure is also decisively responsible for the fact that the sheet-like hard film with the desired specific sheet-like properties or dimensions and the bristle carrier elements, somewhat bulky in comparison with the thin hard film, and, if need be, other regions of the toothbrush grip can be formed in one operation, using the same processing parameters. By the preferred injection-molding method being employed, and, at the same time, due to the relatively simple set-up of the head region, the production process for producing the toothbrush can be largely automated and entails relatively low production costs, even though highly specific parameters or machine settings are necessary.

[0014] Of course, the design according to the invention of the head region, with bristle carrier elements and with a sheet-like hard film, of toothbrushes can also be transferred to electric toothbrushes, for example with oscillating, pivoting or vibrating heads, to mascara brushes, nail varnish brushes, hairbrushes and other body care brushes. Use in domestic brushes, for example in wash-off brushes, wiper sets, shoe brushes, scrubbers, brooms or grill brushes, is also possible.

[0015] Particularly preferred embodiments of the toothbrush according to the invention are described in detail below with reference to the drawing in which in particular, purely diagrammatically,

[0016] FIG. **1** shows a perspective view of a portion of the underside of a toothbrush according to the invention with a plurality of bristle carrier elements which are arranged in a head region and which are connected to a neck region of the toothbrush via a sheet-like hard film; the bristles to be received by the bristle carrier elements are not shown;

[0017] FIG. **2** shows a top view of the underside of the head region of the toothbrush shown in FIG. **1**;

[0018] FIG. **3** shows a top view of a top side of the head region, shown in FIG. **1** and FIG. **2**, of the toothbrush, without the bristles being illustrated;

[0019] FIG. **4** shows a side view of the head region of the toothbrush shown in FIG. **1**-FIG. **3**, without the bristles being illustrated;

[0020] FIG. **5** shows a sectional illustration of the head region, shown in FIG. **1**-FIG. **4**, of a toothbrush according to the invention, without the bristles being illustrated;

[0021] FIG. **6** shows an enlarged sectional illustration of a portion of the head region, shown in FIG. **1**-FIG. **5**, of a toothbrush, without the bristles being illustrated;

[0022] FIG. **7** shows a side view of the head region, shown in FIG. **1**-FIG. **6**, of a toothbrush according to the invention, without the bristles being illustrated, in the case of maximum angling on account of a force acting on the free end region of the head region in the direction of the underside of the toothbrush;

[0023] FIG. **8** shows a side view of the head region, shown in FIG. **1**-FIG. **7**, of a toothbrush according to the invention, without the bristles being illustrated, in the case of its orientation in an injection-molding die, not illustrated;

[0024] FIG. **9** shows a side view of the head region, shown in FIG. **1**-FIG. **8**, of a toothbrush according to the invention, without the bristles being illustrated, in its solidified and non-loaded state in which it is removed from the injection-molding die;

[0025] FIG. **10** shows a top view of the underside of the head region of a further embodiment of the toothbrush according to the invention;

[0026] FIG. **11** shows a top view of the top side of the head region, shown in FIG. **10**, of a toothbrush, without the bristles being illustrated;

[0027] FIG. **12** shows a top view of the underside of the head region of a further embodiment of the toothbrush according to the invention;

[0028] FIG. **13** shows a top view of the top side of the head region, shown in FIG. **12**, of the toothbrush, without the bristles being illustrated;

[0029] FIG. **14** shows a sectional illustration of a detail through a bristle carrier element and the surrounding sheet-like hard film of a toothbrush according to the invention, the bristle carrier element which consists of a hard material and the sheet-like hard film being covered on the top side with a layer consisting of a soft material, and bristles combined into a bristle bundle being oriented obliquely with respect to a longitudinal axis of the bristle carrier element;

[0030] FIG. **15**-FIG. **26** show, in a top view, the undersides of the head region of further particularly preferred embodiments of toothbrushes according to the invention, upper carrier element orifices which are located on the top side and out of which the bristles emerge being depicted by dashes;

[0031] FIG. **27**-FIG. **30** show, in sectional illustrations, details of head regions of various embodiments of toothbrushes according to the invention, in which a layer consisting of soft material is applied to the top side of the bristle carrier element produced from hard material and of the sheet-like hard film;

[0032] FIG. **31** shows a sectional illustration of a sleeve-like bristle carrier element and of regions of the surrounding sheet-like hard film with a layer applied to the top side and consisting of a soft material, before a bristle tufting process;

[0033] FIG. **32** shows a sectional illustration of a detail, shown in FIG. **31**, of a head region with a sleeve-like bristle carrier element after the bristle tufting process, the bristles being melted on the bristle carrier element side, in their free end region, with one another and with the underside end region of the bristle carrier element;

[0034] FIG. **33** shows a top view of the top side of the head region of a further embodiment of a toothbrush according to the invention, in which bristles are combined into bristle bundles having elongately oval or l-shaped cross sections;

[0035] FIG. **34** shows a top view of the underside of the head region shown in FIG. **33**;

[0036] FIG. **35** shows a top view of the underside of the head region of a further embodiment of the toothbrush according to the invention, with bristle bundles which have circular or elongate or l-shaped cross sections;

[0037] FIG. **36** shows a top view of the top side of the head region shown in FIG. **35**;

[0038] FIG. **37** shows a top view of the top side of the head region of a toothbrush according to the invention which is designed as an electric toothbrush with a plug-on brush having an oscillating brush head, the radially outer bristle carrier elements being capable of being angled or deflected elastically with respect to a central region of the brush head via a sheet-like hard film;

[0039] FIG. **38** shows a partially sectional side view of the neck region and of the head region, shown in FIG. **37**, of the plug-on brush;

[0040] FIG. **39** shows a perspective illustration of the underside of the head region and of the contiguous neck region of a toothbrush according to the invention, likewise designed as an electric toothbrush, with an eccentrically shaped drive shaft which acts on the underside of a bristle carrier element arranged on a head element;

[0041] FIG. **40** shows a side view of the head region shown in FIG. **39**, having a head carrier carrying the head element;

[0042] FIG. **41** shows a perspective sectional illustration of the head region shown in FIG. **39** and FIG. **40**;

[0043] FIG. **42** shows a perspective illustration of the underside of the head element with an eccentric receptacle integrally formed on the underside of a bristle carrier element;

[0044] FIG. **43** shows a perspective illustration of the head carrier and of the head element already shown in FIG. **42**;

[0045] FIG. **44** shows a side view of the head region of a further embodiment of a toothbrush according to the inven-

tion, without the bristles being illustrated, in which toothbrush a material bridge spans the underside of the head region; and

[0046] FIG. **45** shows a top view of the underside of the head region of the embodiment, shown in FIG. **44**, of the toothbrush according to the invention.

[0047] A portion of a particularly preferred embodiment of the toothbrush **10** according to the invention is shown in FIG. **1**. This portion comprises part of a neck region **12** which carries a head region **14**. A grip region, not illustrated in FIG. **1**, is contiguous, on the opposite side to the head region **14**, to the neck region **12**.

[0048] The toothbrush **10** according to the invention has an overall length of up to 220 mm, preferably of between 120 mm-140 mm or 190 mm and 200 mm. The length of the grip region of the toothbrush **10** amounts to between 45% and 65% of its overall length. The remaining length is apportioned to the neck region **12** and to the head region **14**. The length of the head region amounts to 10 mm to 35 mm, preferably 15 mm to 24 mm or 26 mm to 30 mm. The width of the head region measures 8 mm to 20 mm, preferably 10 mm to 16 mm.

[0049] The head region **14** carries bristles **16** shown, for example, in FIG. **14** and FIG. **32**. Furthermore, the head region **14** may also be equipped with cleaning or massaging elements, as shown in FIG. **27**-FIG. **30**.

[0050] The grip region, the neck region **12** and the head region **14** are produced predominantly from a hard material H, in particular a hard plastic. What are used as hard material H are, for example, polypropylene (PP), polyester (PET), polycyclohexanediamethanolterephthalate (PCT/PCT-A (acid-modified)/PCT-G (glycol-modified)), polyethylene (PE), polystyrene (PS), styrene acrylonitrile (SAN), polymethylmethacrylate (PMMA), acrylobutadienestyrene (ABS), polyoxymethylene (POM) or polyamide (PA), etc., preferably polypropylene (PP). The modulus of elasticity of the polypropylene (PP) preferably used amounts to 1000 N/mm^2 to 2400 N/mm^2, preferably 1300 N/mm^2 to 1800 N/mm^2, particularly preferably 1450 N/mm^2 to 1650 N/mm^2, in particular 1500 N/mm^2. To form a hard film, described below, and bristle carrier elements, described below, a hard material is preferably used which does not tend to brittle fractures under load. For this reason, styrene-containing hard materials PS, SAN and ABS, are less preferable, in contrast to PP, PE, PA, PET or PCT/PCTA/PCTG.

[0051] Soft materials W used, such as are employed, for example, for soft-elastic layers, return elements, material bridges or cleaning or massaging elements **18** shown in FIG. **26**-**30**, are a soft plastic, for example low density polyethylene (PE-LD), high density polyethylene (PE-HD), polyethylene (PE), polyvinylchloride (PVC), polyurethane (PUR) and preferably a thermal plastic elastomer (TPE). The use of polyolefin-based elastomer is likewise possible. The Shore A hardness of the soft material W is in this case below 90, preferably below 70. Since the soft material W in the head region **14** is likewise applied in a thin layer to the hard material H, and because of the constant alternating loads in the head region **14**, an excellent connection between the soft and the hard material is indispensible. This is achieved by selecting a soft material W which is compatible with the hard material H and which bonds with the hard material H in the boundary layer by means of material connection during a multicomponent injection-molding process. This also applies, of course, to all the other elements produced from soft material.

[0052] In the perspective view of FIG. **1** of an underside **20** of the head region **14** of a particularly preferred embodiment of the toothbrush **10** according to the invention, a number of bristle carrier elements **22** of cup-like shape can be seen. These bristle carrier elements **22** consisting of a hard material H are connected to one another and to the neck region **12** via a sheet-like hard film **24**, likewise consisting of a hard material H, so as to be capable of being deflected or angled elastically. The bristle carrier elements **22** are intended for reception of, for example, bristles **16** shown in FIGS. **14** and **27**-**30**, these emerging out of an upper carrier element orifice **26** of the bristle carrier element **22** toward a top side **28** of the toothbrush **10**.

[0053] As can be seen in the top view of the top side **28** of the head region **14** in FIG. **3**, the bristle carrier elements **22** may be equipped on the top side **28** with a, for example, circular carrier element orifice **26** or else with a plurality of upper carrier element orifices **26**. Thus, in the embodiment shown by way of example in FIG. **1**-FIG. **3**, a bristle carrier element **22** arranged in the outermost longitudinal end region of the head region **14** is provided with 5 upper carrier element orifices. As can likewise be seen in FIG. **3**, moreover, conventional bristle holes **13** may be formed in the rigid neck-side portion of the head region **14**.

[0054] The details of the bristle carrier elements **22** can be seen in FIG. **4** and particularly in the sectional illustration of FIG. **5** and FIG. **6**. The bristle carrier elements **22** with a single upper carrier element orifice **26** have an externally rounded element body **32** with an elliptic cross section and with a beveled closing cap **34**. While the element body **32** serves with its inner recess in the form of a blindhole **36**, above all, for reception of bristles **16**, the outer surface of the closing cap **34** affords the possibility of providing further functions, for example the function of a tongue cleaner or for gum massage by means of a design with scraper edges or scraper bosses or roughenings. There is, further, the possibility of at least partially covering the closing cap **34** at its free end with soft material W and of assuming the functions described above. Alternatively, the element body **32** may also be shaped in the form of a circular cylinder, of a cone frustum, or of other rotationally symmetrical forms, as a parallelepiped with rounded corners or as a truncated pyramid. The closing cap **34** may also be designed as a cone, a blunted cone, a hemisphere or an angular end region. As described in detail later in connection with FIGS. **31** and **32**, it is also possible for the bristle carrier element to have a sleeve-like shape, that is to say without a closing cap **34**.

[0055] The general form of bristle carrier elements **22** and of the closing caps **34**, as well as functional aspects of the outer faces, of a blindhole geometry for the optimal reception and anchoring of the bristles **16**, and also design aspects, is decisively determined by the production process (injection molding). Filling with liquid plastic by means of injection molding and removal of the geometries from an injection-molding die fix various likewise geometric boundary conditions.

[0056] The bristle carrier elements **22** with a single upper carrier element orifice **26**, which are preferably bristle-tufted by means of conventional plugging technology, have a thickness, measured from the top side **28** to the underside **20** from the starting point of the bristle carrier element **22** on the hard film **24** to the free end of the bristle carrier element **22**, of 2 mm to 5 mm, preferably of 3.8 mm to 4.5 mm. The thickness may vary over the head region **14**. The cross section of these

bristle carrier elements **22** amounts, measured in the longitudinal direction of the toothbrush **10**, to 2.5 mm to 4 mm, preferably 2 mm to 3.5 mm. The cross section, measured in the transverse direction of the toothbrush **10**, amounts to between 2 mm and 3.5 mm, preferably 2.5 mm to 3 mm. The cross-sectional particulars given may vary over the entire head region **14**. The wall thickness of the bristle carrier element **22** amounts to a minimum of 1 to 2 times, at most 4 to 8 times, preferably about 1 to 3 times, the thickness of the sheet-like hard film **24**.

[0057] The diameter of the blindhole **36**, in which the bristles **16** are fastened, preferably using conventional stamping technology, by means of small tie plates, amounts to between 1.4 mm and 1.8 mm, preferably to 1.6 mm. The considerations regarding bristle reception holes do not, of course, apply in general only to the blindholes **36** preferred in connection with conventional plugging technology, but also, in a similar way, to the throughholes **48** which are described below in connection with FIG. **31** and FIG. **32** and which are preferably employed in alternative bristle-tufting methods, such as, for example, in the IMT (In Mold Tufting) or AFT (Anchor Free Tufting) method. The hole diameter of the blindholes **36** within the bristle field may vary. In this case, bristle carrier elements **22** with individual blindholes **36** preferably have smaller hole diameters than bristle carrier elements **22** with a plurality of blindholes **36**.

[0058] The depth of the blindhole **36** measures 2 mm to 4.5 mm, preferably 3 mm to 3.7 mm. These quantities, too, may vary over the head region **14**. In addition to a preferred circular design, the blindholes **36** may also have an elliptic, polygonal, sickle-shaped, asymmetric or free form in cross section. The design of the cross section of the blindholes **36** in polygonal, sickle-shaped, asymmetric or free form is preferably employed only when the recent AFT (Anchor Free Tufting) and IMT (In Mold Tufting) methods are used.

[0059] The wall thickness, measured between the blindhole **36** and the outer surface of the element body **32**, amounts to between 0.3 and 0.9 mm, preferably to between 0.4 and 0.8 mm. The hole axis of the blindholes **36** preferably runs parallel to the longitudinal mid-axis of the element body **32**. Consequently, the bristles **16** inserted in the blindhole **36** are also oriented at least virtually parallel to this longitudinal mid-axis and therefore project at least virtually at right angles from the top side **28** of the head region **14**. As is described later in connection with FIG. **14**, however, inclined orientations are also possible.

[0060] As already mentioned above, the bristle carrier elements **22** may also be equipped with a plurality of upper carrier element orifices **26**. In production terms, bristle carrier elements **22** of this type may be formed, for example, by a markedly thickened connecting layer between the bristle carrier elements **22** having a single upper carrier element orifice **26**, said connecting layer having a layer thickness greater than 0.5 mm. The connecting layer is therefore substantially thicker than the sheet-like hard film **24**. The in this case markedly thickened connecting layer between the bristle carrier elements **22** has the effect that no or only insignificant flexible deflection is possible between the bristle carrier elements **22**.

[0061] In the bristle carrier element **22** with 5 upper carrier element orifices **26**, which is shown in FIGS. **1** to **5** and is arranged on the longitudinal end region side, this connecting layer is, for example, filled up, flush with the outer ends of the closing cap **34**. The arrangement of the bristle carrier elements **22** with a plurality of upper carrier element orifices **26** may take place in any positions in the bristle field. Even a plurality of such elements of the same or of a different type may occur in the bristle field symmetrically or asymmetrically with respect to the longitudinal axis of the toothbrush **10**. Different cleaning and flexibility zones can thereby be formed in the bristle field.

[0062] On account of the spacing of the bristle carrier elements **22** from one another and with respect to the neck region **12** by means of the sheet-like hard film **24** or of the preferably completely free lie of the bristle carrier elements **22** on the underside **20** from the sheet-like hard film **24** as far as the free ends of the bristle carrier elements **22**, a labyrinth-like channel structure is formed on the underside **20** of the head region **14**. The individual bristle carrier elements **22** are in this case preferably offset with respect to one another such that no continuously straight bending line can be formed in the longitudinal and the transverse direction in the sheet-like hard film **24**. Instead, the arrangement is preferably selected such that the bending lines occurring during an angling of the bristle carrier elements **22** are angled or branched in the outer marginal regions of the head region **14**. This gives the head region **14** additional stability. Moreover, via the labyrinth-like channel structure, liquids are effectively discharged, and a cleaning of the underside **20** of the head region **14** is assisted.

[0063] In order to prevent an overstretching of the sheet-like hard film **24** during the angling or torsion of one or more bristle carrier elements **22**, the bristle carrier elements **22** are configured in their outer form and arrangement, on the underside **20** of the head region **14**, such that their free movability is correspondingly restricted. In particular, a maximum deflection angle is defined by the thickness of the bristle carrier elements **22**, as measured between the top side **28** and the underside **20**, and by their arrangement and also their mutual spacing. This maximum deflection angle amounts to 30° to 75°, preferably 35° to 50°, and is measured between the mid-normal of the foremost carrier element orifice **26** in the flat state and the mid-normal of the foremost carrier element orifice **26** in the deflected state. The maximum deflection angle also applies to the curved bristle face. In addition to an action as mutual stops which is caused thereby, stop elements may be mounted additionally between the bristle carrier elements **22** consisting of a hard or of a soft material W. Of course, for longitudinal and transverse elasticities and also torsional properties which are different from one another, the maximum deflection angles in the transverse, the longitudinal and the torsional directions may also be different. In this case, it should be remembered that, on account of the material properties, the sheet-like hard film **24** has almost no possibilities for stretching, but can nevertheless be bent elastically. The bending elasticity may be determined via the thickness of the sheet-like hard film **24**, while the layer thickness may vary, as desired, both in the longitudinal and in the transverse direction. Preferably, the selected layer thickness of the sheet-like hard film **24** is greater in the vicinity of the neck that in the free end region of the head region **14**. The maximum layer thickness of the sheet-like hard film **24** lies within 150%, preferably within 130%, of the minimum layer thickness.

[0064] The returnability or elasticity is also codetermined by the properties of the covering soft material W. This material is soft-elastic and can stretch. The layer thickness of the soft material W may vary, as desired, in the longitudinal and in the transverse direction.

[0065] The ratio between the layer thicknesses of the hard material H and of the soft material W may be selected virtually as desired. Preferably, however, thinner layer thicknesses of the sheet-like hard film **24** are balanced with thicker layers of the soft-elastic material, in order to achieve a uniform head thickness in the flexible zones. In addition, by means of the soft-elastic material, additional elements independent of the thickness of the sheet-like hard film **24** may also be formed in particular zones. For example, these may be beads **38**, formed from soft material W, around the carrier element orifices **26** or cleaning and massaging elements **18**. It is perfectly possible, however, to configure a toothbrush without beads **38** and thereby to have a planar configuration for the surface of the soft material W.

[0066] As may be gathered particularly from FIGS. **5** and **6**, the sheet-like hard film **24** extends, flush on the outside, around the upper carrier element orifice **26**, preferably the hard film **24** being configured such that it bears, flush at the top, against the edge of the carrier element orifice **26**. The transition on the underside **20** from the hard film **24** to the bristle carrier element **22** is essentially sharp-edged, and, in the preferred embodiment, at most a minimum radius of lower than 0.3 mm is implemented. On account of a restriction in the flexibility of the sheet-like hard film **24**, it is still possible, although less preferable, to configure this transition with a larger radius by means of bevels or a rounding.

[0067] It is, of course, also possible that the tie-up of the bristle carrier elements **22** to the sheet-like hard film **24** takes place only in portions and, due to recesses in the sheet-like hard film **24**, the element body **32** of the bristle carrier elements **22** is also exposed in portions on the top side **28**. It is likewise conceivable that the connection between the bristle carrier elements **22** and the sheet-like hard film **24** takes place at another position between the top side **28** and the underside **20**, so that, for example, a portion of the bristle carrier elements **22** projects beyond the sheet-like hard film **24** toward the top side **28**.

[0068] Preferably, but not compulsorily, the sheet-like hard film **24** consisting of a hard material H is covered on the top side with a layer consisting of a soft material W. In a preferred production of the toothbrush **10** in a multicomponent injection-molding process, for this purpose the soft material W is injection-molded onto the hard material H. Since preferably at least individual regions of the toothbrush **10**, including the bristle carrier elements **22** and the sheet-like hard film **24**, are manufactured from a single hard material H, preferably a single injection-molding point can be used when the hard material H is being injection-molded. Said individual regions of the toothbrush **10** which consists of hard material H may, for example, lie in the neck region **12** or in the neck region **12** and grip region.

[0069] It is, of course, also possible to use a plurality of types of hard and soft materials H, W which bond with one another during the injection-molding process, so that the desired elasticity properties of the sheet-like hard film **24** can be set specifically. It must be stated, in general, that the elasticity with which the bristle carrier elements **22** can be deflected with respect to the neck region **12** is determined by a series of factors, in particular the thickness of the sheet-like hard film **24**, the distribution of its thickness, the material used and the specific material distribution, for example in terms of the layer of soft material W which is applied to the top side **28**.

[0070] The thickness of the sheet-like hard film **24** amounts to between 0.08 mm and 0.6 mm, preferably between 0.3 mm and 0.5 mm. Preferably, this layer is designed to be slightly wedge-like over the head region **14**, so that the layer thickness amounts to about 0.5 mm in the vicinity of the neck region **12** and to about 0.3 mm in the free end region of the head region **14**. This ensures that, on account of the distance from the neck region which increases in the direction of the free end region of the head region **14**, and therefore because of a longer lever arm, during a deflection of the bristle carrier elements **22** these can be deflected at least virtually identically in the longitudinal direction of the head region **14** during the action of an identical force.

[0071] The thickness of the layer of soft material W applied to the sheet-like hard film **24** on the top side **28** amounts to between 0.2 mm and 1 mm, preferably to between 0.3 mm and 0.7 mm. This affords an overall layer thickness of the sheet-like hard film **24**, together with a layer of soft material W lying above it, of 0.28 mm to 1.6 mm, preferably of 0.6 mm to 1.2 mm. The ratio of the layer thickness of the hard material H to the soft material W amounts to 12.5:1 to 0.8:1, preferably 7:1 to 1.5:1. As already mentioned, however, this ratio may vary and decisively determines the elasticity properties during the deflection of the bristle carrier elements **22**. It may also be mentioned at this juncture that the ratio of the thickness of the sheet-like hard film **24** to the thickness of the bristle carrier elements **22**, in each case measured between the top side **28** and the underside **20** from the starting point of the bristle carrier element **22** on the hard film **24** to the free end of the bristle carrier element **22**, amounts to between 63:1 and 8:1, preferably to between 44:1 and 8:1, particularly preferably to between 30:1 and 12.5:1.

[0072] In a further design possibility, the sheet-like hard film **24** is covered on both sides with soft material W. This means that the sheet-like hard film **24** is also covered, additionally to the above-described covering of the top side **28**, on the underside **20** in the labyrinth-like recesses with a layer of soft material W.

[0073] As described above, in addition to the bristle carrier elements **22**, the sheet-like hard film **24** may have recesses. This also applies, of course, to layers of soft material W.

[0074] As may be gathered again from FIGS. **5** and **6**, a bead **38**, which is elevated in the direction of the top side **28**, is shaped on the top side **28** around the upper carrier element orifice **26** from the soft material W. Said bead forms a layer, enlarged in the manner of a ring, around the upper carrier element orifice **26** and allows a softer guidance of the bristles and also an improved return after their deflection during the cleaning operation. It is also conceivable, of course, to form a bead **38** of this type out of a hard material H, in particular by lengthening the element body **32**, or to omit the bead **38** completely. As shown in FIGS. **1** to **4**, **7** to **13** and **15** to **26**, the outer margin of the head region **14** is provided with a wavy contour line. In this case, thin layers of the sheet-like hard film **24** alternate with outer regions of the bristle carrier elements **22**. The bristle carrier elements **22** project slightly beyond the outer margin of the sheet-like hard film **24** and act as a buffer zone in order to reduce the contact of the sheet-like hard film **24** with the oral cavity. In order to avoid sharp edges at the outer marginal region, these may be covered at least partially with soft material W. As already mentioned, this soft material W may be applied, for example, on the top side **28** and/or on the underside **20** of the sheet-like hard film **24** or so as to be drawn over the edge from the top side **28** to the underside **20**.

Injuries caused by cutting or by knocks in the oral cavity are thereby avoided. Furthermore, the soft material W functions as damping, and a tearing of the sheet-like hard film **24** from outside is prevented. Alternatively, it is also possible to configure the hard material H so as to be thicker in the outer marginal region of the head region **14**, if need be by means of a peripheral frame-like marginal region.

[0075] In order to adapt the elasticity of the head region **14** or else so that material savings can be made, it is possible not to form the layer of soft material W continuously, that is to say clearances (of any geometric forms) will be provided in the layer of soft material W, that is to say the hard material H is not covered in the region of these clearances.

[0076] FIGS. **7-9** present illustrations of various curvatures of the head region **14** of the embodiment, shown in FIGS. **1-6**, of the toothbrush **10** according to the invention. FIG. **7** in this case shows the maximum angling during the action of force upon a bristle carrier element **22** in the outermost free longitudinal end region of the head region **14**. Further angling in the direction of the underside is ruled out by stop-like contacts between the bristle carrier elements **22**. Under a force of 3 N which acts on said bristle carrier element **22**, the maximum angling amounts to between 10° and 40°, preferably to between 25° and 30°, as measured between the mid-normal of the foremost carrier element orifice **26** in the flat state and the mid-normal of the foremost carrier element orifice **26** in the deflected state. The surface of the bristle face, that is to say, inter alia, the sheet-like hard film **24** in the flexible part, forms, under the load, an arcuate bend with a radius of 4 cm to 10 cm, preferably of 5 cm to 8 cm.

[0077] FIG. **8** shows a state in which the toothbrush **10** is still located in its cavity of an injection-molding die, not shown, for solidification after the injection-molding of the hard and the soft material H, W. In this case, the top side is an at least virtually planar face. However, as soon as the toothbrush **10** is removed from the injection-molding die, the head region **14** is deformed slightly in the direction of the top side **28** on account of the shrinkage behavior and, as seen from the top side **28**, forms a concave curvature, illustrated in FIG. **9**. This curvature is attributable to material shrinkage during the curing phase and causes a desired prestress in the direction of the top side **28**. The direction of the curvature may be influenced, and correspondingly set, for example, by means of a different positioning of the sheet-like hard film **24** with respect to the top side **28** and underside **20** of the bristle carrier elements **22**. Thus, for example, an opposite curvature can be achieved if the sheet-like hard film **24** runs, flush with the underside free end of the closing caps **34**. The bending effect can be further reinforced in that, as in the embodiment described above, a layer of soft material W is applied to the sheet-like hard film **24** on the top side **28**, since this layer causes additional prestress on account of its shrinkage behavior. Alternatively, other forms of curvature, such as wave profiles, spindly forms of torsion, one or more kinks or combinations of a plurality of form elements, may be formed in the head region **14**, in that the injection-molding die in which the soft material W is injection-molded positively shapes the preceding hard material H, that is to say the hard material H is introduced under prestress into this die. Owing to the curing of the soft material W, the positive form of the hard material H is "frozen". It is likewise possible to heat the bristle-tufted toothbrush **10** anew and then to cool it in a predetermined positive form. In this case, too, the corresponding positive form is "frozen".

[0078] In complicated injection-molding dies, it is also possible for the hard material H to have a curved shape already. In this case, however, dies equipped with corresponding slides and core pullers are necessary for implementation.

[0079] The head region **14** of the toothbrush **10** is preferably adapted to the tooth outer contour and is curved concavely. The bristle tufting may additionally be arranged in length so that a bristle configuration optimal for cleaning can be implemented. By means of this possibility, the curvature can to some extent be copied.

[0080] The bristle tufting of toothbrushes **10** with curvatures in the head region **14** requires, together with the flexibility configured according to the invention in the head region **14**, that negative reception molds are necessary for the bristle tufting, in order to support the bodies.

[0081] Two further embodiments of head regions **14** are shown in FIGS. **10** to **13**. In the embodiment, the underside **20** of which is illustrated in FIG. **10**, bristle carrier elements **22** with a single upper carrier element orifice **26** are formed in the outer marginal region of the head region **14**, preferably in an arrangement similar to a set of teeth. In the center of the head region **14**, three bristle carrier elements **22** with an elongate cross section and in each case three upper carrier element orifices **26** are formed, as will be gathered from the image of the top side **28** in FIG. **11**. In this case, it can be seen clearly that the spacing of the carrier element orifices **26** with respect to one another on the bristle carrier element **22** may be varied.

[0082] In addition to this row-like arrangement of the upper carrier element orifices **26** in the transverse direction or longitudinal direction of the toothbrush **10**, other designs, such as, for example, along curved lines in S-, T-, U- and cross-shaped arrangements, are also possible. The arrangements may in each case be oriented in a transverse direction or in the longitudinal direction of the toothbrush **10**. Both symmetrical and asymmetric patters (with respect to the longitudinal axis of the toothbrush **10**) of the carrier element orifices **26** can thereby be achieved. The bristle carrier element **22** with five upper carrier element orifices **26** in the free longitudinal end region of the head region **14** may be considered as a further example. As in the embodiment, shown in FIGS. **1** to **9**, of the toothbrush **10** according to the invention, in this embodiment, too, conventional bristle holes **30** are located in a solid part of the head region **14** which is connected rigidly to the neck region **12**.

[0083] In a similar way to the embodiment shown in FIG. **12** and FIG. **13**, it is also possible to equip the majority of the outer marginal regions of the head region **14** with bristle carrier elements **22** which have more than two upper carrier element orifices **26**. In the case of a total number of 32 to 40 upper carrier element orifices **26** in the head region **14** of the toothbrush **10**, bristle carrier elements **22** with 2 to 18 upper carrier element orifices **26**, preferably 2 to 7 or 12 to 18 upper carrier element orifices **26**, are preferably also formed in addition to the bristle carrier elements **22** with a single upper carrier element orifice **26**. These preferably rounded bristle carrier elements **22** having a plurality of carrier element orifices **26** have on the top side **28** an extent in the longitudinal direction of the head region **14** of 4 mm to 12 mm, preferably of 5 mm to 8 mm, and an extent transversely to the longitudinal direction of 4 mm to 14 mm, preferably of 5 mm to 8 mm.

[0084] In each case various types of bristle, bundle forms and bundle sizes in terms of length, diameter and materials may be combined on the bristle carrier elements **22** in the

blindholes **36** of the latter. The bristles **16** are in this case, depending on the orientation of the blindholes **36** in the bristle carrier elements **22**, oriented either virtually at right angles with respect to the top side **28** of the head region **14** or, as shown in FIG. **14**, obliquely with respect to the top side **28** of the head region **14**. As a result of this angular orientation of the bristles **16**, for example, X-shaped bristle bundles may be formed which, in particular, assist a cleaning of interdental interspaces, sloped bundles of bristles **16** may be formed or bundles or bristles **16** projecting beyond the bristle head margin may be formed. In order to achieve an appropriate sloping, the blindholes **36** are likewise shaped according to the slope. The angle of the mid-normal of the sloped blindhole **36** to the mid-normal of a vertically shaped blindhole **36** amounts to between 3° and 30°, preferably to 3° to 15°. Bristle-tufting methods which may be used are both conventional methods by means of anchors for bristle carrier elements **22** of cup-like shape with blindholes **36** and AFT (Anchor Free Tufting) or IMT (In Mold Tufting) methods for bristle carrier elements **22** of sleeve-like shape with throughholes **48**. In general, the properties and design variants of blindholes **36** and throughholes **48** may be interchanged in this publication, since the hole variant depends essentially only on the selected bristle-tufting method. Sleeve-like bristle carrier elements **22** are referred to again particularly in connection with FIG. **31** and FIG. **32**. As described above, a plurality of carrier element orifices **26** may be arranged within a bristle carrier element **22** and may be equipped with cleaning and massaging elements **18**.

[0085] The bristles **16** introduced into the bristle carrier elements **22** or into the carrier element orifices **26** may be of various types. Continuously cylindrical bristles or bristles pointed on one side or two sides may be used. The bristles **16** themselves are preferably produced from polyamide (PA) or polyester (PBT). In addition to the bristles **16**, further cleaning or massaging elements preferably consisting of a soft material W may be formed on the bristle carrier elements **22**. These may, for example, be injection-molded directly in an injection-molding method or be anchored in the blindholes **36** in a similar way to the bristles **16**. The cleaning or massaging elements **18** may be designed, for example, as lamellae, bosses, scales, grooves, edges, tiny hairs, flocked places, strip brush elements, or cylindrical, spherical or stick-like elements. They may be arranged both on the top side **28** and on the underside **20** and project from these. Moreover, particularly on the underside **20**, the closing caps **34** of the bristle carrier elements **22** may additionally be equipped with scales, grooves, edges, roughenings or other recurring surface structures, in order to form a tongue cleaner.

[0086] A tongue cleaner may alternatively be configured in that the layer of soft material W is led further on beyond the margin of the head region **14**. A scraper edge is configured in that the layer of soft material W is continued in a tubular or lamellar manner around the head region **14** from the top side **28** in the direction of the underside **20**. This scraper edge follows the outer edge of the toothbrush head and thereby covers the whole of the bristle carrier elements **22**.

[0087] The layer of soft material W on the top side **28** of the head region **14** of the toothbrush **10** may be thickened at the outer margin, in a similar way to the bead **38**, in order to avoid barrier-like injuries caused by knocks.

[0088] FIGS. **15** to **21** illustrate undersides **20** of head regions **14** of further particularly preferred embodiments of the toothbrush **10** according to the invention. In all these embodiments, in each case a bristle carrier element **22** with a multiplicity of upper carrier element orifices **26**, indicated by dashed lines, are arranged in the outer longitudinal end region of the head region **14**. All the embodiments are likewise equipped with conventional bristle holes **30** in the neck region-side head region **14**. Middle regions of the head region **14** are in each case configured differently from one another with respect to the longitudinal axis of the head region **14**. Thus, the embodiments seen in FIGS. **15**, **16**, **17**, **18** and **20** have in each case, lateral on the outside, bristle carrier elements **22** in each case with two carrier element orifices **26** on the top side **28**. Furthermore, the embodiments in FIGS. **15**, **16**, **19** and **20** are designed with bristle carrier elements **22**, which possess two or more upper carrier element orifices **26**, in a central region of the head region **14**. Moreover, it may be pointed out that the embodiments seen in FIGS. **15**, **16** and **18** are equipped in the neck region-side part of the head region **14** with a contraction of the sheet-like hard film **24**, by means of which the elasticity of the longitudinal end region-side bristle carrier elements **22** with respect to the neck region **12** is further increased. Continuous hole-like film recesses within the sheet-like hard film **24** are not illustrated, but are likewise possible. These serve, like the lateral contractions illustrated, for increasing the elasticity. The film recesses preferably have an elongate slot-like shape and lead through between the adjacent bristle carrier elements. The film recesses are preferably not filled with the following layer of soft material W.

[0089] Moreover, FIG. **21** shows the possibility that the bristle carrier elements **22** are connected to one another by means of minimal webs. The flexibility (direction and extent) of the bristle head can thereby be determined additionally.

[0090] In FIG. **26**, moreover, cleaning and massaging elements **18** are mounted on the underside **20** of the toothbrush **10**. The possibilities for configuration of such elements are illustrated in FIGS. **27** to **30**.

[0091] A further possibility for the design of the bristle head according to the invention is illustrated in FIG. **44** and FIG. **45**. The bristle carrier elements **22** are attached to the sheet-like hard film **24**. A material bridge **74** consisting of soft material W and/or of hard material H is formed, over and beyond the bristle carrier elements **22**, on the underside **20** of the head region **12** of the toothbrush **10**. The material bridge **74** has its engagement points (bridge heads) in the free end region of the head region **14** and, on the other side, at the transition from the sheet-like hard film **24** to the neck region **12** of the toothbrush **10**. Structures, which may serve as tongue scrapers **44**, may be formed on the material bridge **74**. The material bridge **74** serves for setting the flexibility of the head region **14**. The production of the toothbrush **10** illustrated in FIG. **44** is carried out preferably by means of the cavity-freeing lateral slides in the injection-molding die. The material bridge **74** may be formed, in the same operation as the sheet-like hard film **24** and the bristle carrier elements **22**, from the same material, and from the same injection-molding point, by means of injection molding. Alternatively, as already described, the sheet-like hard film **24** and the bristle carrier elements **22** may be formed in a first injection-molding process without lateral slides, and the material bridge **74** may be formed in a second operation with lateral slides. For example, as illustrated by way of example in FIG. **44**, a material bridge **74** of soft material W may be formed from the same material and in the same injection-molding process as the layer of soft material W on the top side **28** of the sheet-like hard film **24**. Alternatively, further or already present materi-

als may also be processed in additional injection-molding processes in order to produce the desired material bridge **74**. In this case, it is essential that the materials used are compatible with one another, in order to form a material bond during the injection-molding process.

[0092] FIGS. **27** to **30** show sectional illustrations of portions of the head region **14** in which cleaning or massaging elements **18** are formed in a different way by means of a combination of hard and soft materials H, W. In the embodiment shown in FIG. **27**, the layer of soft material W applied to the top side **28** above the sheet-like hard film **24** is equipped with sticks or lamella-like extensions which extend essentially at right angles to the top side **28** and parallel to the bristles **16**. FIG. **28** shows a further embodiment in which these sticks or lamella-like cleaning or massaging elements **18** are supported by an inner structure **42** which consists of a hard material H and which is likewise elevated in a stick-like or lamella-like manner, parallel to the bristles **16**, in the direction of the top side **28**. A cleaning or massaging element **18**, likewise consisting of a hard material H, is arranged, opposite the inner structure **42**, on the underside **20** in order to form a tongue scraper element **44**.

[0093] In the embodiment shown in FIG. **29**, as in the embodiment shown in FIG. **27**, a stick-like or lamella-like cleaning or massaging element **18** consisting of soft material W is integrally formed on the top side **28**. The soft material W is also led through a recess **46** in the sheet-like hard film **24** to the underside **20** and there forms a tongue scraper element **44** which, however, is soft-elastic. As in the embodiment shown in FIG. **30**, a soft-elastic tongue scraper element **44** of this type may also be supported or stiffened by an inner structure **42** which is formed from hard material H and which projects in the direction of the underside **20** from the sheet-like hard film **44**. Further forms of cleaning or massaging elements **18** are, of course, also possible, in particular inner structures **42** may be formed from a hard material H, both in the direction of the top side **28** and in the direction of the underside **20**, in order to support a soft-elastic structure.

[0094] As already mentioned, the bristles **16** may also be fastened in bristle carrier elements **22** of sleeve-like shape by means of an AFT method or IMT method.

[0095] Bristle heads manufactured by means of the IMT method correspond largely to the previous design variants. In contrast to the conventional plugging method by means of small tie plates, however, the bristles are previously delivered by injection molding. They are subsequently injection-molded around with plastic in order to form the bristle head. The bristles are thus likewise inserted into the "blindholes" formed by the bristles.

[0096] A sleeve-shaped bristle carrier element **22** used in the AFT method and having portions of the contiguous sheet-like hard film **24** is shown in FIG. **31**. A lower carrier element orifice **50** is formed, opposite the upper carrier element orifice **26**, by the throughhole **48** on the underside **20**. In general, all the considerations and design variants which relate to the bristle carrier elements **22** with blindholes **36** can also be transferred in a similar way to bristle carrier elements **22** with through holes **48**.

[0097] FIG. **32** illustrates the portion shown in FIG. **31** after bristle tufting has taken place by means of the AFT method. In this case, the bristles are pushed through the throughholes of the bristle carrier elements **22**. Subsequently, the rear ends of the bristles are melted for anchoring purposes. In the region of the lower carrier element orifice **50**, the bristles **16** are welded to one another and preferably, in the case of compatible materials, also to the bristle carrier element **22** in a welding portion **52** in order to form a bristle bundle. As a stock of material for welding, it is possible to form within the throughhole **48**, in the region of the lower carrier element orifice **50**, projections which are attached as additional material for welding purposes. Welding takes place by the AFT method by means of a hot ram which melts the bristle material. The cooled body or the welding portion **52** often possesses brows or other welding edges which constitute a risk of injury. In order reliably to cover the termination of the welding portion **52** on the underside **20** of the toothbrush **10**, it is possible to attach a cover consisting of plastic or of another weldable material to the underside **20** of the bristle carrier element below the lower carrier element orifice **50**. The AFT or IMT method makes it possible to form bristle bundles with virtually any desired cross-sectional forms. Thus, for example, elongate l-shaped or c-shaped cross-sectional forms of bristle bundles may be formed. These elongate bristle carrier elements **22** are preferably oriented along the longitudinal and/or transverse direction of the brush head. Examples of head regions **14** configured in this way are illustrated in FIGS. **33** to **36**. Thus, FIGS. **34** and **35** show in each case the underside **20** and FIGS. **33** and **36** in each case the top side **28** of the head region **14**. In FIG. **35**, the design is selected such that not all the carrier element orifices **26** of the top side **28** are surrounded by a bead **38**.

[0098] In addition to the embodiments, shown hitherto, of the toothbrush **10** according to the invention for a manual cleaning of the teeth or oral cavity, electrically assisted embodiments of the toothbrush **10** according to the invention may also be envisaged. A plug-on brush **54** for an electrically operable toothbrush **10** is illustrated as an example in FIG. **38**. As shown both in the partially sectional side view in FIG. **38** and in the top view of the head region **14** in FIG. **37**, bristle carrier elements **22**, which are connected elastically to a central region of the head region **14** via a sheet-like hard film **24**, are formed radially on the outside. In addition to bristles **16**, the bristle carrier elements **22** may also receive cleaning or massaging elements **18**. In this embodiment, too, it is possible to form bristle carrier elements **22** with a plurality of upper carrier element orifices **26**. Other design variants of flexibly suspended bristle carrier elements **22** may, of course, also be envisaged. In all applications, however, in addition to the flexibly suspended bristle carrier elements **22**, a fixed and rigid connection to the drive of the brush head is necessary, this corresponding to the central region in FIG. **38**.

[0099] A further embodiment of the toothbrush **10** according to the invention is presented in FIGS. **39** to **43**. This embodiment, too, is an electrically operable toothbrush. This has an electric drive device, not shown, which acts on the underside **20** of the bristle carrier elements **22** by means of an actuator, in this case by means of an eccentric **58** formed on a rotatable drive shaft **56**. In this case, a head carrier **60** is equipped with a slotted recess **62**, in which the drive shaft **56** is guided, and the head element **65** is equipped with an eccentric reception element **70**. The eccentric reception element **70** has formed in it an eccentric receptacle **68**, into which the eccentric **58** engages and thereby acts on the special head element **65**. As can be seen clearly in FIG. **43**, the head carrier **60** has a head receptacle **64** which receives the head element **65**, shown in FIG. **42**, which corresponds essentially to the embodiments of the head region **14** which were shown above. The head element **65** is fastened to the head carrier, for

example, by means of welding (ultrasound or a hot ram), by being injection-molded around with a further hard or soft material W, by adhesive bonding, clamping or mechanical anchoring, for example a snap connection or keying on the head carrier **60**.

[0100] The drive axle **56** is mounted, in its free head region-side end region, in a cylindrical axle receptacle **66** in the head carrier **60**. The eccentric **58** formed by means of a bend of the drive shaft **56** engages into the eccentric receptacle **68** of the eccentric reception element **70**. The eccentric reception element **70** itself is fastened to the underside **20** of a bristle carrier element **22** or of a plurality of bristle carrier elements **22** or directly to the sheet-like hard film **24**.

[0101] In the event of an electrical feed of the drive device, the drive shaft **56** is set in rotation about its longitudinal axis. Rotation preferably runs through 360°, but reversing movements within a smaller angular range are also possible. The speed of movement preferably amounts to between 5000 to 15 000 rev/min, particularly preferably 8000 to 12 000 rev/min. In this case, in the design of the geometries, particular attention must be paid to alternating loads which occur. Along with the drive shaft **56**, the eccentric **58** also rotates and at the same time periodically deflects the eccentric reception element **70** and the bristle carrier element **22** connected to this, the bristle carrier elements **22** or the sheet-like hard film **24**. On account of the elastic deflectability of the eccentric reception element **70** by the latter being fastened via the sheet-like hard film **24**, both the bristle carrier element **22** connected directly to the eccentric reception element **70** and adjacent bristle carrier elements **22** and the bristles **16** received by them are set in wave-like movement. The eccentric receptacle **68** of the eccentric reception element **70** is preferably equipped with an oval cross section which has a larger diameter preferably at least virtually parallel to the orientation of the bristles **16**. Depending on the extent of the eccentric receptacle **68**, the bristle carrier element **22** can also be driven in a type of wiping movement in addition to a raising and lowering movement.

[0102] The configuration of the form of the eccentric receptacle **68** and of the eccentric **58** determines the movement pattern and the deflection amplitude of the bristle carrier element or bristle carrier elements **22** and of the hard film **24**. An eccentric receptacle **68** with a circular cross section has the effect that both the raising and lowering movement and the wiping movement are taken off to an equal extent in both directions from the drive shaft **56**. If the circular eccentric receptacle **68** is of the same size as the diameter of the drive shaft **56** in the region of the eccentric **58**, the movement 1:1 is transmitted from the eccentric **58** to the eccentric receptacle **68**. An oval configuration of the form of the eccentric receptacle **68** has the effect that the movement of the eccentric **58** is transmitted to a greater extent in the direction of the shorter axis of the oval cross section than in the direction of the longer axis of the oval cross section. The shaping of the cross section must always obey the boundary conditions, that is to say the spacing between the head element **65** and the head carrier **60** is to be considered as the deflection maximum. In the preferred embodiment of the drive shaft **56**, of the eccentric **58** and of the eccentric receptacle **68**, the drive shaft **56** has a cross-sectional diameter of 0.5 mm to 2 mm, preferably of 0.75 mm to 1.5 mm. The eccentric **58** is offset in the drive shaft with a deflection of 0.25× to 1.25×, preferably 0.5× to 1× the diameter of the drive shaft **56**. The maximum deflection of the bristle field is transmitted in the ratio of 1:1 from the eccentric **58**. If the eccentric receptacle **68** is formed to be larger than the diameter of the drive shaft **56** in the region of the eccentric **58**, the deflection is reduced by the amount of the difference between the diameter of the drive shaft **56** and the diameter of the eccentric receptacle **68**. In a preferred variant, the bristle field moves vertically 0.05 mm to 1 mm, preferably 0.1 mm to 0.5 mm, and horizontally 0.05 to 1.5 mm, preferably 0.1 to 1 mm.

[0103] Alternatively, it is possible to implement the eccentric receptacle **68** as a fork profile, in which case the profile is narrowed on the open side, so that the drive shaft **56** can be held by means of this narrowing. This configuration entails the possibility of achieving different travels of the massaging and cleaning elements **18** in a head element **65**. Moreover, it should be mentioned that, on the drive shaft **56**, further eccentrics **58** may be formed which, via corresponding further eccentric reception elements **70**, can drive bristle carrier elements **22** connected to them in a movement. These eccentrics **58** are not necessarily oriented uniformly, that is to say in the same direction, on the drive shaft **56**. It should likewise be mentioned that the slotted recess **62** may be covered toward the underside **20** by means of additional elements. In order to minimize the risk of injury, the open spacing between the head element **65** and head carrier **60** may likewise be covered. For this purpose, a lateral wall from the head carrier **60** may be implemented, which preferably reaches as far as the open end of the head receptacle **64**. Furthermore, it is possible to configure the head region **14** shown in FIGS. **39** to **43** and the adjoining neck region **12** in the form of a plug-on brush. The arrangements described hitherto for the drive shaft **56** and for the eccentric receptacle **68** assume that in the mounted state, without the eccentric **58** introduced, these two elements are arranged, centered on the drive shaft **56**.

[0104] The movement pattern of the cleaning and massaging elements **18** on the head element **18** is codetermined by the most diverse possible factors. Factors are: the arrangement of the bristle carrier elements **22**, the form of the bristle carrier elements **22**, properties of the sheet-like hard film **24**, the fastening of the head element **65** in the head carrier **60**, the number of eccentric reception elements **70**, etc.

[0105] The mounting of the drive shaft **56** has a sustained influence on the appliance. Inaccurate mounting entails a situation where, on the one hand, noises occur due to friction and, on the other hand, the frictional losses give rise to a higher motor power. So that the mounting can be configured more exactly, it is also possible to fix a metallic carrier in the head carrier **60** (for example, by injection-molding over it, by mechanical mounting by means of a press fit or by other suitable fixing methods). The mounting is thus designed to be directly metallic and can be produced with higher precision.

[0106] The displacement of the center point in the mounted state, without the eccentric **58** of the eccentric receptacle **68** being introduced, with respect to the longitudinal mid-axis of the drive shaft **56** again causes special drive patterns. A thickening or different dimensional configuration of the drive shaft **56** in the region of the eccentric **58** gives rise to higher deflections of the eccentric reception element **70**.

[0107] The embodiment illustrated in FIG. **39** to **43** relates to the head region **14** of an electric toothbrush. The head design described can be attached in various ways to a drive unit with an energy store of an electric toothbrush. On the one hand, it is possible to implement the head design on a correspondingly configured plug-on brush. Consequently, the drive part and brush part of the electric toothbrush are sepa-

rated, thus making it possible to exchange the plug-on brush **54** when it is worn. On the other hand, the components may be formed integrally. This means that, when the brush is worn, the entire appliance has to be replaced.

[0108] The plug-on brush **54** is configured such that, when the brush part is plugged onto the drive unit, the drive shaft **56** of the plug-on brush **54** is coupled together with the drive shaft of the drive unit.

[0109] The set-up of the head region, that is to say the head carrier **60**, drive shaft **56** and head element **65**, makes it possible to have a wide diversity of variants at minimal outlay. For the implementation of, for example, various movement patterns or various head designs, the head element **65** may be configured differently. It is thus possible to manage without any variation in the other parts.

[0110] The mounting of the multipart head region **14** takes place in several steps. First, the drive shaft **56** is introduced into the bristle-tufted head element **65**. Thereafter, this combination is mounted together into the head carrier **60**, that is to say, first, the drive shaft **56** is threaded in and then the head element **65** is placed on the basic body, subsequently the drive shaft **56** is introduced into the axle receptacle **66**, and finally the head element **65** is fastened to the head carrier **60**, for example by means of ultrasonic welding or other suitable fixing methods. After these steps, connection to the drive unit or to the gear takes place.

[0111] All the above-described embodiments of the toothbrush **10** according to the invention, in particular of its head region **14**, may also be transferred to electric toothbrushes, for example with oscillating, pivoting or vibrating heads, to other body care brushes, such as, for example, mascara brushes, nail varnish brushes, hairbrushes, and also to domestic brushes, for example, and not exclusively, to wash-off brushes, wiper sets, shoe brushes, scrubbers, brooms or grill brushes. Likewise, instead of bristles **16**, also only cleaning or massaging elements **18** may be formed on the bristle carrier elements **22** and thereby form an instrument which, for example, is to be used exclusively as a tongue cleaner.

[0112] The most important precondition for producing the toothbrush **10** according to the invention is the possibility of injection-molding or applying hard and soft material H, W in sheet-like or film-like thin layers. In production by an injection-molding method, it is necessary for this purpose, for example for the hard material H preferably used, which does not tend to brittle fractures, particularly preferably polypropylene PP, to have injection-molding pressures in the injection-molding die of above 800 bar, preferably of between 1000 and 1500 bar. Normally, polypropylene for toothbrushes with corresponding cross sections is processed at an injection-molding pressure of 500 bar to 750 bar. The temperature of the hard material H to be injected amounts in this case to between 220° C. and 280° C., preferably to between 235° C. and 265° C. It may be mentioned that the preferred injection-molding pressures mentioned amount to a multiple of what is used for the production of conventional toothbrushes. The use of said injection-molding parameters ensures that the sheet-like hard film **24** has the desired sheet-like flexible properties, and at the same time the bristle carrier elements **22** can be shaped in the desired configuration and size without sink marks. For forming specific curved top sides **28**, and also blindholes **38** or throughholes **48** running obliquely with respect to the top side **28**, it is necessary, where appropriate, to use slides and cores in the injection-molding dies to be employed.

[0113] Of course, the design variants shown in this publication are by way of example, and the individual features and elements of these design variants may be combined with other design variants, without departing from the scope of this invention.

1. A toothbrush with a grip region and with a neck region which is contiguous to the grip region and which carries, opposite the grip region, a head region which has at least one bristle carrier element for the reception of bristles, the bristles emerging from at least one upper carrier element orifice toward a top side of the toothbrush, and the bristle carrier element being deflectable elastically with respect to the neck region, wherein the bristle carrier element (**22**) is connected elastically to the neck region via a sheet-like hard film consisting of a hard material, the sheet-like hard film extending at least in portions, flush on the outside, around the upper carrier element orifice.

2. The toothbrush as claimed in claim **1**, wherein measured between the top side and an opposite underside, the thickness of the sheet-like hard film is a lot smaller than the length of the bristle carrier element, and the thickness of the sheet-like hard film amounts to 0.08 mm to 0.6 mm.

3. The toothbrush as claimed in claim **1**, wherein the wall thickness of the bristle carrier element corresponds to a minimum of 1 to 2 times, a maximum of 4 to 8 times, the thickness of the sheet-like hard film.

4. The toothbrush as claimed in claim **1**, wherein the bristle carrier element can be elastically angled, in particular at right angles to the top side, with respect to a longitudinal axis and/or a transverse axis of the head region and/or can be elastically rotated about an axis of the head region.

5. The toothbrush as claimed in claim **1**, wherein the toothbrush has a plurality of bristle carrier elements which are connected to the neck region and, if appropriate, to one another via the sheet-like hard film and of which the deflection out of a unloaded position of rest is limited in each case by an adjacent bristle carrier element or adjacent bristle carrier elements, and the maximum deflection angle, measured between the mid-normal of the foremost upper carrier element orifice in the flat state and the mid-normal of the foremost upper carrier element orifice in the deflected state, amounts to 30° to 75°.

6. The toothbrush as claimed in claim **1**, wherein the bristle carrier element is of sleeve-like shape.

7. The toothbrush as claimed in claim **6**, wherein the bristles are melted with one another in their carrier element-side end region at a lower carrier element orifice, opposite the top side, of the bristle carrier element.

8. The toothbrush as claimed in claim **1**, wherein the bristle carrier element is of cup-like shape with a bottom and thereby forms a blindhole in which the bristles are fastened by means of anchors.

9. The toothbrush as claimed in claim **1**, wherein the bristle carrier element is designed to be exposed at least in portions toward the underside opposite the top side.

10. The toothbrush as claimed in claim **9**, wherein edges or recurring elements or structures are formed on the underside of the bristle carrier element in order to form a tongue scraper.

11. The toothbrush as claimed in claim **1**, wherein the bristle carrier element and the sheet-like hard film are produced from a single hard material.

12. The toothbrush as claimed in claim **1**, wherein the hard material is a plastic not tending to brittle fractures, including polypropylene, polyester, polycyclohexanediamethanol-

terephthalate, polyethylene, polymethylmethacrylate, polyoxymethylene or polyamide and in addition to the bristle carrier element and the sheet-like hard film, further parts of the toothbrush consisting of the hard material are produced by means of injection-molding.

13. The toothbrush as claimed in claim **1**, wherein a layer consisting of a further material is applied to the sheet-like hard film.

14. The toothbrush as claimed in claim **13**, wherein the further material is a soft plastic material, including low density polyethylene, high density polyethylene, polyethylene, polyvinylchloride, polyurethane or a thermoplastic elastomer.

15. The toothbrush as claimed in claim **13**, wherein the layer thickness of the further material amounts to between 0.2 mm and 1 mm.

16. The toothbrush as claimed in claim **13**, wherein the total thickness of the sheet-like hard film consisting of the hard material and of the further layer consisting of a soft material amounts to between 0.28 mm and 1.3 mm.

17. The toothbrush as claimed in claim **13**, wherein the ratio of the layer thickness of the sheet-like hard film to the layer thickness of a soft material located above it and forming the further material layer amounts to 12.5:1 to 0.8:1.

18. The toothbrush as claimed in claim **13**, wherein the further material layer is a soft material on the bristle carrier element that forms on the top side and/or on the opposite underside a bead which, if appropriate, is enlarged in the longitudinal direction of the bristles.

19. The toothbrush as claimed in claim **1**, wherein the bristle carrier element has two to eighteen upper carrier element orifices.

20. The toothbrush as claimed in claim **1**, wherein elastomeric cleaning and/or massaging elements are arranged on the bristle carrier element.

21. The toothbrush as claimed in claim **13**, wherein the further material layer is of soft material and the elastomeric cleaning and/or massaging elements are manufactured with the same material and from the same injection-molding point.

22. The toothbrush as claimed in claim **1**, wherein the top side of the head region has one or more curvatures, as seen from the top side.

23. The toothbrush as claimed in claim **1**, wherein the thickness and the material of the sheet-like hard film are selected such that, under a force of 5N acting in the longitudinal direction of the bristles (**16**), the bristle carrier element is angled by the amount of 5 mm to 10 mm, with respect to its relieved position of rest in the direction of the acting force.

24. The toothbrush as claimed in claim **1**, wherein bending lines formed in the sheet-like hard film extend rectilinearly over only an inner portion of the head region and are angled or branched with respect to outer marginal portions of the latter.

25. The toothbrush as claimed in claim **1**, wherein a material bridge extending beyond the bristle carrier elements is formed on the underside of the head region.

26. The toothbrush as claimed in claim **1**, wherein the toothbrush is equipped with an electric drive device, by means of which can be driven an actuator, which acts on the bristle carrier element, and which deflects said bristle carrier element in order to assist the cleaning action.

27. A method of producing a toothbrush as claimed in claim **1**, wherein in the production of the toothbrush, an injection-molding pressure of more than 800 bar, prevails in a cavity of an injection-molding die for forming the toothbrush.

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