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Inventor(s)	Kumpf; Ingo et al.

METHOD FOR PRODUCING BRISTLE PRODUCTS, AND BRISTLE PRODUCT PRODUCTION DEVICE

Abstract

A method for producing bristle products (**1**), in particular brushes, having a bristle carrier (**2**) and a bristle set (**3**) of bristle filaments (**4**), wherein a bristle carrier (**2**) and fastening-proximal ends (**5**) of bristle filaments (**4**) are connected to one another by a thermal joining process, and the bristle carrier (**2**), in particular its external contour, is deformed from an initial shape to a target shape by a temperature variation of the bristle carrier (**2**). A bristle product production device (**100**) to carry out the method is also provided.

Inventors: **Kumpf; Ingo (Todtnau, DE), König; Marc (Wittnau, DE), Zimmermann; Stefan (Zell im Wiesental, DE), Kiefer; Florian (Fröhnd, DE)**

Applicant: **Zahoransky AG** (Todtnau, DE)

Family ID: **1000008486883**

Assignee: **Zahoransky AG (Todtnau, DE)**

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from German Patent Application No. 10 2024 104 581.7, filed Feb. 19, 2024, which is incorporated herein by reference as if fully set forth.

TECHNICAL FIELD

[0002] The invention relates to a method for producing bristle products, in particular brushes, and to a bristle product production device.

BACKGROUND

[0003] Bristle products are known in various embodiments, for example as brushes or else as toothbrushes. The shaping of a brush, in particular of its bristle carrier, contributes significantly toward its performance characteristics.

[0004] In this context, shapes of the bristle carrier that however may also impede the production of the bristle product, in particular fastening of the bristle filaments to the bristle carrier, are also conceivable and desirable.

SUMMARY

[0005] It is, therefore, an object of the invention to provide a method and a device of the type mentioned at the outset, which permit bristle products, in particular brushes, with improved performance characteristics and a greater degree of freedom in terms of design to be efficiently produced.

[0006] In order to achieve this object, the method having one or more of the features disclosed herein is firstly provided. Proposed in particular for achieving the object is thus a method for producing bristle products, in particular brushes, preferably toothbrushes, which have a bristle carrier and a bristle set of bristle filaments, wherein a bristle carrier and fastening-proximal ends of bristle filaments are connected to one another by a thermal joining process, and wherein the bristle carrier, in particular its external contour, is deformed from an initial shape to a target shape by a temperature variation of the bristle carrier.

[0007] In this way, an adaptation of the shape of the bristle carrier, and in particular of its external contour, is brought about while utilizing the temperature variation of the bristle carrier in the thermal joining process. Any mechanical deformation of the bristle carrier, thus a deformation in which the bristle carrier is impinged with a force by a mechanical tool and is thus deformed, can be avoided in this procedure. The bristle filaments and the bristle carrier used when carrying out the method are preferably composed of plastics material.

[0008] The method according to the invention enables an efficient deformation which is particularly gentle on the bristle carrier. Damage to the bristle carrier due to its deformation can be avoided in the process, because the bristle carrier can be deformed without applying a mechanical molding tool.

[0009] The force for deforming the bristle carrier can be generated, preferably solely, by the temperature variation of the bristle carrier to which the bristle carrier is subjected in the thermal joining process. The temperature variation can consist in heating and/or cooling of the bristle carrier.

[0010] The bristle carrier and the fastening-proximal ends of the bristle filaments can be heated in order to bring the bristle carrier and the fastening-proximal ends to the temperature desired for their connection. The connection between the bristle carrier and the bristle filaments can be a materially integral connection. The connection between the bristle carrier and the bristle filaments can be established without the use of fastening anchors or fastening loops.

[0011] In one embodiment of the method, the fastening-proximal ends of the bristle filaments—as opposed to the bristle carrier—can be fused. The bristle carrier and the bristle filaments of the bristle set can subsequently be connected to one another. The bristle filaments and the bristle carrier can be brought into contact with one another once they have been heated, so as to enable the connection between the bristle filaments and the bristle carrier.
[0012] In one preferred embodiment of the method, it is provided that the bristle carrier is deformed by the temperature variation after the bristle carrier has been connected to the bristle filaments. Connecting the bristle filaments to the bristle carrier can thus take place while the bristle carrier has not yet been deformed, which may simplify the connection between the bristle carrier and the bristle filaments because the bristle carrier in its initial shape may have a shape which is favorable for connecting to the bristle filaments and is only subsequently imparted its shape optimized in terms of the performance characteristics. In this embodiment of the method, the bristle carrier is then deformed by the temperature variation only once the connection between the bristle filaments and the bristle carrier has been established.
[0013] In one embodiment of the method, the bristle carrier, in particular its bristle set side, is concavely deformed by the temperature variation. As a result of this concave deformation, a user-proximal surface of the bristle set, thus the surface in which the free ends of the bristle filaments are then disposed on the bristle product, is also ultimately concavely deformed. A bristle set deformed in such a manner can be particularly suitable for special cleaning operations, for example for cleaning teeth, if the bristle product is designed and used as a toothbrush.
[0014] The thermal joining process can comprise a cooling step in which the bristle filaments and/or the bristle carrier are cooled so as to deform the bristle carrier. The temperature variation for deforming the bristle carrier can thus comprise cooling the bristle carrier. The process step of the thermal joining process in which the bristle carrier is cooled can comprises active and/or passive cooling of the bristle carrier. In passive cooling, the bristle carrier can be exposed to the ambient temperature, for example, and then cool down by discharging heat to the environment. The cooling time of the bristle carrier can be reduced or influenced in a targeted manner by actively cooling the bristle carrier by means of a cooling device, for example. The cooling device herein can apply a cooling temperature which may be below the average room temperature of a room in which the method is applied.
[0015] The bristle carrier can have a pre-load which is caused by its production, for example by injection molding. The pre-load can be reduced or dissipated by the thermal joining process while deforming the bristle carrier. Due to the pre-loading of the bristle carrier in its non-deformed initial position, the bristle carrier can have a shape that deviates from the target shape. The bristle carrier can then change its pre-loaded initial shape while dissipating the pre-load, and assume the desired target shaped. It is thus conceivable, for example, that the bristle carrier in its initial shape has a negative curvature, thus is convexly curved on its bristle set side, for example. The negative curvature can be cancelled by the deformation of the bristle carrier in such a way that the bristle carrier after the thermal joining process then has a flat bristle set side without a curvature.
[0016] In one embodiment of the method, the bristle carrier is at least peripherally heated to a temperature above its glass transition temperature. The heating of the bristle carrier to a temperature above its glass transition temperature can facilitate the preferably materially integral connection between the bristle carrier and the bristle filaments, on the one hand, and also its deformation caused by the temperature variation, on the other hand.
[0017] The bristle carrier can have a pre-load which is caused by additives in its material and/or an admixture in the bristle carrier such as, fibers for example, which pre-load is reduced or dissipated by the temperature variation of the bristle carrier in the thermal joining process while deforming the bristle carrier.
[0018] In another embodiment of the method, the bristle carrier can consist of at least two plastics-material components which have different coefficients of thermal expansion and/or different

shrinkage properties and/or form different portions of the bristle carrier. In this way, the bristle carrier can deform differently due to the temperature variation in the different portions.
[0019] In one embodiment of the method it is provided, for example, that the bristle carrier on its bristle set side consists of a first plastics-material component, while its rear side is formed from a second plastics-material component which has a coefficient of thermal expansion deviating from the first plastics-material component and/or a different shrinkage behavior.
[0020] In the event of a temperature variation of the bristle carrier, the different reactions which the different plastics-material components display in terms of their shape and/or deformation in response to a temperature variation can then be utilized for an overall deformation of the bristle carrier to the desired target shape.
[0021] In one embodiment of the method, the deformation of the bristle carrier can at least in portions be restricted by a detent. A filament holder by which the bristle filaments are held when connecting to the bristle carrier can serve as a detent, for example.
[0022] In one embodiment of the method, the deformation of the bristle carrier can also be predefined by an initial geometry of the bristle carrier.
[0023] In the process, the bristle carrier can have a preferably pre-loaded initial shape which changes to the target shape due to the temperature variation of the bristle carrier, as has already been explained above. The bristle carrier can also have local material thickenings which predefine the deformation of the bristle carrier by the temperature variation of the bristle carrier in a targeted manner. The same also applies to cross-sectional reductions, recesses, constrictions or comparable local material weak spots which may be provided by the initial geometry of the bristle carrier and which predefine the deformation of the bristle carrier during temperature variations of the bristle carrier.
[0024] The bristle carrier can have at least one defined deformation region which has a lower resistance to deformation in comparison to an adjacent region of the bristle carrier. The deformation region can thus be a region of the bristle carrier that by virtue of its position on the bristle carrier influences and defines the deformation by the temperature variation of the bristle carrier in a targeted manner.
[0025] The bristle carrier can have at least one reinforcement region, in particular in which the bristle carrier has a greater material thickness and/or is provided with a reinforcement. The reinforcement region can have a greater resistance to deformation than a neighboring region of the bristle carrier. A deformation of the bristle carrier can then also be influenced in a targeted manner by the at least one reinforcement region of the bristle carrier.
[0026] In one embodiment of the method, it can be provided that the bristle carrier for deformation is heated locally to a higher or lower temperature than in an adjacent region. The adjacent region can be a region adjacent to the region of the local temperature control of the bristle carrier.
[0027] A temperature gradient between a bristle set side of the bristle carrier and a rear side of the bristle carrier can be generated in order to deform the bristle carrier. This temperature gradient can also influence the deformation of the bristle carrier from the initial shape to the target shape.
[0028] As has already been discussed above, the thermal joining process can comprise a cooling step in which the bristle carrier is preferably actively cooled and deformed to the target shape by the bristle carrier. It is also possible for the bristle carrier to be locally cooled and to be locally heated at another location. Generating a temperature gradient on different sides of the bristle carrier can also be caused by local heating and local cooling of the bristle carrier.
[0029] For the targeted deformation of the bristle carrier, a cooling time and/or a cooling rate can be predefined. As has already been explained above, the bristle carrier can be locally cooled, and different regions of the bristle carrier can be cooled using different temperatures and/or cooling rates and/or cooling times. This can also cause a targeted deformation of the bristle carrier due to its temperature variation.
[0030] The bristle carrier can be held by a holder which contacts the bristle carrier only by way of a

sub-region of its external face. The external face can be, for example, an external face of the bristle carrier adjacent to the bristle set side, said external face including the rear side of the bristle carrier that faces away from the bristle set side.

[0031] The use of a holder of this type is helpful, in particular for producing a bristle product with a delicate bristle carrier and/or with a bristle set with only a minor peripheral spacing from the periphery of the bristle carrier. It has been specifically demonstrated that a mechanical contact between the holder and the bristle carrier can influence the thermal joining process between the bristle carrier and the bristle filaments. As a result of its mechanical contact with the bristle carrier, the holder can lead to a discharge of process heat from the bristle carrier. In this way, in particular peripheral regions of the bristle carrier can be undesirably cooled due to the mechanical contact between the holder and the bristle carrier, which can potentially compromise a reliable connection, based on a secure process, between the bristle filaments and the bristle carrier specifically in the peripheral region of the bristle carrier.

[0032] Owing to the fact that the holder contacts the bristle carrier only by way of a sub-region of its external face, any discharge of heat from the bristle carrier caused by the holder can be reduced to a tolerable amount with a view to a secure connection between the bristle carrier and the bristle filaments.

[0033] The bristle carrier can be held by a holder that has a holding contour for holding at least one bristle carrier, which is penetrated by at least one clearance in such a way that the holder contacts the bristle carrier only by way of a sub-region of its external face. For example, the holder can have at least one recess as a clearance, so that any direct mechanical contact between the holder and a rear side of the bristle carrier is established only by way of part of the rear side of the bristle carrier. Owing to the at least one clearance on the holder, an air cushion can be formed at least across a sub-region of the rear side of the bristle carrier, for example, while the bristle carrier is disposed on the holder. This also avoids any undesirable discharge of heat from the bristle carrier when carrying out the thermal joining process.

[0034] A user-proximal surface of the bristle set, which can also be referred to as the cleaning side, can be contoured when carrying out the method. This can take place prior to connecting the bristle filaments to the bristle carrier, while connecting the bristle filaments to the bristle carrier and/or upon connecting the bristle filaments to the bristle carrier.

[0035] For contouring the cleaning side of the bristle set it is possible to support the bristle filaments, in particular on their cleaning side, with a profiled counter-holder. For this purpose, the bristle product production device—which will be explained in more detail hereunder—can have a correspondingly profiled counter-holder.

[0036] Potential fastening-proximal projections of the bristle filaments of the thus profiled bristle set can be fused or burnt away, and leveled out as a result, by the thermal joining process. Trimming potential fastening-proximal projections is also conceivable in order to level out the fastening side of the bristle set prior to or when carrying out the thermal joining process.

[0037] In one embodiment of the method, it is provided that the bristle carrier and fastening-proximal ends of the bristle filaments of the bristle set for connecting to one another are pressed against one another with a defined joining force. The joining force can be between 0 and 10 Newton, for example. Connecting the bristle carrier to the bristle filaments while applying a defined joining force can have a positive effect on the quality of the fastening of the bristle filaments to the bristle carrier.

[0038] The joining force can be determined by a force measuring device, in particular by a load cell, by a compression spring and/or by means of a current consumption of an actuating drive by which the holder and the bristle filaments are pressed against one another. The joining force determined by the force measuring device can then be compared with a target value, and the actuating drive by which the bristle carrier and the bristle filaments are pressed against one another can be correspondingly readjusted. The joining force measured can serve as an input variable for a

control unit of a bristle product production machine which is specified to carry out the method.
[0039] The control unit of the bristle product production machine can then correspondingly readjust the actuating drive as a function of the actually measured joining force, so as to perform the connection between the bristle carrier and the bristle filaments with the desired joining force.
[0040] The force measuring device can also be specified to determine the joining force by means of a current consumption of an actuating drive by which the holder and the bristle filaments are pressed against one another.
[0041] If the force measuring device comprises a compression spring, the joining force can be determined by means of a compression of the compression spring, based on the known spring characteristic of the latter.
[0042] Also provided for achieving the object is also a bristle product production device which is specified to carry out the method for producing a bristle product as disclosed herein.
[0043] The bristle product production device can have a heating device which is specified to heat fastening-proximal ends of bristle filaments of a bristle set and a bristle carrier to which the bristle filaments of the bristle set are to be connected. The heating device herein can be specified to fuse the fastening-proximal ends of the bristle filaments—as opposed to the bristle carrier.
[0044] The heating device can comprise two heating surfaces of which a first heating surface is provided for heating fastening-proximal ends of bristle filaments of a bristle set of a bristle product to be produced, and a second heating surface is provided for heating a bristle carrier of the bristle product to be produced and to which the bristle filaments of the bristle set are to be connected.
[0045] The heating device can be specified to heat the fastening-proximal ends of the bristle filaments and the bristle carrier to different temperatures. For this purpose, the heating device can be specified to heat its heating surfaces to different temperatures. Heating the fastening-proximal ends of the bristle filaments and the bristle carrier herein can take place by heat radiation, for example. In this context, the heating device can have at least one heating element, for example a glow bar and/or a heating reflector.
[0046] The heating device can be specified to heat the first heating surface to a temperature which is sufficient for fusing the fastening-proximal ends of the bristle filaments. The heating device can also be specified to heat the second heating surface to a temperature which is sufficient to heat the bristle carrier to a temperature below its melting temperature and/or above its glass transition temperature. This can have a positive effect with a view to a reliable connection between the bristle filaments and the bristle carrier.
[0047] In one embodiment of the bristle product production device, the two heating surfaces face away from one another. The heating element, or the heating elements, on which the heating surfaces can be formed, can thus be disposed between the bristle filaments offered up for connecting, on the one hand, and the bristle carrier, on the other hand, in order to correspondingly heat the bristle carrier and the fastening-proximal ends of the bristle filament for their connection.
[0048] The bristle product production device can have a cooling device for actively cooling the bristle carrier, so as to be able to carry out the cooling step, already mentioned above, in the thermal joining process.
[0049] The bristle product production device can have a filament holder for holding, in particular in a clamping manner, the bristle filaments of the bristle set. As has already been discussed in the context of the method, the filament holder can serve as a detent for restricting a deformation of the bristle carrier.
[0050] Also provided in order to achieve the object is also a bristle product production device having one or more of the features disclosed herein, directed toward a bristle product production device of this type. This bristle product production device can also be specified for producing bristle products having a bristle carrier and a bristle set of bristle filaments, in particular according to the method directed toward such a method. The bristle product production device has a holder which is specified to hold, in particular in a clamping manner, at least one bristle carrier by way of

a sub-region of its external face.
[0051] The holder can be specified and provided to hold at least one bristle carrier when carrying out the thermal joining process already described in detail above.
[0052] Due to its design, this special holder avoids an excessive discharge of heat from the held bristle carrier when carrying out the thermal joining process. This facilitates a reliable connection between bristle filaments and a bristle carrier which has only a small mass and/or a minor volume, and therefore, as a result of the mechanical contact between the holder and the bristle carrier, would potentially cool down too rapidly for a secure connection between the bristle filaments and the bristle carrier.
[0053] The holder can have a holding contour for holding at least one bristle carrier, which can be formed on a holding space of the holder for a bristle carrier and/or be penetrated by at least one clearance. The clearance can be a clearance that avoids any direct contact between the bristle carrier and the holder, in particular between the holder and a rear side of the bristle carrier.
[0054] As a clearance, the holder can have at least one recess on a holding space for a bristle carrier, for example. The at least one recess can be a recess that faces a holding space for a bristle carrier and/or a rear side of a bristle carrier located in a holding position on the holder. The recess can be present in the form of a pocket or a depression, for example. An air cushion between the material of the holder and the bristle carrier located at the holding space can the form in this clearance, as a result of which any direct mechanical contact between the holder and the bristle carrier, and an associated discharge of heat from the bristle carrier, can be avoided.
[0055] The holder can have at least one holding finger which forms at least part of the holding contour. The holding finger can have a contact face with the bristle carrier, which is significantly smaller than the external face of the bristle carrier to be held.
[0056] The holder can be designed as a gripper and have at least two mutually assigned gripper jaws on which is formed at least part of the holding contour of the holder. At least one pair of mutually assigned holding fingers can be disposed on the gripper jaws. In this way, each gripper jaw can have at least one holding finger. Each gripper jaw can also have a clearance in a side that faces a rear side of a bristle carrier to be gripped, by way of which any direct contact between the gripper jaw and the bristle carrier can be avoided.
[0057] For contouring the cleaning side of the bristle set it is possible for the bristle filaments to be supported by a profiled counter-holder. For this purpose, the bristle product production device can have a correspondingly profiled counter-holder.
[0058] In one embodiment of the bristle product production device, the latter has an actuating drive which is specified to press with a defined joining force a bristle carrier against offered-up bristle filaments so as to connect the bristle carrier to the bristle filaments.
[0059] The bristle product production device can have a force measuring device, for example with a load cell and/or a compression spring, for determining the joining force.
[0060] In one embodiment, the force measuring device of the bristle product production device can be disposed in the force flux direction between the actuating drive and the holder for the bristle carrier. A driving force of the actuating drive can then be transmitted to the holder by way of the force measuring device, in particular if the latter is designed as a load cell.
[0061] For transmitting the driving force of the actuating drive to the load cell, a first force transmission element, in particular a strut, can be disposed between the actuating drive and the load cell.
[0062] A second force transmission element, in particular a second strut, by way of which the driving force can then be transmitted as the joining force from the load cell to the holder, can be disposed between the load cell and the holder.
[0063] For example, a pneumatic, hydraulic or electric actuating drive can be used as the actuating drive. A pneumatic actuating drive can comprise at least one pneumatic cylinder, for example. A hydraulic actuating drive can comprise at least one hydraulic cylinder, for example.

[0064] When using an electric actuating drive, the joining force which is transmitted from the actuating drive to the bristle carrier by way of the holder can also be determined by means of a current consumption of the electric actuating drive. In this embodiment of the bristle product production device, the force measuring device is thus specified for deriving a joining force from a current consumption of the actuating drive.
[0065] The bristle product production device can have a control unit which is specified to control the actuating drive as a function of a determined joining force.
[0066] A value representing the joining force can be used by a control unit of the bristle product production device as an input variable, as a function of which the actuating drive is controlled in order to perform the connection between the bristle carrier and the bristle filaments with the defined joining force.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0067] The invention will be described in more detail hereunder with reference to exemplary embodiments, but is not limited to these exemplary embodiments. Further exemplary embodiments are derived by combining the features of individual or of a plurality of claims with one another, and/or by combining individual or a plurality of features of the exemplary embodiments. In the figures:
[0068] FIG. **1** shows a perspective view of a bristle product production device according to the invention, having a holder for a bristle carrier, the holding contour thereof being penetrated by clearances in such a way that a discharge of heat from the bristle carrier in the thermal joining process, caused by mechanical contact between the holder and the bristle carrier, is reduced;
[0069] FIG. **2** shows the detail marked by the circle in FIG. **1** in an enlarged illustration;
[0070] FIG. **3** shows a perspective lateral view of the device shown in FIG. **1**;
[0071] FIG. **4** shows the device shown in the preceding figures, having a heating device located in the heating position between the bristle carrier and the bristle filaments when heating the bristle carrier and the fastening-proximal ends of the bristle filaments;
[0072] FIG. **5** shows the situation shown in FIG. **4** in a perspective lateral view;
[0073] FIG. **6** shows the device shown in the preceding figures, having the bristle carrier positioned by the holder of the device in the joining position at the fastening-proximal ends of the bristle filaments;
[0074] FIG. **7** shows the situation shown in FIG. **6** in a perspective lateral view;
[0075] FIG. **8** shows the device shown in the preceding figures, having an activated cooling device for carrying out a cooling step of the thermal joining process;
[0076] FIG. **9** shows the situation shown in FIG. **8** in a perspective lateral view;
[0077] FIG. **10** shows the device shown in the preceding figures, having the bristle carrier still located on the filament holder but already connected to the bristle filaments, wherein the cooling device is still activated for cooling the bristle product thus generated;
[0078] FIG. **11** shows the situation shown in FIG. **10** in a perspective lateral view;
[0079] FIG. **12** shows a perspective lateral view of the bristle product still located on the filament holder of the device;
[0080] FIG. **13** shows a perspective lateral view of the bristle product from FIG. **12**, wherein the bristle product has been retrieved from the filament holder by a retrieving device, and the bristle carrier is still not deformed;
[0081] FIG. **14** shows a perspective lateral view of the bristle product from FIG. **13**, wherein the bristle carrier has already been somewhat deformed by its temperature variation, presently by its cooling;

[0082] FIG. **15** shows a perspective lateral view of the bristle product from FIG. **14**, having the bristle carrier deformed to its target shape;
[0083] FIG. **16** shows a perspective view of a further bristle product production device according to the invention, having a holder for a bristle carrier, the holding contour thereof being penetrated by clearances in such a way that a discharge of heat from the bristle carrier heated in the thermal joining process, caused by mechanical contact between the holder and the bristle carrier, is reduced, wherein the bristle product production device has a force measuring device for determining a joining force with which a bristle carrier disposed on the holder is pressed against fastening-proximal ends of bristle filaments in thermal joining; and
[0084] FIG. **17** shows the bristle product production device shown in FIG. **16** in a perspective lateral view.

DETAILED DESCRIPTION

[0085] All of the figures show at least parts of a bristle product production device which as an entity is denoted by the reference sign **100**. The bristle product production device **100** is specified to produce bristle products **1**. In the exemplary embodiment shown, the bristle products **1** which can be produced on the bristle product production device **100** are brushes, specifically toothbrushes.
[0086] The bristle product **1** which is able to be produced by the bristle product production device **100** has a bristle carrier **2** and a bristle set **3** of bristle filaments **4**. Both the bristle carrier **2** as well as the bristle set **3** of bristle filaments **4** herein consist of a plastics material.
[0087] In the method for producing bristle products **1**, which can be carried out on the bristle product production device **100**, the bristle carrier **2** and fastening-proximal ends **5** of the bristle filaments **4** are connected to one another by a thermal joining process. In the process, the bristle carrier **2**, specifically its external contour, is deformed from an initial shape to a target shape by a temperature variation of the bristle carrier **2**. A force for deforming the bristle carrier **2** is generated by the temperature variation of the bristle carrier **2**. The deformation of the bristle carrier **2** can thus take place without any mechanical forces directed into the bristle carrier **2**.
[0088] For connecting to one another, the bristle carrier **2** and the fastening-proximal ends **5** of the bristle filaments **4** are heated. The fastening-proximal ends **5** of the bristle filaments **4** herein—as opposed to the bristle carrier **2**—are fused. Subsequently, the bristle carrier **2** and the bristle filaments **4** of the bristle set **3** are connected to one another, as is shown in FIGS. **6** and **7**.
[0089] FIGS. **4** and **5** show the situation in which the bristle carrier **2** as well as the fastening-proximal ends **5** of the bristle filaments **4** are heated prior to being connected to one another.
[0090] The bristle carrier **2** is deformed by the temperature variation after the bristle carrier **2** has been connected to the bristle filaments **4**. The deformation of the bristle carrier **2** upon connecting the bristle carrier **2** to the bristle filaments **4** is shown in FIGS. **12** to **15**. FIG. **15** in particular shows that the bristle carrier **2**, specifically its bristle set side **6** in particular, is concavely deformed by the temperature variation.
[0091] In the exemplary embodiment shown in the figures, the method provides that the bristle carrier **2** is deformed automatically by the thermal joining process and by a temperature variation of the bristle carrier **2** caused in the process.
[0092] FIGS. **8** to **11** show that the thermal joining process can comprise a cooling step. The bristle filaments **4** and/or the bristle carrier **2** are actively cooled in the cooling step. On the one hand, cooling can take place in order to faster cure the connection between the bristle filaments **4** and the bristle carrier **2**, and on the other hand in order to deform the bristle carrier **2** in a targeted manner, or in order to restrict its deformation, respectively.
[0093] Depending on the embodiment of the method, a bristle carrier **2** which has a pre-load caused by its production, preferably by injection molding, can also be used. The pre-load in this instance can be reduced or dissipated by the temperature variation of the bristle carrier **2** in the thermal joining process while deforming the bristle carrier **2**.

[0094] The temperature management in the method can provide that the bristle carrier **2** is at least peripherally heated to a temperature above its glass transition temperature when carrying out the thermal joining process. The material of which the bristle carrier **2** is composed becomes soft when reaching the glass transition temperature, which may favor a reliable connection between the bristle carrier **2** and the bristle filaments **4**.
[0095] In one embodiment of the method, it is provided that a bristle carrier **2** which has a pre-load caused by additives and/or an admixture in the bristle carrier **2**, such as fibers for example, is used. The pre-load can be reduced or dissipated by the temperature variation of the bristle carrier **2** in the thermal joining process while deforming the bristle carrier **2**.
[0096] The bristle carrier **2** which is used in one embodiment of the method can consist of at least two plastics-material components which can form different portions of the bristle carrier **2**. The bristle carrier **2** can then deform differently due to the temperature variation in the different portions, in particular when the different portions of the bristle carrier **2** produced from the different plastics-material components react differently to the temperature variation of the bristle carrier **2**.
[0097] The deformation of the bristle carrier **2** can at least in portions be restricted or delayed by a detent **7**, presently a filament holder **8** of the bristle product production device **100**. The detent **7** is provided by the filament holder **8** of the bristle product production device **100** by which the bristle filaments **4** are held when connecting to the bristle carrier **2**.
[0098] The deformation of the bristle carrier **2** can also be predefined by an initial geometry of the bristle carrier **2**. In this way it is possible, for example, that the bristle carrier **2** is deformed in the initial position, and herein has a pre-load which has been mechanically incorporated into the bristle carrier **2**. This pre-load can then be dissipated—similar to a stress relief heat treatment, so to speak—as a result of which the bristle carrier **2** then changes its initial shape and assumes its target shape.
[0099] The bristle carrier **2** can have at least one defined deformation region which has a lower resistance to deformation in comparison to an adjacent region of the bristle carrier **2** and influences the deformation of the bristle carrier **2**. Furthermore, the bristle carrier **2** can have at least one reinforcement region, in particular in which the bristle carrier **2** has a greater material thickness and/or is provided with a reinforcement. The reinforcement region can have a higher resistance to deformation than an adjacent region of the bristle carrier **2** and influence the deformation of the bristle carrier **2**.
[0100] In one embodiment of the method, the bristle carrier **2** for deforming can be locally heated to a higher or a lower temperature than in an adjacent region. Owing to the local heating of the bristle carrier **2** to a temperature different than in adjacent regions, the deformation of the bristle carrier **2** can also be controlled in a targeted manner.
[0101] For deforming the bristle carrier **2**, a temperature gradient between different portions of the bristle carrier **2**, in particular between a bristle set side **6** of the bristle carrier **2** and a rear side **9** of the bristle carrier **2**, can be generated. Generating a temperature gradient is achieved, for example, by the cooling step as part of the thermal joining process, which is shown in FIGS. **8** and **9**, or **10** and **11**, respectively.
[0102] It can be seen in FIGS. **10** and **11** that the rear side **9** of the bristle carrier **2** is actively cooled, while the bristle filaments **4** are still located within the filament holder **8** and are thus not cooled. As a result, the bristle set side **6** of the bristle carrier **2** is also protected against direct cooling, because said bristle set side **6** faces the filament holder **8** and faces away from a cooling device **17** of the bristle product production device **100**, as is likewise highlighted in FIGS. **10** and **11**.
[0103] A cooling time as well as a cooling rate can be predefined for the targeted deformation of the bristle carrier **2**. Moreover, the bristle carrier **2** can be locally cooled, as is shown in FIGS. **10** and **11**. In the latter, only a rear side **9** of the bristle carrier **2** is directly cooled in that the rear side **9**

of the bristle carrier **2** is impinged with cold air by the cooling device **17**.
[0104] It is furthermore conceivable to cool different regions of the bristle carrier **2** using different temperatures and/or cooling rates and/or cooling times.
[0105] Furthermore, the bristle carrier **2** is held by a holder **10** which is part of the bristle product production device **100** and is moreover designed in such a way that the bristle carrier **2** in the holder **10** is contacted only by way of a sub-region of its external face **11**. The external face **11** can be the surface of the bristle carrier **2** that is adjacent to the bristle set side **6** of the bristle carrier **2** and moreover also comprises the previously mentioned rear side **9** of the bristle carrier **2**. The configuration of the holder **10** can be particularly well seen in the detailed illustration of FIG. **2**.
[0106] Accordingly, the bristle carrier **2** is held by a holder **10** which has a holding contour **12** for holding the bristle carrier **2**, which is penetrated by a plurality of clearances **13** in such a way that the holder **10** contacts the bristle carrier **2** only by way of a sub-region of its external face **11**.
[0107] The bristle product production device **100** which is shown in the figures is specified to carry out the previously described method. For this purpose, the bristle product production device **100** has a heating device **14**. The heating device **14** is specified to heat fastening-proximal ends **5** of the bristle filaments **4** of the bristle set **3** and the bristle carrier **2** to which the bristle filaments **4** of the bristle set **3** are to be connected.
[0108] The heating device **14** herein is specified to fuse the fastening-proximal ends **5** of the bristle filaments **4**—as opposed to the bristle carrier **2**. For this purpose, the heating device **14** comprises two heating surfaces **15** and **16**, of which a first heating surface **15** is provided for heating fastening-proximal ends **5** of the bristle filaments **4** of the bristle set **3** of the bristle product **1** to be produced, and a second heating surface **16** is provided for heating the bristle carrier **2** of the bristle product **1** to be produced.
[0109] The heating device **14** is specified to heat the fastening-proximal ends **5** of the bristle filaments **4** and the bristle carrier **2**, and to fuse the fastening-proximal ends **5** of the bristle filaments **4**—as opposed to the bristle carrier **2**. The heating device **14**, by way of its two heating surfaces **15** and **16**, is thus specified to heat the fastening-proximal ends **5** of the bristle filaments **4** and the bristle carrier **2** to different temperatures. FIGS. **1** to **11** furthermore show that the heating surfaces **15** and **16** face away from one another.
[0110] For carrying out the cooling step already explained above, the bristle product production device **100** furthermore has a cooling device **17** which is shown in use in FIGS. **8** and **9**, or **10** and **11**, respectively. The cooling step of the method, reflected in FIGS. **10** and **11**, does not have to take place in that station of the bristle product production device **100** in which the heating device **14** is used. It is conceivable to transfer the bristle product **1**, which has already been almost completed in FIGS. **10** and **11**, in the clamped state shown, to one or a plurality of downstream cooling stations in order to carry out the cooling step of the thermal joining process in the latter.
[0111] In principle the following correlation may apply: the longer and the more intensely the bristle carrier **2** is cooled after having been connected to the bristle filaments **4**, the smaller the deformation by the thermal joining process. The in particular active cooling of the bristle carrier **2** causes at least partial curing of the bristle carrier **2** in the specifically clamped shape.
[0112] As has already been mentioned above, the bristle product production device **100** comprises a filament holder **8** which can also serve as a detent **7** for restricting or delaying the deformation of the bristle carrier **2**. Furthermore, the filament holder **8** is specified to hold the bristle filaments **4** of the bristle set **3** in a clamping manner.
[0113] Furthermore, a counter-holder **18** of the bristle product production device **100** can be seen below the filament holder. The counter-holder **18** is profiled and serves to profile the bristle set **3** on its cleaning side, thus to provide the latter with a certain profile. Projections of the bristle filaments **4** generated on the fastening side due to the profiling of the bristle set **3** can be leveled out prior to connecting the bristle carrier **2** to the bristle filaments **4**. This leveling out is possible, for example, by trimming the projections, or else by fusing or burning away the fastening-proximal

projections of the bristle filaments **4**. In the method shown in the figures, the fastening-proximal projections of the bristle filaments **4** have already been removed prior to connecting the bristle carrier **2** to the bristle filaments **4**.

[0114] The bristle product production device **100** also has the holder **10**, already described above. The holder **10** is specified to hold at least one bristle carrier **2** by way of a sub-region of its external face **11**.

[0115] For this purpose, the holder **10** has a holding contour **12** for holding at least one bristle carrier **2**. The holding contour **12** is formed on a holding space **19** of the holder **10** and is penetrated by a plurality of clearances **13**. FIG. **2** in particular highlights that the holder **10** has a plurality of holding fingers **20** which form at least part of the holding contour **12** of the holder **10**. Between the individual holding fingers **20** there are clearances **13** in which the holder **10** is not in mechanical contact with the bristle carrier **2** held therein.

[0116] The holder **10** shown in the figures furthermore has a recess **21** as a further clearance **13**, by which the holding contour **12** of the holder **10** is interrupted. The recess **21** faces the holding space **19** and also the rear side **9** of the bristle carrier **2** located in the holding position on the holder **10**.

[0117] The rear-side recess **21** can be particularly readily seen in FIG. **2**. The rear-side recess **21** prevents any direct mechanical contact between the holder **10** and the bristle carrier **2** located on the holder **10** in the region of the rear side **9** of the bristle carrier **2**. The clearances **13** avoid that heat from the bristle carrier **2** is discharged due to mechanical contact between the holder **10** and the bristle carrier **2**, which heat is required for a secure connection between the bristle carrier **2** and the bristle filaments **4**.

[0118] In this way, a bristle product **2** can be produced, of which the bristle set **3** can have a minor peripheral spacing from a circumferential periphery of the bristle carrier **2**. A minor peripheral spacing herein can be as large as, or else smaller than, a bore diameter of a receptacle bore **22** in the bristle carrier **2**.

[0119] FIG. **1** in particular highlights that the bristle carrier **2** has a multiplicity of receptacle bores **22** of this type, in which the fastening-proximal ends **5** of the bristle filaments **4** combined in bundles can be incorporated for fastening to the bristle carrier **2**.

[0120] The holder **10** of the bristle product production device **100** shown in the figures is designed as a gripper and has two mutually assigned and movable gripper jaws **23** and **24**. At least part of the holding contour **12** is formed on each of the two gripper jaws **23** and **24**.

[0121] In this way, the gripper jaws **23** and **24** support in each case four of the total of eight mutually assigned holding fingers **20** of the holder **10**, and also each have half of the rear-side recess **21** serving as the clearance **13**.

[0122] The bristle carrier **2** in its gripper portion **25** is supported and held by a height-adjustable gripper **26** of the bristle product production device **100**. The height-adjustable gripper **26** also functions as a retrieval device of the bristle product production device **100**, by way of which the finished bristle product **1** can be retrieved from the filament holder **8** of the bristle product production device **100**.

[0123] FIGS. **16** and **17** show a further embodiment of a bristle product production device which as an entity is denoted by the reference sign **100** and in terms of construction is identical to the bristle product production device **100** shown in the previous figures.

[0124] The bristle product production device **100** has an actuating drive **29** which is specified to press a bristle carrier **2** with a defined joining force **33** against offered-up bristle filaments **4**, in order to connect the bristle carrier **2** to the bristle filaments **4**.

[0125] In the bristle product production device **100** shown in FIGS. **16** and **17**, the bristle filaments **4** for connecting to the bristle carrier **2** are also disposed in a filament holder **8** of the bristle product production device **100**.

[0126] The bristle product production device **100** which is shown in FIGS. **16** and **17** has a force measuring device **27** having a load cell **28**. The force measuring device **27** by way of its load cell

28 is specified to determine the joining force with which the bristle carrier **2** is pressed against the fastening-proximal ends **5** of the offered-up bristle filaments **4**, in order to connect the bristle carrier **2** and the bristle filaments **4** to one another.

[0127] As can be seen, the force measuring device **27** here is disposed in the force flux direction between the actuating drive **29** and the holder **10**. A pneumatic, a hydraulic or else an electric actuating drive can be used as the actuating drive **29**.

[0128] The bristle product production device **100** has a control unit **30**. The control unit **30** is specified to actuate the actuating drive **29** as a function of the actual joining force determined by the force measuring device **27** in such a way that the bristle carrier **2** on the holder **10** is pressed against the fastening-proximal ends **5** of the offered-up bristle filaments **4** with a desired, defined joining force of, for example, up to 10 Newton, so as to connect the bristle carrier **2** and the bristle filaments **4** to one another.

[0129] The bristle product production device **100** shown in FIGS. **16** and **17** is specified to press a bristle carrier **2** and the bristle filaments **4** of the bristle set **3** against one another in order to connect them to one another. The joining force **33** in the process can be at most 10 Newton, for example.

[0130] The joining force **33** is determined by the force measuring device **27**, already mentioned above, and its load cell **28**.

[0131] FIGS. **16** and **17** show that the load cell **28** is disposed in the force flux direction between the actuating drive **29** and the holder **10** for the bristle carrier **2**. The actuating drive **29** transmits its driving force in the form of the joining force **33** to the load cell **28** by way of a first force transmission element **31**.

[0132] A second force transmission element **32**, by way of which the driving force of the actuating drive **29** is then transmitted to the holder **10** and by way of the latter to the bristle carrier **2** located on the holder **10**, is disposed between the load cell **28** and the holder **10**. The two force transmission elements **31** and **32** are designed as struts between which is disposed the load cell **28**.

[0133] Instead of a load cell **28**, the joining force **33** can also be determined by a compression spring, based on the known spring characteristic of the latter. By determining the spring travel of the compression spring when carrying out the method, the joining force **33** can be derived from the spring characteristic.

[0134] It is also possible to determine the joining force **33** by means of a current consumption of the actuating drive **29**, already mentioned above, in particular if the actuating drive **29** is an electric actuating drive. In this instance, a load cell can be dispensed with in this variant.

[0135] Controlling the actuating drive **29** can take place by the control unit **30** of the bristle product production device **100** as a function of the determined joining force **33** which acts on the holder **10** and on the bristle carrier **2** located thereon.

[0136] The actually prevailing joining force **33** determined with the aid of the force measuring device **27** then serves as an input variable for the control unit **30** and is taken into account when controlling the actuating drive **29**.

LIST OF REFERENCE SIGNS

[0137] **1** Bristle product [0138] **2** Bristle carrier [0139] **3** Bristle set [0140] **4** Bristle filament [0141] **5** Fastening-proximal end of **4** [0142] **6** Bristle set side [0143] **7** Detent [0144] **8** Filament holder [0145] **9** Rear side [0146] **10** Holder [0147] **11** External face [0148] **12** Holding contour [0149] **13** Clearance [0150] **14** Heating device [0151] **15** First heating surface [0152] **16** Second heating surface [0153] **17** Cooling device [0154] **18** Counter-holder [0155] **19** Holding space of **10** [0156] **20** Holding finger [0157] **21** Rear-side recess [0158] **22** Receptacle bore [0159] **23** Gripper jaw [0160] **24** Gripper jaw [0161] **25** Gripping portion [0162] **26** Height-adjustable gripper [0163] **27** Force measuring device [0164] **28** Load cell [0165] **29** Actuating drive [0166] **30** Control unit [0167] **31** Force transmission element [0168] **32** Force transmission element [0169] **33** Joining force [0170] **100** Bristle product production device

Claims

1. A method for producing bristle products (**1**) having a bristle carrier (**2**) and a bristle set (**3**) of bristle filaments (**4**), the method comprising: connecting fastening-proximal ends (**5**) of bristle filaments (**4**) to the bristle carrier (**2**) by a thermal joining process; and deforming an external contour of the bristle carrier (**2**) from an initial shape to a target shape by a temperature variation of the bristle carrier (**2**).
2. The method as claimed in claim 1, further comprising generating a force for deforming the bristle carrier (**2**) by the temperature variation of the bristle carrier (**2**).
3. The method as claimed in claim 1, further comprising at least one of a) heating the bristle carrier (**2**) and the fastening-proximal ends (**5**) of the bristle filaments (**4**), or b) fusing the fastening-proximal ends (**5**) of the bristle filaments (**4**), for the connecting of the bristle carrier (**2**) and the bristle filaments (**4**) of the bristle set (**3**) to one another.
4. The method as claimed in claim 1, wherein at least one of a) the deforming of the bristle carrier (**2**) by the temperature variation takes place after the connecting of the bristle carrier (**2**) to the bristle filaments (**4**), or b) the deforming of the bristle carrier (**2**) includes concavely deforming the bristle carrier (**2**) by the temperature variation.
5. The method as claimed in claim 1, wherein the thermal joining process comprises a cooling step in which at least one of the bristle filaments (**4**) or the bristle carrier (**2**) is cooled.
6. The method as claimed in claim 1, further comprising reducing or dissipating a pre-load in the bristle carrier (**2**), which is created during production, by the temperature variation of the bristle carrier (**2**) in the thermal joining process while deforming the bristle carrier (**2**).
7. The method as claimed in claim 1, wherein the bristle carrier (**2**) is at least peripherally heated to a temperature above a glass transition temperature thereof.
8. The method as claimed in claim 1, further comprising reducing or dissipating a pre-load in the bristle carrier (**2**), which is caused by at least one of additives or an admixture in the bristle carrier (**2**), by the temperature variation of the bristle carrier (**2**) in the thermal joining process while deforming the bristle carrier (**2**).
9. The method as claimed in claim 1, wherein the bristle carrier (**2**) comprises at least two plastic-material components which form different portions of the bristle carrier (**2**) such that the bristle carrier (**2**) is deformed differently by the temperature variation in the different portions.
10. The method as claimed in claim 1, wherein the deformation of the bristle carrier (**2**) is at least in portions at least one of restricted or delayed by a detent (**7**) by which the bristle filaments (**4**) are held when connecting to the bristle carrier (**2**).
11. The method as claimed in claim 1, wherein the deformation of the bristle carrier (**2**) is predefined by an initial geometry of the bristle carrier (**2**).
12. The method as claimed in claim 1, wherein at least one of a) the bristle carrier (**2**) has at least one defined deformation region which has a lower resistance to deformation in comparison to an adjacent region of the bristle carrier (**2**) and influences the deformation of the bristle carrier (**2**), or b) the bristle carrier (**2**) has at least one reinforcement region in which the bristle carrier (**2**) at least one of has a greater material thickness or is provided with a reinforcement, and the reinforcement region has a greater resistance to deformation than a neighboring region of the bristle carrier (**2**) and influences the deformation of the bristle carrier (**2**).
13. The method as claimed in claim 1, further comprising during the deforming, heating a region of the bristle carrier (**2**) locally to a higher or to a lower temperature than in an adjacent region.
14. The method as claimed in claim 1, further comprising generating a temperature gradient between different portions of the bristle carrier (**2**) for the deforming of the bristle carrier (**2**).
15. The method as claimed in claim 1, wherein the deforming includes a targeted deformation of the bristle carrier (**2**) by at least one of a) using at least one of a predefined cooling time or cooling

rate, b) locally cooling the bristle carrier (**2**), or c) cooling different regions of the bristle carrier (**2**) using at least one of different temperatures, cooling rates, or cooling times.

16. The method as claimed in claim 1, further comprising holding the bristle carrier (**2**) by a holder (**10**) which contacts the bristle carrier (**2**) by way of a sub-region of an external face (**11**) thereof, which is adjacent to a bristle set side (**6**).

17. The method as claimed in claim 1, further comprising holding the bristle carrier (**2**) by a holder (**10**) that has a holding contour (**12**) for holding at least one said bristle carrier (**2**), which is penetrated by at least one clearance (**13**) such that the holder (**10**) contacts the bristle carrier (**2**) only by way of a sub-region of an external face (**11**) thereof.

18. The method as claimed in claim 1, wherein the connecting of the bristle carrier (**2**) and fastening-proximal ends (**5**) of the bristle filaments (**4**) of the bristle set (**3**) to one another includes pressing the bristle carrier (**2**) and fastening-proximal ends (**5**) of the bristle filaments (**4**) of the bristle set (**3**) against one another with a defined joining force (**33**).

19. The method as claimed in claim 18, wherein the joining force (**33**) is determined by at least one of a force measuring device (**27**), a load cell (**28**), a compression spring, or a current consumption of an actuating drive (**29**) by which the bristle carrier (**2**) and the bristle filaments (**4**) are pressed against one another.

20. The method as claimed in claim 1, further comprising using a bristle product production device (**100**) to carry out the method.

21. A bristle product production device (**100**), comprising: a heating device (**14**) which is specified to heat fastening-proximal ends (**5**) of bristle filaments (**4**) of a bristle set (**3**) and a bristle carrier (**2**) to which the bristle filaments (**4**) of the bristle set (**3**) are to be connected; and the heating device (**14**) is adapted to fuse the fastening-proximal ends (**5**) of the bristle filaments (**4**) and not the bristle carrier (**2**).

22. The bristle product production device (**100**) as claimed in claim 21, wherein the heating device (**13**) comprises first and second heating surfaces (**15**, **16**), the first heating surface (**15**) is provided for heating the fastening-proximal ends (**5**) of the bristle filaments (**4**) of the bristle set (**3**) of a bristle product (**1**) to be produced, and the second heating surface (**16**) is provided for heating the bristle carrier (**2**) of the bristle product (**1**) to be produced.

23. The bristle product production device (**100**) as claimed in claim 22, wherein the first and second heating surfaces (**15**, **16**) face away from one another.

24. The bristle product production device (**100**) as claimed in claim 21, further comprising a cooling device (**17**) for actively cooling the bristle carrier (**2**).

25. The bristle product production device (**100**) as claimed in claim 21, further comprising a filament holder (**8**) for holding the bristle filaments (**4**) of the bristle set (**3**), and a profiled counter-holder (**18**) for profiling the bristle set (**3**) of a bristle product (**1**) to be produced.

26. The bristle product production device (**100**) as claimed in claim 21, further comprising a holder (**10**) which is adapted to hold at least one said bristle carrier (**2**) by way of a sub-region of an external face (**11**) thereof.

27. The bristle product production device (**100**) as claimed in claim 26, wherein the holder (**10**) has a holding contour (**12**) for holding at least one said bristle carrier (**2**), and the holding contour (**12**) is at least one of formed on a holding space (**19**) of the holder (**10**) or is penetrated by at least one clearance (**13**).

28. The bristle product production device (**100**) as claimed in 26, wherein at least one of a) the holder (**10**) has at least one holding finger (**20**) which forms at least part of a holding contour (**19**), or b) the holder (**10**) has a clearance (**13**) with at least one recess (**21**) that faces a holding space (**19**) for at least one of the bristle carrier (**2**) or a rear side (**9**) of a bristle carrier (**2**) situated in a holding position on the holder (**10**).

29. The bristle product production device (**100**) as claimed in claim 27, wherein the holder (**10**) comprises a gripper and has at least two mutually assigned gripper jaws (**22**, **23**) on which is

formed at least part of the holding contour (**12**).

30. The bristle product production device (**100**) as claimed in claim 26, further comprising an actuating drive (**29**) which is specified to press with a defined joining force (**33**) the bristle carrier (**2**) against the fastening-proximal ends (**5**) of the bristle filaments (**4**) to connect the bristle carrier (**2**) to the bristle filaments (**4**).

31. The bristle product production device (**100**) as claimed in claim 30, further comprising a force measuring device (**27**) for determining a joining force (**33**) with which the bristle carrier (**2**) and fastening-proximal ends (**5**) of the bristle filaments (**4**) of the bristle set (**3**) are pressed against one another.

32. The bristle product production device (**100**) as claimed in claim 31, wherein the force measuring device (**27**) is disposed between the actuating drive (**29**) and the holder (**10**).

33. The bristle product production device (**100**) as claimed in claim 30, wherein the actuating drive (**29**) comprises a pneumatic, hydraulic or electric actuating drive, and the bristle product production device (**100**) further comprises a control unit (**30**) for controlling the actuating drive (**29**) as a function of a measured joining force (**33**).