May 29, 1951 R. DANGIN 2,554,777

METHOD AND MEANS FOR ROUNDING OFF AND POLISHING THE ENDS OF THERMOPLASTIC BRUSH BRISTLES

Filed March 31, 1950 3 Sheets-Sheet 1

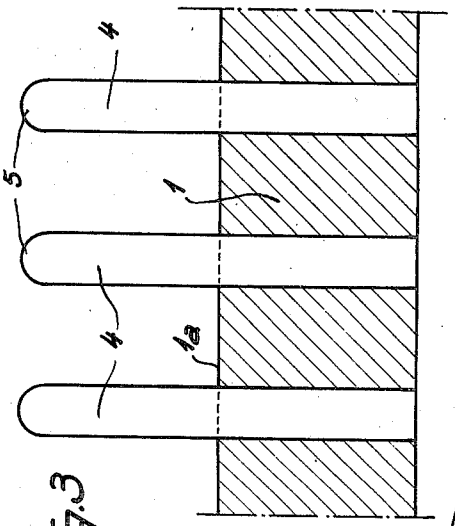

Fig. 3

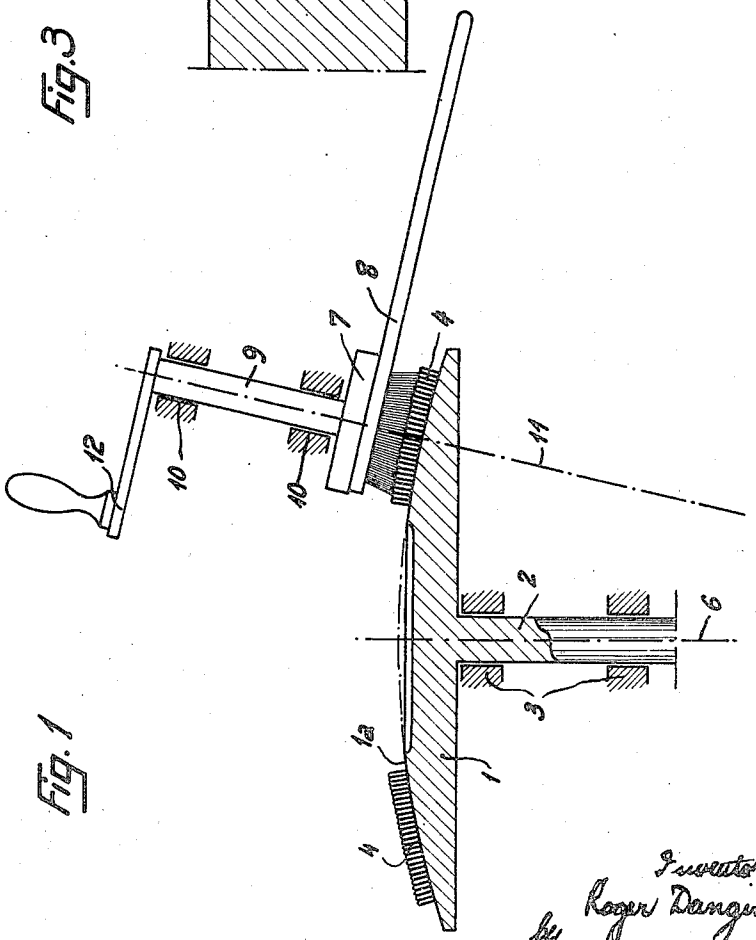

Fig. 1

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Fig. 6

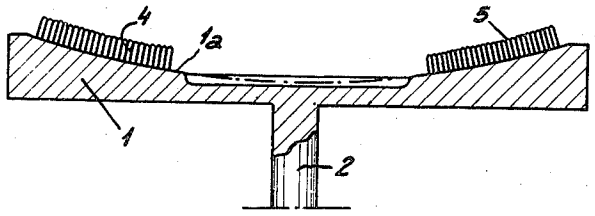


Fig. 5

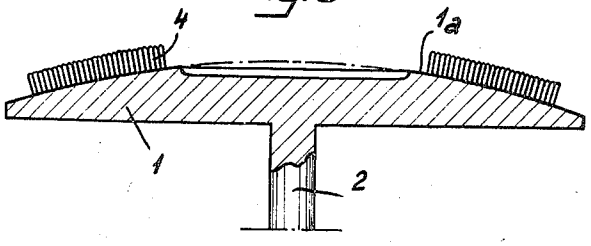


Fig. 4

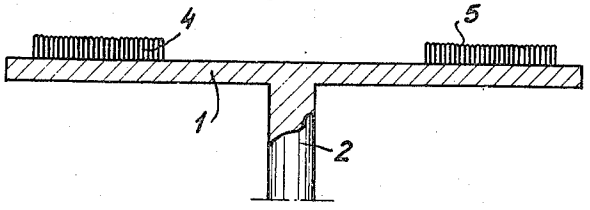
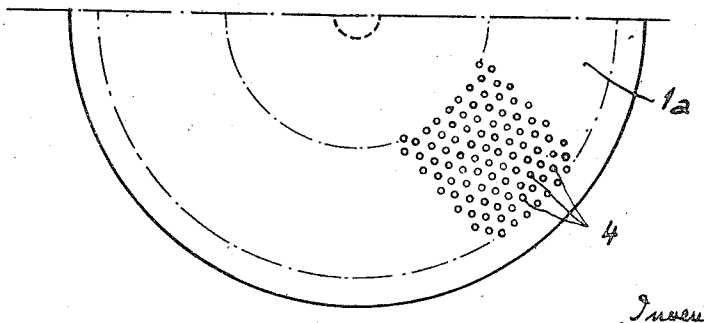


Fig. 2



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Filed March 31, 1950 3 Sheets-Sheet 3

Fig. 7.

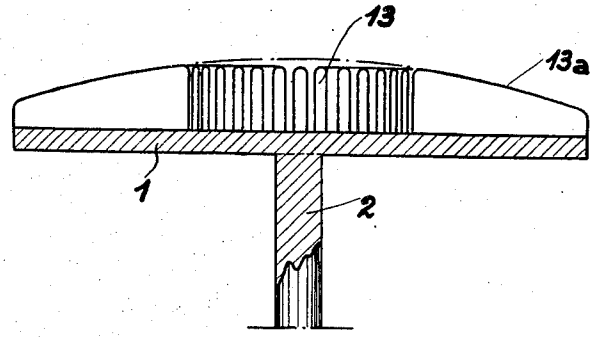

Fig. 8.

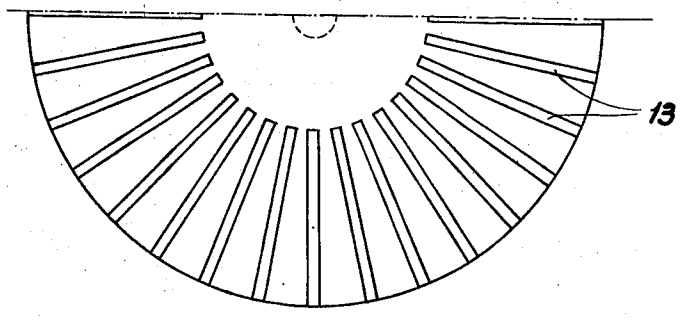

Fig. 9.

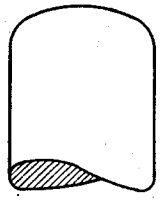

Fig. 10.

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METHOD AND MEANS FOR ROUNDING OFF AND POLISHING THE ENDS OF THERMO-PLASTIC BRUSH BRISTLES

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Application March 31, 1950, Serial No. 153,034
In France January 11, 1950

20 Claims. (Cl. 18—1)

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This invention relates to brushes of the type in which the bristles are formed from tough synthetic fibre such as polyamide filaments and similar thermo-plastic synthetic materials, and provides an improved method and apparatus for imparting a satisfactory finish to the bristles of such a brush.

In the manufacture of brushes of this type, it is important if a neatly finished article is to be obtained to remove, in a finishing step, any sharp angles, splinters and/or burrs that may remain at the free ends of the bristles as a result of the cutting operation.

It has already been suggested to round off the free ends of each bristle in a brush provided with bristles made of a thermoplastic synthetic material by cutting the bristles to a blunt form, or alternatively to subject the bristles to an abrading operation.

It is a general object of this invention to impart an improved finish to the ends of the bristles in a brush of the type described in a more simple and efficient manner than heretofore possible.

Another object is to provide such a finish without incurring any loss of the bristle material, as occurs when using a cutting or an abrading process for a similar purpose.

A further object is to provide a method of rounding off and polishing the ends of thermo-plastic bristles in a single quick operation.

And another object is to provide such a method which makes use of the inherent thermo-plasticity of the bristle material.

Another object is to provide comparatively simple apparatus for imparting a highly satisfactory rounded and polished finish to the bristle-ends of such a brush, and one which is capable of ready adjustment for controlling within reasonable limits the shape imparted to the bristle-ends, and for making it possible to handle various sizes and shapes of brushes.

With the above and further objects in view, the invention essentially provides a method of simultaneously rounding off and polishing the free ends of bristles made of a thermo-plastic material which comprises subjecting the end portions of said bristles as mounted on the brush to the action of finely polished rounded elements having a high rate of relative motion with respect to said bristles, thus locally to generate at the ends of the bristles an amount of heat sufficient to cause a softening of the material thereof and at the same time to exert a forming action on the softened material adapted to round off and polish the ends of said bristles.

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While the method of the invention may be used to polish the ends of bristles previously rounded off, it will be of greatest value when applied directly after the curing operation, inasmuch as it is self-sufficient and makes it possible to round off and polish the end of each bristle, removing all sharp edges and any loose particles or fibres that may and usually do occur at the ends of the fibres.

It is emphasized that the method as just defined is entirely distinct from an abrading process, in that the action of the rapidly moving elements in contact with the bristle ends is not to strip or chip off particles of the bristle material by friction but rather to exert a hammering and rubbing action thereon effective first to generate sufficient heat to bring the thermo-plastic material to its softening point, and then continue to exert such hammering and/or rubbing action to form the softened material to a rounded shape and at the same time polish the rounded ends thus obtained. Thus it will be seen that the method of the invention, contrarily to what would be true in the case of an abrading process, does not result in any waste of thermo-plastic material undergoing treatment. It will also be seen that this method makes use of the inherent thermo-plasticity of the material being treated.

The invention further provides apparatus for carrying the above-defined method into practice. This apparatus essentially comprises a rotary tool or support carrying a set of shaping elements made of a hard material, finely polished and having rounded ends, so disposed on said rotary support that their rounded and polished ends will lie on a surface of revolution having as a generatrix curve the cross-sectional contour of the brush to be treated, means for imparting a rapid rotation to said support and means for applying the free bristle surface of the brush against the surface generated by the rotation of the ends of the elements.

Preferably said shaping elements comprise pins of hardened polished steel provided with rounded ends substantially semi-spherical or paraboloidal in shape. The rotary support may desirably be formed as a disc, and the tool-supporting surface of this disc may be flat in the case flat brushes are to be treated, concave where the brushes are convex and vice versa. The pins are in any case arranged in a uniformly spaced array over an annular area of the disc adjacent to the periphery thereof and having a radial

extent no smaller than the length of the bristle surface to be treated.

While according to a preferred embodiment of the invention the tool elements used comprise rounded pins, as just described, in order to exert a more penetrating action and to act in the manner of comb teeth on the bristles of the brush, tool elements in the form of radially-extending upstanding ribs or blades having rounded top edges may be used, or further milled projections formed with rounded and polished edges.

A rapid movement of rotation is imparted to the tool assembly and the brush to be finished is pressed thereagainst in such a way that the bristles will be subjected to the action of the polished blunt elements. This simultaneously produces the following effects:

(1) A local temperature elevation due to the impacts and friction of the tool elements against the bristle ends, raising the temperature of the latter to the softening point of their constituent thermo-plastic material;

(2) A hammering forming action, similar to a forging effect, of the softened material by the blunt tips of the tool elements; and

(3) A polishing action, the flexible softened tips of the bristles being smoothed down by the polished surface of the tool elements.

The above-noted effects are exerted along a preferential direction, that corresponding to the direction of rotation of the tool assembly. In order to secure optimum results and a regular distribution of the forming effect all around the periphery of each bristle end, the brush is preferably caused to revolve during the treatment at a slow rate about an axis preferably extending through the centre of and normal to the bristle surface, providing of course that the surface of the brush is of such shape as to allow of such rotation.

Where the brush surface is so shaped that it may not be so revolved without disengagement between the active surface of the tool assembly and the bristle surface of the brush, the tool is preferably caused to act successively in at least two opposite directions, the direction of rotation of the tool assembly being reversed; still more preferably, the action of the tool is successively applied in four directions; for this purpose at least two tool assemblies may be used operating in concurrent directions and each successively rotated in reverse directions.

Some exemplary embodiments of the invention will now be described for purposes of indication and not of limtation, with reference to the accompanying diagrammatic drawings in which:

Fig. 1 is a vertical section, in diagrammatic form, of one embodiment of a device according to the invention, the brush and the supporting means therefor being shown in elevation,

Fig. 2 is half an overhead plan view of a first embodiment of the rounding and polishing tool assembly, only part of the blunt pins thereof being shown,

Fig. 3 is a vertical section on an enlarged scale of a fragment of the tool assembly shown in Figs. 1 and 2 illustrating in greater detail the shape and arrangement of the pins,

Fig. 4 is an axial section of a form of tool assembly usable in connection with a flat brush,

Figs. 5 and 6 are similar views of tool assmblies usable respectively where concave and convex brushes are to be treated,

Fig. 7 is a similar view of an alternative form of tool assembly more specifically for a concave brush,

Fig. 8 is half an overhead view of the tool assembly of Fig. 7, and

Figs. 9 and 10 are enlarged fragmentary views of different shapes that may be imparted to the tips of the individual bristles when using the method of the invention.

In the exemplary embodiment shown in Fig. 1, an improved bristle finishing device designed for use with a brush of concave form comprises a tool-supporting member consisting of a disc 1 having a convex spherical upper surface 1*a* in a peripheral annular zone of the disc integral or rigidly connected with a shaft 2 the centre axis 6 of which extends through the centre of the sphere of which the surface 1*a* forms part. The shaft is supported in bearings 3 and is adapted to have a rapid rotation imparted to it from any suitable drive means not shown.

Upon the annular spherical zone 1*a* which extends adjacent to the periphery of the disc 1 over a radial extent not smaller than the length of the brush to be treated, a multiplicity of cylindrical pins 4 are fitted normally to the surface of the surface 1*a* and are formed with tips 5 of generally spherical or paraboloidal form. The pins are made of a hard grade of steel, carefully heat-treated and polished and are disposed in a regular pattern, as shown in Fig. 2, the free spacing between adjacent pins being substantially equal to about twice the diameter of each pin. During rotation of the tool assembly thus formed, the pins are caused to project no more than a few millimeters deep in between the bristles of the brush; accordingly the pins may be made quite short, say about 6 to 8 mm. long, so as not to be subjected to substantial bending strains in operation and to act upon the bristles to be treated in the manner of a comb. The surface 1*a* is determined with due consideration to the length of the pins 4, in such a way that the tips 5 of the pins will lie over a spherical zone generated by rotation of the cross-sectional contour of the brush about the axis 6.

A suitable clamping member 7 for holding the brush 8 during the finishing operation is secured to one end of a shaft 9 supported in bearings 10, so disposed that the centre axis 11 of the shaft will extend through the centre of the sphere of which the surface 1*a* forms a part. Any suitable means such as an operating crank 12 are provided to enable a slow rotation to be imparted to the brush-holder 7 with the brush 8 therein about the axis 11 during operation of the tool. The shaft 9 is mounted in the bearings 10 in such a manner as to allow some amount of axial displacement of the shaft in said bearings.

The above-described apparatus operates as follows: The crank handle 12 is rotated back to raise the brush holder 7 and the brush 8 to be treated is clamped in the holder 7. Then the tool-support 1 is set into rapid rotation, if stationary. By way of indication, a rate of 5,000 R. P. M. or so has been found satisfactory in the case of a tool support in which the annular pin-supporting area has a mean diameter of 150 mm. The crank-handle 12 is actuated to lower the bristle surface of the brush 8 into engagement with the ends of the pins 4 and cause said pins to penetrate by a few millimeters in between the bristles. Still maintaining pressure on the crank 12, a slow rotary motion is imparted to it in order to cause the brush to describe at least one complete revolution while in engagement with

the pins. The degree to which the pins project into the bristles may be adjusted preliminarily through the use of any suitable known device adapted to limit the axial displacement of the shaft 9, said adjustment being so made as to allow the pins 4 to reach the shortest bristles of the brush.

At any given instant the absolute velocity of the point of contact of a pin with the end of a bristle may be split into a component normal to the common tangent plane to both surfaces at that point and a component lying in said tangent plane. The normal component exerts a hammering action effective to form the bristle-ends, while the tangential component produces a polishing or smoothing effect, and both these components act simultaneously to raise locally the temperature of the thermoplastic to its softening point.

It may easily be understood that the particular form of the pin tips, and especially the depth to which these pins exert an effective action with respect to the bristle tips, may alter in a substantial manner the final shape imparted to the tip of each bristle. Thus, if the pins are large and their effective depth of penetration small, the bristle will tend to assume a blunt, flat shape shown in Fig. 9. Where on the other hand the pins are small and their depth of penetration great, then the bristle will tend to assume a comparatively tapered form as shown in Fig. 10.

In practice, excellent results have been obtained with the use of a tool assembly fitted with pins 2.5 mm. in diameter spaced 6 mm. between centres, so as to project about 8 mm. above the surface of the tool support, and the brush-holder being so adjusted that the pins will penetrate to a depth of about 2 or 3 mm. beyond the bristle surface.

It is clear that in order to obtain a satisfactory finish, it is necessary that all the bristles of the brush receive uniform treatment, and this requires that discs of appropriate profile be used. In the case of brushes flat in cross-sectional configuration, a disc of the type shown in Fig. 4 may be used, wherein the tips 5 of the pins, all of equal height, lie in a common plane at right angles to the axis 6. In this case, the shaft 9 would be mounted parallel to the shaft 2. If the brush to be treated instead of having a concave configuration in cross-section, as previously described in connection with Fig. 1, is convex in shape, then instead of the tool-supporting disc illustrated in Figs. 1 and 5, a disc similar to that shown in Fig. 6 would be used, in which the pin-supporting surface 1*a* is concave, and so designed that the tips 5 of the pins will lie on a spherical zone complementary in contour to that of the brush cross-section.

In the event the tips of the bristles do not all lie on a common surface, some of said bristles being shorter than others, then it may be found desirable, in order to round off the ends of all of the bristles uniformly without imparting an excessively long taper to the longer bristles, to arrange the pins 4 on the tool-support in such a way that the tips of said pins will lie on two parallel surfaces spaced by about 1 to 1.5 mm. from each other. With this arrangement, some of the pins, namely the longer ones, will penetrate to a greater depth into the body of bristles, thus to act upon the shorter bristles therein, while the longer bristles will be formed by the shorter pins.

Tool elements other than the pins so far described may be used to perform the specific softening, forming and smoothing actions of the invention. While pins have generally been found to afford best result, especially in that they act on a greater peripheral area of the bristle tip, the forming elements may for instance be provided in the form of upstanding blades having a rounded top edge. Thus Figs. 7 and 8 illustrate in elevation and plan respectively a tool assembly according to the invention which comprises a disc 1 rigid with its shaft 2 driven in rotation by any suitable means, said disc having secured thereon by any suitable means radially-extending upstanding blade elements 13 normal to the surface of the disc 1 and provided with a rounded active top edge 13*a*. The blades are arranged in a peripheral annular array and their active top edges are accurately complementary to the contour of the brush to be treated.

As a further alternative for the pins 4 and blades 13, the forming elements may be provided in the form of projections obtained by milling a suitable supporting surface, the ends of said projections being rounded and then carefully polished. Any other suitable means may of course be used, within the scope of the invention, to provide the requisite forming projections on a rapidly moving surface substantially reproducing the contour of the brush to be treated as seen in the direction of displacement of said surface.

In the case of brushes having a sinuous contour, it is clearly impossible to impart to the brush a complete revolution about an axis parallel to the general direction of the bristle without the active surface of the tool assembly disengaging the bristle surface. In such cases, the method of the invention will be applied in a plurality of successive steps, the tool being first rotated in one direction then in the opposite direction to cause the pins to act at least in two different directions on each bristle. The rounded form of the bristle tips will in such a case be considerably improved if use is made of two tools acting in directions substantially at right angles to each other and each successively driven in two reverse directions, thereby obtaining four different directions for the action of the tools on the bristles.

It should also be understood that the tool elements such as the pins, blades or projections described, may be provided on a supporting surface other than a disc, for instance on a cylinder or other surface of revolution. More specifically, in the case of brushes having a sinuous cross-sectional contour, good results will be obtained by first using a disc provided with pins acting on the bristles transversely of the brush, and then using a cylinder provided with pins or blades acting on the bristles in a longitudinal direction.

Many other modifications can of course be made in the specific details of structure and procedure described, illustrated and/or mentioned herein without exceeding the scope of the invention. Thus, the manual operating crank-handle 12 may be replaced by an automatic device being adapted to bring the brush into engagement with the tool assembly and then impart to the brush a complete revolution while maintaining it in engagement therewith, and finally to disengage the brush after one or more revolutions of the brush have been made.

What I claim is:

1. Method of finishing the tips of thermo-plastic fibre bristles on a brush which comprises subjecting said bristle-tips over a predetermined length thereof to contact with a plurality of hard blunt polished surfaces and imparting a rapid relative displacement between said surfaces and said bristles in a direction generally normal to said bristles at a rate sufficient to raise locally the temperature of said bristle-tips substantially to the softening point of said thermo-plastic fibre.

2. Method of finishing the tips of thermo-plastic fibre bristles on a brush which comprises subjecting said bristle-tips to contact with a plurality of hard blunt polished surfaces, imparting a rapid relative displacement between said surfaces and said bristles on a surface generally normal to said bristles at a rate sufficient to raise locally the bristle-tip temperature to softening point, and concurrently imparting to said brush a slower bodily rotation about an axis parallel to the general direction of its said bristles to produce a uniform finishing action around each bristle.

3. Method of finishing the tips of thermo-plastic fibre bristles on a brush having an arcuate cross-sectional bristle contour, which comprises subjecting said bristle-tips to contact with a plurality of hard blunt polished surfaces, imparting a rapid relative displacement to said surfaces with respect to said bristles in a first direction generally normal to said bristles, then reversing said relative displacement, the rate of said displacement being sufficiently high to raise the bristle-tip temperature substantially to softening point.

4. Method of finishing the tips of thermo-plastic fibre bristles on a brush which comprises subjecting said bristle-tips to contact with a plurality of hard blunt polished surfaces and imparting rapid relative displacements to said surfaces with respect to said bristles on a surface generally normal to said bristles in a plurality of successive directions, the rates of all said relative displacements being high enough to locally raise the bristle-tip temperature to softening point.

5. Method of rounding off and polishing the bristle-tips on a brush provided with thermo-plastic bristles, which comprises subjecting a predetermined length of said bristle-tips to contact with a plurality of hard blunt highly-polished surfaces and imparting a relative displacement at a tangential rate of about 40 metres per second to said surfaces with respect to said bristles, whereby the bristle-tips are brought to a softening temperature and are simultaneously formed to a blunt shape and smoothed by said surfaces.

6. Device for finishing the thermo-plastic bristle-tips on a brush of the type described, which comprises in combination a tool support mounted for rotation, means imparting to said support a rapid rotation about an axis, tool elements mounted on said support and presenting a multiplicity of hard blunt polished projecting surfaces lying on an envelope surface of revolution having as a generatrix a cross-sectional contour of said brush, and means for holding said brush with its bristle tips in engagement with said surfaces.

7. Device as in claim 6 wherein said tool elements comprise cylindrical pins made of hardened steel with polished blunted ends of sufficient diameter relatively to their free height to be subjected to no appreciable bending in operation.

8. Device as in claim 7 wherein the spacing between adjacent pins is in a range at from about once to twice the diameter of each pin.

9. Device as in claim 8 wherein the tips of said pins have a substantially hemi-spherical contour.

10. In a device for finishing thermo-plastic bristle-tips on a brush, a rotary support and means for imparting rapid rotation thereto said support including an annular surface centred on the axis of rotation, a plurality of elements mounted on said annular surface and having hard blunt smooth surfaces projecting therefrom the tops of said surfaces describing in the rotation of said support a surface of revolution having a generatrix corresponding to a cross-sectional configuration of said brush, and means for holding said brush over said surface with its bristle-tips engaged over a predetermined end length thereof against said projecting surfaces.

11. Device as in claim 9 wherein said elements comprise angularly-spaced radially-extending blades upstanding on said support and formed with a blunt polished top edge formed to said cross-sectional configuration.

12. In a device for finishing thermo-plastic bristle-tips on a brush, a rotary support and means for imparting rapid rotation thereto said support including an annular surface centred on the axis of rotation, a plurality of hard blunt polished pins upstanding from said annular surface, means for holding said brush above said surface with its bristle-tips engaging said pins, and means for slowly rotating said brush with its bristles thus engaged, about an axis generally parallel to said bristles.

13. In a device as in claim 12, means for raising and lowering said brush-holding means relatively to said pins and means for positively restricting the depth of engagement of said bristles therewith.

14. In a device for finishing thermo-plastic bristle-tips on a brush having a part spherical bristled surface, a rotary support including a part-spherical annular peripheral surface complementary to said bristled surface centred on the axis of rotation of said support, hard blunt polished pins all equal in height upstanding from said annular surface, means for holding said brush with its bristles engaged over a predetermined depth on said pins with the normal to said bristled surface through the centre thereof extending substantially through the centre of said part-spherical annular surface, and means for imparting a slow rotation to said brush about said normal.

15. Device as in claim 14 for use with a concave brush wherein said annular surface is complementarily convex.

16. Device as in claim 14 for use with a convex brush wherein said annular surface is complementarily concave.

17. In a device for finishing thermo-plastic bristles on a brush cylindrical support, means for imparting rapid rotation to said support about its cylinder axis, a multiplicity of hard blunt polished surfaces projecting radially from said cylindrical support, and means for holding a brush with its bristles engaging said surfaces over a predetermined depth.

18. In a device for finishing thermo-plastic bristles on a brush a rotary tool and means for imparting rapid rotation thereto about its axis, said tool being formed with hard blunt polished

projecting surfaces lying generally on a surface of revolution having as a generatrix a cross-sectional contour of said brush, and means for holding said brush with its bristles in engagement over a predetermined depth with said surfaces.

19. In a device for finishing thermo-plastic bristles on a brush having bristles of more than one length, rotary means and means for imparting rotation thereto, and a plurality of hard blunt polished surfaces projecting from said rotary means and having more than one length, the ends of said projecting surfaces all lying in the vicinity of a mean surface of revolution corresponding to the mean cross-sectional contour of said brush, and means for holding said brush with its bristles engaging said projecting surfaces in a relative position thereto such that the shorter projections will engage the longer bristles and that the longer projections will engage the shorter bristles.

20. In a device for finishing thermo-plastic bristle-tips on a brush a rotary means, means for imparting rapid rotation thereto, a plurality of hard blunt projections on said rotary means lying in a general plane corresponding with the cross-sectional configuration of the brush, brush-holding means adapted to hold said brush with its bristles in engagement over a predetermined depth with said projections, a shaft secured to said brush-holder means normally to the general surface of the brush, means supporting said shaft for rotation and limited axial displacement, manual means for rotating and axially displacing said shaft and means positively restricting the axial displacement of said shaft to restrict the depth of engagement of said bristles with said projections.

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No references cited.