The invention relates to a brush bar for a surface treating appliance, including a supporting body, at least one retaining member welded to the supporting body and at least one bristle tuft clamped in place on the supporting body by the retaining member. The use of welding to attach the retaining member to the supporting body allows for a reduction in the wall thickness of the supporting body, which is advantageous for locating a motor inside the brush bar.
FIG. 6a

FIG. 6b
BRUSH BAR FOR A SURFACE TREATING APPLIANCE

[0001] REFERENCE TO RELATED APPLICATIONS

[0002] This application claims the priority of United Kingdom Patent Application No. 0922107.8 filed 18 Dec. 2009, the entire contents of which are incorporated herein by reference.

FIELD OF THE INVENTION

[0003] The present invention relates to a brush bar for a surface treating appliance, for example for a vacuum cleaning appliance.

BACKGROUND OF THE INVENTION

[0004] Brush bars generally comprise a hollow supporting body, which is normally cylindrical, and a plurality of bristle tufts secured to the supporting body. The bristles themselves are commonly formed from a relatively wear-resistant material such as Nylon (PA); however, for reasons of economy, the supporting body is often formed instead from a cheaper material, such as Acrylonitrile butadiene styrene (ABS) or Polypropylene (PP).

[0005] The bristle tufts have conventionally been mechanically secured to the cylindrical body by stapling. The use of staples is normally effective in retaining the bristle tufts during use of the brush bar, but the method requires a relatively large wall thickness, partly to ensure that once the staple is driven down into the brush bar, there is then sufficient friction between the staple and the brush bar in order adequately to secure the tuft during normal use of the brush bar. For example, in the case of a vacuum cleaning appliance, the bristle tufts are typically secured to resist a nominal pull force of 40N. and in this case a local brush bar wall thickness of around 8 mm is typically required. The increased local wall thickness may be provided by one or more helical ribs on the supporting body; these helical ribs are arranged to run on the inside of the hollow supporting body so as to limit the undesirable presence of discontinuities in the outer surface of the brush bar.

[0006] In some surface treating appliances, the brush bar is driven by a motor. The motor is often located outside the brush bar, and connected to the brush bar by some sort of intermediate transmission such as a drive belt, normally via fixed reduction gearing. However, it has also been proposed to house the motor inside the brush bar as a space-saving measure. In this sort of arrangement, the wall thickness of a given brush bar can become a limiting factor on the motor design, and particularly on the overall size of the motor which can be used. It would be preferable therefore to reduce the wall thickness of the brush bar, and hence increase the interior volume of the brush bar for a given external diameter of the brush bar. It is envisaged that reducing the wall thickness would also have the advantage of reducing like-for-like material costs and weight.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to seek to provide an improved arrangement for securing bristle tufts to a brush bar, in particular an arrangement which is suitable for use on a relatively thin-walled brush bar.

[0008] According to the present invention there is provided a brush bar comprising a supporting body, at least one retaining member welded or surface-bonded to the supporting body and at least one bristle tuft secured on the supporting body, the bristle tuft being secured in place at least in part by mechanical interlocking of the retaining member either with the bristle tuft or with one or more intermediate anchor elements attached to the bristle tuft.

[0009] By "surface-bonded" is meant that the retaining member is bonded onto the outer external surface of the supporting body. Suitable bonding methods may include, for example, adhesive bonding or solid-state diffusion bonding.

[0010] The use of a weld or surface bond to attach the retaining member to the support body has the advantage that it removes (or at least significantly reduces) the conventional limitation on the wall thickness associated with the use of stapling. Consequently, a relatively thin-wall supporting body can be used. In addition, the use of a separate retaining member in order to clamp the bristle tuft means that clamping can be achieved without having locally to deform and reshape the supporting body around the bristle tuft in order mechanically to clamp or lock the bristle tuft in place, tending to reduce post-production working of the supporting body.

[0011] Ultrasonic welding of the retaining member to the brush bar has been found to be particularly suitable, but other welding methods may be used. Where appropriate, the integrity of the weld may be controlled through appropriate choice of weld-compatible materials for the supporting body and the retaining member. In particular, the supporting body and the retaining member may be formed from the same material e.g. ABS or PP. Nevertheless, because the tuft is secured in place at least in part mechanically by the retaining member, at least some degree of retention of the bristle tuft is provided which is substantially independent of other material constraints imposed on the supporting body and retaining member. This has the advantage that corresponding welding constraints on the material used for the retaining member and supporting body are not directly imposed on the bristle tuft itself.

[0012] The bristle tuft may be welded or otherwise bonded to the retaining member or supporting body, in addition to being mechanically interlocked with the retaining member, such that the bristle tuft is only partly mechanically secured in place on the supporting body. Alternatively, the bristle tuft may be secured in place entirely by said mechanical interlocking of the retaining member with the bristle tuft or anchor element(s) (i.e. without it being necessary additionally to weld the bristle tuft or provide any other retention means). In the latter case, the operational retention of the bristles is entirely mechanical and therefore substantially independent of the material used to form the bristles; this has the advantage that none of the material weld constraints on the retaining member and supporting body are imposed on the bristle tuft itself. Thus, where the retaining member and brush bar are formed from the same or similar, weld-compatible materials such as ABS, PP or an ABS-PP blend, the bristles themselves may nevertheless be formed from an entirely different material, for example a relatively wear-resistant material such as Nylon.

[0013] The nature of the mechanical interlock between the bristle tuft and the retaining member may vary. For example, the bristle tuft may be clamped between the retaining member and the supporting body, the retaining member may be over-
molded onto the bristle tuft, or the bristle tuft may be mechanically clamped between opposing portions of the
retaining member.

[0014] The retaining member may form a collar around the bristle tuft for laterally supporting the bristles against exces-
sive bending during use of the brush bar. The collar need only extend around a portion of the bristle tuft, though it is envis-
aged that in practice it would be particularly advantageous for the collar entirely to surround the bristle tuft in order to
provide multi-directional support against bending.

[0015] The bristle tuft may extend through a hole in the
retaining member. Thus, the retaining member forms a con-
tinuous surface around the bristle tuft. The retaining member
may be in the shape of a washer, which may be circular or
non-circular. The hole itself likewise need not be circular.

[0016] The anchor element may be welded or otherwise
bonded to the bristle tuft, or it may formed by joining together
the base of the bristles, for example by melting the bristles,
possibly using hot gas.

[0017] The bristle tuft may comprise a plurality of pairs of
bristles, each pair of bristles being formed by a single bristle
filament looped underneath part of the anchor element or
retaining member. In a particular arrangement, the anchor
element is in the form of a locking pin and the bristle tuft
comprises a plurality of pairs of bristles, each pair of bristles
being formed by a single bristle filament looped underneath
the locking pin. Preliminary tests have indicated that this
arrangement provides a particularly secure retention of the
bristle tufts. The locking pin itself may take various shapes.
In particular, it may have any cross-sectional shape and may
be curved, straight, or comprise curved sections and/or straight
sections.

[0018] According to another aspect of the present inven-
tion, there is provided a method of manufacturing a brush bar
having a supporting body and one or more bristle tufts
secured on the supporting body, the method comprising securing
at least one bristle tuft by welding or surface-bonding a retain-
ing member onto the supporting body and mechanically inter-
locking the retaining member either directly with the bristle
tuft or with an intermediate anchor element which conse-
quently anchors the bristle tuft in place.

[0019] The retaining member may be welded to the support-
ning body using ultrasonic welding.

[0020] According to a yet further aspect of the present inven-
tion, there is provided an apparatus for over-molding an anchor
element or retaining member onto a bristle tuft, the apparatus
comprising a centrifugal mold having one or more mold
cavities which incorporate a radially-extending bristle-
retaining portion for retaining a bundle of bristles, and an
outer over-mold portion configured to conform to the nominal
shape of the anchor element or retaining member.

[0021] The over-molding apparatus according to the present
invention may be used in a method of over-molding an anchor
element or retaining member onto the bristle tuft, the method
comprising placing a bundle of bristles in the bristle retaining
portion of the mold cavity, subsequently injecting a thermoplastic resin into the mold cavity and simultaneously
and/or subsequently rotating the mold in order to drive the
thermoplastic resin into the outer-mold portion of the cavity
under centrifugal action.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] Embodiments of the invention will now be described
by way of example, with reference to the accompanying drawings, in which:

[0023] FIG. 1 is a perspective view of a brush bar;
[0024] FIGS. 2a and 2b are schematic cross-sectional
views illustrating an arrangement for securing a bristle tuft to
a brush bar using an anchor element;
[0025] FIG. 3 is a schematic cross-sectional view illustrat-
ing the effect of a collar portion of an anchor element in
supporting a bristle tuft against bristle bending fatigue;
[0026] FIG. 4 is a schematic cross-sectional view showing
an alternative form of anchor element;
[0027] FIG. 5 is a schematic plan view showing part of
an apparatus for over-molding an anchor element on a bristle
tuft;
[0028] FIG. 6a is an exploded perspective view illustrating
a further arrangement for securing a bristle tuft to a brush bar,
using an anchor element in the form of a locking pin;
[0029] FIG. 6b is a schematic cross-sectional view of the
arrangement shown in exploded view in FIG. 6a;
[0030] FIG. 7 is an exploded perspective view showing
illustrating a further arrangement for securing a bristle tuft to
a supporting body of a brush bar;
[0031] FIG. 8 is a schematic cross-sectional view showing
a yet further arrangement for securing a bristle tuft to a sup-
porting body of a brush bar, wherein the bristle tuft is
mechanically clamped between opposing portions of a retain-
ing member;
[0032] FIG. 9 is a schematic cross-sectional view illustrat-
ing a process for clamping a bristle tuft with a retaining
member; and
[0033] FIGS. 10, 11 and 12 are schematic cross-sectional
views of the arrangements shown respectively in FIGS. 2, 6
and 8, in each case giving examples of suitable dimensions for
various component parts of the respective arrangement.

DETAILED DESCRIPTION OF THE INVENTION

[0034] In the embodiments described, corresponding fea-
tures have been given the same reference numerals.

[0035] FIG. 1 shows a brush bar 1 comprising a cylindrical
supporting body 2 and a plurality of bristle tufts 3 secured to
the cylindrical supporting body 2. In use in a surface treating
appliance, the cylindrical supporting body 2 is typically
mounted inside a cleaner head or floor tool for rotation about
a rotation axis A, driven by a motor. Neither the motor nor any
other features of the cleaner head or floor tool are shown in
FIG. 1, however.

[0036] The bristle tufts 3 must be sufficiently secure to
resist detachment from the supporting body 2 under maxi-
imum loading during use of the brush bar 1. In the case of a
typical vacuum cleaner, this may equate to the bristle tuft
being capable of resisting a pull force of around 40N and/or
resisting bending fatigue failure during the course of approxi-
mately 95 million impacts per tuft (which, merely as an
example, is based on 75% of an assumed 600 hour operational
life for the brush bar and a brush bar speed of approximately
3500 rpm).

[0037] FIGS. 2a and 2b show a first arrangement for secur-
ing the bristle tufts 3 to the supporting body 2. Here, the
individual bristles in the bristle tuft 3 are joined together at
their base to form an enlarged root portion 4, which is seated
in a recess 5 on the outer surface of the supporting body 2. The
bristle tuft 3 is clamped in place on the supporting body 2 by
a retaining member 6 which is welded to the supporting body
2 in order mechanically to lock the enlarged root portion 4 in
position within the recess 5, firmly securing the bristle tuft 3.
on the supporting body 2. The enlarged root portion 4 thus acts as an anchor element for holding the bristle tuft 3 in place on the supporting body 2.

[0038] The retaining member 6 is in the shape of a washer. In this case the retaining member is in the shape of an annular washer, but the retaining member may be in the shape of a non-circular washer such as a square washer. The bristle tuft 3 extends through a central hole in the retaining member 6 such that the retaining member 6 effectively constitutes a collar around the bristle tuft 3. The formation of a collar around the bristle tuft resists lateral bending of the bristle tuft 3 effectively by shifting the bristle fulcrum closer to the tip of the bristles, and may be used conveniently to reduce the risk of bending fatigue failure of the bristle tuft 3 during use of brush bar 1, where appropriate. The effect is illustrated in FIG. 3 which is a split-view showing, on the right, bending of bristles in the absence of a collar and, on the left, bending of bristles in the presence of a collar; in this case, the collar is constituted by an annular lip 6a on the retaining member 6. The hole itself need not be circular; it may for example be triangular, square or oblong.

[0039] The recess 5 is counter-bored to accommodate the retaining member 6, which sits on an annular shoulder 5a formed by the respective counter-bore 5b. The depth of the counter bore 5b equates substantially to the depth of the retaining member 6; this has the advantage that the upper surface of the retaining member 6 is substantially continuous with the outer surface of the supporting body 2 so that there is little or no discontinuity on the outer surface of the supporting body 2, in the region of the bristle tuft 3. In the arrangement shown in FIGS. 2a and 2b a counter-bore 6a is additionally formed in the underside of the retaining member 6 in order to accommodate the depth of the enlarged root portion 4; the counter bore 6a may be required if the enlarged root portion 4 is configured to be sufficiently shallow in depth to sit below the level of the shoulder 5a. It will be appreciated that the retaining member may conveniently be formed so that it initially includes the relevant counter bores; the term “counter-bore” in this sense is not intended to be limited to a feature formed in the manner of a post-production boring of the retaining member and/or supporting body.

[0040] The enlarged root portion 4 may be formed by fusing the bristles together, for example using a hot gas or hot plate. The use of hot gas to form an enlarged portion on a bristle bundle per se is discussed in European Patent No. EP 1181144 (Schiffer); preliminary tests confirm that similar methods may be used to form the anchor element 4 in the context of the present arrangement.

[0041] An alternative form of anchor element may be used. In FIG. 4, an anchor element in the form of a ‘puck’ 16 is ultrasonically butt-welded to the bristle tuft 3 in conventional manner using a sonotrode. This method of forming the anchor element has the advantage that it is relatively quick—the puck 16 can generally be sonic-welded to the bristles in less than a second—although preliminary tests indicate that the resulting bristle tuft 3 may be more susceptible to bending fatigue failure during use of the brush bar 1, in which case the provision of a collar can be used to reduce the bending fatigue on the bristles, as discussed above. It is thought that the reduced resistance to bending fatigue may be as a result of gas bubbles being trapped in the region of the weld, and therefore it may also be possible to reduce bending fatigue by minimizing the formation of gas bubbles during the welding process, for example by reducing the amount of water vapor entering the weld zone.

[0042] The anchor element may alternatively be overmolded onto the bristle filaments forming the bristle tuft 3. FIG. 5 illustrates a method for over-molding the anchor element using a centrifugal mold 7. The mold 7 is a two-part injection mold comprising a bottom mold plate 7a, shown in FIG. 5, and a top mold plate, not shown, which is configured for sealing engagement with the mold plate 7a to form a plurality of mold cavities 8 (sixteen mold cavities 8, in the case of the arrangement shown in FIG. 5). Each mold cavity 8 comprises a radial bristle-retaining portion 8a and an outer, over-mold portion 8b which conforms to the nominal shape of the anchor portion. The mold cavities 8 are each in fluid communication with a respective runner 9, which in turn communicate with an injection sprue (not shown) in the top mold plate.

[0043] The mold 7 is mounted for high-speed rotation about an axis B.

[0044] A bristle tuft is arranged radially inside each mold cavity 8, and is held in place by the walls of the bristle-retaining portion 8a. Thermoplastic resin is then injected into the runners 9 via the injection sprue in the top mold plate and the entire mold 7 is rotated about the axis B such that the thermoplastic resin is forced outwardly under centrifugal action to fill the over-mold cavities 8b. This method has the advantage that undesirable resin “creep” radially inward along the bristle tuft is opposed by the centrifugal action of the mold 7.

[0045] Essentially the same process may be used to over-mold a retaining member onto a bristle tuft, with over-mold portions being shaped to correspond to the nominal shape of the retaining member rather than an anchor element. In this manner, overmolding may be used to provide a mechanical interlock between the retaining member and the bristle tuft.

[0046] FIGS. 6a and 6b show a different arrangement for securing a bristle tuft using an anchor element. In this arrangement, the anchor element is in the form of a steel locking pin 10 and the bristle tuft 3 comprises a plurality of pairs of bristles (e.g. 3a and 3b), with each pair of bristles being formed by looping a bristle filament underneath the locking pin 10 (the individual filaments are not shown in FIG. 5).

[0047] A retaining member 6 is welded to the support body, in similar manner to the retaining member 6 in FIGS. 2a and 2b, which clamps the locking pin 10 against the supporting body 2 to trap the bristle filaments in place, thus mechanically locking the bristle tuft 3 to the supporting body.

[0048] A recess 11 is cut into the supporting body 2 for accommodating the looped portion of the bristle filaments underneath the locking pin 10. The recess 11 is counter-bored in similar manner to the recess 5 (see FIGS. 2a and 2b) in order to accommodate the retaining member 6. The undersurface of the retaining member 6a is in turn provided with a counter-bore 6a to accommodate the locking pin 10. The locking pin 10 may bear against the shoulder 11a formed by the counter bore 11b in the recess 11 but this is not considered essential, provided that the locking pin 10 traps the bristle filaments in place to mechanically lock the bristle tuft to the supporting body 2.

[0049] The anchor element in the arrangement shown in FIGS. 6a and 6b need not be a locking pin, specifically—
other forms of anchor element may be used provided that the bristle filaments can be looped underneath the anchor element. [0050] FIG. 7 shows an arrangement which is similar to the arrangement shown in FIGS. 6a and 6b, but which does not incorporate an anchor element. Instead, a retaining member 15 incorporates two (semi-circular) holes 15a, 15b separated by a partition 15c. The bristle tuft comprises a plurality of pairs of bristles, with each pair of bristles being formed by looping a bristle filament underneath the partition such that the two bristles extend respectively through holes 15a and 15b.

[0051] The retaining member 6 may be formed from any suitable material, including metal or plastics such as ABS, PP or an ABS-PP blend. The supporting body 2 may also be formed from metal, or plastics such as ABS, PP or an ABS-PP blend, and may be formed from the same material as the retaining member to ensure good weld integrity between the retaining member 6 and the supporting body 2. The bristle tuft is mechanically locked in place by the retaining member and is not subject to welding constraints; consequently, the bristles themselves may be formed from a different material altogether, for example a relatively wear resistant material such as Nylon.

[0052] It is not essential that the bristle tuft is clamped-in between the retaining member and the supporting body, nor is it essential to use an anchor element. FIG. 8 shows a different arrangement, in which there is no anchor element as such and a bristle tuft 3 is clamped in place between opposing portions of a retaining member 12 welded to the supporting body 2.

[0053] The retaining member 12 may be welded to the supporting body using an ultrasonic welding process. Again, the retaining member 12 and supporting body 2 may be formed from the same material, for example a metal or a plastic such as ABS, PP or an ABS-PP blend, in order to promote a strong weld between the retaining member 12 and the supporting body 2. The retaining member 12 may be seated in a recess in the supporting body 2; in the arrangement shown in FIG. 8, the retaining member 12 stands slightly proud of the outer surface of the supporting body 2, though this is not essential.

[0054] The retaining member 12 is not shaped like a washer, but instead is formed (or provided) with a blind central bore 12a (cf. the washer-shaped retaining member 6 in FIG. 5, which comprises a central through-hole). The bristle tuft 3 is inserted within this central bore 12a in the retaining member 12 and pinch-clamped in place by deforming the walls of the central bore 12a. A suitable arrangement for deforming the walls of the central bore 12a is shown in FIG. 9. Here, the bristle tuft 3 is retained in a bristle clamp 13 and pinched by necking a nominal upper part of the bore 12a using a press 14 to flatten the respective end of the retaining member 12. The retaining member 12 is initially formed with chamfered sides in order to ensure that the flattened end of the retaining member 12 does not extend beyond the footprint of the retaining member 12. In the case where the retaining member 12 is recessed on the supporting body 2, the angle of chamfer is set such that the flattened end of the retaining member 12 fills the mouth of the recess; this may help prevent trapping of debris between the retaining member 12 and the walls of the recess.

[0055] The press 14 may be a hot or cold press. The use of a hot press to assist with deformation of the retaining member 12 may be particularly suitable where the retaining member 12 is formed from a plastic. Cold working of the retaining member on the other hand may be appropriate if the retaining member is formed from metal.

[0056] It is envisaged that pinch-clamping the bristle tuft may be sufficient mechanically to lock the bristle tuft to the retaining member 12 during use of the brush bar 1, allowing the use of dissimilar materials for the bristles and retaining member 12. Where it is found that the bristles are prone individually to release during use of the brush bar, an anchor element may optionally be provided at the root of the bristle tuft (below the necked portion of the retaining member 12) to consolidate the bristle tuft 3. The anchor element may be formed using any of the methods referred to above; for example, the bristle roots may be fused together using a hot gas method.

[0057] If pinch-clamping is not sufficient to lock the bristle tuft to the supporting body 2, then the bristle tuft may additionally be welded to the retaining member 12. For example, referring back to FIG. 8, the retaining member 12 may additionally be butt-welded to the bristle tuft 3 using a sonotrode as the press 14. In the case where the bristle tuft 3 is welded to the retaining member 12, the pinch clamping of the bristle tuft 3 by the retaining member 12 nevertheless additionally secures the bristle tuft 3 to the retaining member 12. The retention of the bristle tuft 3 is thus at least partly mechanical, reducing the strength of weld required between the bristle tuft 3 and the retaining member 12, and in turn relaxing the material constraints on the bristle tuft 3 and retaining member 12. Consequently, it is envisaged that the retaining member 12 and bristles may be formed from different materials without unduly affecting retention of the bristle tuft 3 during use of the brush bar 1. For example, the bristles may be formed from Nylon, whereas the retaining member may be formed from PA-ABS.

[0058] The present invention allows for a significant reduction in the local wall thickness of the brush bar. Assuming a typical local wall thickness of 8 mm for a stapled brush bar, preliminary tests indicate that by using the arrangement of the present invention, like-for-like performance can be maintained with a greater than 50% reduction in local wall thickness, measured from the inside surface of the supporting body to the outer surface of the retaining member. In particular, satisfactory results have been obtained using the following dimensions (refer to FIGS. 10, 11 and 12):

[0059] Wall thickness of supporting body 2 (a): 2.0 mm
[0060] Thickness of retaining member 12 (b): 2.0 mm
[0061] Diameter of retaining member 12 (c): 8.5 mm
[0062] Depth of counter-bore 12a (d): 1.5 mm
[0063] Diameter of retaining member 6 (f): 8.5 mm
[0064] Length of locking pin 10 (g): ~6.0 mm
[0065] Diameter of locking pin (Dp): 0.5 mm
[0066] Depth of collar portion 6a (h): 0.5 mm
[0067] Depth of retaining member 6 (i): 1.5 mm
[0068] Diameter of collar portion 6a (j): 4.5 mm
[0069] Width of recess 5 (k): 6.0 mm
[0070] The above dimensions are provided by way of example and are not intended to be limiting.

1. A brush bar comprising a supporting body and at least one bristle tuft, the bristle tuft being secured on the supporting body by a retaining member welded or surface-bonded to the supporting body, wherein the bristle tuft is either mechanically clamped in place between the retaining member and the supporting body or anchored in place by one or more inter-
mediate anchor elements which are mechanically clamped between the retaining member and the supporting body.

2. A brush bar according to claim 1, wherein the anchor element is welded to the bristle tuft.

3. A brush bar according to claim 1 or 2, wherein the base of the bristles forming the bristle tuft are joined together to form the anchor element.

4. A brush bar according to claim 1, wherein the bristle tuft comprises a plurality of pairs of bristles, each pair of bristles being formed by a single bristle filament looped underneath part of the intermediate anchor element or retaining member.

5. A brush bar according to claim 4, wherein the intermediate anchor element is a locking pin.

6. A brush bar according to claim 1, wherein the bristle tuft extends through one or more holes in the retaining member.

7. A brush bar according to claim 6, wherein the retaining member is in the shape of a washer.

8. A brush bar according to claim 6 or 7, wherein the retaining member forms a supporting collar around the bristle tuft for laterally supporting the bristles against excessive bending during normal use of the brush bar.

9. A brush bar according to claim 1, wherein the retaining member and brush bar are formed from substantially the same material or from a weld compatible pair of materials.

10. A method of manufacturing a brush bar having a supporting body and one or more bristle tufts secured on the support body, the method comprising: securing at least one bristle tuft by either clamping the bristle tuft in place between a retaining member and the supporting body or anchoring the bristle tuft in place using an intermediate anchor element which is clamped between a retaining member and the supporting body, and;

   welding or surface-bonding the retaining member to the supporting body.

11. A method according to claim 10, wherein the retaining member is welded to the supporting body using ultrasonic welding.

12. An apparatus for over-molding an anchor element or retaining member onto a bristle tuft, the apparatus comprising a centrifugal mold having one or more mold cavities which incorporate a radially-extending bristle-retain portion for retaining a bundle of bristles, and an outer over-mold portion configured to conform to the nominal shape of the anchor element or retaining member.

13. A method of over-molding an anchor element or retaining member onto a bristle tuft using the apparatus of claim 12, the method comprising placing a bundle of bristles in the bristle retaining portion of the mold cavity, subsequently injecting a thermoplastic resin into the mold cavity and either simultaneously and/or subsequently rotating the mold in order drive the thermoplastic resin into the over-mold portion of the cavity under centrifugal action.

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