United States Patent

Schlegel, Jr. et al.

[15] **3,638,270**

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[54] **MONOFILAMENT PILE CLEANING TOOL**

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[22] Filed: **Oct. 22, 1969**

[21] Appl. No.: **871,445**

Related U.S. Application Data

[62] Division of Ser. No. 674,078, Sept. 25, 1967, abandoned.

[52] **U.S. Cl.**.....**15/114,** 15/106, 15/117, 15/121, 15/209, 15/244, 112/410, 161/66

[51] **Int. Cl.**.....**A46b 3/00,** A47l 13/12, D03d 27/00

[58] **Field of Search**.....15/114, 115, 118, 121, 106, 15/117, 208–210; 28/72 P; 161/65, 66; 112/410, 411

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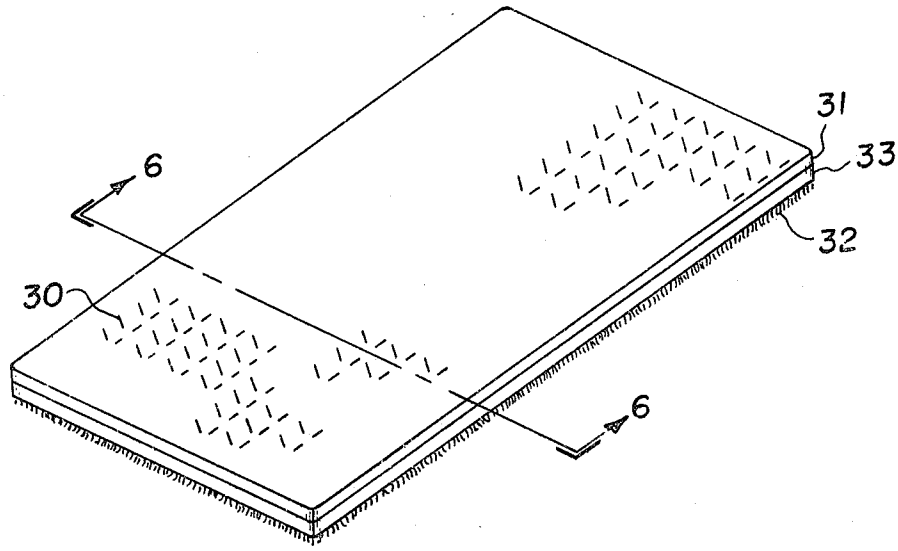
[57] **ABSTRACT**

A cleaning tool is formed with a base, a woven backing fabric secured to the base, and a monofilament of resilient resin woven into the backing fabric so that lengths of the monofilament turn away from the plane of the backing fabric and extend outward from the backing fabric at a predetermined uniform angles to form a sparse pile of bristles stiff enough to stand free and resiliently self-supporting in a regular array for cleaning.

12 Claims, 15 Drawing Figures



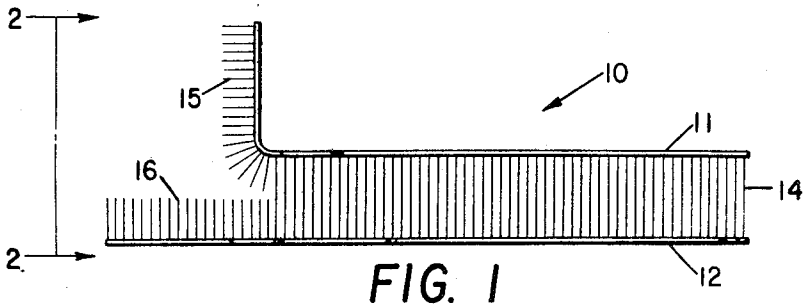


FIG. 1

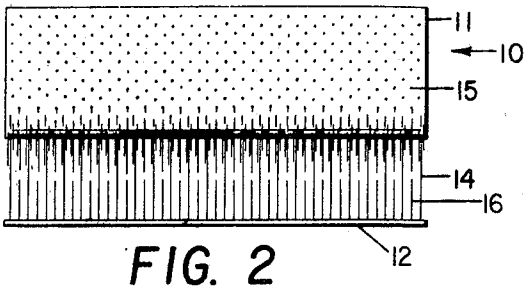


FIG. 2

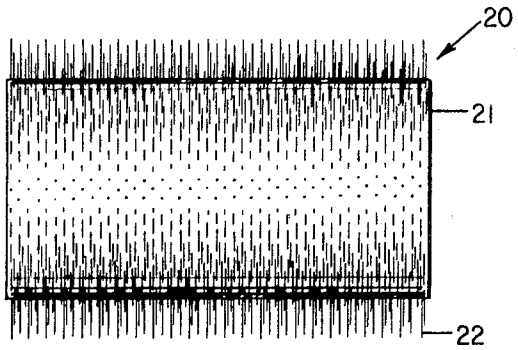


FIG. 3

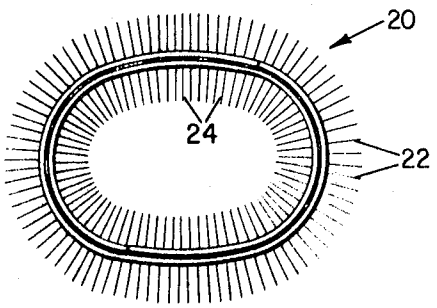


FIG. 4

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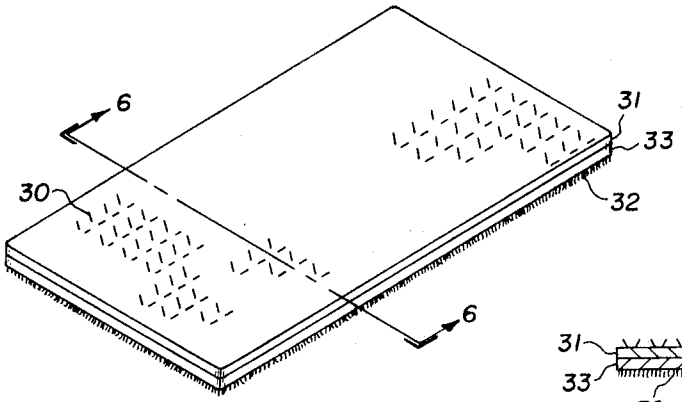

FIG. 5

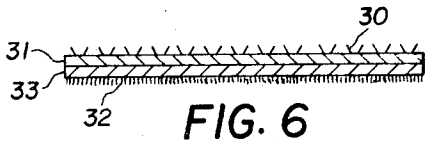

FIG. 6

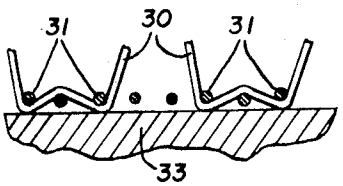

FIG. 6a

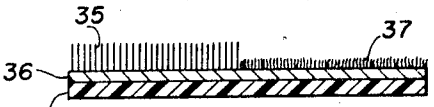

FIG. 7

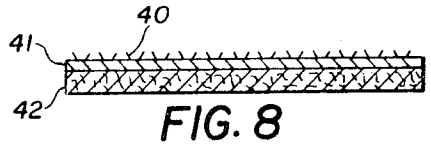

FIG. 8

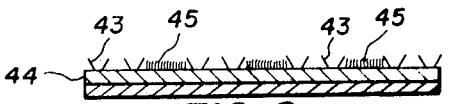

FIG. 9

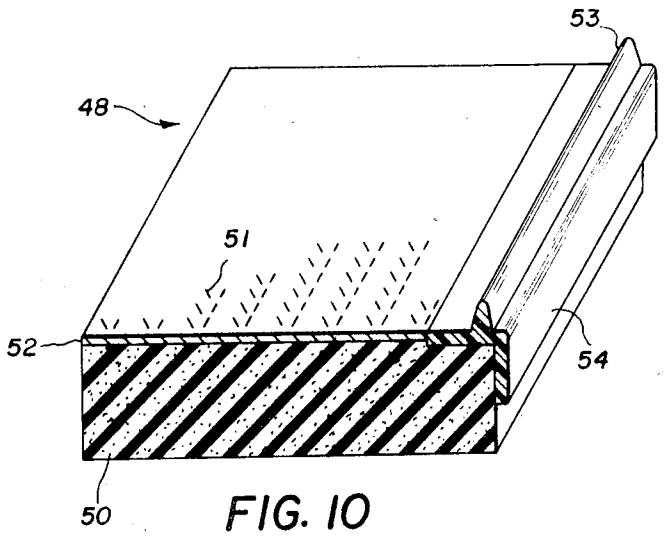

FIG. 10

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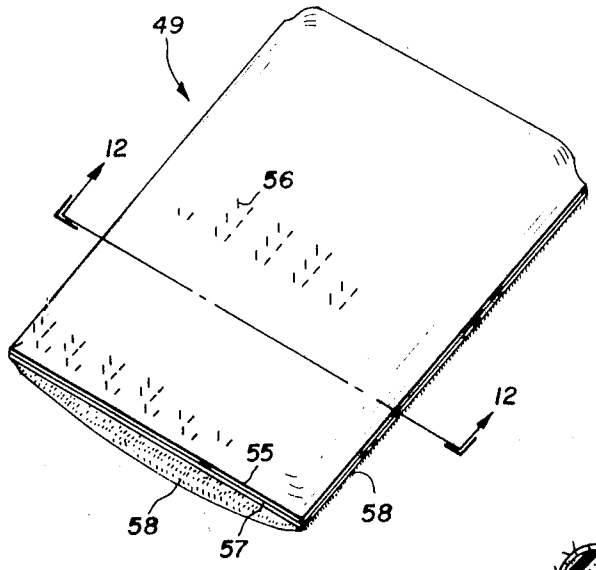

FIG. 11

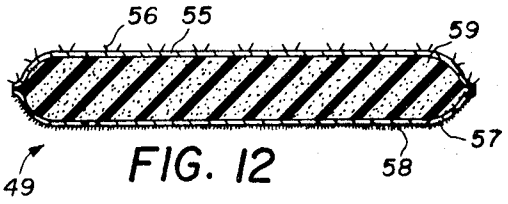

FIG. 12

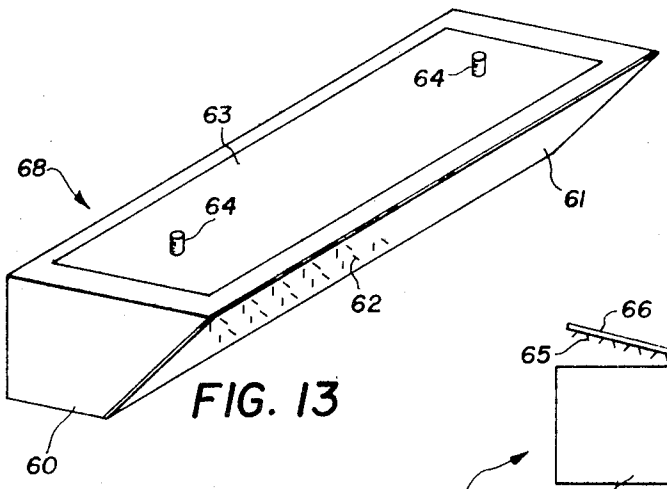

FIG. 13

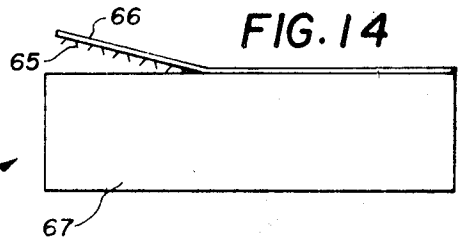

FIG. 14

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MONOFILAMENT PILE CLEANING TOOL

RELATED APPLICATIONS

This application is a divisional of our copending parent application Ser. No. 674,078, filed Sept. 25, 1967, now abandoned and entitled PILE FABRIC.

BACKGROUND OF THE INVENTION

This invention relates to a cleaning tool suitable for brushes, scouring pads, etc., and including a woven bristle pile. The invention involves the recognition of the advantages for many cleaning purposes of a distinctive bristle pile material, and the invention includes several unique cleaning tools formed with such a material.

SUMMARY OF THE INVENTION

The invention includes a base formed of a material for supporting the tool for cleaning, and a woven cloth backing fabric secured to the base. A monofilament of resilient resin woven into the backing fabric is arranged so that lengths of the monofilament turn away from the plane of the backing fabric and extend away from the base at substantially predetermined angles. Also, the turning points for the monofilaments are spaced across the backing fabric so that the bristle portions extending away from the backing fabric form a sparse pile with the area between the bristles substantially more than half the area of the backing fabric. The bristles are substantially straight and uniform in length and are sufficiently stiff to stand freely and resiliently self-supporting in a regular array.

DRAWINGS

FIG. 1 is a fragmentary side elevation of a partly cut, partly uncut, double cloth that is constructed in accordance with one embodiment of this invention;

FIG. 2 is a fragmentary view thereof taken along the line 2—2 of FIG. 1, looking in the direction of the arrows;

FIG. 3 is a side elevation of a generally cylindrical finger brush that is constructed in accordance with one embodiment of the present invention;

FIG. 4 is an end view thereof;

FIG. 5 is a perspective view of a flat cleaning tool of bristle pile material according to the invention;

FIG. 6 is a cross section of the cleaning tool of FIG. 5 taken along the line 6—6 thereof;

FIG. 6*a* is an enlarged fragmentary sectional view of the bristle pile material of FIG. 6;

FIG. 7 is a cross-sectional view of an alternative cleaning tool of the inventive bristle pile;

FIG. 8 is a cross-sectional view of another alternative cleaning tool of the inventive bristle pile;

FIG. 9 is a cross-sectional view of an alternative tool having the inventive bristle pile;

FIG. 10 is a perspective, cross section view of a sponge scrubber having the inventive bristle pile and a squeegee fin;

FIG. 11 is a perspective view of a scouring pad having the inventive bristle pile.

FIG. 12 is a cross-sectional view of the scouring pad of FIG. 11 taken along the line 12—12 thereof;

FIG. 13 is a perspective view of a sponge mop head having the inventive bristle pile; and

FIG. 14 is an end elevation of the inventive bristle pile cooperating with a sponge material to form a two-part, separable fastener.

DETAILED DESCRIPTION

Referring now in detail to the drawings by numerals of reference, the numeral 10 denotes generally a fabric product that is known in the industry as a double cloth, and that is partly cut and partly uncut. This double cloth is formed with a pair of woven backing members 11 and 12 respectively. These backing members, in the uncut portion of the double cloth, are secured to each other in a substantially uniformly spaced-

apart relation by pile filaments 14 that are woven into the backing members.

The pile filaments 14 are woven into the backing members 11 and 12 respectively in the warp of each of these woven backings, and in addition, extend from one of the backing members to the other, being united to each, and securing the two backing members together. When the pile filaments 14 are cut midway between the woven backings, the pile filaments form a woven pile on each backing member. Thus, as shown in FIGS. 1 and 2, the upper half of the pile filaments 14 forms a pile 15 on the backing 11, and the lower portion of the pile filaments forms a pile 16 on the lower woven backing 12.

The pile filaments 14 are preferably formed from a material such as polypropylene in monofilament form. The monofilament preferably has a diameter in the range from about 0.005 inch up to about 0.020 inch. Such monofilaments have sufficient stiffness to be self-sustaining in shape and in position relative to the backing member into which the monofilament is woven. Other resin materials are also suitable for the monofilament of the inventive pile material, but polypropylene is preferred for its economy, resilience, and flex life. Bristles of polypropylene and other resilient resins can be bent repeatedly in scrubbing or brushing operations and still return to their free, upstanding position. Also, stiff and self-sustaining monofilaments can be woven individually as shown in FIG. 1 or can be woven in groups of from two to 10 monofilaments standing together.

The uncut double cloth that is constructed in accordance with the present invention can be woven on a loom using substantially conventional techniques that are well known in the trade. The backings may be woven from any desired material, depending upon the application for which the product is intended. A plain weave is preferred. The fabric structure may be one up, two down, or alternatively, two up, one down.

Pile fabrics that are made in accordance with the present invention may be constructed with a variety of different pile densities and pile depths. Filaments of relatively large diameter are selected when a relatively very stiff pile is desired. The smaller diameter monofilament size is selected when a less rigid pile is satisfactory. Also, bristle stiffness is increased as bristles are made shorter or as monofilaments are combined in groups woven together.

The uncut double cloth that is made in accordance with this invention is particularly desirable material fro the construction of shoe cushioning pads. The pile filaments are sufficiently rigid and there are a sufficient number of them, to provide a substantial amount of support and to perform a load-bearing function. Other applications for the uncut double cloth include carpet padding, filter constructions, and thermal insulators of many different kinds. The superb flex life of the polypropylene monofilament makes it an excellent choice for a filament material for an uncut double cloth that is to be used in load-bearing applications, as in the construction of inner soles for shoes and sneakers where the pile may be expected to undergo repeated flexing during use. Moreover, the chemical inertness of the polypropylene monofilament insures a long and useful life even in environments where the monofilament is subjected to active chemical agents.

The monofilaments woven with the backing fabric have sharp radii at the points where they turn from the plane of the backing fabric and extend away from the backing fabric, and the monofilaments are stressed at these sharp radii. In the uncut double cloth, such stress may not be an important factor in performance because of several reasons, for example, the direction of the stress may average out; and, since each pile filament is secured at its ends to the two opposite backing members, the relatively small effect of a stress on an individual filament tends to be overcome by the manner in which the pile filament is woven with the backing members. However, with a pile fabric that has been cut from a double cloth and that has only a single woven backing, with the pile projecting from that backing, the stress on individual pile filaments may be important. The filaments may not project in uniform directions, for

example, and may not react uniformly in a given application. The importance of this varies somewhat with the extending length of the pile filaments in question, and the purpose for which the articular bristle pile is intended.

It has now been discovered that to eliminate such stresses and to set the pile filaments at desired predetermined angles at their turning points from the fabric backing material, for monofilaments of thermoplastic resin such as polypropylene, the monofilaments can be relaxed by heating the woven angles at their turning points to remove stresses from the resin material. Upon subsequent cooling, the monofilaments are set in a thermally relaxed state at preselected, and substantially uniform angles relative to the backing fabrics and maintain such set angles resiliently during the life of the bristle pile.

The angles of the monofilaments at their turning points are also controlled by the closeness of the weave of the backing fabric. Increasing the number of cross threads or picks per inch in the backing fabric forms a denser cloth that better sustains the angles of the monofilaments at their turning points away from such cloth.

This technique can be used, for example, in the manufacture of a surgical scrub brush such as is shown, for example, in FIGS. **3** and **4**. The numeral **20** denotes generally a substantially cylindrical brush that has a woven, generally tubular and cylindrical backing **21** that is formed from two lengths of the pile fabric made in accordance with the present invention, as will be described presently, and glued together, back to back. There are thus provided an external layer of pile bristles **22** that project radially outwardly from the backing **21**, and an internal layer of pile bristles **24** that project radially inwardly of the backing.

A surgical scrub brush that is made in accordance with the present invention, with a woven cotton or like backing and polypropylene monofilament fibers, is most useful for scrubup procedures in preparation for surgery. A cylindrical brush of the kind illustrated is particularly useful for scrubbing the fingers, and since the double thickness backing is flexible and readily pliable, the brush is versatile and can be folded to reach all areas of the hands and arms. Brushes of this kind can be made without the heat relaxing step, and are useful. However, the bristle or pile filament inclinations relative to the backing ordinarily are not uniform when the heat relaxation step is not employed and the pile filaments may not produce uniform results for this reason, and may have a harsh action in some cases.

In order to relax the pile filaments and set them at a right angle to the backing, which is the position shown in FIG. **1**, before the fibers or filaments are cut the backing members of the uncut double cloth are subjected to a heat treatment to raise the temperature of the turning portions of the filament at the backing to a temperature in the range from about 100° F. to about 150° F. This can be conveniently accomplished by a bank of infrared lamps, an oven, dielectric heating, or in any other convenient way. The elevated temperature should be maintained over a sufficiently long period of time to permit relaxation of the filament resin to occur. The amount of time required may range from a few seconds to several minutes, depending upon the temperature, the filament thickness, the chemical constitution of the filament, and the like. After the filaments have been subjected to the elevated temperature for a sufficient period of time to accomplish relaxation at least at the sharp radii of the filaments at their turning points from the backing fabrics, the filaments are permitted to cool to set them in the thermally relaxed state, and at a right angle or another desired angle relative to each of the backing members. The double cloth is then cut to form the two separate pieces of pile fabric, in which the pile filaments are heat relaxed and heat set. When two such pieces are employed to make a surgical scrub brush by adhering them back to back, and then adhering opposite ends of this assembly together to form a cylindrical tube, a brush is obtained in which all of the filaments project from the composite backing in a substantially radial direction relative to the cylindrical backing. The uniformity of the projecting filaments produces a uniform performance by the scrub brush that is highly desirable in its intended presurgery applications.

For some applications, the inclination of the pile filaments relative to the backing may be desired to be other than a right angle. When all of the filaments are to be uniformly inclined, the inclination can be produced very simply by shifting the position of one backing member relative to the other, of an uncut double cloth, that is constructed in accordance with the present invention, so as to incline the pile filaments relative to the two confronting spaced backing members. The heat relaxing, setting process is then carried out, and the two backing members are maintained in the desired position until the pile filaments have cooled and have become set at the desired inclination. The double cloth is then cut to produce the two pieces of pile fabric in which the filaments are uniformly inclined relative to the backings.

In order to make a surgical scrub brush that is generally cylindrical in shape, as shown in FIGS. **3** and **4** in the drawings, it is preferred to use a polypropylene monofilament having a diameter of about 0.008 inches. Since the polypropylene is substantially inert chemically to cleansing agents and other materials, the brush that is produced has highly desirable characteristics. While polypropylene is a preferred material for the monofilaments that is used in making the pile, other thermoplastic materials may also be employed if the requisite stiffness is possessed by the monofilament material so that the pile fibers are self-sustaining in shape and in position relative to the backing.

The backing may be made from any desired filament or fiber material. Thus, for specialized applications where the properties of polypropylene are particularly desired, the backing as well as the pile filaments may be woven from polypropylene material, and the backing may be woven either from monofilament or multifilament polypropylene. However, for many applications, such as, for example, surgical scrubup brushes, ordinary cotton backings are quite satisfactory.

Some of these applications, for which pile fabrics that are made in accordance with this invention are particularly useful, include lint brushes, conveyor belting covers, clothing for cotton mill cards, and doffers, and the like. For greater wear characteristics, the backing may be impregnated with rubber or other elastomeric materials. The pile may be impregnated with abrasive grit that may be secured to the pile fiber and to the backing with glue, or that may be contained within the pile filament itself, for specialized abrasive applications. Other applications will readily occur to those skilled in the art.

A particularly useful and attractive product can be made as shown in FIG. **10** by securing a polyurethane or similar foam pad to the backing of a pile fabric that is constructed in accordance with this invention. Such an item is very useful for cleaning household utensils, the white sidewalls on tires, and the like. The foam pad retains moisture and detergent or soap, and complements the bristle function of the pile filaments.

Many practical embodiments of a monofilament bristle pile according to the invention are woven in a "W" weave of either single monofilaments or from two monofilaments to about six monofilaments woven together into a double cloth that is cut to form a pair of bristle pile elements having bristles standing alone or in groups of from two monofilament to about six monofilament strands. Depending upon the intended use of such a bristle pile, more than six monofilaments could be woven together and as many as **10** monofilaments could be grouped in a single strand, but it is preferred that the monofilaments remain sufficiently stiff to stand resiliently and self supporting as independent bristles. The monofilaments should not be so multiplied that they interfere with each other's movement or become so dense as to substantially fill the space over the backing fabric and eliminate open areas between bristles for bristle motion or for holding dust, lint or material picked up by bristles. Where particularly stiff bristles are required, weaving of a thick single monofilaments is more difficult and less successful than weaing several monofilaments in a strand or bundle.

Also, bristle pile according to the invention is made successfully with upstanding, resilient bristles maintaining the set angles of their turning points without the thermal relaxation as described above, particularly if the bristles are relatively short. Thus a double cloth with closely spaced fabric backing members can be cut as described above to provide short-bristled pile fabrics the individual monofilaments of which turn away from the plane of each backing fabric and stand resiliently upright and unsupported without thermal relaxation. The set angles of the turning points for such bristles are maintained by the woven strands of the backing fabric —the denser the weave the more firmly the angle of the turning point is set. Unrelaxed pile is ordinarily not quite as uniform as a thermally relaxed pile, but for short bristles, and some uses, this is not so important. Furthermore, it can have positive advantages. Thus, for a "W" weave in which monofilaments in the form of rows of upright "W"s are woven into a backing fabric at the bottom of the "W" and have upstanding legs generally assuming the position of the outer upright legs of the "W", there is a tendency for the bristle in the one leg of the "W" to be angled away from the bristle in the opposite leg of the "W" by a generally small and approximately equal amount relative to the plane of the backing fabric. A tighter backing fabric weave tends to hold such "W" bristles more nearly perpendicular to the backing fabric, and a looser weave tends to let such "W" bristles slope outward away from each other. When such a bristle pile is used as a scrubbing or scouring instrument, approximately half the bristles are set at an acute angle to a scrubbing stroke in either direction, and form strong and effective cleaning times.

FIGS. 5–13 show several preferred embodiments of the inventive bristle pile in scouring or scrubbing tools. FIGS. 5 and 6 show a flat cleaning tool having short bristle pile 30 preferably woven in a "W" weave with overlapping, staggered, or spaced-apart rows of "W"s, and cut from a double cloth as described above to extend from the upper surface of a backing fabric 31. Secured to the opposite face of the backing fabric 31 is a dense, soft pile 32 formed of a multitude of closely packed fibers that support each other and extend from the face of a backing fabric 33. Backing fabrics 31 and 33 are secured together by adhesive, heat sealing or other means. Alternatively, dense, soft pile 32 can be woven into the same backing fabric in which bristle pile 30 is formed, to eliminate an additional backing fabric.

FIG. 7 shows additional variations in pile and backing arrangements for the inventive bristle pile. Bristle pile 35 is deeper and formed of monofilaments that stand up taller than the stiffer pile 30 shown in FIGS. 5 and 6. Because of its greater depth, pile 35 is preferably thermally relaxed as described above. Pile 35 is woven into one portion of the face surface of fabric 36, and another portion forming preferably half the face surface of backing fabric 36 is provided with soft, dense pile 37 that functions as a more gentle polishing or buffing tool in association with the tougher, bristly pile 35.

The cleaning tool of FIG. 7 also illustrates an alternative pile backing surface in the form of a solid film or lamina 38 of resin secured to the back of fabric 36. Resin sheet 38 can be glued, fused, coated, or otherwise secured to the back of fabric 36 and serves as a stiffener and water-proofing member. FIG. 8 shows another form of cleaning tool having bristle pile extending from backing fabric 41. Pile 30 is similar to pile 30 of FIGS. 5 and 6, and pile 40 can also vary as to numbers of monofilaments woven together in a group, the types of weave used, and the length of the bristles. The scouring pad of FIG. 8 also differs in its padded backing that is a fibrous material 42 either loosely woven or nonwoven and matted. Fibrous material 42 serves as a buffing or polishing pad on the opposite face from bristle pile 40.

The cleaning tool of FIG. 9 has bristle pile monofilaments 43 woven to extend from the upper face of backing fabric 44 in spaced-apart rows, and soft, dense pile 45 is woven to extend from backing fabric 44 between the rows of monofilament bristles 43. With such an arrangement, soft pile 45 collects dust and lint loosened by tougher bristles 43 and gives a polishing and softening effect to the tool.

The piles, materials and backing elements of the cleaning tools of FIGS. 5–9 can be interchanged as desired for the brushing or cleaning purpose intended. Also, such bristle pile fabrics can be formed in belts, strips, rolls, disks, sheets, or other convenient shapes or sizes for the purposes desired.

The inventive bristle pile is also embodied in scouring pads, including sponge materials such as foamed resins, as shown in FIGS. 10–13.

Sponge 50 of the cleaning tool 48 of FIG. 10 can be any known sponge material such as a foamed resin material, a foamed polyurethane, or any other spongy material suitable for cleaning and scrubbing purposes. Sponge 50 is formed in the illustrated block shape or any other convenient shape for the cleaning purpose intended. The inventive bristle pile 51 is woven to extend from backing fabric 52 which is secured to one face of block 50 as by adhesive, heat sealing, or other means. Bristle pile 51 can be short and tough, single or multistranded monofilament weave, or relatively longer, more flexible, and gentler as desired.

Fin 53, preferably formed of an extruded resin material is formed on base member 54 and secured to an edge of sponge block 50 to form a squeegee blade. Base member 54 can be flat and secured adjacent one edge of sponge block 50 by adhesive or other means, or can extend around an edge of sponge block 50 as illustrated, for better support of squeegee blade 53. With such an arrangement, cleaning tool 48 acts both as a scrubber, a moisture and detergent holding element, a sponge, and a squeegee.

The scouring pad 49 of FIGS. 11 and 12 is pillow-shaped as illustrated, and includes an outer casing formed at least in part of backing fabric 55 having bristle pile 56. Backing fabric 55 and bristle pile 56 can form the entire casing for scrubber 49 with the edges of the casing secured together by adhesive, a heat seal, or other means. Also, as illustrated, the casing for pad 49 can include backing fabric 57 having a soft, dense pile 58. Backing fabrics 55 and 57 are secured together in the illustrated pillow-shape so that bristle pile 56 extends from the opposite face of pad 49. The casing is preferably filled with a sponge material such as resin 59 or other soft, cushioning material, so that pad 49 is a soft scrubber. Bristle pile 56 forms a tough scrubbing surface on one side of the pillow and soft pile 58 forms a polishing or buffing surface on the other side of the pillow. Various bristle piles, and other surfaces can be formed on pad 49 within the spirit of the invention.

FIG. 13 shows a mop head 68 formed of a block 60 of sponge material and having secured to one face a backing fabric 61 having the inventive bristle pile 62. The upper surface of mop head 68 is formed with a plate 63 adapted for attachment to a conventional mop handle by screws 64. Mop head 68 combines previously known sponge mop capabilities with the enchanced scrubbing power of bristle pile 62 to form an advantageous mopping implement. In addition the squeegee fin 53 (FIG. 10) can be added to mop head 68 if desired.

FIG. 14 shows use of the inventive bristle pile 65 as a two-part separable fastener. Pile 65 is preferably a fairly short and sparsely woven array of bristles extending from backing fabric 66 for engagement with foamed resin material 67. Fabric 66 is pressed against foam material 67 so that bristles 65 are embedded in one face of foam material 67 to fasten fabric 66 and foam 67 together. Bristles 65 tend to stick in the surface of foamed material 67 and offer great resistance to any shearing stress tending to pull fabric 66 laterally across the face of foam material 67. The inventive bristle pile thus serves well as part of a fastener having great resistance to shear stress between two elements.

Persons wishing to practice the invention should remember that other embodiments and variations can be adapted to particular circumstances. Even though one point of view is necessarily chosen in describing and defining the invention, this should not inhibit broader or related embodiments going beyond the semantic orientation of this application but falling within the spirit of the invention. For example, the bristle pile cleaning elements can be included in many cleaning tools in many ways.

We claim:

1. A cleaning tool comprising:

a. a base formed of material supporting said tool for cleaning;

b. a woven cloth backing fabric;

c. means for securing said backing fabric to said base;

d. a monofilament of resilient resin woven into said backing fabric in a W weave configuration;

e. lengths of said monofilament turning from the plane of said backing fabric and extending away from the face of said backing fabric opposite said base;

f. said lengths of said monofilament being set at substantially predetermined angles to the plane of said backing fabric at points of said turning to form the outside legs of said W weave configuration;

g. said turning points being spaced across said backing fabric so that bristle portions of said lengths of said monofilaments extending beyond said turning points away from said backing fabric form a sparse, bristle pile;

h. said bristle portions of said monofilaments being substantially straight and uniform in length;

i. said monofilament being sufficiently stiff so that said bristle portions stand freely and resiliently self-supporting at substantially said predetermined angles in a regular array to serve as cleaning elements; and

j. said predetermined angles of said W weave legs are substantially equal and oppositely oriented.

2. The cleaning tool of claim 1 wherein said base comprises a lamina of synthetic resin material.

3. The cleaning tool of claim 1 having a dense, soft, pile material arranged between rows of said bristle portions of said monofilament.

4. The cleaning tool of claim 1 having a dense, soft, pile material on a portion of said fabric backing material.

5. The cleaning tool of claim 1 wherein said base comprises a block of foamed resin material.

6. The cleaning tool of claim 5 including a flexible fin of resilient material secured to said block along an edge thereof to form a squeegee.

7. The cleaning tool of claim 1 wherein said fabric material surrounds and encases said base.

8. The cleaning tool of claim 7 wherein a dense, soft pile material is formed on a portion of said fabric material.

9. The cleaning tool of claim 7 wherein aid fabric material is pillow-shaped, said base is a pillow-shaped cushion formed of foamed resin material.

10. The cleaning tool of claim 9 wherein a dense, soft, pile material is formed on a portion of said backing fabric.

11. The cleaning tool of claim 1 wherein said base comprises a mop head formed of foamed resin material.

12. The cleaning tool of claim 11 including a fin of resilient material secured to said mop head along one edge thereof to form a squeegee.

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