June 20, 1967 W. SAWKIW 3,325,845

NYLON BRISTLE RESEMBLING NATURAL BRISTLE

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Fig. 1.

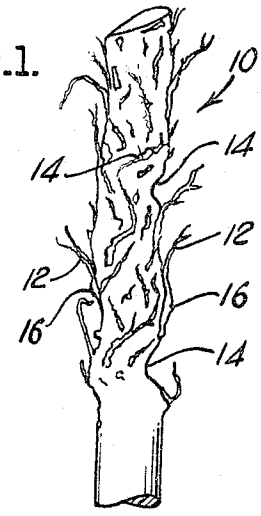

Fig. 2.

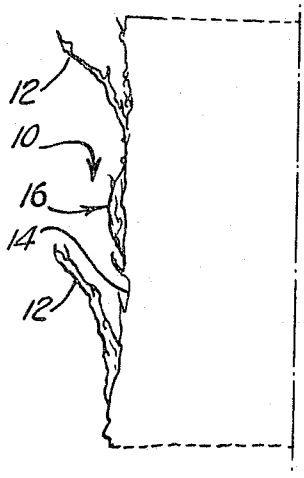

Fig. 3.

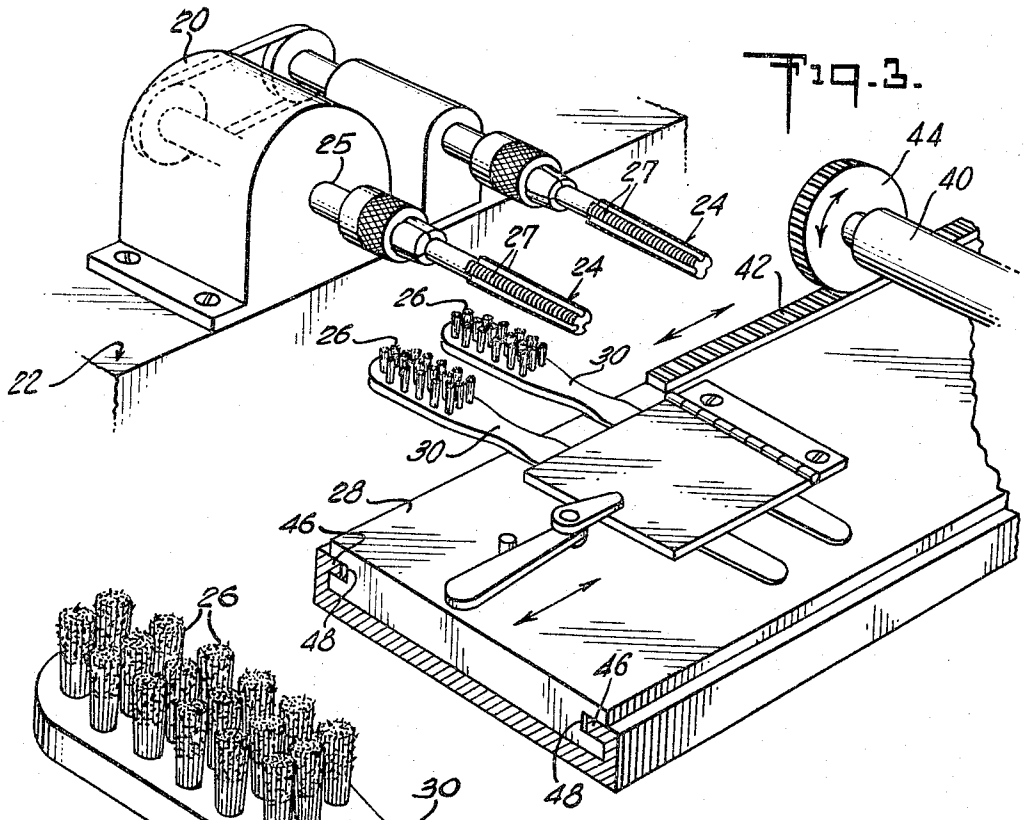

Fig. 4.

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NYLON BRISTLE RESEMBLING NATURAL BRISTLE

Filed Feb. 26, 1965 2 Sheets-Sheet 2

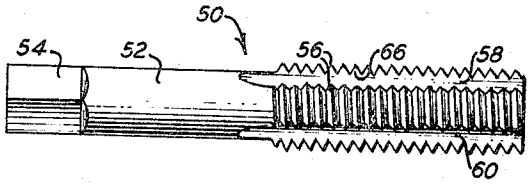

FIG. 5.

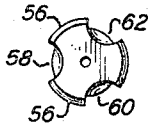

FIG. 6.

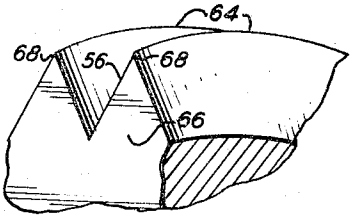

FIG. 7.

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NYLON BRISTLE RESEMBLING NATURAL BRISTLE

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Filed Feb. 26, 1965, Ser. No. 435,522
11 Claims. (Cl. 15—159)

This invention relates to bristles for brushes, and more particularly, is directed to synthetic filaments useful as bristles in brushes and to a method of making such filaments.

The superiority of natural bristles over synthetic bristles for providing brushing elements has long been recognized. This long recognition has led many to attempt making synthetic bristles which would approach the cleansing and water retention ability of natural bristles but such has not, until my present invention, been accomplished.

By my invention, I have provided a monofilament of synthetic material which has surface characteristics of natural bristles. The synthetic monofilament has randomly scored, indented and raised surface portions and from random sites on the surface of the filament are finger-like projections. The surface skin caused by case hardening inherent from extrusion of a synthetic filament is removed or partially removed in areas defining a random pattern over the surface of the extruded synthetic filament. Furthermore, the surface of the synthetic filament of my invention, in addition to being generally roughened, has numerous minute finger-like projections extending from the terminal ends of some of the random score lines impressed upon the synthetic filaments where complete removal of the synthetic material from the score line does not take place.

Because of these minute finger-like projections, the synthetic filaments of my invention acquire a surface characteristic which is best defined as "pubescent," i.e., covered with fine hairs.

This pubescent surface characteristic of the synthetic filaments of my invention along with the irregular and random pattern of score lines therein provide for the first time a synthetic bristle useful for brushes which is equal to or surpasses the heretofore superior qualities of a natural bristle. Since the skin of case hardening has been removed in random score lines in the synthetic bristle and because of its pubescent characteristic such that it no longer has a smooth, hard surface, more water and cleansing material can be held by the individual bristle than has heretofore been possible.

Similarly, since former attempts to provide synthetic bristles of irregular or roughened shapes have primarily involved the extrusion of a synthetic filament through a die having an irregular cross section (i.e., octagonal, star-shaped, fluted etc.) and since such an extruded filament is usually made approximately twice the diameter to which it is subsequently stretched down, any contour which is forced into the filament by the die, which initially has sharp edges, cannot be retained because during the stretching operation the sharp edges break down or round off somewhat. According to my invention, the sharp edges are retained by the score lines and roughened surface of the synthetic filament since they are cut into the preformed filament by my discovery of suitable apparatus for making such cuts and by making such cuts subsequent to all preforming operations upon the filament. As such, sharp edges are retained in the scored filament which aid in the cleaning of surfaces or elements brushed with brushes made therefrom.

The following description is directed to toothbrushes employing the bristles of my invention for convenience

only. It is to be understood that the bristles of my invention are equally adaptable to brushes of all sorts such as hairbrushes, scrubbing brushes, paintbrushes, and the like.

In order that the invention is even more readily understood, reference should be had to the accompanying drawings and following specification wherein there are illustrated and described one embodiment and a method of manufacture therefore, but it is to be understood that the inventive concept is not to be considered limited to the constructions disclosed except as determined by the scope of the appended claims.

Referring to the acompanying drawings:

FIGURE 1 is an enlarged perspective view of a synthetic filament having surface characteristics in accordance with the present invention.

FIGURE 2 is a greatly enlarged fragmentary plan view showing at one edge a longitudinal cut through the surface of the synthetic filament of the present invention.

FIGURE 3 is an elevational view of suitable apparatus for forming the synthetic bristles in accordance with the invention; and

FIGURE 4 is an enlarged elevational view of the bristle-carrying portion of a toothbrush embodiment using bristles of this invention.

FIGURE 5 is a side elevational view of a typical internal screw thread tap used in the method of this invention.

FIGURE 6 is a view in elevation of the right hand end of the internal screw thread tap of FIGURE 5 showing the arrangement of the teeth.

FIGURE 7 is an enlarged elevational view of parts of two individual teeth of the internal screw thread tap of FIGURE 5.

Referring first to FIGURES 1 and 2, there is shown a monofilament of synthetic material generally designated by the numeral **10**. Projecting outwardly from the surface of the monofilament **10** are numerous, irregularly spaced and postioned finger-like projections **12**. These finger-like projections **12** are themselves or irregular, crooked shapes and of varying cross sections presenting an overall impression of a pubescent surface on the synthetic monofilament. As is also shown in FIGURES 1 and 2, the surface of the synthetic monofilament has numerous sharp edged irregularly shaped and sized depressed areas or scores, cuts or grooves **14** which extend in varying directions and to varying depths over, around and into the synthetic monofilament **10**. In some instances, the material cut or taken away from the score lines or grooves **14** in a manner more fully described hereafter forms a built-up area in the form of sharp edged irregularly shaped and directed mounds **16** on the surface of the monofilament **10**. In other instances, the material partially removed from the scored lines or grooves **14** forms the dendritic, finger-like projections **12** described above.

In FIGURE 3, there is shown apparatus and a method for forming a preformed extruded synthetic monofilament into the synthetic monofilament **10** of improved cleansing capabilities described above. The apparatus consists of a motor **20** secured to a fixed surface **22** and adapted to rotate cutting elements **24** coupled to drive shaft **25** of said motor **20**. Spaced from cutting members **24** and adapted to hold one or more tufts **26** of preformed extruded synthetic monofilaments perpendicular to the longitudinal axis of cutting element **24** is a reciprocating member **28** reciprocatable in a longitudinal direction transverse to the longitudinal axis of said cuttting member **24**.

In the embodiment shown in FIGURE 3, rotating cutting elements **24** are metal cutting taps well known in the art for forming an internal screw thread. FIGURE 5 shows an internal screw thread tap **50** typical of those

used in the practice of this invention. The tap comprises a shank **52** with a portion **54** which is squared off so that the chuck of a machine tool may grasp the tap firmly for rotation. A series of raised teeth **56** are provided between which there are hollowed out areas or flutes such as **58**, **60** and **62**. The teeth are arranged in a helical pattern on the shank and each individual tooth has a sharp top edge **64** and a flat triangular leading face **66**. The top edge **64** is curved and the apex **68** of the front triangular face **66** is slightly higher than the apex of the rear triangular face, not shown. The triangular face **66** of each tooth is relatively short and blunt as compared to the needles and sharp knives used by the prior art in treating bristles. Laterally spaced from rotating taps **24** and perpendicular to the longitudinal axis thereof are a plurality of tufts **26** of synthetic monofilaments, in this instance, inserted as bristle tufts in toothbrushes **30** in any manner well known in the art. The bristle tufts **26** are maintained in a perpendicular relationship to the longitudinal axis of the rotating taps **24** by being clamped securely to reciprocating member **28** which is reciprocated in a longitudinal direction by a reversing motor (not shown) driving shaft **40** suitably rotatably journaled in fixed position and adapted to drive rack **42** secured to reciprocating member **28** through pinion **44**. Reciprocating member **28** is maintained in a predetermined, fixed longitudinal relationship by tongue track **46** mated to lateral grooves **48** in reciprocating member **28**. As the tap rotates the bristle is contacted by the front triangular face **66** and top edge **64** to deform and superficially cut the surface of the bristle to form depressed and raised areas and hair-like projections as shown in FIGURES 1 and 2. This bristle construction is new and not shown in any of the prior art.

As taps **24** are rotated, the reciprocating assembly is positioned to carry the tufts of bristles **26** back and forth longitudinally in a direction transverse to the longitudinal axis of rotating taps **24** and at a distance spaced from rotating taps **24** such that the tufts of bristles **26** are dragged through the rotational path of the cutting edges **27** of taps **24**.

In the embodiment shown in FIGURE 3, wherein the synthetic monofilaments are mounted as tufts **26** of bristles in a toothbrush **30** prior to being cut by the rotating taps **24** to form the synthetic bristles of the present invention, varying the space between the rotational path of the cutting edges **27** of the taps **24** and the base of the bristles results in being able to vary the distance over which the pubescent, scored and raised surface extends along the length of the bristle. As shown, particularly in FIGURE 4, the pubescent, scored and raised surface of the bristles extends from the free end thereof toward the mounted or fixed end thereof a distance equal to about two-thirds the length of the bristle. Such treatment of the bristles is accomplished by adjusting the reciprocating member **28** holding the brush **30** in which the bristles are mounted a distance away from the lowermost rotational point of the rotating cutting edges **27** such that the cutting edges of the rotating tap **24** reach into the tuft of bristles a distance approximately equal to two-thirds of their lengths. From the above, it can be readily seen that the distance to which the bristles are scored and cut by the rotating member can be widely varied. As described hereafter, the distance of scoring can extend even the full length of the bristle.

While the embodiment shown depicts the cutting of bristles by a rotatable member which bristles are mounted in a brush head, it is to be understood that synthetic monofilaments can be cut and scored by the rotatable tap member prior to being mounted in a brush. In such instances, a plurality of synthetic monofilaments of any given length are secured at one end into bundles and mounted on a reciprocating member by any suitable means such as a clamp. The bristles are then dragged through the rotational path of the rotating tap members

to any given depth in the bundle. This results in substantially the total length of the synthetic monofilaments being cut and scored and the surface thereof rendered pubescent. Following such treatment of unmounted synthetic filaments, the bundle can then be removed from the reciprocating apparatus, cut into desired lengths for forming tufts of bristles for the brush desired and then mounted in the bristle-carrying portion in the brush by any means well known in the art. In this manner, synthetic filaments forming the bristles of the brush obtain the scored, raised and pubescent surface characterizing the bristles of this invention substantially throughout their entire lengths.

Thus, by the above methods and apparatus, the present invention provides for the first time, bristles of synthetic polymerized plastic materials which are equal to or surpass the ability of natural fibers, to hold and retain fluids and cleansing materials and for scouring and brushing surfaces. Suitable synthetic polymerized plastics from which the bristles of the present invention can be made are nylon (a copolymer of hexamethylenediamine and adipic acid), Lucite (a methyl methacrylate polymer), cellulose acetate, cellulose acetate butyrate, polymerized vinyl acetate and the like. In general, any polymerized plastic-like material which can be formed by extrusion into a long, thin monofilament can be used. However, in the practice of the present invention, the advantageous results are obtained by extruding the synthetic plastic material down to its finally desired dimensions prior to the cutting and scoring thereof by the apparatus above described. In this manner, all the edges of the scored and built-up areas and finger-like projections on the surface of the plastic monofilament retain their sharp, irregular configurations as formed. Accordingly, the bristles of the present invention accomplish better scrubbing and fluid retention than synthetic bristles heretofore available and in some instances, better than natural bristles.

Often, synthetic filament material is supplied as a continuous filament on a spool, or as a group of continuous filaments wound together on a spool in the form of a "rope." In such instances, it might be desirable to score the filaments continuously before they are cut into prescribed lengths in a bristling or bundling machine. The only modification required to accomplish continuous treatment of a single continuous filament or a "rope" of continuous filaments in accordance with the present invention is to pass the material over the top of one rotating tap member and under another, preferably positioned close together. In this form, it is not required to have a reciprocating mounting member for a bundle of filaments. Again, it is seen that this method produces synthetic filaments which obtain a pubescent surface substantially throughout their lengths such that when they are mounted as bristles in brushes, the bristles also have pubescent surfaces along their entire lengths.

It is to be understood that while the specific apparatus described for making bristles of the present invention depicts stationary rotating cutting elements through which synthetic filaments are dragged by a reciprocating mounting member, the same results can be achieved by having the rotating cutting elements reciprocate back and forth through the synthetic filaments mounted on a stationary member, or by having both the cutting elements and the mounting member holding the synthetic filaments each reciprocate back and forth in opposite directions. It is only necessary that there be moving contact between the cutting elements and the bristles to be treated. Further, while reciprocating motion has been specifically described and illustrated, and continuous linear motion has been described, arcuate motion, as by a pendulum or rocking arm, can similarly be employed.

While I have described my invention with particular reference to a specific toothbrush embodiment, it is to be understood, that it is not to be limited thereto, but is to be construed broadly and restricted solely by the scope of the appended claims. Also, while I have described my

invention with particular reference to specific apparatus for forming the same, it is readily apparent that various changes, alterations, and modifications therein can be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. In a brush having a bristle-carrying portion and a plurality of tufts of bristles fixed therein, the improvement comprising bristles of a synthetic plastic material, each bristle consisting of a monofilament having a pubescent surface, the surface of said monofilament being further characterized by having sharp edged irregularly spaced, randomly directed, depressed areas of varying sizes and shapes and sharp edged irregularly spaced, randomly directed, raised areas of varying sizes and shapes intermediate said depressed areas.

2. The invention of claim 1 wherein said synthetic plastic material is selected from the group consisting of nylon, Lucite, cellulose acetate, cellulose acetate butyrate and polymerized vinyl acetate.

3. The invention of claim 1 wherein the pubescent, depressed and raised surface of said synthetic monofilament extends from the free ends of said bristles toward the fixed ends thereof a distance equal to about two-thirds the length of said bristles.

4. A toothbrush as defined in claim 1.

5. A toothbrush as defined in claim 2.

6. A toothbrush as defined in claim 3.

7. The method of making brush bristles of a synthetic plastic material, said bristles having a pubescent, randomly and irregularly scored and raised surface, said method comprising the steps of (1) extruding a plastic material into a monofilament of predetermined thickness, and (2) scoring said monofilament with a series of helically arranged longitudinally spaced rotating cutting elements by maintaining relative contacting motion between said monofilament and said rotating cutting elements, said relative contacting motion being in a direction transverse to the longitudinal axis of said spaced rotating cutting elements, each of said cutting elements having a flat triangular front face and a sharp top edge.

8. The method of making brush bristles of a synthetic plastic material, said bristles having a pubescent, randomly and irregularly scored and raised surface, said method comprising the steps of (1) extruding a plastic material into a monofilament of predetermined thickness, (2) securing a plurality of said extruded monofilaments at one end thereof into a bundle, and (3) scoring said monofilaments with a series of helically arranged longitudinally spaced rotating cutting elements by maintaining relative contacting motion between said bundle of monofilaments and said rotating cutting elements, said relative contacting motion being in a direction transverse to the longitudinal axis of said spaced rotating cutting elements, said bundle being maintained substantially perpendicular to the longitudinal axis of said spaced rotating cutting elements, each of said cutting elements having a flat triangular front face and a sharp top edge.

9. The method as defined in claim 8 wherein said monofilaments are formed into bundles and secured at one end by mounting a plurality thereof into the bristle-carrying portion of a brush.

10. The method as defined in claim 8 wherein said relative contacting motion is directed in a plane such that the path of rotation of said spaced cutting elements extends into said bundle from the free ends of said monofilaments a distance equal to approximately two-thirds the length of said monofilaments.

11. The method of making brush bristles by roughening a monofilament of high molecular weight polymeric whereby the monofilament resembles a natural bristle which comprises the steps of:

(1) providing an extruded monofilament of selected polymeric material having a predetermined thickness;

(2) providing a selected number of deforming cutting tools having a base with an outwardly projecting, raised, short in height cutting surface which has a substantially flat face and a sharp top edge;

(3) causing relative contacting motion between the monofilament and the cutting surface, said relative contacting motion being in the direction transverse to the longitudinal axis of said filament so that the flat face of the cutting surface hits the side of the filament;

(4) to roughen the side wall surfaces of the monofilament by cutting and scoring the individual filament along such side wall surfaces with the cutting surface;

(5) continuing the contacting of the cutting surface with the monofilament until the desired degree of roughening is obtained whereupon the side wall surfaces of the monofilament are provided with:

numerous sharp edged, irregularly shaped and sized, randomly positioned, depressed areas and raised areas which extend in varying directions and to varying extent over, around and on the monofilament, and numerous, sharp edged, randomly positioned finger-like projections of irregular, crooked shapes and of varying cross-sections presenting an impression of a pubescent surface, whereby the roughened monofilament is adapted to hold and retain water and cleansing materials similar to a natural filament, and

(6) removing the contact between the monofilament and the cutting surface.

References Cited

UNITED STATES PATENTS

1,773,969	8/1930	Dreyfus et al.	15—159.1
2,110,371	3/1938	Radford	161—180
2,245,191	6/1941	Guenther et al.	161—180 X
3,112,160	11/1963	Rush	161—180

FOREIGN PATENTS

1,043,990	6/1953	France.
713,188	8/1954	Great Britain.
897,404	5/1962	Great Britain.
941,679	11/1963	Great Britain.
383,545	1/1965	Switzerland.

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