ABSTRACT

This invention relates to new and useful brush making apparatus which allows the manufacture of a wide variety of different types of constructions having pretrimmed synthetic filament tufts. The apparatus is capable of picking and trimming all tufts required in a single tufted construction simultaneously, and simultaneously assembling said tufts in said construction. The apparatus comprises a filament stock box for dispensing cut-to-length synthetic filament, a picking unit containing tuft-forming pickers which when inserted into the stock box will pick and trim the desired tuft, and means for fusing the end of the picked tuft and for mounting the prefused end thereof to form a tufted construction.

7 Claims, 60 Drawing Figures
BRUSH MACHINERY AND INSTANT BRUSH CONSTRUCTION


This invention relates to new and useful brush making machinery, and more specifically, to machinery for continuously fabricating tufted constructions. The machinery is particularly adapted to form a variety of tufted constructions wherein the ends of the tufts are fused and supported before they cool, so that the cooled, prefused ends only connect the tuft and the support, or hold the tuft in the support.

The brush industry and the brush making art during the last 50 years has remained, for the most part, unchanged. The only major changes taking place have been in the substitution of synthetic monofilaments (thermoplastic fibres, i.e., nylon monofilament) for the vegetable and hair fibres previously employed. The emphasis has been on finding ways to substitute directly the synthetic for the natural, utilizing the same brushing equipment, i.e., stapling machinery, and little or no emphasis has been placed upon improving the methods and machinery used. Great strides have been made wherein two or three brushes can be stapled simultaneously, however, it still requires one picking and stapling cycle for each fibre tuft staple-set in the brushback. There has been no advancement toward finding a way of placing all the desired tufts in a brushback or other support simultaneously; and performing this operation in the same amount of time required to pick and staple said one fibre tuft employing conventional brush machinery.

The need to improve the machinery for fabricating brush components can be illustrated by comparing and describing conventional brushing machinery with the machinery of this invention. The brushmaking machinery of this invention differs from the ordinary brush machinery in that it employs a new method of picking fibre tufts. The conventional stapling machine employs a picker which removes a fibre tuft from a stock or feed box by first entering the stock box approximately at its mid-section (lateral to the parallel fibre) and picking a given amount of fibre at the fibre's mid-section. The picker then proceeds to transport the predetermined volume of parallel fibre to a means for doubling the fibre at its mid-section (prior to stapling), thus resulting in a tuft having a U-shape wherein both ends of the individual fibre are located at the working tip of the resultant tuft. A still further improvement is that the head of the fibre tuft (tuft number) is then inserted to the U-shaped loop and the tuft then forced into a pre-drilled hole in a brushback. Each tuft is formed in this manner one after another until the necessary number of holes have been filled.

The picking device of the machinery of this invention works on an entirely different principle. The picker or picking unit enters the fibre stock box from the end (longitudinal to the fibre) and engages the fibre from the end, thus instantaneously forming a fibre tuft. The fibre employed in forming tufts in this manner is one-half the original length of the fibre required using conventional picking methods. The instantly formed fibre tuft is then automatically mounted on a support. The resultant fibre tuft can be anchored in many ways, i.e., heat-sealing, set in epoxy, and the like. However, the preferred method is to heat-seal the fibre tuft. This could be done either prior to inserting the tuft in the brushback, or after inserting the tuft through a portion of a brushback. However, the preferred method is to heat-seal the fibre tuft and mount the heat-softened end on a support whereby the tuft will be secured to the support when the heat-softened end cools. Fibre tufts formed in this manner are anchored securely and can not be removed.

Since, when forming tufts using the method of this invention there is no requirement for doubling the fibre prior to mounting, tufts so formed in accordance with this invention require no trimming. This results in an appreciable savings to the manufacturer. A second economical savings is also realized, in the elimination of a staple or anchor or other means for securing the tuft to the support.

It is of particular importance in this invention that the picking device employed operates in such a manner that a plurality of fibre tufts may be formed simultaneously. In one of the embodiments of this invention a tufted construction is formed simultaneously by employing a series of picking devices (hereinafter referred to as picking units) set in a pre-arranged pattern and heat-sealing all the fibre tufts simultaneously for mounting on a support. In this way a single tufted construction may be formed in the same cycling time it takes to pick and staple set one fibre tuft using conventional machinery.

By utilizing the machinery of this invention one or more tufts having prefused ends may be supported in a variety of ways as will be evident to those skilled in the art. For example, the prefused tuft end may be inserted in an aperture before the end cools, the said prefused end conforming to the internal confines of the aperture to hold the tuft in the aperture when the tuft end cools. The tuft receiving aperture may be in a brushback of conventional design, or in another type of support such as a scrub or household sponge. When mounted in a brushback the prefused end conforms to the geometrical confines of the generally non porous internal surface of the aperture. When mounted in a
sponge the prefused end also conforms to the internal confines of the aperture, however, the prefused filamentary material also penetrates the porous sponge material to hold the tuft in the sponge when said prefused end cools.

The machinery of this invention may also be adapted to form tufted constructions wherein the prefused tuft end is mounted on a heat-softened depression on a sheet of the filamentary material.

Additional tufted constructions may also be formed wherein the prefused tuft end is mounted on a single strand, or on woven and nonwoven mesh. The strand or mesh may be of wire, cellulosic or plastic material, and is embedded in the prefused tuft end before the end cools.

Finally, the tuft may be picked by or inserted into a sheet support exposing both the working and nonworking ends of the tuft. The nonworking end may then be heat-sealed to retain the tuft in the support.

It will be obvious to those skilled in the art that a wide variety of different tufted constructions may be made utilizing the machinery of this invention.

Accordingly, it is an object of this invention to provide new and useful brushmaking machinery adaptable for use in forming a single tuft of mono-filament fibres, multiple fibre tufts, complete brush or tufted components simultaneously formed, and continuous modular brush or tufted constructions.

It is another object of this invention to provide a machine which will simultaneously pick fibre tufts, assemble the tufts in a predetermined pattern, and form an integral fibre tuft support modular tufted construction.

It is another object to provide a brush machine wherein the picking unit comprises one or more individual tuft pickers adapted to receive the complete fibre portion of the tufted construction to be formed simultaneously.

It is a further object of this invention to provide a machine for forming tufted constructions including means for heat-sealing the fibre tufts integral with a support.

It is a further object to provide a machine for making tufted constructions which assembles cut-to-length thermoplastic fibres into fibre tufts, each of said tufts having a prefused end for mounting and a working end which does not require trimming.

It is yet another object to provide a tufted construction wherein one or more mono-filament tufts are formed, an end thereof heat-sealed, and fused and mounted on and embedded in a mesh support.

It is a further object to provide a tufted construction wherein one or more mono-filament synthetic tufts are formed, and heat-sealed and fused and mounted on a heat-softened portion of a sheet support of said filamentary material.

It is a further object to provide a tufted construction wherein a plurality of mono-filament tufts extend from a prefused end thereof, said end being mounted on a woven or nonwoven mesh, said construction adapted to be attached to a base member to provide additional support.

These and other objects will become readily apparent with reference to the drawings and following description wherein:

FIG. 1 is a longitudinal sectional view of a tuft-forming picker of this invention;

FIG. 1A is a cross-sectional view taken along line A—A of FIG. 1;

FIG. 2 is a longitudinal sectional view of another tuft-forming picker of this invention having an internal venturi section;

FIGS. 2A and 2B are cross-sectional views taken along lines A—A and B—B of FIG. 2;

FIG. 3 is a longitudinal sectional view of a tuft-forming picker of this invention having a square cross-sectional construction;

FIG. 3A is a cross-sectional view taken along line A—A of FIG. 3;

FIG. 4 is a longitudinal sectional view of a tuft-forming picker of this invention having a star-like cross-sectional construction;

FIG. 4A is a cross-sectional view taken along line A—A of FIG. 4;

FIG. 5 is a longitudinal sectional view of a tuft-forming picker of this invention having a triangular cross-sectional construction;

FIG. 5A is a cross-sectional view taken along line A—A of FIG. 5;

FIG. 6 is a longitudinal sectional view of a tuft-forming picker having an internal tapered section in accordance with this invention;

FIGS. 6A, 6B, and 6C are cross-sectional views taken along lines A—A, B—B, and C—C, respectively, of FIG. 6;

FIG. 7 is a longitudinal sectional view of the tuft-forming picker of FIG. 6 containing parallel synthetic fibre in accordance with this invention;

FIG. 7A is a cross-sectional view taken along line A—A of FIG. 7;

FIG. 8 is a longitudinal sectional view of a tuft-forming picker in accordance with this invention employed to form a shaped end on a fibre tuft;

FIG. 9 is a perspective view illustrating the tuft-forming picker of FIG. 8 forming a predetermined quantity of individual synthetic fibres into a tuft;

FIG. 10 is a perspective view of a tuft as formed in accordance with this invention with one end heat-sealed to form the tuft base and the other end possessing a rounded trim;

FIG. 11 is a fragmentary longitudinal sectional view of an alternate tuft-forming picker illustrating a tuft end formed according to this invention;

FIG. 12 is a fragmentary longitudinal sectional view of a tuft-forming picker of this invention showing an alternate shape which may be implanted to the tuft end;

FIG. 13 is a fragmentary longitudinal sectional view of a tuft-forming picker of an alternate tuft-forming picker of this invention illustrating another shape which may be imparted to the tuft end in accordance with this invention;

FIG. 14 is a longitudinal sectional view of a plurality of tuft-forming pickers of this invention illustrating the fibre ends prior to tuft end formation;

FIG. 15 is a longitudinal sectional view of one of the tuft-forming pickers of FIG. 14 containing a heat-sealed fibre tuft formed in accordance with this invention;

FIG. 16 is a view of a brushback with tuft formed in accordance with this invention in partial section;

FIG. 17 is a detailed fragmentary view in perspective and partly in section showing one arrangement of tuft-forming pickers, a synthetic fibre stock box, a heat-
sealing die and a brushback fibre tuft assembly stationed in accordance with this invention; FIG. 18 illustrates the machinery of FIG. 17 having the tuft-forming pickers stationed opposite the sealing means; FIG. 19 shows the machinery of FIG. 17 having the tuft-forming pickers stationed opposite the support assembly station; FIG. 20 is a cross-sectional view taken along line A—A of FIG. 17; FIG. 21 is a fragmentary partial sectional view taken along line B—B of FIG. 17; FIG. 22 is a cross-sectional view taken along line C—C of FIG. 17; FIG. 23 is a cross-sectional view taken along line D—D of FIG. 17; FIG. 23A is a cross-sectional view taken along line E—E of FIG. 19; FIG. 24 is a perspective view in partial section illustrating the tuft-forming pickers of FIG. 1 employed to form a continuous tufted strip brush construction; FIG. 25 is a perspective view of the strip brush construction formed as shown in FIG. 24; FIG. 26 is a longitudinal sectional view of an alternate tuft-forming picker of this invention; FIG. 27 is a cross-sectional view taken along line 27—27 of FIG. 26; FIG. 28 is an end elevational view of the tuft-forming picker of FIG. 26; FIG. 29 is a longitudinal sectional view of an alternate tuft-forming picker of this invention; FIG. 30 is a cross-sectional view taken along line 30—30 of FIG. 29; FIG. 31 is an end elevational view of the tuft-forming picker of FIG. 29; FIG. 32 is an end elevational view of a tuft-forming picker of this invention adapted to be used in making a broom construction; FIG. 33 is a cross-sectional view taken along line 33—33 of FIG. 32; FIG. 34 is a cross-sectional view taken along line 34—34 of FIG. 33; FIG. 35 is a perspective view of a tufted broom construction formed with the picker of FIG. 32; FIG. 36 is a longitudinal sectional view of a tuft-forming picker having a fuzzer and a tuft-forming casing for receiving the picked filament tuft; FIG. 37 is a longitudinal sectional view of the tuft-forming casing of FIG. 36 containing a heat-sealed tuft of filament; FIG. 38 is a detailed fragmentary view in perspective showing one arrangement of the tuft-forming picker, a synthetic fibre stock box, a heat-sealing die, and a tuft support for receiving the heat-sealed tuft in accordance with this invention; FIG. 39A is a fragmentary sectional view of a heat-sealed tuft and a mesh support therefor; FIG. 39B is a sectional view of the heat-sealed tuft of FIG. 39A mounted on a woven mesh; FIG. 40 is a sectional view of the tufted construction of FIG. 39B with a decorative covering over the mesh support; FIG. 41 is a fragmentary sectional view of a tufted construction wherein a heat-sealed tuft is mounted on a sheet of tuft material; FIG. 42 is a sectional view of the tufted construction of FIG. 40 having an adhesive backing on the mesh support; FIG. 43 is a perspective view of a container having the tufted construction of FIG. 42 mounted thereon; FIG. 44 is an elevation of a tufted construction having tufts mounted on a ring of plastic mesh in accordance with this invention; FIG. 45 illustrates a tufted construction of artificial grass wherein the tufts are mounted on a mesh support in accordance with this invention; FIG. 46 is a perspective view with a portion removed the tufted construction having tufts mounted on a mesh support and surrounded by a sponge material; FIG. 47A is an elevation of a board construction in accordance with this invention wherein tufts are mounted on a mesh support; FIG. 47B is an elevation of a dart to be used with the dartboard of FIG. 47A wherein the dart is a heat-sealed tuft of filamentary material formed in accordance with this invention.

In order to describe the invention more fully, reference is now made to the specific embodiments illustrated in the drawings. The invention is directed to brush making wherein tufted constructions are formed employing tuft-forming pickers in such a manner that the tufts are simultaneously picked, simultaneously heat-sealed for mounting, and mounted on a support thus forming a complete tuft construction in the same amount of time required by a conventional brush machine to pick and staple set one fibre tuft. This new and novel method of picking fibre tufts is achieved by employing a longitudinal generally tubular picker having a pre-selected cross-sectional configuration, and in a preferred embodiment, an inside length less than the length of the fibre used for forming the tuft. Tuft-forming pickers of this invention are shown, for example, at FIGS. 1 through 5, 26 through 34, and FIG. 36.

The tuft-forming picker 1 of FIG. 2 has a venturi section approximately midway along the internal wall as indicated by line 2B—2B. As seen in FIG. 2B the venturi section 4 is a constriction forming a smaller opening than opening 2 at line 2A—2A. When fibre enters the opening 2, it is allowed to flow along the tube-like picker 1, and as the fibre approaches the venturi 4 the fibre is further compressed in order to tighten the fibre tuft formed and to hold the fibre tuft in the picker. The external tapered pin section 3 provides a means for holding the tuft-forming picker in a suitable mounting device (not shown).

As shown in FIGS. 1A, 3A, 4A, 5A, and 27, the picker of this invention may be formed so that the internal walls thereof describe in cross-section any desired geometric shape such as a circle, triangle, square, or star. After heat sealing the end, the tuft formed according to this invention will maintain, in cross-section, the internal configuration of the picker used. It should be appreciated that pickers of any desired cross-sectional configuration may be employed within the scope of this invention.

Another suitable tuft-forming picker is shown at FIG. 6 wherein the exterior face of the picker has a section 7 having a slightly larger diameter which serves to minimize friction between the fibre and the external wall of the picker during the removal of the tuft-forming picker from the stock box.
If desired, a tapered section 9 may replace the venturi section 4 shown in FIG. 2. Tapered section 9 is disposed abutting the trim-forming end 5 of the picker of FIG. 6. As fibres enter the picker at opening 8 and travel along the internal surface to stop at the trim-forming end 5, tapered section 9 acts to compress the fibres and retain them in the picker when the picker is withdrawn from the stock box.

In addition, with reference to FIG. 26, the area of maximum constriction may coincide with the opening 50 of picker 52. The internal walls 54 of picker 52 taper from the constricted opening 50 to the end wall 56. If so that the internal cross-sectional area of picker 52 will reach a maximum at end wall 56. A bevelled section 58 adjacent opening 50 is provided for inserting the picking device in the stock box. A tapered pin (not shown) may also be attached at the base 60 of picker 52 for mounting the said picker, or any other conventional mounting means may be utilized.

With reference to the picker 62 shown in FIGS. 29–31, slightly tapered internal walls 64 provide an increase in cross-sectional area from the tuft-receiving opening 66 to the end 68 of the picker 62. A longitudinal, tapered probe 70 extending from end 68, coaxially, toward opening 66 is also provided to facilitate retention of the picked tuft within the picker when the picker is withdrawn from the stock box. As the filament travels through the opening 66 toward the end 68, probe 70 constrains the filament against the internal wall 64 of the said picker.

It will be obvious to those skilled in the art that the picker 62 may also have any desired cross-sectional configuration. In the preferred embodiment, the cross-sectional configuration of probe 70 should describe the same geometric figure as that of walls 64 to provide for a uniform constriction of the fibres when the tuft is formed. For example, in FIGS. 29–31, the cross-sectional configuration of walls 64 is a square to coincide with the cross-sectional configuration of probe 70. However, if the cross-sectional area of picker 62 was a circle, as in FIG. 26, the cross-sectional configuration of probe 70 should also be a circle. In addition, as in the picker of FIG. 26, a bevelled section 72 is provided adjacent opening 66 to facilitate insertion of picker 52 into the stock box. In summary, the picker of this invention retains the filament therein by compressing the said filament against the internal walls thereof as the said filaments enter the opening in the picker and proceed toward the end thereof. The internal walls of the picker may form a constricted area to compress the said filaments, and the area may be located at any point within the picker from the tuft-receiving opening to the end thereof. Also a probe may be coaxially mounted within the picker to compress the filament. The probe may be used in conjunction with an internal constriction of the picker walls, or the probe alone may be used to retain the tuft within the picker, when the picker walls are not constricted.

FIGS. 8, 9 and 10 illustrate how a tuft 11′ can be formed presenting a rounded trim without physically trimming the tuft. Fibres 11 are inserted into the tuft-forming picker and the ends 12 conform to the interior end 12′ of the picker. This forms at the opposite end 12″ a concave shape. The sealed fibre tuft will have a fibre length the same as the interior length of the picker. The excess fibre ends 12‴ as shown in FIG. 9 extend outwardly from the tuft-forming picker for a length sufficient to heat-seal the ends. FIG. 10 shows a finished fibre tuft of FIG. 9 after having been heat-sealed at 12″ presenting a rounded trim 12 and a heat-sealed tuft end 13.

The fibres 14 in FIG. 11 are trimmed to conform to the interior shape at 14′, and fibres 15 and 16 at FIGS. 12 and 13, respectively, conform to the interior shapes at 15′ and 16′. In order to form the heat-sealed tuft similar to the heat-sealed tuft of FIG. 10 it is necessary to heat the end portion of a group of parallel fibres to approximately the melting point temperature for the particular type of synthetic fibre employed. Most thermoplastic fibres have softening points which make them pliable and capable of fusing together under a slight pressure. In the case of oriented synthetic fibres, deorientation usually begins at their softening temperature, thus causing a decrease in length and an increase in diameter. Consequently as the heated, oriented ends of the fibre soften they must be shaped and made to fuse in order to create a self-supporting heat-sealed tuft. It is usually convenient to cause the fibre ends to become softened while contained in a heated shaping mold. In FIG. 14 the tuft-forming picker 17 contains fibres 18 and is moved in the direction D causing the fibre ends 18′ to enter the heat-shaping mold at 19, the section 19 being more or less a guide means, filling the cavity 20′ of section 20. The tuft-forming picker is allowed to remain in this position long enough for the fibre ends 18′ to become fused and shaped like the tuft end 18″ of FIG. 15. The cavity section plate of FIG. 14 can be fashioned from stainless steel, however, Teflon (the trade name for a polyfluoride polymer made by DuPont) makes a much more suitable material. The heating means 21 can be set at such a temperature that the time lag of the fibre's entry of the end 18′ into the cavity 20′ will cause the fibres to fuse but not melt. It is desirable, after fusing the fibres together and imparting the desired shape to the fused portion to immediately insert the still softened end 18″ into a predetermined tuft-receiving aperture 22 in a brashback 23 of FIG. 16 causing the end 18″ to take the form of the aperture. After insertion into the aperture the softened fused portion takes a new shape 18‴ and becomes solid upon cooling. When the tuft-forming picker 17 is drawn away, the heat-sealed fibre tuft 24 is left exposed and securely anchored in a brashback without the need of conventional wire or anchor staple.

While the internal surface of a tuft-receiving aperture 22 in a conventional brashback is relatively rigid and non-porous, it has been discovered that the heat-softened end of a tuft may also be mounted in a tuft-receiving aperture in a relatively flexible porous material, such as a sponge. When the heat-softened tuft end is seated in the aperture, the softened material seeps into the porous surface as the tuft end is molded to conform to the internal confines of the said aperture. When the filamentary material cools the tuft is then retained within the aperture by the confines thereof and by the surface attachment within the aperture. This procedure is a subject of my copending patent application Ser. No. 10,475, filed Feb. 11, 1970, and the disclosure thereof is hereby incorporated by reference. It will be obvious to those skilled in the art that this procedure may be adapted for mounting any compatible filament tufts on a porous surface. If the heat-softened
tuft end is permitted to seep into the surface and subsequently cool the tuft may be securely mounted without an aperture.

It has also been discovered that the heat-softened tuft end may be retained in a heat-softened aperture or depression formed in a sheet of the filamentary material. This article is generally pictured at FIG. 41, and the construction thereof will be subsequently explained.

Furthermore, the heat-softened tuft end may be mounted on a filamentary connector strand or thread whereby the strand is embedded in the heat-softened tuft end. When the tuft end cools the tuft will be firmly secured to the said strand. This method and tufted constructions made according thereto are the subject of my copending patent applications Ser. Nos. 20,624, filed Mar. 18, 1970, and 154,055, filed June 17, 1971, and the disclosure thereof is hereby incorporated by reference.

It has also been discovered that a variety of tufted articles may be made by mounting the heat-softened tuft end on a mesh support. The mesh may be either woven or nonwoven, and is adapted to be embedded in the heat-softened end of said tuft before the end cools. As will be subsequently explained, FIGS. 39A, 39B, 40 and 42 illustrate this procedure while FIGS. 43, 44, 45, 46, and 47 describe different types of articles that may be made according thereto.

While the machinery of this invention may be embodied in many different forms, FIGS. 17, 18, 19, and 38 describe the specific embodiments thereof. These embodiments are not intended to be illustrative and are not intended to limit the scope of this invention.

In order to describe the machinery of this invention particular attention is directed to FIGS. 17, 18 and 19. The automatic brushmaking machinery consists of three basic stations: a synthetic fibre stock box 25, a heating unit 26 for the heat-sealing the fibre tuft ends and a mounting fixture 27 for a brushback or other support. The tuft-forming, picking unit 31 of FIG. 17 includes individual tuft-forming pickers 29 and 29' which may be similar to the tuft-forming picker illustrated in FIG. 1. If desired, the outer tuft-forming picker 29 may have a larger diameter than the inner tuft-forming picker 29', as shown in FIG. 20. By using tuft-forming pickers having different diameters, a tufted article may be constructed having larger tufts positioned around its perimeter. The tuft-forming pickers 29 and 29' in the picking unit 31 are arranged to conform to the desired tuft arrangement for the finished article.

Picking is carried out by inserting the picking unit 31 into the stock box 25 longitudinally to the fibres therein, as shown in FIGS. 17 and 21, through fibre-retaining holes 28 and 28'. The pickers first contact the ends of the fibre 30 and by employing a quick entry in the direction E the fibres are forced into the interior cavity of each tuft-forming picker. Upon withdrawing the picking unit 31, the individual tuft-forming pickers retain a predetermined number of synthetic fibres forming tufts. When the pickers are withdrawn from the fibre stock box 25 additional fibres 30' fall to occupy the empty spaces created by removal of fibres 30. Suitable means may be employed for vibrating the fibre stock box in order to facilitate fibre alignment and mobility.

After completing the picking operation the machine support 32 is indexed forward in the direction F in order to align the heating unit 26 with the tuft-forming picking unit 31, as shown in FIGS. 18 and 22. The picking unit 31 is then moved in the direction G until the fibre tufts contained in each tuft-forming picker come into contact with the cavities 34 and 34' of the shaping mold 33. This shaping mold is preferably constructed of or the molding surface coated with Teflon thermoplastic polymer. The mold is attached to a steel mounting plate 36 which may contain an electric heating element 35.

It will be obvious to those skilled in the art that any conventional heat-sealing device may be utilized. For example, the fibre ends may be heat sealed and fused with a conventional ultrasonic device or an open flame may be utilized. The choice of the particular heating means utilized to heat-seal the fibre ends according to this invention will depend upon a variety of factors well known to those skilled in the art. This invention is not intended to be limited to the particular heating device 27 shown, but is intended to include the substitution of ultrasonic or flame-heating, or any other well known heat-sealing means.

The fibre ends become heated and shaped in the same fashion as previously described and shown in FIG. 14. Preferably the fibres 30 are inserted into the cavities 34 and 34' and heated for 5 to 10 seconds while the actual temperature of the cavities is kept higher than the melting point of the fibres; i.e., isotactic polypropylene fibres melt in the range of from 135–145°C. (100,000–200,000 molecular weight polymer.) The cavities in this case are kept at temperatures of from 150–160°C. After the ends of the fibres have become heat-sealed, the picking unit 31 and the tuft heat-sealed portion are withdrawn from the cavities. This action may be facilitated by first applying a mold release to the inner surface of the mold cavities. However, if Teflon is employed for the cavity structure, a mold release agent is not necessary.

The machine support 32 is then indexed forward in the direction H to align the support 36 and the picking unit 31 carrying fibre tufts having heat-sealed (still moldable) ends. In FIGS. 19 and 23 the picking unit 31 is then advanced in the direction J whereupon the still moldable fibre tuft ends are inserted into the cavities 39 and 39' of the brushback 38. As the tuft ends come into contact with the cavities, the moldable end conforms to the cavity contour and cools. The brushback is held against the support by means of fixtures 37. Upon withdrawing the picking unit 31 in the direction J the tuft-forming pickers release the fibre tufts and the overall result is a finished brush as shown in FIG. 23A. The brushback 38 then mounts heat-sealed fibre tufts 30". The preferred time taken for complete fabrication of one unit is approximately 10 seconds. However, each cycle depends upon the type of synthetic fibre employed and the size of the fibre tuft desired. There is no trimming required after forming the brush of this invention since there is no disalignment of fibres when forming the fibre tufts.

A preferred embodiment of the fibre stock box 25 is described and claimed in my U.S. Pat. No. 3,563,609. It will be obvious to those skilled in the art that the number and configuration of the fibre retaining holes 28 or 28' will be dictated by the cross-sectional configuration of pickers 29 and 29' and the
type of tufted construction desired. For example, the fibres 30 may have a circular cross-section, or they may have an X cross-section, or that of a square, star, or triangle. The picker 29 may also have any desired internal cross-sectional configuration as previously described. If desired, two or more stock boxes and two or more picking units may be employed simultaneously to pick tufts of different colored filaments. After heat-sealing, the picker tufts may be assembled in any desired configuration on each tuft support.

By employing the tuft pickers of FIG. 24 it is possible to form continuous modular strips of thermoplastic tufted constructions. In order to achieve this, it requires an assembly of tuft-forming pickers 39, arranged side by side in a line. After the fibre 44 is inserted in the pickers 39, the unit is moved toward the forming mold 40 in the direction K to allow the tuft ends to soften and fuse in the cavity 41. The mold 40 is attached to a steel housing 43 which contains suitable heating elements 42. Upon cooling the fused fibre ends 44 the mould construction 45 is indexed in the direction L allowing the picking unit to repeat its cycle. When this operation is carried out properly the modular brush construction as shown in FIG. 25 results wherein the heat-softened tuft material is utilized to form the integral tuft support.

Instead of the brushback support 27, a wide variety of other supports may be employed to form tufted constructions. In FIG. 39A, a mesh 80 is supported on a base 82. Base 82 may also be constructed of Teflon or may be Teflon coated. The picking unit (not shown) carrying the tuft and heat-softened tuft ends 84 is indexed as previously described in the direction shown until, as in FIG. 39B, the mesh 80 is embedded in the heat-softened tuft end 84. When the tuft end cools, the picking unit is withdrawn and the tuft 86 will be securely mounted on mesh 80. It will be obvious to those skilled in the art that the mesh 80 may be either woven or nonwoven, and that the mesh may be made of any conventional material such as metal wire or thermoplastic fibres. By picking a plurality of tufts, heat-sealing the tufts in a heating element and mounting the tuft to a mesh support an instant brush or tufted construction may be formed which may be utilized in a variety of different ways. For example, as shown in FIG. 40, a decorative fabric or plastic material 88 may be utilized to cover mesh 80 surrounding the fused tuft end 84. Then, as shown in FIG. 42, an adhesive backing 90 may be applied for mounting the instant brush construction 92 on any desired type of support such as a sponge, a mitten, a rigid hand grip, or the container 94 for a cleaning composition. In the latter embodiment the composition may be poured onto the surface to be cleaned and the surface scrubbed utilizing the bottle as a scrub brush.

As an alternate embodiment the tufts 86 may be mounted on a plastic mesh ring 96 with the heat softened ends 84 utilized to secure the ends 98 of ring 96 to form the ring when the said heat-softened tuft ends 84 cool. The ring may then be snap-fitted on a container (not shown) as decoration or the container assembly may be utilized as a scrubbing assembly. In this manner the instant brush ring of FIG. 44 may be used to form a construction similar to that of FIG. 43 eliminating the need for an adhesive backing to hold the tufted construction on the container. If multicolored tufts are mounted on a flexible ring 96 the article may be used for decorative purposes, for example, on packages, dolls, and the like.

With reference to FIG. 45, the instant brush of FIG. 39B may also be utilized to form artificial grass. After mounting the tufts 100 on a mesh support 102 as described with relation to FIG. 39B, air heated to a temperature above the fibre melting temperature may be forced upwardly through the bottom 104 of the mesh 102 to soften the thermoplastic fibres in tufts 100. As the fibres soften they intermingle to simulate grass, and when cool, retain the grass-like appearance pictured in FIG. 45. When polyethylene filament tufts are mounted on mesh to form artificial grass according to this invention, the tufts are relatively closely spaced on the mesh support, and when heated, the tufts lose their individual identity as the fibres soften and warp. After the heated tufts cool a foam or other type backing (not shown) may be applied to the bottom surface 104. The artificial grass construction of this invention may be utilized for a variety of purposes. A strip of the artificial grass, for example, may be utilized on a water slide at a pool; the artificial grass may be utilized for play surfaces; or it may be utilized indoors to replace rugs, for example, in a playroom. The method of this invention may then be utilized to construct an inexpensive artificial turf that is highly durable and capable of a wide variety of uses.

With reference to the article of FIG. 46, the instant brush tufted construction of FIG. 39 is also suitable in constructing tufted sponges. After the tufts 106 are heat softened and mounted on the mesh 108, as discussed above in relation to FIG. 39B, a foam backing 110 may be attached to the lower surface of mesh 108 opposite the tufts. A synthetic sponge material 112 having tuft-receiving apertures 114 may be secured to the upper surface of mesh 108 as shown in FIG. 46. The working ends of tufts 106 may be recessed below the upper surface 116 of sponge 112; they may be mounted so that the working ends are flush with the surface 116; or they may be mounted so that the working ends extend from the upper surface 116 of sponge 112.

As will be obvious to those skilled in the art, the tufted sponge of FIG. 46 may be constructed in a variety of different ways. For example, the sponge 112 may be secured to mesh 108, and subsequently tufts 106, having heat-softened ends as shown in FIG. 39A, inserted through the tuft-receiving apertures 115 for mounting on mesh 108. In the alternative, the tufts 106 may be mounted on mesh 108 as shown in FIG. 39B, and subsequently a foam premix material may be applied to the upper surface of mesh 108 to surround tufts 106. As the premix cures, a flexible synthetic foam will be formed surrounding the tufts 106 as described and claimed in my aforementioned patent application Ser. No. 20,624. If desired, the lower surface 110 of the tufted sponge of FIG. 46 may mount a fabric mitten or other type of gripping device to facilitate use of the working ends of the tufts for scrubbing. In addition, the tufted sponge article of FIG. 46 may be clamped in a brushback support (not shown) in a conventional manner to form a household brush.

With reference to FIGS. 47A and 47B, the instant brush of FIG. 39B is susceptible to a wide variety of uses in the construction of toys and games. FIG. 47A illustrates a dartboard comprising a plurality of tufts mounted as shown in FIG. 39B, adjacent, and in
close proximity to each other. The board 115 is a circular mesh support mounting concentric rings 118 of colored tufts. Each of the tufts in a ring are composed of the same color fibres so that the tufted construction has the appearance of a conventional dartboard. The dart 120 shown at FIG. 47B to be utilized with board 115 comprises a hollow dart frame 122 having a tuft-receiving opening 124 with a tuft of filaments 126 mounted therein and extending therefrom. The tuft 126 may be heat-sealed and seated in the hollow interior of dart 120 in the manner described above in relation to brush backs. The casing 122 may also be weighted and balanced so that when the dart 120 is thrown the exposed ends of tuft 126 will encounter the filaments and the tufts on board 115 and be retained therein. Play would proceed then as in a conventional dart game.

With attention to FIG. 41, it has also been discovered that a heat-sealed tuft 128 may be mounted on a sheet of a filamentary material 130. In the preferred embodiment, a hot probe having a concave tip (not shown) is placed on sheet 130 until the material softens. The tuft 128 is picked and heat-sealed as described above, and subsequently the heat-softerned tuft end 132 is seated on the heat-softerned depression 134 so that when the heat-softerned material cools the tuft 128 will be retained on sheet 130. It will be obvious to those skilled in the art that any conventional heating means including an ultrasonic means may be utilized to form the heat-softerned depression 134 in sheet 130. In this way, a tufted construction with an integral base may be formed as an alternate procedure to that described above with relation to FIGS. 24 and 25.

The brushmaking machinery of this invention, FIGS. 17-19, may be modified to provide for picking a single tuft of filaments, which tuft simultaneously forms a tufted construction.

With attention to FIG. 38, the broom article of FIG. 35 may be made, according to this invention, of a single tuft. The stock box 136 has at least one rectangular aperture 138 for exposing the ends of filament 140. The picking unit comprises a single rectangular picker 142 adapted to conform to the aperture 138. The picker 142 may be mounted on a reciprocating support 144. The picker 142 is inserted through aperture 138 to pick a single tuft of filaments 140 in the configuration of a broom head. Picker 142 is then withdrawn from stock box 136, and support 146 indexes to place the heat-softerned means 148 in registration with the picker support 144. The picker support 144 then, as described above with relation to FIGS. 17-19, approaches the heat-softerned unit 148 until the ends of the picked tuft (not shown) are within the heated mold cavity 150. After the tuft ends have been heat-softerned and fused the picking support 144 withdraws the picker 142 and tuft (not shown) from the heat-softerned means and the base 146 indexes until the brushback support 152 is in registration with the picker support 144. The heat-softerned ends of the picked tuft within picker 142 are urged into brushback 154 which is retained in support 152. When the ends cool, after having been molded to conform to the internal confines of the tuft-receiving aperture 156 in brushback support 154, the picker 142 is withdrawn leaving the tuft mounted in the brushback support 154 to form the broom article of FIG. 35, wherein tuft of filaments 153 is retained in support 154.

A preferred broom picking unit 142 is shown at FIGS. 32-34. Picking unit 142 has a bevelled section 156 surrounding the tuft-receiving opening 158 to permit insertion of the picker 142 into the stock box 136. The internal walls 158 of picker 142 taper from a minimum diameter at the filament-receiving opening 156 to a maximum at the internal end of the tuft. To facilitate retention of the tuft 153 within the picker 142 a tapered probe is coaxially mounted on end plate 150 extending longitudinally from the said end plate toward the opening 156. The probe 152 may taper uniformly from the leading edge 154 thereof to the base, or it may be provided with a bevelled leading edge 156 as shown in FIG. 32.

FIGS. 36 and 37 illustrate alternate embodiments of this invention whereby a single tuft of filaments may be picked and utilized to form a tufted construction. With attention to FIG. 36 the picking element 158 has a tuft-receiving opening 170 which is adapted to be inserted through the picker receiving aperture in the stock box to pick a tuft of filament as hereinabove described. The picker is also equipped with a plunger 172 which is normally retracted against the rear wall 174 of the picker 158. After the tuft of filaments has been picked the plunger may be utilized to dispense the tuft of filaments. A casing 175 is provided for attachment to the tuft-receiving opening of picker 158. The casing may have a tuft-receiving opening 178 which has a cross-sectional configuration conforming to the cross-sectional configuration at the tuft-receiving opening of picker 158. The walls 180 of casing 175 are adapted to slope from the cross-sectional configuration of opening 182 to a rectangular cross-sectional configuration at 182 which is maintained throughout the length of the casing 175. With attention to FIG. 37, a tuft 181 from picker 158 is inserted through opening 178 until the said tuft 181 extends through casing 175 with the working end of the tuft 181 extending from opening 184. When the tuft is inserted in casing 175 the tuft takes the shape of the internal configuration of the said casing. The end of tuft 181 extending from opening 178 is then heat-sealed at 186 to retain the said tuft within the casing.

With attention to FIG. 17 stock box 25 having circular apertures 28 may be utilized in conjunction with a picker similar to that of FIG. 1 with the plunger attachment of picker 168 and casing 175 to form a tufted broom construction wherein each picked tuft simultaneously forms a single tufted broom construction.

Another method for utilizing a single picker to simultaneously form a tufted broom construction utilizes the casing 175 as a picker with the stock box 136 of FIG. 38. Casing 175 may be formed of thermoplastic material, and opening 178 may be closed with a plug means (not shown). If casing 175 is inserted through aperture 178 a single broom tuft may be formed simultaneously within the casing 175. The tuft formed may be retained within the casing after the casing is withdrawn from the stock box 136 through the use of any conventional ultrasonic heat-sealing means to fuse the non-working end thereof within the casing 175 to the internal walls of the casing.

In summary, three alternate procedures have been described which may be utilized to form a tufted broom-type construction with single picked tuft. In one embodiment the picker element has a rectangular configuration as does the tuft dispensing aperture in
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the stock box. The picked tuft is then heat-sealed and mounted in a support. In the second method the picker includes an internal plunger element for dispensing the picked tuft into a broom or brush forming casing. The tuft is then heat-sealed and thereby retained within the casing. In the third embodiment the picker itself is adapted to mount the picked tuft and the tuft is internally retained within the picker by utilizing a heat-sealing means to fuse the tuft to the internal walls of the picker.

The tuft-forming pickers of this invention as hereinabove described can be constructed from any conventional metal elements or thermoplastic materials such as polypropylene, polyacetal, polyamide, and the like. The tuft-forming pickers are not limited to any given size, internal diameter, or internal cross-sectional configuration.

It has been found that the tuft-forming picker of this invention will pick tufts from assembled parallel cut-to-length synthetic fibres having any cross-sectional configuration, such as circular, X-shaped, star shaped, hollow and the like. The diameter of the fibres picked range from 0.005 inches to at least 0.250 inches. The length of the cut-to-length fibres can range from about 0.5 up to 30 inches. The compositions of the synthetic fibre picked and assembled into fibre tufts is not limited, and thermoplastic fibres either oriented or unoriented can be used to form tufts in accordance with this invention. Polymers such as polyamide, polypropylene, polyethylene, copolymers for polypropylene and ethylene, polyfluoride, and the like may be employed.

The tuft-forming pickers of this invention retain the picked tufts when the pickers are withdrawn from the stock box by compressing the said filaments against the internal walls of the picker. The filament may be compressed either by providing a constriction at or near the tuft-receiving opening of the picker, a venturi section between the said tuft-receiving opening and the internal end wall of the picker, or by providing an internal constriction at the end wall. A further means of compressing the fibres against the internal walls of the picker includes an internal probe coaxially mounted at the end wall and extending longitudinally toward the tuft-receiving opening therein. The said probe may be employed in a picker having a constant internal diameter throughout the length thereof, or preferably it may be employed in a picker having a constriction at or near the tuft-receiving opening with internal walls tapering from the said constriction to the internal end wall thereof.

More than one stock box may be employed within the scope of this invention, and one or more picking elements may also be employed. If more than one stock box is employed it is possible to pick one color and diameter fibre during one picking step, another color and diameter during a second picking step, and then simultaneously heat-seal and assemble the combination of fibre tufts in a single tufted construction.

Finally, it has been discovered that the machinery of this invention may be adapted to form an instant brush wherein picked tufts are heat-sealed and mounted on a mesh or filamentary support whereby the mesh or connector is embedded in the heat-sealed tuft end before the said end cools to retain the tuft on its support. An instant brush formed of one or more tufts interconnected and supported by a mesh extending through the heat-sealed ends thereof may have a decorative covering over the said mesh connector and may be equipped with an adhesive backing for mounting on a rigid support. The instant brush construction may be also utilized with a sponge having tuft-receiving apertures therein. The said sponge is mounted on the mesh so that the tufts extend from the mesh through the apertures therein to provide a household or scrub tufted sponge construction.

In the alternative the instant brush construction may be utilized to form a wide variety of novelty items or to form an inexpensive durable artificial grass. The mesh may be any conventional material such as wire, or plastic and the mesh may be mounted in a variety of ways to form tufted scrubbing constructions for household and industrial use.

Finally, an integral tuft-brushback support may be formed wherein the picked tuft is heat-sealed in a brushback mold so that the heated filamentary material fuses to form an integral brushback with the tuft extending therefrom. In the alternative, a sheet of filamentary material may have a heat-softened, tuft-receiving depression formed therein and the heat-sealed tuft end mounted thereon so that when the heat-softened portion of the sheet and the heat-sealed end of the tuft cool the tuft will be retained on an integral support of the filamentary material.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. In an apparatus for making tufted constructions including a stock box for supporting parallel cut-to-length synthetic fibres, means for picking a plurality of said fibres from said stock box to form a tuft thereof, means for heat-sealing and fusing the nonworking end of said tuft, and means for mounting the nonworking end on a support, the improvement comprising: a hollow picking element having a fibre-receiving opening therein; retaining means disposed within the element for compressing fibres entering the opening against a portion of the internal walls of said element to retain the tuft formed therein.

2. The device of claim 1 wherein the retaining means includes an internal constriction at the fibre-receiving opening of said picking element.

3. The device of claim 1 wherein the retaining means includes a probe mounted at the internal end wall of said element and extending longitudinally toward the opening therein, said probe adapted to compress the fibres entering said opening against the internal walls of said element to retain said tuft in said picking element.

4. The picking element of claim 3 wherein the probe is tapered to a leading edge adjacent the fibre-receiving opening.

5. The picking element of claim 1 further comprising a normally retracted plunger disposed therein at the internal wall opposite the fibre-receiving opening, and
registering thereon, said plunger adapted to advance from said wall towards said opening to force the picked fibre tuft from the element through the opening.

6. The apparatus of claim 5 further comprising a tuft shaping casing adapted to receive a picked tuft and hold the tuft in a broom-type configuration, said casing having a tuft-receiving opening adapted to conform to the configuration of the tuft-receiving opening in said picking element; means for attaching the casing and the element at their respective tuft-receiving openings so that a tuft formed in said picking element may be forced therefrom by said plunger into said casing for final securement.

7. The apparatus of claim 1 wherein the internal wall of the picking element describes a rectangular cross-sectional configuration, said walls tapering from a minimum diameter at the tuft-receiving opening to a maximum at the end wall opposite the opening; a wedge-shaped probe mounted within said element at the end wall thereof, said probe extending longitudinally from the end wall toward said opening and terminating in a leading edge adjacent said opening, said element adapted to pick a single tuft of fibre from the stock box and simultaneously form the tuft in the shape of a broom construction.

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