United States Patent

[11] 3,604,043

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[73] Assignee Tucel Industries, Inc.
Middlebury, Vt.
Division of Ser. No. 578,840, Sept. 12, 1966, Pat. No. 3,471,202.

[54] **BRUSH AND BRUSH CONSTRUCTIONS**
6 Claims, 36 Drawing Figs.

[52] U.S. Cl. 15/159, 15/183, 15/192, 300/21
[51] Int. Cl. A46b 3/04
[50] Field of Search 15/191–195, 159; 300/21, 2, 179–183

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Primary Examiner—Peter Feldman
Attorney—Le Blanc & Shur

ABSTRACT: A tufted brush and tufted modular construction are presented comprising synthetic filament tufts fused at the base end and integrally attached to a support means.

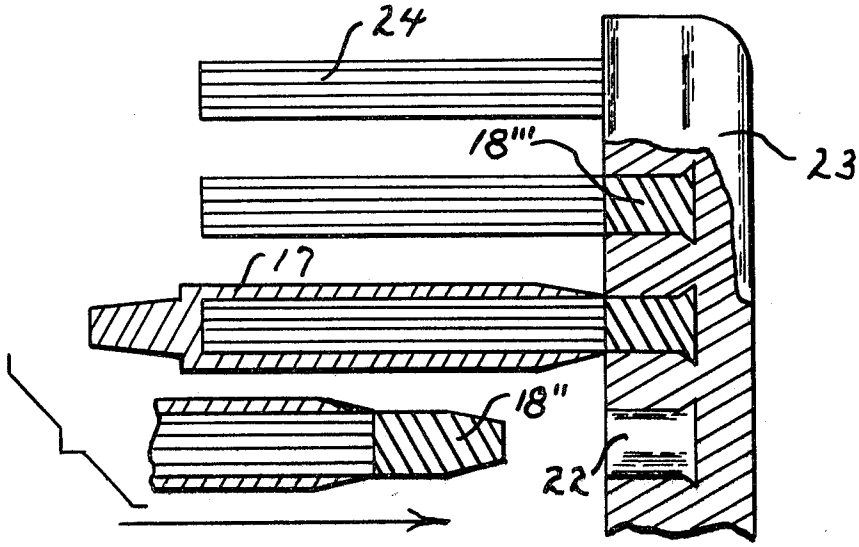


FIG - 1

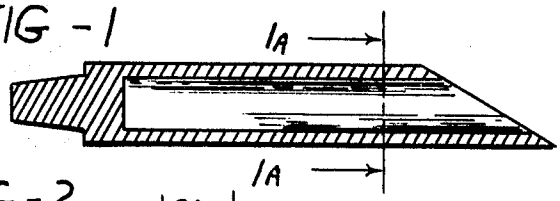


FIG - 1A



FIG - 2

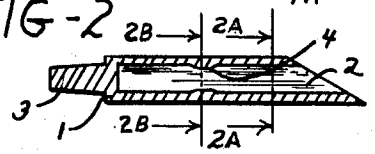


FIG - 2A FIG - 2B



FIG - 3

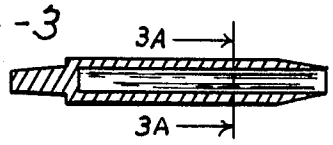


FIG - 3A



FIG - 11

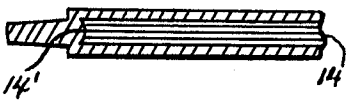


FIG - 4

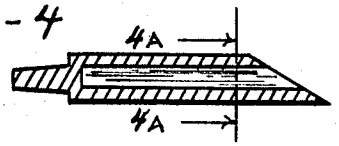


FIG - 4A



FIG - 12



FIG - 5

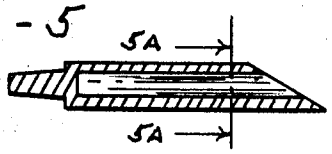


FIG - 5A



FIG - 13

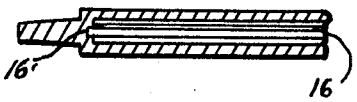


FIG - 6

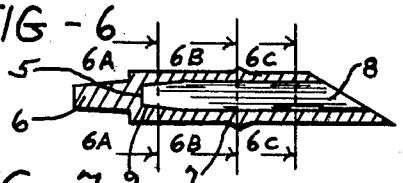


FIG - 6A FIG - 6B FIG - 6C



FIG - 7

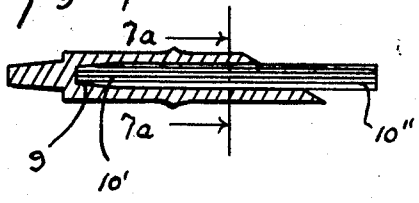


FIG - 7A



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FIG - 8

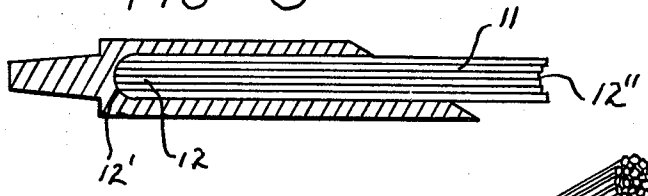


FIG - 9

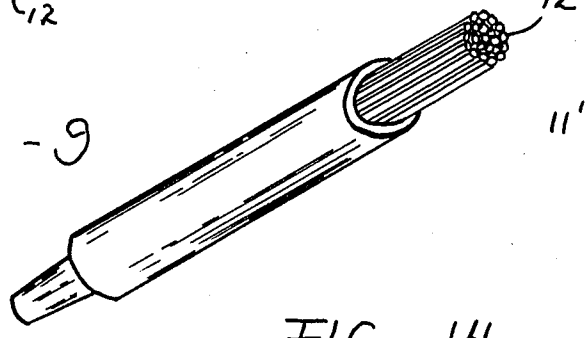


FIG - 10

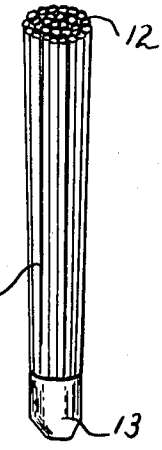


FIG - 14

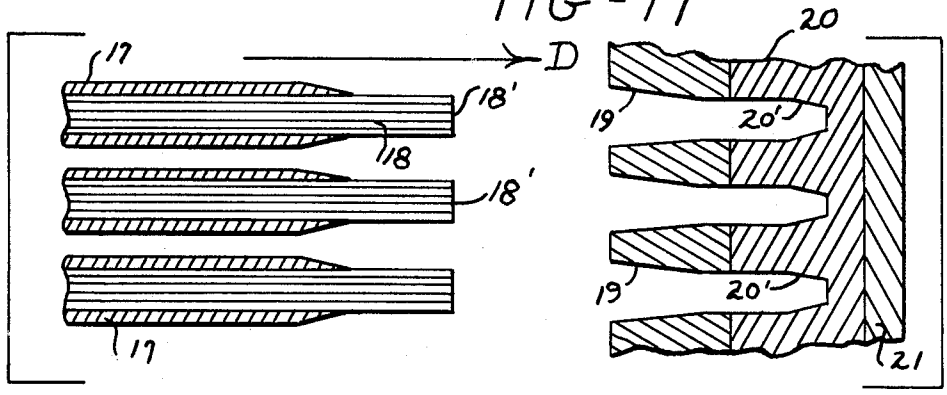


FIG - 15

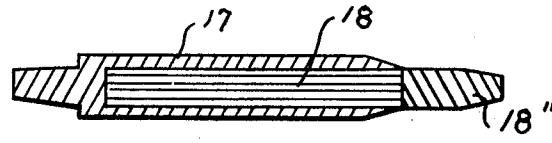
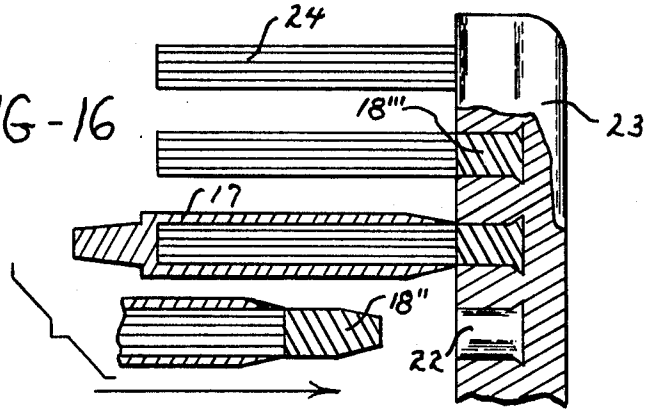


FIG - 16



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FIG-20

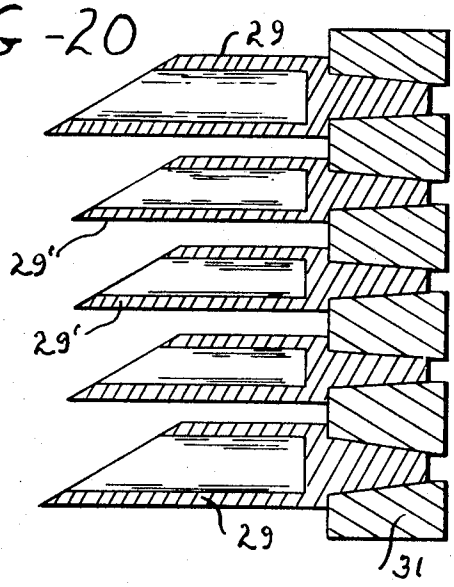


FIG-17

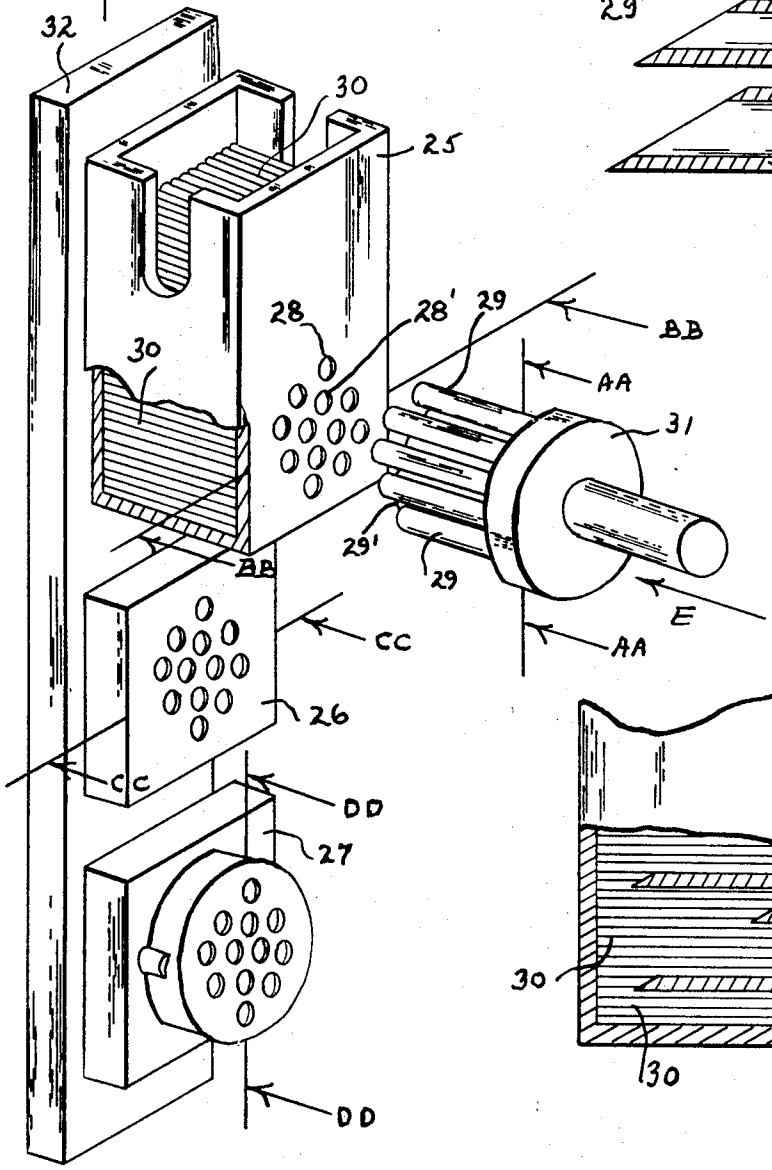


FIG-21

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FIG-19

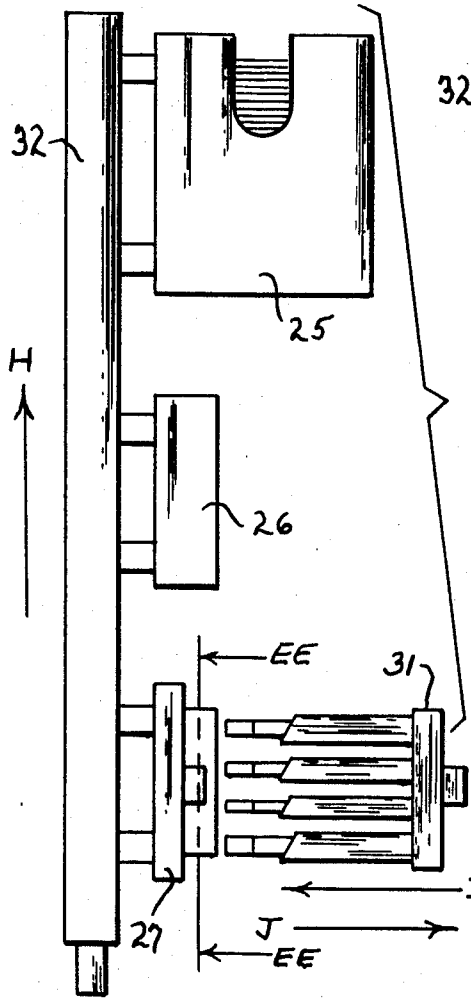
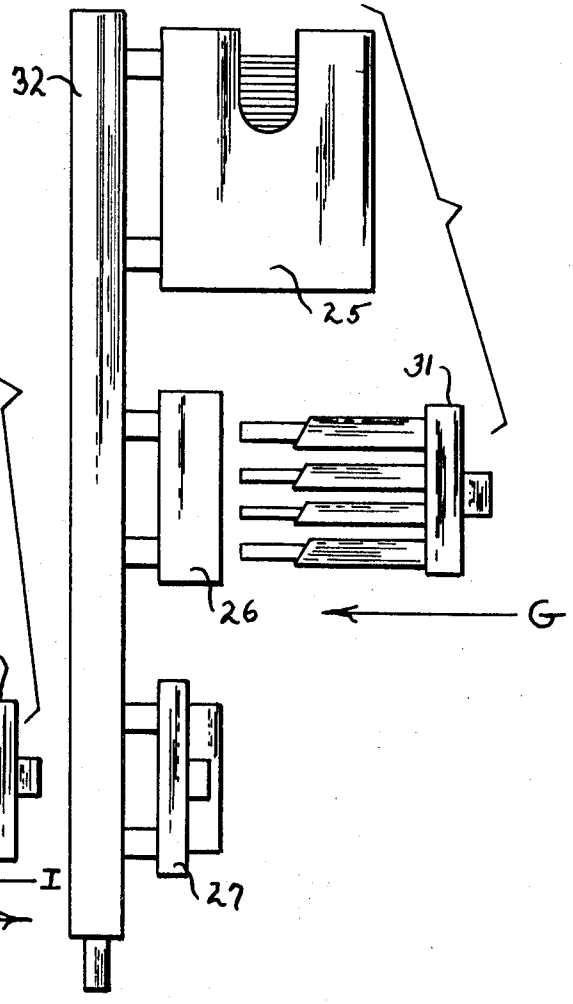


FIG-18



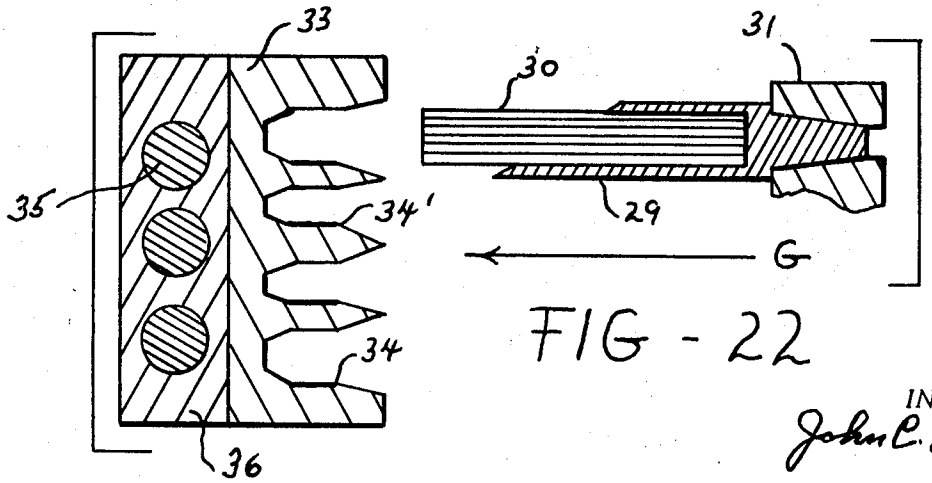


FIG-22

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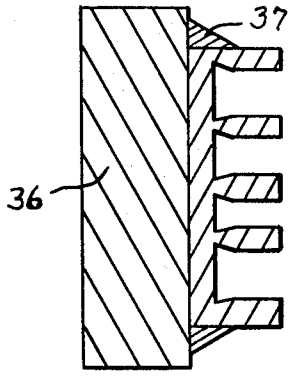
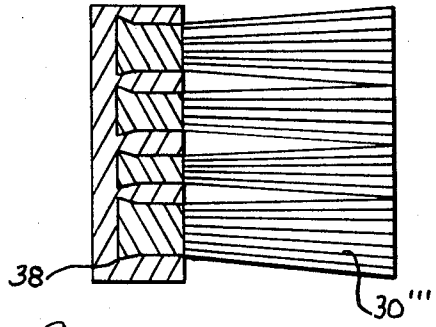


FIG -23

FIG -23A



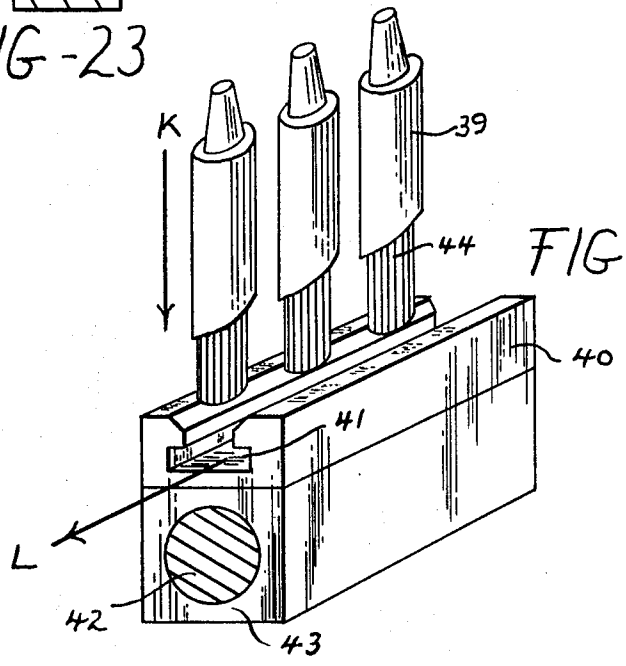


FIG -24

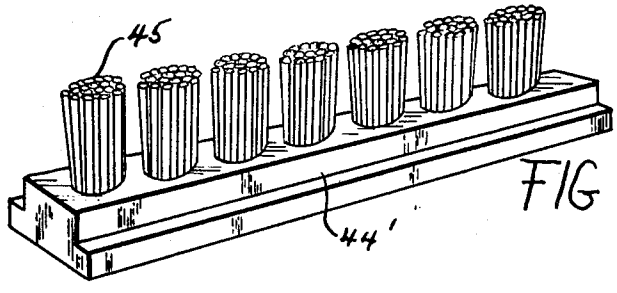


FIG -25

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BRUSH AND BRUSH CONSTRUCTIONS

This application is a division of my copending application, Ser. No. 578,840, filed Sept. 12, 1966, now U.S. Pat. No. 3,471,202.

This invention relates to new and useful brushes. More specifically, it relates to brushes and brush constructions having synthetic filament tufts arranged in such a manner that all the tufts are pretrimmed prior to insertion into the brush back, and all the desired tufts are simultaneously inserted without the required metal anchor whereby, new and useful brushing tools are obtained.

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 fibers, i.e., nylon monofilament) for the vegetable and hair fibers previously employed. The emphasis has been on finding ways to substitute directly the synthetic for the natural, utilizing the same brush making equipment, i.e., stapling machinery, and little or no effort 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 fiber tuft staple-set in the brush back. In this area, there has been no advancement toward finding a way of placing all the desired tufts in a brush back simultaneously; and performing this feat in the same amount of time required to pick and staple-set one fiber tuft employing conventional brush machinery.

The need to improve the machinery for fabricating brush components can be illustrated by comparing and describing conventional brush making machinery with the machinery of this invention. The brush making machinery of this invention differs from ordinary brush machinery in that it employs a new method of picking fiber tufts. The conventional stapling machine employs a picker which removes a fiber tuft from a stock or feed box by first entering the stock box approximately at its midsection (lateral to the parallel fiber) and picking a given amount of fiber at the fibre's midsection. The picker then proceeds to transport the predetermined volume of parallel fiber to a means for doubling the fiber at its midsection (prior to stapling), thus resulting in a tuft having a U-shape wherein both ends of each individual fiber are located at the working tip of the resultant tuft. A staple or an anchor (wire member) is then inserted through the U-shaped loop and the tuft then forced into a predrilled hole in a brush back. 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 fiber stock box from the end (longitudinal to the fiber) and engages the fibers from the end, thus instantly forming a fiber tuft. The fiber employed in forming tufts in this manner is one-half the original length of the fiber required using the conventional picking method. The instantly formed fiber tuft is then automatically inserted into a brush back. Brush backs can be selected from wood, metal, and thermoplastic compositions or any other conventional brush back material. The resultant fiber tuft can be anchored in many ways; i.e., heat sealed, set in epoxy, and the like. However, the preferred method is to heat seal the fiber tuft. This can be done either prior to inserting the tuft into the brush back or after inserting the tuft through a portion of the brush back. Fiber tufts formed in this manner are anchored securely within the brush back and can not be removed.

Since, when forming tufts using this new and novel method of picking, there is no requirement for doubling the fibers prior to insertion into the brush back, tufts so formed in accordance with this invention require no trimming. This results in an appreciable savings to the brushmaker. A second economic savings is also realized, that being the elimination of the staple or anchor.

It is of particular importance in this invention that the picking device employed operates in such a manner that at least two fiber tufts are simultaneously formed. However, the preferred cycle for picking is one in which a complete brush component is formed simultaneously by employing a series of picking devices (hereinafter referred to as a picking unit) set in a prearranged pattern and heat sealing all the fiber tufts instantly, thus forming a brush in the same cycling time it takes to pick and staple-set one fiber tuft using the conventional machinery.

Many brushes and brush constructions containing tufted synthetic filaments as demonstrated in U.S. Pat. Nos. 2,576,546 to Starr, dated Nov. 27, 1951; 2,672,640 to Peterson et al., dated Mar. 23, 1954; and 3,186,018 to Shaw, dated June 1, 1965 disclose brushes having, heat-sealed filaments mounted in brush supports without the aid of any mechanical means, however, none of these disclosures relate to brush constructions as described in the specification and appended claims, and the disclosure of these patents is hereby incorporated herein by reference.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the methods, combinations, compositions and improvements pointed out in the appended claims.

The invention consists in the novel steps, methods, combinations, compositions and improvements herein shown and described.

The objects of this invention will now be described. While the invention is primarily concerned with new and novel brush constructions, it should be realized that the principles of this invention are attained only through the novel method of picking and forming fiber tufts, and these principles are applicable to situations wherein: (1) single fiber tufts are formed (2) multiple fiber tufts are formed (3) complete brush components are simultaneously formed and (4) continuous nodular brush components are formed.

An object of this invention is to provide a tufted brush construction comprising pretrimmed heat sealed synthetic filament tufts. A further object of this invention is to provide a tufted brush construction comprising at least two different size heat sealed tufts, said tufts being formed from thermoplastic filaments having an original length only slightly larger than the length of the finished filament tuft. Yet still a further object of this invention is to provide a tufted brush construction comprising heat-sealed filament tufts possessing different trims wherein the tufts are set in such a pattern as to be opposing one another.

Another object of this invention is to provide a tufted brush construction comprising pretrimmed synthetic filament tufts wherein the filament comprising all the tufts is picked and trimmed simultaneously, and inserted into the brush support within the time it normally requires to pick and staple-set one fiber tuft.

Yet still another object of this invention is to provide tufted brush construction having 100 percent support filament composition, consisting from the group of synthetic thermoplastic polymers such as polyamides, polystyrines, polyvinylchlorides and polyolefins. Another object of this invention is to provide a brush construction of the type set forth in the foregoing object wherein the brush support is molded from polypropylene, the pretrimmed filament tufts are made from polypropylene, and said tufts are held in the support without any required anchor.

Yet still a further object of this invention is to provide a tufted-type brush construction which is superior to known constructions, but at a reduced cost.

In the drawing:

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 1A—1A 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 2A—2A and 2B—2B respectively 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 3A—3A of FIG. 3.

FIG. 4 is a longitudinal sectional view of a tuft-forming picker of this invention having a starlike cross-sectional construction. FIG. 4A is a cross-sectional view taken along line 4A—4A 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 5A—5A 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 6A—6A, 6B—6B and 6C—6C respectively of FIG. 6.

FIG. 7 is a longitudinal sectional view of the tuft-forming picker of FIG. 6 containing parallel synthetic fiber in accordance with this invention. FIG. 7A is a cross-sectional view taken along line 7A—7A of FIG. 7.

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

FIG. 9 is a perspective view illustrating how the tuft-forming picker of FIG. 8 may be employed to form a predetermined quantity of individual parallel synthetic fibers into a tuft.

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

FIGS. 11, 12 and 13 are longitudinal sectional views of tuft-forming pickers illustrating other shapes which may be imparted to tufts in accordance with this invention.

FIG. 14 is a longitudinal sectional view of a group of tuft-forming pickers in accordance with this invention illustrating fiber 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 fiber tuft as formed in accordance with this invention.

FIG. 16 is a sectional view in cross section of a brush back with tufts as formed in accordance with this invention.

FIG. 17 is a detailed fragmentary view in perspective and partly in section showing one arrangement of the tuft-forming pickers, a synthetic fiber storage hopper, a heat sealing die and and a brush back/fiber tuft assembly station in accordance with this invention wherein the tuft-forming pickers are opposite the fiber storage hopper. FIGS. 18 and 19 are further extensions of FIG. 17 wherein the tuft-forming pickers are opposite the heat sealing die and the brush back/fiber tuft assembly station respectively.

FIG. 20 is a side cross-sectional view taken along line AA—AA in FIG. 17 of one arrangement of the tuft-forming pickers employed to form a brush in accordance with this invention.

FIG. 21 is a side cross-sectional view taken along line BB—BB of FIG. 17 of the synthetic fiber storage hopper.

FIG. 22 is a side cross-sectional view taken along line CC—CC in FIG. 17 of the heat sealing die.

FIG. 23 is a side cross-sectional view taken along line DD—DD in FIG. 17 of a brush back and brush back mounting support.

FIG. 23A is a side cross-sectional view taken along line EE—EE in FIG. 19 illustrating a brush with tufts made according to this invention.

FIG. 24 is a perspective view illustrating how the tuft-forming pickers of FIG. 1 may be employed to form a continuous tufted strip-brush construction.

FIG. 25 is a perspective view of a strip brush made according to the manner illustrated in FIG. 24.

In order to describe the invention more fully, reference is now made to specific embodiments illustrated in the drawings. The invention is directed to brush making wherein tufted brushes are formed employing tuft-forming pickers in such a manner that each tuft contained in the brush back is simultaneously picked, simultaneously prepared for insertion as a heat-sealed tuft into a brush back thus forming a complete brush in the same instant of time it requires an ordinary brush machine to pick and staple-set one fiber tuft. This new and novel way to pick fiber tufts is achieved by employing a longitudinal tube having a definite shape, i.e., circular cross section, and limiting its inside length to that of somewhat less than the length of the fibers used for forming a fiber tuft. Such tuft-forming pickers are shown in FIGS. 1 through 5.

The tuft-forming picker 1 of FIG. 2 has a venturi section 4 approximately midway along the internal wall as indicated by line 2B—2B. As seen in FIG. 2B, the venturi section is constructed such that it is constricted thus forming a smaller opening 2 at line 2A—2A. When fiber enters the opening at 2, it is allowed to flow along the tubelike picker and as the fibers approach the venturi at 4, the fibers are further compressed in order to tighten the unsealed fiber tuft which results in holding the fibers together more firmly in order that they may not fall away. The tapered pin section at 3 provides the means for holding the tuft-forming picker in any suitable mounting device.

By employing tuft-forming pickers of the type shown in FIGS. 1, 3, 4 and 5 it is possible to form tufts having different shapes. It should be appreciated that other shaped cross sections can be employed without deviating from the scope of this invention.

A more suitable type of tuft-forming picker of this invention is shown in FIG. 6 wherein the exterior surface of the picker has a section at 7 having a slightly larger diameter which serves to minimize friction between the fiber and the external wall during removal of the tuft-forming picker from the stock feed box. A tapered section is placed at 9 allowing fibers to first enter the picker at 8, travel through the internal section up to 9 and stop at the trim-forming end, 5. The shape or contour of 5 will determine the trim of the finished fiber tuft. The smaller diameter at 9 acts in much the same way the venturi does in FIG. 2. The tapered pin section 6 provides means for support of the picking device.

FIG. 7 shows the tuft-forming picker of FIG. 6 containing synthetic fibers 10 in parallel arrangement. The end of the fibers 10' is slightly compressed together due to the internal taper at 9. Fiber ends 10'' projects somewhat beyond the end of the tuft-forming picker; this end 10'' will eventually form the heat-sealed portion of the fiber tuft. By controlling the length of both the fibers and the tuft-forming picker, it is possible to form tufts having different trim lengths and heat-sealed portions.

FIGS. 8, 9 and 10 illustrate how a heat-sealed tuft 11' can be formed possessing a rounded trim without having to physically trim the tuft. Fibers 11 in parallel arrangement are inserted into the tuft-forming Fibers and the ends 12 conform to the interior end 12' of the picker. This results in the opposite end 12'' conforming to the shape of a concave contour. The sealed fiber tuft will have a fiber length the same as the length for that of the interior of the picker. The excess fiber ends 12'' as shown in FIG. 9 extend outwardly from the tuft-forming picker for such a length which makes them desirable for heat sealing. FIG. 10 shows the finished fiber tuft after having been heat sealed at 12'' in FIG. 9 possessing a rounded trim 12 and a heat-sealed tuft end 13.

FIGS. 11, 12 and 13 illustrate different interior configurations which can be employed for forming different trims in fiber tufts. The fiber 14 in FIG. 11 conforms to the interior shape at 14', likewise, fiber 15 and 16 of FIGS. 12 and 13 respectively conform to the interior shapes at 15' and 16'.

In order to form a heat-sealed tuft like the one shown in FIG. 10 it is necessary to heat the end portion of a group of parallel fibers to a temperature of approximately to that of the melting point of the particular type of synthetic fiber employed. Most thermoplastic fibers have softening points which make them pliable and capable of fusing together under a slight pressure. In the case of oriented synthetic fibers, they

usually begin to deorient at their softening temperature, thus causing a decrease in length and an increase in diameter. Consequently, as the heated oriented ends of the fiber 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 fiber ends to become softened while contained within a heated shaping mold. In FIG. **14** the tuft-forming picker **17** containing fiber **18** is moved in the direction D causing the fiber ends **18'** to enter the heated shaping mold **19**, the section **19** being more or less a guide means, and filling the cavity **20'** of section **20**. The tuft-forming picker is allowed to remain in this position long enough for the fiber ends **18'** to become fused and shaped like the tuft end **18''** of FIG. **15**. The cavity section **20** 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 fibers to fuse but not melt. It is desirable, after, fusing the fibers together and imparting the desired shape to the fused portion, to immediately insert the still softened end **18''** into a predetermined tuft hole **22** in a brush back **23** of FIG. **16** causing the end **18''** to take the form of the tuft hole. After insertion into the tuft hole, 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 fiber tuft **24** is left exposed and is securely anchored in the brush back without the aid of the conventional wire anchor or staple.

While the invention is susceptible of embodiment in many different forms, there is shown now in FIGS. **17**, **18**, and **19** specific embodiments with the understanding that the present disclosure is to be considered as an exemplification of the principle of the invention and is not intended in any way to limit the invention to the embodiments illustrated.

Particular attention is now given to the automatic brush machine shown in FIGS. **17**, **18** and **19**. This automatic unit consists of three basic forming stations; a synthetic fiber stock box **25**, a heating unit for forming the heat-sealed fiber tuft ends **26** and a mounting fixature for the brush back **27**. The tuft-forming picking device **31** in FIG. **17** is comprised of individual tuft-forming pickers **29** and **29'** having configurations like the tuft-forming picker of FIG. **1**. Outer tuft-forming pickers **29** are larger in diameter than the inner tuft-forming pickers **29'** as shown in FIG. **20**. By having larger diameter tuft-forming pickers, a brush may result having larger tufts positioned around its outer parameter. The tuft-forming pickers **29** and **29'** in the forming device **31** are arranged in such a manner so as to conform to the tuft arrangement desired in the finished brush. Picking is carried out by allowing the picking unit **31** to enter longitudinally to the fibre's length into the stock box **25** as shown in FIGS. **17** and **21**, through fiber retaining holes **28** and **28'**. The pickers first come into contact with the ends of the fibers **30** and by employing a quick entry in the direction of E the fibers are forced into the interior cavity of each tuft-forming picker. Upon reversing the motion of the picking unit **31** the individual tuft-forming pickers retract, each filled with a predetermined amount of synthetic fibers. As the picking unit leaves the fiber stock box more fibers **30'** falls so as to occupy the empty spaces created by the removal of fibers **30**. Suitable means may be employed for vibrating the fiber stock box in order to facilitate fiber alignment and mobility. After completing the picking operation, the machine support **32** is indexed forward in the direction F in order to allow the heating unit **26** to align itself opposite the tuft-forming picking unit, as shown in FIGS. **18** and **22**. The picking unit is moved forward in the direction G until the fibers contained in each tuft-forming picker comes into contact with the cavities **34** and **34'** of the shaping mold **33**. This shaping mold is preferably constructed from Teflon thermoplastic polymer. The mold is attached to a steel mounting plate **36** containing suitable electric heating elements **35**. The fiber ends become heated and shaped in the same fashion as previously described and shown in FIG. **14**. Preferably, the fibers **30** are inserted into the cavities and allowed to become heated for 5–10 seconds while the actual temperature of the cavities is kept higher than the melting point of the fibers; i.e., isotactic polypropylene fibers melt in the range from 135° to 145° C., (100,000 to 200,000 molecular weight polymer). The cavities **121** this case might be kept at **173** in the order of from 150° to 160° C. After the ends of the fiber tufts have been heat sealed, the picking unit **31** is reversed allowing the tuft heat-sealed to come away from the cavities. This removal can be facilitated by first applying a mold release to the inner surfaces of the mold cavities. However, if Teflon is employed for the cavity structure, a mold releasing agent is not necessary. The machine support **32** is indexed forward in the direction H in order to align the brush support **36** opposite the heat-sealed (still moldable) fiber tufts. In FIGS. **19** and **23** the picking unit is then advanced forward in the direction of I whereupon the still moldable fiber tuft ends are inserted into the cavities **39** and **39'** of the brush back **38**. As the tuft ends come into contact with the cavities, the moldable end conforms to the cavity contour and cools. The brush back is held against the brush support by means of fixtures **37**. Upon reversing the picking unit **31** in the direction J the tuft forming pickers release the fiber tufts and the overall result is a finished brush as shown in FIG. **23A**. The brush back **38** has a heat-sealed fiber tufts **30'''**. The preferred time taken for the complete fabrication of the brush is approximately 10 seconds. However, there is no definite time cycle. Each cycle depends upon the type of synthetic fiber employed and the size of the fiber tuft desired. There is no trimming required after forming the brush of this invention since there is no disalignment of fibers when forming the fiber tufts. This is true because there is no doubling of fibers prior to insertion.

By employing tuft-picking units as shown in FIG. **24** it is possible to form continuous modular strips of thermoplastic tufted brush constructions. In order to achieve this, it requires an assembly of tuft-forming pickers **39** arranged side by side in a line. After the fibers **44** are inserted in the tuft-picking unit, the unit is then moved toward the forming mold **40** in the direction K thus allowing the fiber ends **44** to become softened and fused within the cavity **41**. The mold **40** is attached to a steel housing **43** which contains suitable heating elements **42**. Upon cooling of the fused fiber ends **44'** the tuft pickers are moved away leaving the fiber tufts exposed and the molded construction **45** is indexed forward in the direction L allowing the picking unit to repeat its cycle. When this operation is carried out properly, the modular brush construction **45** as shown in FIG. **25** results. The tufted construction which results is comprised of 100 percent fibers, the melted portion of the fiber ends serving as the sole means of support for the tufts.

The tuft-forming pickers of this invention can be constructed from any of the conventional metal elements or alloys known to man. Also, it is possible to construct the picking devices from thermoplastic materials; i.e., polypropylene, polyacetal, polyamide, and the like. The tuft-forming pickers are not limited to any given size since they can have any length and internal diameter so long as they conform to a given fiber tuft.

It has been found that the tuft-forming pickers of this invention will pick tufts from assembled parallel cut-to-length synthetic fibers having any cross-sectional shape; i.e., circular, X-shaped star shaped, hollow, and the like. The diameter of the fibers picked range from 0.008 to 0.250 inches. The lengths of the cut-to-length fiber can range from 0.5 to 30 inches. The composition of the synthetic fiber picked and assembled into fiber tufts is not limited, and thermoplastic fibers either oriented or unoriented can be used for form tufts in accordance with the invention. Polymers like polyamide, polypropylene, polyethylene, copolymers of polypropylene and ethylene, polyfluoride, and the like can be employed.

If more than one fiber stock box is employed, it is possible to pick one color and diameter fiber during one picking step, and another color and diameter during a second picking step and then instantaneously heat seal and assemble the combination of fiber tufts into a brush back.

The foregoing considerations conclusively demonstrate the advantages to be gained by providing picking devices of the type hereinbefore described. When such picking devices are incorporated into automatic brush making equipment there is attained new and novel brush constructions heretofore not known.

The invention in its broader aspects is not limited to the specific steps, methods, compositions, combinations and improvements described but departures may be made therefrom in the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

I claim:

1. In a tufted modular construction having a base and a plurality of mutually spaced filament tufts extending therefrom the improvement comprising: a plurality of the tuft-receiving apertures in said base, each aperture receiving a prefused homogeneous mass of said filamentary material with integral filament tufts extending therefrom so that when the mass of material cools, the said mass conforms to the geometrical confines of the aperture to hold the said tuft in the base.

2. A tufted modular construction according to claim 1 wherein both the tufts and base are formed from the same material.

3. A tufted brush construction according to claim 2 wherein both the base and the tufts are polypropylene.

4. A tufted modular brush construction comprising: a plurality of mutually spaced filament tufts extending integrally from a brush back, said back comprising a base having mutually spaced apertures therein; each tuft comprising a plurality of synthetic filaments extending from a prefused homogeneous mass of said filamentary material, each of said prefused masses received in an aperture in said base and conforming to the geometric confines of said aperture to hold said tufts to said brush back.

5. The tufted modular brush construction of claim 4 wherein the synthetic filament tufts and integral base support are formed from the same material.

6. The tufted modular brush construction of claim 5 wherein both the tufts and the integral base are formed of polypropylene.