United States Patent [19]

Brumlik

[11] **3,922,455**

[45] **Nov. 25, 1975**

[54] **LINEAR ELEMENT WITH GRAFTED NIBS AND METHOD THEREFOR**

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[73] Assignee: **Ingrip Fasteners, Inc.**, Montclair, N.J.

[22] Filed: **Sept. 26, 1973**

[21] Appl. No.: **401,084**

Related U.S. Application Data

[63] Continuation of Ser. No. 256,068, May 23, 1972, abandoned.

[52] **U.S. Cl.** **428/85;** 2/DIG. 6; 24/204; 24/DIG. 18; 428/86; 428/100; 428/372; 428/400

[51] **Int. Cl.**[2] **A44B 17/00**

[58] **Field of Search** 161/55, 59, 64, 67, 69, 161/75, 172, 174–176, 179, 180, 48, 53; 24/DIG. 18, 204; 2/DIG. 6

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[57] **ABSTRACT**

Linear elements such as filaments having grafted nibs are disclosed. The grafted nibs are generally fibrils and/or scales which can be flexible or rigid. The nibs can be randomly grafted onto the linear element or they can be inclined or oriented in one direction so as to offer relatively little resistance to penetration into a material and greater resistance to pulling out. The linear element with grafted nibs can be twisted or spun into a yarn or it can be used as a yarn component. The linear element with grafted nibs or a yarn thereof can be used as a non-slip thread, as laces, and the like or they can be a component of woven and non-woven articles.

Also disclosed is a method for making the linear elements having a plurality of nibs physically bonded thereto. A substantially linear element such as a thread, a wire, a monofilament, a yarn, a ribbon or the like is contacted with a static or agitated mass of nibs thereby causing same to become physically bonded to the linear element. If desired, the linear element with nibs bonded thereto can be cut into discrete lengths which can be used as gripping elements in the manufacture of a multi-element self-gripping device for example.

1 Claim, 20 Drawing Figures

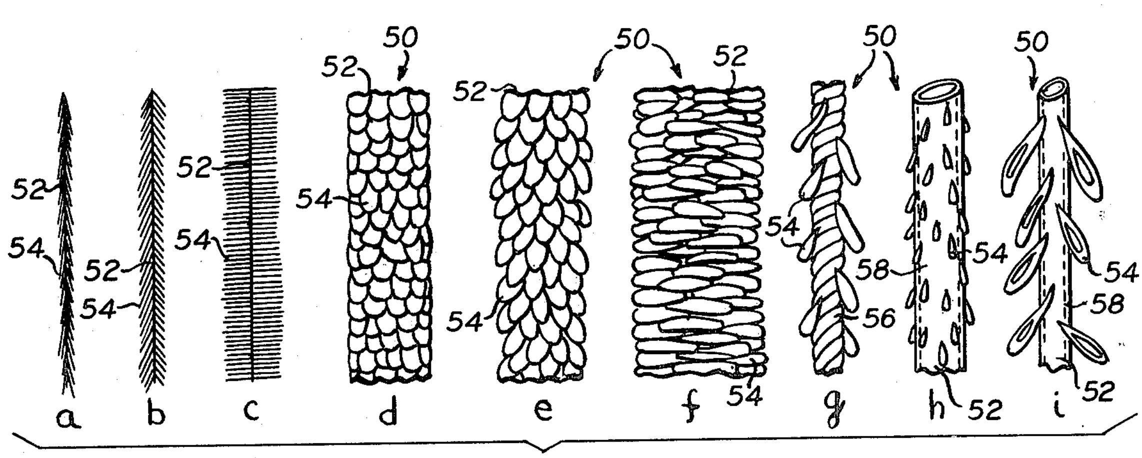


FIG. 1.

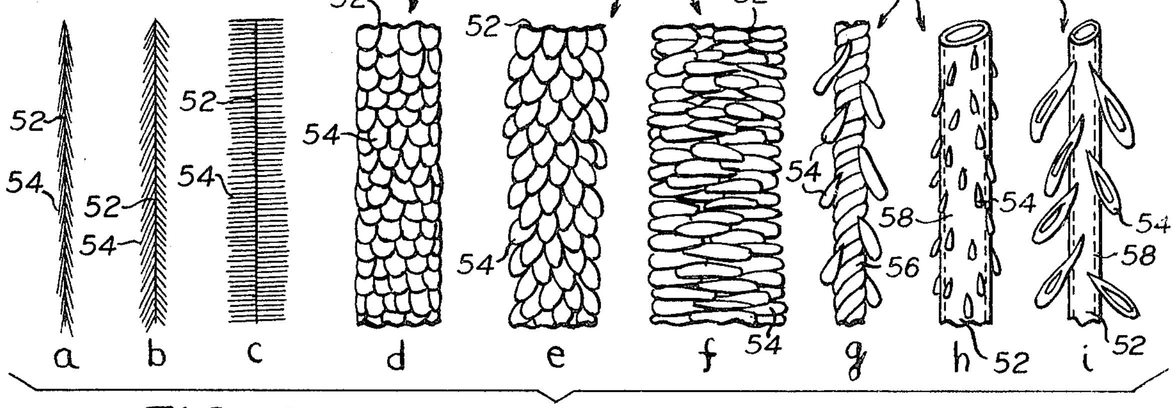


FIG. 2.

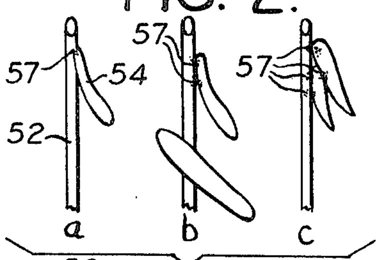


FIG. 3.

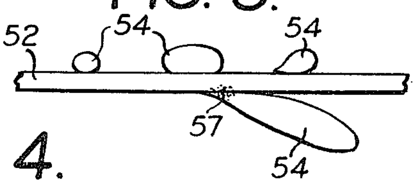


FIG. 4.

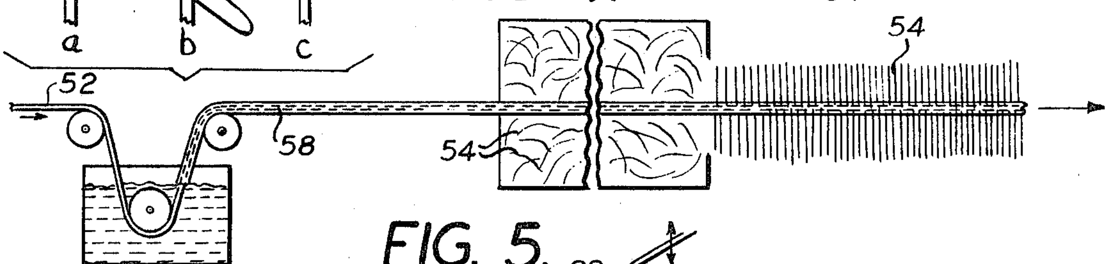


FIG. 5.

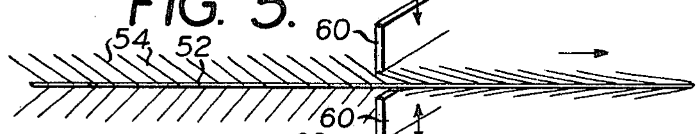


FIG. 6.

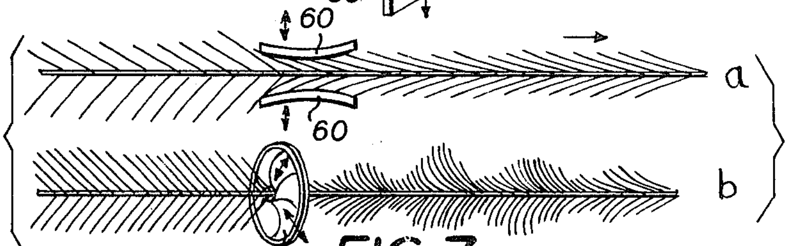


FIG. 7.

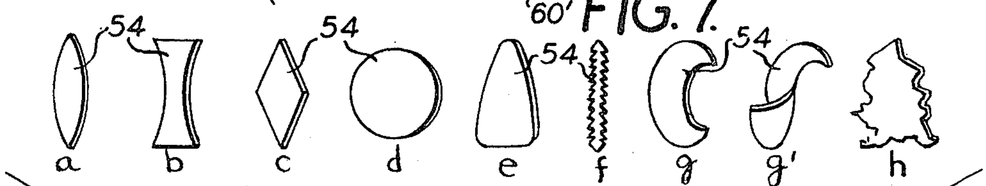


FIG. 8.

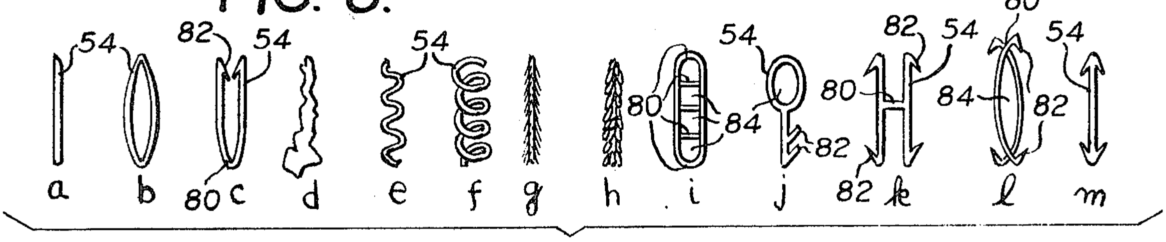


FIG. 9.

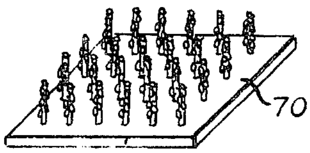


FIG. 10.

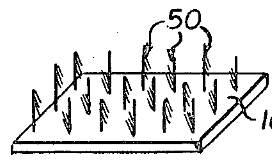


FIG. 11.

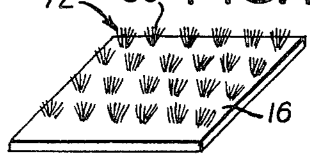


FIG. 12.

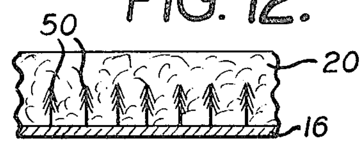


FIG. 13.

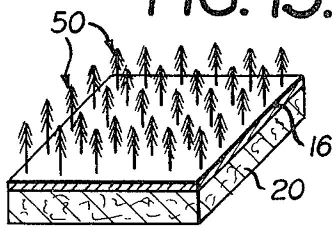


FIG. 14.

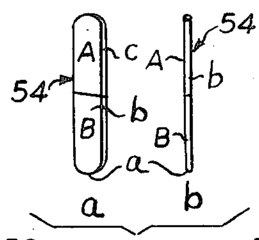


FIG. 15.

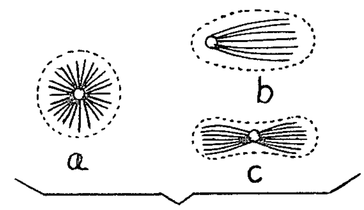


FIG. 16.

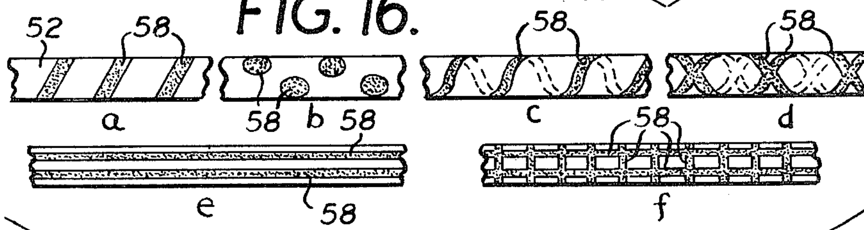


FIG. 17.

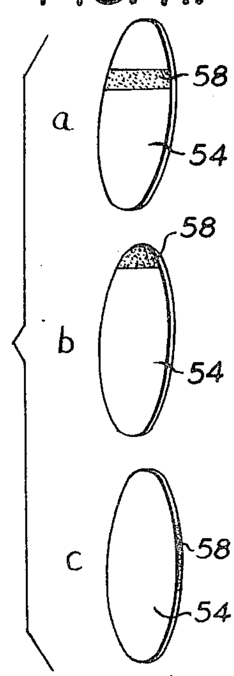
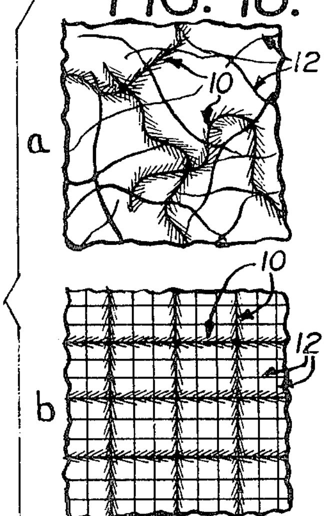


FIG. 18.



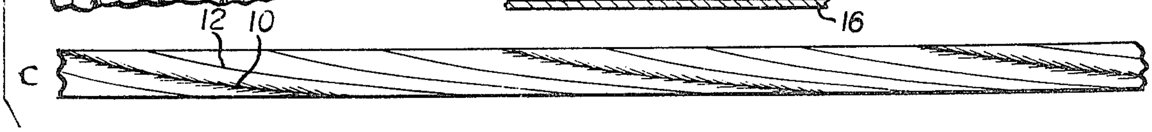


FIG. 19.

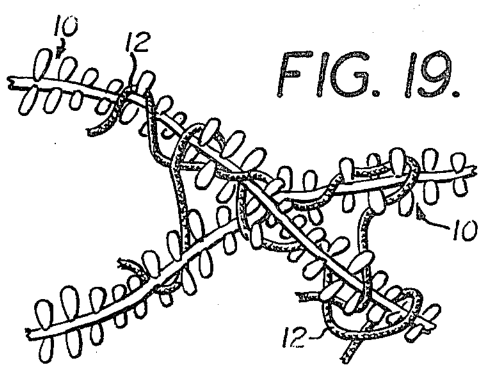
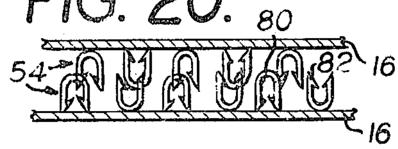


FIG. 20.



LINEAR ELEMENT WITH GRAFTED NIBS AND METHOD THEREFOR

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation application of my application Ser. No. 256,068 filed May 23, 1973, now abandoned.

BACKGROUND

This invention relates to linear elements having grafted nibs in relatively thick profusion and to a method for making same.

Most commercially available fibers, filaments and yarns are smoothly continuous and lack lateral projections. This smoothness imparts a lack of ability to resist motion within a medium of which they are a part or through which they pass. The smooth nature of commercial fibers, filaments and yarns including those made from plastics, metal and glass makes possible relative motion in both the forward and rearward directions along the longitudinal axis. This smoothness also limits the effect of space which a fiber, filament or yarn can occupy within a woven or non-woven article.

SUMMARY

The present invention provides linear elements which overcome the disadvantages of smooth fibers and filaments and which provide advantages and capabilities not possessed by conventional fibers and filaments.

The linear element of the invention comprises a substantially linear element such as a thread, a wire, a monofilament, a yarn, a ribbon or the like having physically bonded thereto in relatively thick profusion a plurality of nibs such as fibrils and/or scales.

According to the method of the present invention a substantially linear element is contacted with a static or agitated mass of nibs thereby causing same to become physically bonded thereto. The nibs can be randomly bonded to the linear element or they can be oriented in one direction. The linear element with nibs bonded thereto can be cut into discrete lengths and in a preferred embodiment these lengths are used as gripping elements to form multi-element self-gripping devices which are also a part of the present invention.

The linear element with grafted nibs offers numerous advantages including an increase in bulk, resistance to motion due to the ability of the linear elements to interlock and if desired a preferential resistance to motion in one direction. Another advantage of the present invention resides in the fact that the linear element and grafted nibs can exist in an almost endless variety of combinations with respect to material, relative size, and shape, combinations of shapes, etc.

DESCRIPTION OF THE DRAWING

FIGS. **1***a–i* are side elevational views broken away showing segments of linear elements having fibrils and scales physically bonded thereto according to the present invention.

FIG. **2** is a side elevational view illustrating three ways in which nibs can be physically bonded to a linear element.

FIG. **3** is a side elevational view illustrating a further way in which the nib can be physically bonded to a linear element;

FIG. **4** is a diagrammatic view illustrating one embodiment of the method of the invention wherein a linear element is coated with an adhesive and thereafter contacted with a mass of nibs.

FIG. **5** is a diagrammatic view illustrating one way in which nibs can be biased or oriented after being physically bonded to a linear element.

FIGS. **6a** and b are also diagrammatic views illustrating two further ways in which nibs can be biased or oriented after being physically bonded to a linear element.

FIGS. **7***a–h* are side elevational views illustrating several embodiments for the nibs in the form of scales which can be physically bonded to a linear element.

FIGS. **8***a–m* are side elevational views illustrating several embodiments for the nibs in the form of fibrils that can be physically bonded to a linear element.

FIG. **9** is a perspective view illustrating a self-gripping device of the invention utilizing a linear element with grafted nibs of the invention cut into discrete lengths and attached in an upright fashion to a base.

FIG. **10** is a perspective view illustrating a self-gripping device of the invention wherein discrete linear elements with grafted nibs are flocked onto a base.

FIG. **11** is a perspective view of a self-gripping device of the invention wherein discrete linear elements with grafted nibs are tufted into a base.

FIG. **12** is a side elevational view illustrating embodiments of the self-gripping device of the invention wherein a protective layer is utilized therewith or a hybrid gripping surface is provided.

FIG. **13** is a perspective view illustrating a further embodiment of a self-gripping device of the invention.

FIGS. **14***a* and *b* are side elevational views of nibs that can be utilized in the invention illustrating properties thereof and bonding sites.

FIGS. **15***a–c* are cross-sectional views illustrating several ways in which the nibs can be laterally oriented with respect to the linear element.

FIGS. **16***a–f* are side elevational views illustrating various ways in which an adhesive pattern can be applied to a linear element to provide a pre-determined pattern for physically bonding nibs thereto.

FIGS. **17***a–c* are side elevational views illustrating various ways in which an adhesive can be selectively applied to a nib to predetermine its bonding site with respect to a linear element.

FIGS. **18***a–c* are diagrammatic views illustrating various ways in which a linear element with grafted nibs can be utilized as a component of non-woven and woven materials and yarn;

FIG. **19** is a diagrammatic view demonstrating one way in which linear elements with grafted nibs of the invention interlock with each other and the conventionally smooth filaments.

FIG. **20** is a side view in elevation of a multi-element device with a plurality of the pile elements of FIG. **8***c* attached upright to a base.

DESCRIPTION

The term "nibs" is used herein to generically describe scales, fibrils, piles, globules and the like or similar projecting or protruding bodies that can be pointed and/or rounded and/or uniformly or irregularly shaped. The edges of these bodies may be blunt or sharp and if pointed they may be blunt or sharp.

Referring now to the drawing, linear elements **50** are shown in FIG. **1** and include a linear member **52** having physically bonded thereto nibs **54** such as the fibrils illustrated in FIGS. **1** *a–c* or the scales illustrated in FIGS. **1** *d–i*.

The linear members **52** can be made of metal, plastic or glass, or composites of any of these, and can be in the form of a wire or monofilaments as shown in FIGS. **1** *a–c*, *h* and *i*, a ribbon as shown in FIGS. **1** *d–f* or yarn **56** as shown in FIG. **1** *g*. The nibs **54** can be readily bonded to the member **52** as illustrated in FIGS. **1** *c* and *f* or they can be oriented in one direction so as to lay nearly flat against member **52** as illustrated in FIG. **1** *a* and *d* or they can be oriented so as to be inclined or biased at any angle desired as illustrated in FIGS. **1** *b*, *e*, *g*, *h*, and *i*.

The nibs **54** in addition to being oriented longitudinally can also be oriented laterally with respect to the linear member **52** as illustrated in FIGS. **15** *a–c*. The dotted lines surrounding the views in FIG. **15** demonstrate several ways in which the grafted nibs can greatly increase bulk without unduly increasing weight.

Referring now to FIG. **4,** the elements **50** can be conveniently made in a continuous fashion by passing a substantially continuous linear member **52** through a mass of nibs **54,** and in this illustration the nibs **54** become physically bonded to member **54** by reason of the adhesive coating **58** applied to the member **52** by passing same through an adhesive band as shown before coated member **52** contacts the mass of nibs **54.**

As the member **52** exits from the mass of nibs **54,** the nibs **54** have become physically bonded thereto by means of the adhesive coating **58.** As illustrated in FIG. **4,** nibs **54** can be randomly bonded to the coated member **52.** If desired, the member **52** with nibs **54** bonded thereto can be post-treated by being passed through a variable opening or gates which will orient the nibs **54** in one direction. FIGS. **5** and **6** *a–b* illustrate several suitable arrangements for orienting the nibs **54** utilizing pairs of gate members **60** or a variable iris **60′**. The pairs of gate members **60** and the iris **60′** shown in FIGS. **5** and **6** can be used to obtain any desired configuration in orienting the nibs **54.** For example, the gates **60** or iris **60′** can be periodically closed against member **52** or repositioned or modulated with respect to member **52** to either orient and/or to remove nibs therefrom at spaced intervals or to create any desired oriented configuration as illustrated, for example, in FIG. **6***b* and in the several views shown in FIGS. **1** and **15.**

By removing nibs at spaced intervals and orienting the nibs that remain inbetween and thereafter cutting the linear element, corresponding members having biased nibs **54** attached at one end can be obtained. Such a gripping element can be readily flocked onto a base in a statistical arrangement as shown in FIG. **10** and described in greated detail herein.

A unique feature of the present invention resides in the fact that there is control over all elements of the invention making it possible to produce an almost endless variety of linear members with grafted nibs. For example, there is control over the selection of the material, of construction, configuration, and or shape of the linear member **52** and the nibs **54.** There is also control over the pattern in which the nibs **54** become physically bonded to the member **52** as well as control over the site on the nibs **54** at which they become bonded to the linear member **52.** In addition, as discussed above, there is control over the angular inclination of the nibs **54** with respect to the member **52,** both in the longitudinal and lateral directions as well as the angular orientation of the nibs **54** with respect to themselves.

In FIG. **14** *a*, for example, a nib **54** in the form of a longitudinal scale is indicated as having bonding sites for attaching to the linear member **52** at its end *a*, on its flat face *b* or anywhere on its edge *c*. FIG. **17** illustrates how these bonding sites can be predetermined for the nibs **54** by selectively applying an adhesive coating **58** at any desired location on the nib **54** be it on the flat face, near the end or anywhere on the edge as illustrated in FIGS. **17** *a–c*, respectively.

FIG. **14** *b* shows a nib **54** in the form of a fibril having bonding sites at its ends *a* or anywhere inbetween for example at *b* as shown. Thus the bonding site for fibrils can be predetermined by the selective application of an adhesive in a manner similar to that shown for the scale-like nibs shown in FIG. **17.**

FIG. **16** illustrates several ways in which the pattern in which the nibs **54** become bonded to the linear member **52** can be controlled by the selective application of an adhesive to the linear member **52.** For example, an adhesive **58** can be selectively applied in a random or uniform pattern to the member **52** using known printing, masking or similar techniques in the form of strips, spots, spirals, lengthwise stripes or a combination of lengthwise and lateral strips as illustrated in FIGS. **16** *a–f*, respectively. In addition, in FIG. **16** *d* the adhesive pattern can be formed from a combination of helixes rotating in the same or opposite directions and they can be further controlled to be in or out of phase to any controlled degree.

Referring again to FIG. **4,** the mass of nibs **54** can be static or agitated, that is, kept in a constant state of motion. This can be accomplished using flocking, electrostatic, pneumatic, and similar means. For example, a vertical column can be used containing a fluidized bed of nibs **54** and the linear member **52** passed upwards through the fluidized bed. The nibs can be attached for example at their ends parallel to each other using any of these techniques.

FIG. **2** illustrates nibs **54** in the form of scales secured at **57** at several sites on the nib **54** to the member **52** as well as to each other in an overlapping relationship. FIG. **3** illustrates a nib **54** in the form of a scale fused at **57** to the linear member **52.**

As shown in several views of FIG. **1,** the nibs **54** can be smaller than, equal to or larger than the diameter of the linear member **52.** According to the invention, the nibs **54** are spaced randomly or uniformly in relatively thick profusion on the linear member **52.** By this it is meant that for a given use or application of the linear element of the invention, there are sufficient numbers of grafted nibs to enable the linear element to function in the manner described herein. Thus the nibs are spaced in thick profusion relative to the manner in which the linear elements are used.

FIGS. **7** *a–h* illustrate various shapes for the nibs **54** in the shape of scales while FIGS. **8** *a–m* illustrate various shapes for the nibs in the form of fibrils. As noted above, there is complete control over the shape and characteristics of the nibs utilized and in this regard it should be noted that the grafted nibs bonded to a particular element may be all of the same type or may be a mixture of different kinds of nibs. The majority of the nibs shown in FIGS. **7** and **8** are self-explanatory and with respect to the nib shown in FIG. **7** *e* it can be added that the particular shape shown is aerodynamic and such nibs will thus orient themselves when pneumatically contacted and bonded to a linear member. This is known as a canoeing effect that can be used to advantage in a flocking process. FIGS. **8** *g* and *h* illustrate that the fibrils themselves can be composite and functional in shape.

In FIGS. **8** *c, i, j, k* and *l* the particular configurations shown are also pile self-gripping elements having at least one bridge or connecting portion **80** which is capable of entering into self-gripping engagement with a gripping element. These pile elements can also have one or more gripping detents **82** and/or one or more windows **84**, and are especially useful by themselves for flocking on a surface to form a highly functional multi-element pile in addition to being grafted to a linear element as described herein. The bridge **80** can be part of an open structure (FIG. **8***c* and *k*) or it can be a window **84** (FIG. **8** *j*) or it can cross a longitudinal loop dividing it into a plurality of windows **84** (FIG. **8** *i*) or it can be a crossing or meeting point (FIG. **8** *l*).

These pile elements can also be attached upright, for example by flocking using known techniques, to a base or surface to form a multi-element device. That is, in the case of the U-shaped element of FIG. **8***c* having gripping detents at the ends thereof, half will be flocked with the gripping ends down and the other half with the ends up as shown in FIG. **20.** The same is true for the configuration of FIG. **8** *j* having a gripping detent at the end of a lateral element joined to a closed loop. The symmetrical elements of FIGS. **8** *k* and *l* can have gripping detents at one or both ends and can also be assembled into a self-gripping device. The longitudinal loop pile of FIG. **8** *i* is symmetrical, non-irritating and is capable of engaging gripping elements at various levels.

Referring again to FIG. **4**, any suitable type of adhesive or adhesive composition may be used to form the coating **58** shown in FIG. **4** or the selective applications illustrated in FIGS. **16** and **17.** Suitable adhesives include hot melted adhesives, solvent activated adhesives, catalyzed room and elevated temperature hardening polymer adhesives, air hardening adhesives and the like.

Because the nibs and the linear element are initially formed independently of each other, a desirable molecular or crystalline orientation (e.g. axial or biaxial) can be obtained in either the nibs or the linear element or in both. For example, the linear element can be made of fiber forming linear polymers such as polyolefins, polyester, polyamides, and the like, and axially oriented while the nibs can be cut from axially oriented linear elements made from metals, plastics, glass or composite materials.

As noted in FIG. **3,** it is possible to do away with an adhesive coating or selective application and simply heat the linear member **52** so that the nibs **54** will fuse to it and bond upon contact. To accomplish this the linear member and/or nibs must be made from a material capable of fusing or sealing upon the application of heat. Such materials include glass, plastics and metal. The linear member may be heated and/or the nibs heated to cause fusion or sealing upon contact. Heating can be accomplished by passing electrical current through a conducting linear member, by means of electromagnetic induction or by applying a secondary or external heat source.

Also shown in FIG. **3** are nibs **54** which can be formed from molten globules of metals, glass, and plastics. The globules can attach themselves to a heated linear element **52** and can remain generally spherical or they can be distorted while still pasty and soft to form elongated or tear drop shapes as shown by passing the linear element with globules attached through a viscous fluid or through a mass of metal shot sand or the like or by directing a blast of gas thereagainst.

In addition to the electrostatic and pneumatic means mentioned above for agitating a mass of nibs, electromagnetic, ultrasonic, vibratory, and electrical techniques may also be employed depending on the nature of the linear member and/or the nibs.

In addition to or in place of gate member **60** shown in FIGS. **5** and **6,** it is also possible to use a comb-like device or variable iris (**60′** in FIG. **6** *b*) to conform or orient the nibs.

FIG. **9** illustrates a self-gripping device utilizing a plurality of upright gripping elements **50,** for example, as cut from the linear member of FIG. **1** *h* and attached to a base **70.**

In FIG. **10,** flocked-on gripping elements **50** are attached to a base member **16** utilizing known techniques and, due to the nature of the flocking process, approximately half of the gripping elements are attached lower end down and the remaining elements are attached upper end down. However, because the gripping means are only attached adjacent one end of the stem, there is no interference with the self-gripping capabilities of the device.

In FIG. **11,** gripping fibers **50,** for example, any of those shown in FIG. **1,** are tufted into or on base **16** using conventional techniques to form a plurality of gripping tufts **72** which can be uniformly or randomly arranged on the base **16.** Because the individual gripping fibers **50** in the tufts **72** radiate in several directions, self-gripping engagement can take place at several angles resulting in cooperative or additive self-gripping action by the individual fibers **50** in each tuft **72.**

As indicated previously, the nibs **54** are physically bonded to the member **52** by fusion, sealing or adhesively securing these gripping members to the member **52.** The member **52** may be a monofilament made of natural or man-made fibers or it may be made of glass or metal or a composite of any of these materials. It may also be made of a plastic in the form of a thin rod or it may be a composite including plastic. It may also be a dimensioned or textured filament or trunk thread or yarn such as used for sewing, knitting, weaving and the like. It is also possible to form the member **52** and later make it rigid by fusion, adhesive coating, etc.

Nibs in the form of fibrils and scales such as shown in FIGS. **7** and **8** may be made of metal in the form of short segments of wire, particles of foil or small shavings or other forms of fibrils or scales. They may be additionally made of plastic, glass, ceramics or a composite of the foregoing. The fibrils may be made from monofilament which may be stretched and oriented, they may be made from slit film or may be molded or extruded and cut to obtain any desired shape or form. The scales such as those shown in FIG. **7** may be cut from foil, cut from extruded forms, they may be punched, photo etched or photo formed from sheet materials or an extruded profile or they may be molded to obtain any desired shape or texture. The scales or fibrils may be laminated so as to have a shape which can be used as such or post-altered by mechanically, physically or chemically treating the fibrils or scales before or after physically bonding to the stem member **52.** The fibrils and scales may also be twisted into convaluted or spiral forms of any desired hardness, pitch, convalutions and the like to obtain any desired geometrical form. This is illustrated in FIG. 7 *g'*.

It is also within the scope of the present invention to utilize nibs having particular physical and/or optical properties and two or more such properties may be combined in a single nib as suggested in FIGS. **14** *a* and *b* by the regions designated A and B. Thus the nibs may have ferro-magnetic, ferri-magnetic, antiferro-magnetic or piezoelectric properties. Linear elements having grafted nibs with properties such as these can thus be utilized as components in electronic devices.

The nibs used in the invention may also possess or have imparted thereto physical and/or optical properties such as absorption, reflection or dispersion of electromagnetic radiation resulting in patterns of color flourecence, gloss, metallic sheen and other properties valuable in electronics such as spectroscopy and other instrumentation.

For example, a nib may have a predetermined pattern printed, etched, or otherwise formed on its sufrace or edge or even contained within its body. A magnetizable material such as barium ferrite can be used in the linear member or the nibs.

Either opposite faces of nibs can contrast or differ in properties and a flipping back and forth can result in a change which can be interpreted as a memory unit for a computer or similar signal or memory device. If the contrasts were in colors the linear element would be one color when punched or stroked in one direction and the opposite and different color when punched or stroked in the other direction.

The linear elements made according to the method of the invention as illustrated for example in FIG. 4 may be cut into gripping elements which are suitable for use in multi-element self-gripping devices as described herein by being attached in an upright fashion to a base which may be a line, a sheet or a point.

The elements shown in FIG. **1** for example are especially useful in forming asymmetrical self-gripping devices as are disclosed in detail in my copending application Ser. No. 171,701 filed Aug. 13, 1971, now abandoned and in forming self-gripping devices having L-shaped gripping elements according to my copending application Ser. No. 186,874 filed Oct. 6, 1971, now abandoned.

The elements as shown in FIG. **1** may also be used in other areas, for example as a component of fibers and fabrics, felts, filters, packing and insulating materials, porous plastics and as a material for reinforcing other materials such as plastics, plastic foams and the like resulting in greatly increased properties of tension and impact. FIG. **18** *a* illustrates a linear element with grafted fibril-like nibs as a component part of a non-woven material while FIG. **18** *b* shows a similar linear element incorporated into a woven material and FIG. **18** *c* shows such a linear element incorporated into a twisted yarn. FIG. **19** illustrates the way in which linear elements of the invention with grafted nibs can interlock with each other as well as with a smooth filament. This type of interaction occurs, for example, in the various embodiments shown in FIG. **18**. It is also possible by virtue of the interaction demonstrated in FIG. **19** to use the linear elements of the invention in waterless or other techniques of paper manufacture as well as a magnetic binder component.

A linear member with grafted nibs may also be used in sewing to produce a material which has different co-

efficients of friction in two directions. That is, a thread or lace would pull easier in one direction as compared to the opposite direction due to the orientation of the fibrils and/or scales physically bonded to the linear element. It is obvious that depending on the use for the elements as shown in FIG. **1** that they can range in size from extremely small to relatively large. The fibrils and/or scales attached to the member **52** may be ruffled or may be nearly flattened against the member **52.** It is also possible to inscribe a helical pattern about the member **52** using a suitable tool to impose same. It is also understood that any number of fiblrils and/or scales of any varying size may be used in combination in the same element as to provide varying properties, etc. Thus a single fibril or scale may be used to form a somewhat homogeneous element or a hybrid mixture can be used to cover a single member **52.**

FIGS. **18** *a–c* illustrate various ways in which a linear element with grafted nibs indicated generally by reference numeral **10** can be incorporated into various structures with conventionally smooth filaments and fibers **12.** In FIG. **18***a* the element **10** is shown as a component of a non-woven structure, in FIG. **18***b* as a component of a woven structure, and in FIG. **18***c* as a component of a yarn.

FIG. **19** is a greatly enlarged view showing one way in which linear elements with grafted nibs **10** interlock with each other and the conventially smooth filaments **12.**

Referring now to FIGS. **9–13,** the self-gripping device of the invention is shown to include a plurality of upright gripping elements **50** stiffly attached in thick profusion or in relatively close proximity to each other to a base such as a sheet or tape **70** shown in FIG. **9** or a disc-like patch or a linear element such as the filament.

The term generally upright is intended to include gripping elements inclined at an angle to the base for example from about 25° up to 90°. In some instances, it is preferred to incline the entire assembly of all the gripping elements at an angle relative to the base to promote self-gripping action or for particular applications for example where the self-gripping device is mounted on a vertical surface. It should also be noted that a plurality of gripping elements **50** such as shown in FIG. **9** for example, cooperate in gripping a receiving material and effectively distribute the force over a given area thus eliminating concentrations of stress. Combinations of gripping elements which vary in shape and/or size may also be utilized in the same device.

In FIG. **9–13,** the upper ends of the gripping elements **50** can be characterized as having a penetrating profile or shape to facilitate penetration into a receiving material. This may be accomplished by any of the shapes illustrated in FIG. **1.** In addition, flat stems can be cut at an angle or pointed, rounded or otherwise shaped. In those instances, where skin irritation is to be avoided, the upper end of the gripping elements **50** are preferably rounded.

As indicated above, the self-gripping elements of the device of the invention are adapted to penetrate and become lodged in a receiving material. The device of the invention is especially useful with receiving materials which comprises fibers, yarns, fibrils, filaments or thin walled cells, webs or sheets.

Thus, the self-gripping device of the invention is particularly adapted for self-gripping a wide variety of materials such as woven, non-woven and knitted fabrics, fibers and fiber aggregates, carpets, carpet-like materials, foamed rubber and plastics, felt, wood, cork, sponge, animal and artificial fur and hair, feathers, leather, paper, cardboard, corrugated cardboard, metal and plastic mesh, filter sheets, expanded and perforated sheet materials and composites of any of the foregoing.

The receiving material may also be a thin wall or lamina which is capable of being penetrated or pierced by the gripping element such as a sheet per se or an interior cellular wall; also included are web-like structures having thinned out or localized areas capable of being self-gripped. For example, such sheets can be a sheet with densely punched holes relatively close to each other or expanded sheets such as expanded metal.

Especially suitable receiving materials and structures are disclosed in my copending applications Ser. Nos. 126,708 and 126,706, both filed Mar. 22, 1971, and Ser. No. 154,589, filed June 18, 1971.

Referring now to FIG. **12,** a self-gripping device of the invention comprising a sheet **16** and upright gripping elements **50** is shown in self-gripping engagement with a receiving layer **20** which is shown to be fibrous in nature foı purposes of illustration.

In certain applications, it is desirable to utilize a receiving layer such as that shown in FIG. **12** as a protective layer for the gripping elements **10** which can be stripped off to prepare the device for self-gripping engagement. The use of a protective layer makes it possible to ship and handle the gripping device of the invention without irritation to the user or premature self-gripping engagement. The protective layer may have a thickness equal to less than or greater than the height of the gripping elements **50.** Such a protective layer can be readily utilized with any of the various embodiments of the invention such as those shown in FIGS. **9** through **13** for example.

It is also possible to use the receiving layer **20** as a component part of the device of the invention. In this instance the layer **20** is made of a resilient material such as felt, carpets, carpet-like materials, woven, non-woven and knitted fabrics and fibers, mats made of monofilaments or staple fibers in parallel, braided or random orientation, sponge, plastic and rubber foam and the like, that remains in place over the gripping elements **50** forming what can be called a hybrid self-gripping surface. The gripping elements **50** in this embodiment can extend below to or beyond the surface of layer **20.** Thus, when the layer **20** is compressed, the elements **50** are exposed and protrude out of the layer **20** and are then capable of self-gripping engagement with a receiving layer or material or a similar hybrid self-gripping device.

In FIG. **13,** a receiving material **20** described above is attached to the back of sheet **16** forming another hybrid type of device that can loop around and self grip itself or be gripped by other devices.

In general, the gripping elements are sufficiently stiff such that they resist deflection which would otherwise prevent them from penetrating and becoming lodged in a receiving layer or material. It is also necessary that the gripping elements be sufficiently stiffly attached to the base to enable the gripping elements to enter into self-gripping engagement. Thus, the gripping elements can be attached to a base by any suitable technique consistent with the nature of the gripping element and the base. The base itself can be fabricated from a wide variety of materials such as metal, wood, plastics, glass, paper, cardboard, porous, woven and non-woven materials and the like.

The gripping elements can be attached to the base by inserting the lower ends in a sheet, patch or strip such as shown in FIG. **9** and/or by mechanically attaching the gripping elements using, hot melt adhesives, tufting (as in FIG. **11**), electrostatic and other flocking process, fiber laying followed by cutting and bending up, weaving, knitting, pulling out by needle felting, welding or heat sealing techniques. The gripping elements **50** may also be attached to base **16** in a staple-like fashion.

The gripping elements generally range in length from about 0.002 to about 0.75 inch. It should be noted that extremely small gripping elements can form the device of the invention and yet be invisible to the naked eye.

Plastics for the linear member **52** and for the nibs include both thermosetting and thermoplastic materials such as nylons, propropylene, polyesters, polyamides, polyacetals, polysulfones, polycarbonates, polyvinyl chlorides, polyethers, halogenated polymers, phenolic and melamine resins and the like. The member **52** can have any desired cross-sectional shape such as round, oval, flat and the like.

FIG. **20** illustrates a multi-element device formed by flocking the pile element of FIG. **8** *c* onto a base **16.** Because of the nature of the flocking operation, the pile elements are attached in a predetermined statistical fashion to the base such that half are attached with the detents down and half are attached with the detents up. Similar multi-element devices can be formed utilizing the pile elements of FIGS. **8** *b, i, j, k* and *l*, for example.

The self-gripping devices such as shown in FIGS. **9–13** may be used in a variety of ways to efficiently and quickly render virtually any surface or article self-gripping. The device of the invention can be readily used by individuals and commercial users to render selected areas of articles or entire articles self-gripping such as carpets, fabrics, felts, wall cladding materials, panels, tile, sheets, fibers, decorative trim, and the like. The self-gripping devices of the invention also find uses per se for example as conveyor belts and material separators and as a teasel for raising a nap on a woven or non-woven material.

What is claimed is:

1. Self-gripping device comprising a multiplicity of gripping elements stiffly attached in an upright fashion to a base and distributed over substantially the entire surface area thereof, said gripping elements comprising discrete lengths of a linear member having physically bonded thereto in relatively thick profusion a plurality of scales rounded at one end and bonded at the other end to said linear member with the ronded ends pointing down towards said base, said scales being bonded to said linear member in overlapping relation to one another so as to substantially completely cover said linear member, said gripping elements being adapted to penetrate and become lodged in a receiving material.

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