United States Patent [19]

Brumlik

[11] **3,913,183**

[45] **Oct. 21, 1975**

[54] **MULTI-ELEMENT GRIPPING DEVICE**

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[22] Filed: **June 28, 1973**

[21] Appl. No.: **374,711**

Related U.S. Application Data

[63] Continuation of Ser. No. 200,336, Nov. 19, 1971, and a continuation-in-part of Ser. No. 126,706, March 27, 1971, Ser. No. 126,708, March 27, 1971, and Ser. No. 154,589, June 18, 1971.

[52] **U.S. Cl.** **24/204**

[51] **Int. Cl.** **A44b 17/00**

[58] **Field of Search** ..... 24/204, 81 F

[56] **References Cited**

UNITED STATES PATENTS

553,645	1/1896	Green	24/204
3,114,951	12/1963	DeMestral	24/204
3,119,191	1/1964	Vitzthum	24/204
3,128,514	4/1964	Parker	24/204
3,130,111	4/1964	Izumi	24/204
3,137,054	6/1964	Demestral	24/204
3,686,718	8/1972	Brumlik	24/204
3,762,000	10/1973	Menzin	24/204
3,778,870	12/1973	Bennett	24/204

FOREIGN PATENTS OR APPLICATIONS

1,551,245	11/1968	France	24/204
102,197	11/1916	United Kingdom	24/204

Primary Examiner—Bernard A. Gelak

Attorney, Agent, or Firm—Burgess, Dinklage & Sprung

[57] **ABSTRACT**

A multi-element self-gripping device is disclosed and includes a plurality of upright gripping elements stiffly attached to a base which may be a common point, a line or a surface. Each of the gripping elements define a trough lined with an edge and are adapted to penetrate and become lodged in a receiving material.

4 Claims, 20 Drawing Figures

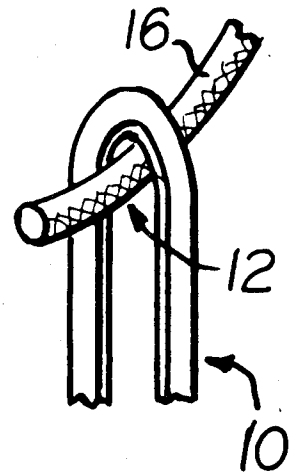


FIG. 1.

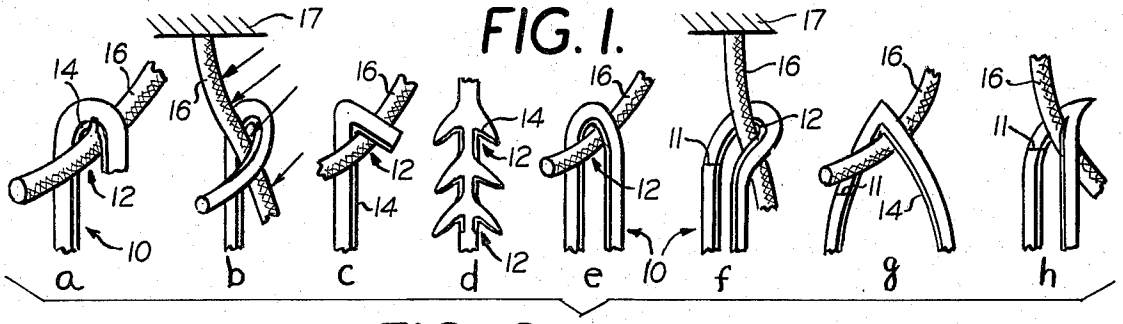


FIG. 2.

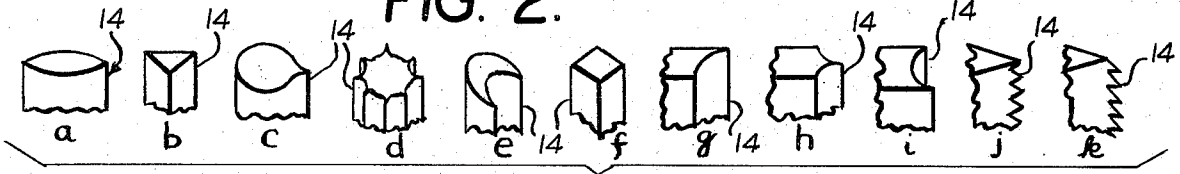


FIG. 3.

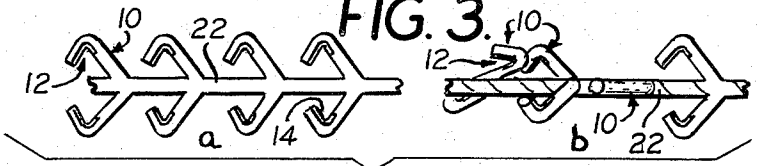


FIG. 6a.

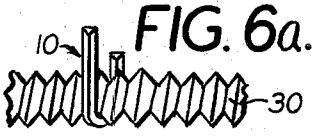


FIG. 4.

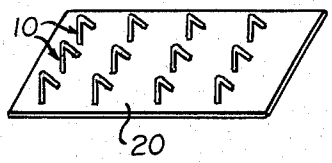


FIG. 5.

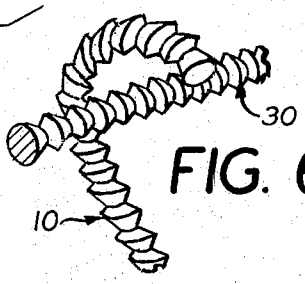
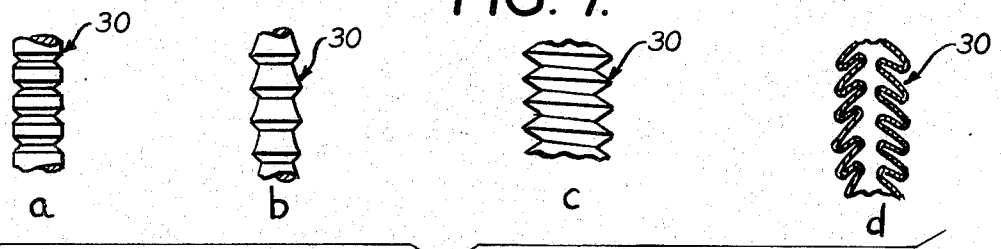


FIG. 6b.

FIG. 7.



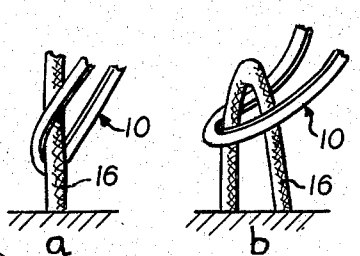


FIG. 8.

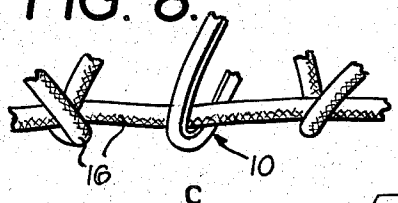
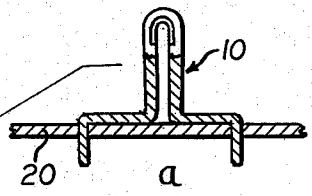
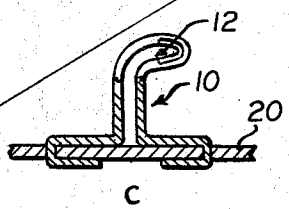


FIG. 9.





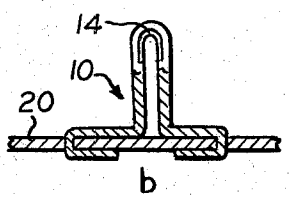


FIG. 10.

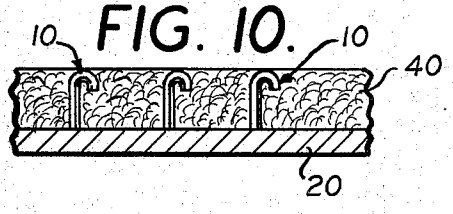


FIG. 11.

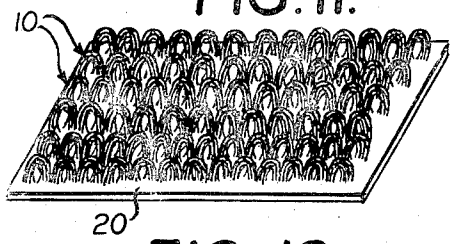


FIG. 12.

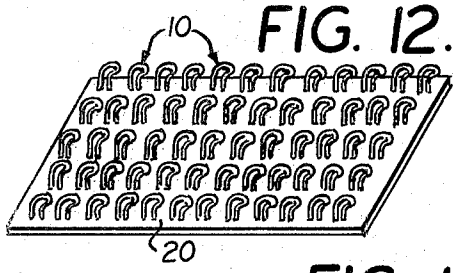


FIG. 13.

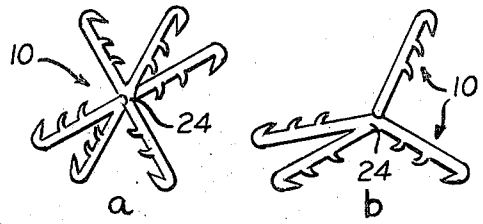


FIG. 14.

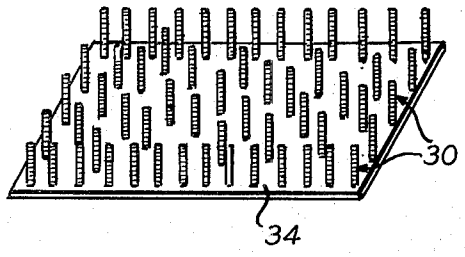


FIG. 17.

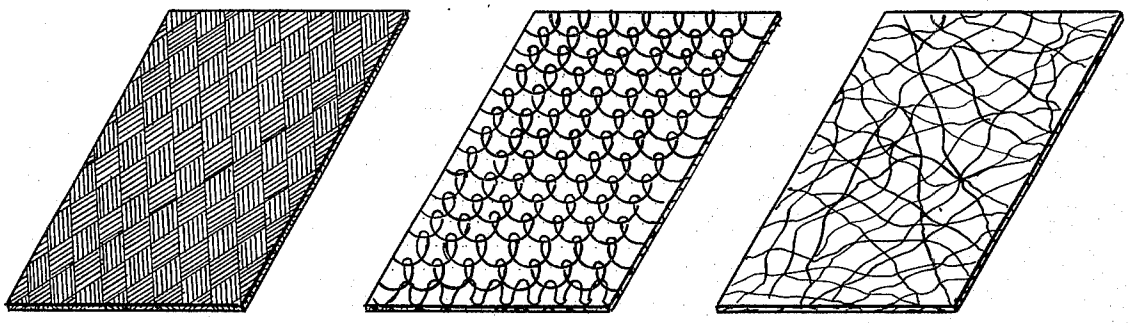


FIG. 15.

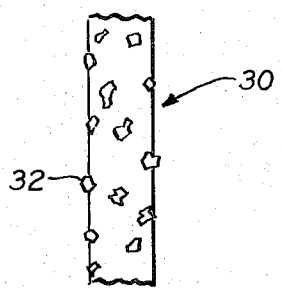


FIG. 16.

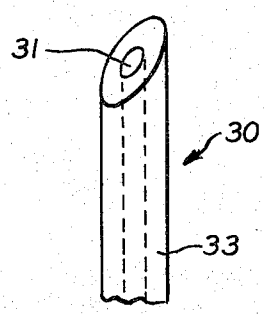


FIG. 18.

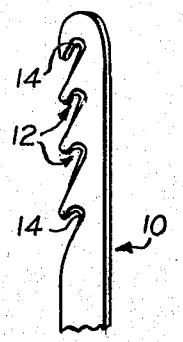
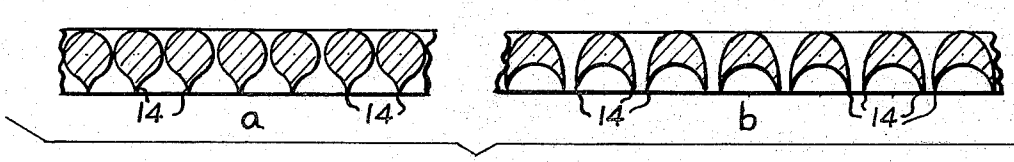


FIG. 19.



MULTI-ELEMENT GRIPPING DEVICE

RELATED APPLICATIONS

This is a continuation of application Ser. No. 200,336, filed Nov. 19, 1971, and a continuation-in-part of copending applications Ser. Nos. 126,706 and 126,708 both filed on Mar. 27, 1971 and Ser. No. 154,589, filed June 18, 1971.

BACKGROUND

This invention relates to a self-gripping device having a plurality of stiffly attached gripping elements having gripping edges which are adapted to penetrate a receiving material. The devices of the invention are particularly adapted for self-gripping receiving materials comprising fibers, fibrils, filaments and edges or portions of thin layers of recticular, cellular or perforated bodies.

Self-gripping devices have been known for some time but only recently have they begun to replace conventional fastening devices such as staples, snaps, nails, adhesives and the like. In general, self-gripping devices perform many unique functions which conventional fasteners cannot provide. For instance, there is unlimited freedom of self-gripping engagement over an area by virtue of the vast number of gripping sites in a receiving material. This has the effect of eliminating alignment criticalities that seriously hamper conventional fasteners, involving mating specific fastening sites such as a bore or hole with corresponding fastening devices such as a screw, bolt, snap or rivet or the two halves of a zipper.

A reversible or permanent self-gripping connection can be formed simply by hand without the need for special tools. Once a reversible self-gripping connection is formed it can be pulled apart due to the releasible nature of the self-gripping connections. This may provide for invisible attachment that leaves no visible marks once the connection is pulled apart and established elsewhere on the surface. This is especially true for carpet covered walls and ceilings which are finding increased use as an interior surface finish.

Also, a plurality of gripping elements in a self-gripping device cooperate to provide the required amount of self-gripping holding force and distribute same over a predetermined area thus avoiding localized stress concentrations such as occurs with conventional fasteners.

Another desirable feature is that the gripping elements of a device may be inherently flexible which allows a self-gripping connection to accommodate dimensional changes caused by large thermal coefficients of expansion that occur between similar or dissimilar articles connected to each other by a self-gripping mechanism. This prevents buckling and cracking of joined articles.

One more capability of self-gripping devices is the ability to form a self-gripping connection between articles on any face, edge or corner by simply bringing any pair of these into contact at the desired location.

With increasing use and advancing sophistication of self-gripping devices, the ability of a self-gripping device to enter into self-gripping engagement with various types of receiving materials becomes important. One such receiving material widely used but which cannot be readily and effectively self-gripped by present day self-gripping devices is a material made up of fibers, fibrous composites, yarns or the like attached at one end

such as occurs in natural and artificial fur, hair, fabrics such as velvet and woven, piled, tufted and flocked carpets.

SUMMARY

The present invention provides self-gripping devices which add new dimensions to the self-gripping art. The devices of the invention make it possible to self-grip fibers at any given point, even fibers attached at one and also provide for unlimited freedom of self-gripping engagement not only over an entire surface but also in depth of a receiving material.

The device of the invention includes a plurality of upright gripping elements which are stiffly attached to a base. Each of the gripping elements are flat or wire-like members and define a trough lined with an edge. The gripping elements are adapted to penetrate or become lodged in a receiving material and especially receiving materials made up to fibers, fibrils, filaments and thin walled cells, webs and sheets. The gripping elements are particularly adapted for self-gripping fibers, fibrils, fascicles, filaments, braids, tufts, yarns, which may be parts of a great variety of natural and man-made materials, and especially any of these loose at one end. Such fibers and the articles they form part of offer an infinite number of engaging sites and the devices of the invention are capable of gripping along the entire length of the fibers.

DESCRIPTION OF THE DRAWINGS

FIGS. **1** *a* through *h* are side elevational views showing various wire-like gripping elements each curved or bent to define a trough lined with an edge.

FIGS. **2** *a* through *f* are perspective views partially broken away illustrating various cross-sectional shapes that may be used to form the wire-like gripping elements.

FIGS. **2***g* through *k* are perspective views partially broken away illustrating the position and profile of suitable edges for the gripping elements.

FIGS. **3** *a* and *b* are perspective views illustrating two embodiments of gripping elements attached to a linear base, FIG. **3** *b* showing the device of FIG. **3** a twisted about its longitudinal axis.

FIG. **4** is a perspective view illustrating gripping elements attached to a sheet or tape.

FIG. **5** is a perspective view illustrating gripping elements attached to both sides of a disc-shaped patch.

FIGS. **6** *a* and *b* are perspective views illustrating wire-like gripping elements in engagement with filaments having transverse striations.

FIGS. **7** *a* through *d* are side elevational views partially in section illustrating various profiles or filaments which provide for highly efficient self-gripping engagement with the device of the invention.

FIGS. **8** *a* through *c* are perspective views illustrating several ways in which gripping elements enter into self-gripping engagement with fibers or filaments.

FIGS. **9** *a* through *c* are side elevational views partially in section illustrating the attachment of a wire-like gripping element to a base in a staple-like fashion.

FIG. **10** is a side sectional view illustrating further embodiments of the invention, wherein the self-gripping device includes a protective layer or a hybrid gripping surface.

FIGS. 11 and 12 are perspective views illustrating devices of the invention having closed loop gripping elements attached to a base.

FIGS. 13 *a* and *b* are perspective views illustrating embodiments of the self-gripping device wherein the gripping elements are attached to a common point.

FIG. 14 is a perspective view of a receiving layer utilizing filaments having striations are shown in FIG. 7.

FIGS. 15 and 16 are side elevational views showing further embodiments of fibers or filaments suitable for use in receiving material as shown in FIG. 14; and

FIGS. 17 *a* through *c* are perspective views of receiving materials made from wire-like members having any of the profiles shown in FIG. 2 or from the filaments shown in FIGS. 7, 15 or 16.

FIG. 18 is a side elevational view of a flat gripping element having a plurality of troughs each lined with an edge.

FIGS. 19 *a* and *b* are cross-sectional views illustrating alternate embodiments of the receiving materials shown in FIG. 17.

DESCRIPTION

Referring now to the drawing and in particular to FIGS. 3, 4, 5, 11, 12 and 13, the self-gripping device of the invention is shown to include a plurality of upright gripping elements indicated generally by the reference numeral 10 stiffly attached in thick profusion or in relatively close proximity to each other to a base such as a sheet or tape 20 shown in FIGS. 4, 11 and 12, the disc-like path 21 shown in FIG. 5, or a linear element such as the filament 22 shown in FIGS. 3*a* and 3*b* or a common point 24 as shown in FIGS. 13*a* and 13*b*. Similar or dissimilar gripping elements 10 which can vary in size relative to each other may be arranged on a base in an irregular or uniform pattern and they may also extend from both sides of a base as shown in FIGS. 5 or they may radiate about a line or linear element 22 as shown in FIGS. 3*a* and 3*b* (3*a* twisted) or about a common point such as the sixth element symmetrically arrangement shown in FIG. 13*a* or the fourth element tetrahedron arrangement shown in FIG. 13*b*. . The elements attached to element 22 may be at a 90° angle or inclined at a greater or lesser angle as shown. The linear devices shown in FIG. 3 may also form a woven or non-woven structure to constitute a self-gripping device of the invention.

Wire-like gripping elements suitable for use in the present invention are illustrated in FIGS. 1 and 2 and are shown to include a trough 12 lined with an edge 14. The gripping element 10 in this embodiment can be formed from wire-like members having any of the profiles illustrated in FIG. 2 and are bent or curved as illustrated in FIG. 1 to define the trough 12 lined with an edge 14. It should be noted that the edge 14 need only be at the bottom of trough 12. The wire-like gripping elements 10 can be curved or bent in generally the same plane as shown in FIGS. 1*a* and 1*c* and may include a plurality of troughs 12 lined with edges 14 as shown in FIG. 1*d*. The wire-like gripping elements 10 may also be curved or bent out of plane as illustrated in FIG. 1*b*. The wire-like gripping elements 10 may also be curved or bent in a wide variety of ways in the form of a closed loop to define the trough 12 lined with edges 14 as illustrated in FIGS. 1*e* through *h*. The loop may also be cut as shown in FIGS. 1*f–h* at all to form a gripping element capable of functioning as a hook per se as well as the trough 12 functioning to self-grip. It should be understood that the elements of FIGS. 1*e–h* can be used in any of the embodiments shown in FIGS. 4, 5, 11, 12 and 13.

The trough 12 may be gently curved as shown for example in FIGS. 1*a* and 1*e* or it may be sharply angled as shown in FIGS. 1*c* and 1*g*, for example.

The troughs 12 may be lined with a plurality of edges 14 as is shown for example in FIGS. 2*e* and *i*. . The edge or edges 14 may be located at the rim of the trough 12 for example in FIGS. 2*e*, *g* and *i*, or it may be located internally in the trough as shown in FIGS. 2*a*, *b*, *c*, *f* and *h*. In addition, the edge may be serrated as shown by the reference numerals 14′ and 14″ in FIGS. 2*j* and *k*. The wire-like gripping elements may also be provided with one or more exterior cutting edges as shown in FIGS. 2*a*, and *f*. Such exterior cutting edges facilitate penetration into a receiving material. The wire-like elements may also have transverse striations as shown in FIG. 6*b* which in profile define a trough lined with a serrated edge. Similar suitable striations are shown in FIGS. 7*a–c*.

It should be noted that portions of the gripping elements used in the present invention are also capable of functioning as a barb which enhances self-gripping ability. For example, in the embodiment shown in FIGS. 1*c*, 1*d* and 3, the gripping elements 10 may also function as a barb. However, in other embodiments of the invention, for example, as shown in FIGS. 1*e* and *f* there is no barb and self-gripping is accomplished by engagement of a receiving layer with a trough 12. The absence of a barb is desirable to prevent skin irritation when the device of the invention is applied or utilized by hand. Thus, the invention provides the unique self-gripping device which eliminates the use of barbs but also makes it possible to utilize barbs in combination with a trough lined with an edge.

FIG. 18 shows a flat gripping element 10 having troughs 12 lined with an edge 14. The flat element may be curved or twisted for added stiffness and one or more troughs can be provided on one or both edges of the flat element in a random or uniform pattern. The upper end of the flat element may be sharp or rounded or even blunt and may have a cutting edge.

As indicated previously, the self-gripping device of the present invention can be used for self-gripping receiving materials which are fibrous in nature and shape such receiving materials wherein fibers, tufts, yarns and the like are loose at one end. In FIGS. 1*b* and 1*f* filaments 16 loose at one end are attached to a base 17 at one end are shown as being engaged by two different gripping elements each having a trough 12 lined with an edge 14. The arrows in FIG. 1*b* illustrate that engagement is unlimited in depth and can occur at any place along filament 16. Other embodiments in FIG. 1 also illustrate the manner in which a filament or fiber 16 is self-gripped by the gripping element used in the invention. The embodiments shown in FIG. 8 illustrate further the manner in which the gripping elements used in the invention can engage an upright filament (FIG. 8*a*), a loop or tuft (FIG. 8*b*), each attached to a base, or a filament intertwined with other filaments (FIG. 8*c*).

As noted previously, the gripping elements are generally described as being stiffly attached in an upright fashion to a base. While the gripping elements on a whole are attached in a generally upright fashion, the

upper portions thereof may be disposed in any position to the base. Examples of this are illustrated in FIGS. **1***f*, 1*h*, 8*a*, 8*b*, 9*c* and **12** wherein the upper portions are capable of functioning as a hook or loop. Note in FIGS. **1***f*, 8*b*, 9*c* and **12** that the hook or loop is in the same plane as the base and parallel thereto or inclined up or down. It should also be understood that 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 gripping element at an angle or a portion thereof 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 **10** such as shown in FIG. **12** 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.

Generally speaking, the upper ends of the gripping elements **10** 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 FIGS. **1, 8, 9** and **15.** In addition, flat members **11** as shown in FIG. **15** can be cut at an angle or rounded as shown. In those instances where skin irritation is to be avoided, the upper end of the gripping elements **10** 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 which for purposes of the invention generally comprise fibers, fibrils, filaments or thin walled cells, webs or sheets all of which can enter into self-gripping engagement with the trough. in FIG. **17** formed from wire-like material having any of the cross-sectional shapes shown in FIG. **2** or from any of the fibers or filaments shown in FIG. **7.** Thus, the receiving materials may also have edges (FIG. **2**) or striations (FIG. **7**) to promote self-gripping engagement.

The troughs lined with one or more edges can compress and/or displace or interlock with a filament (FIGS. **6***a* and *b*) and can also partially cut into the filament to obtain self-gripping (FIG. **1***a*). This ability to cut notch, abrade or slip along a fiber or filament also enables separation of a device of the invention from the receiving layer or material and because of the nature of the receiving layer or material, the ability to again enter into self-gripping engagement is not impaired by virtue of the fact that there are virtually thousands of self-gripping sites within a receiving layer or material of the nature described herein.

Referring now to FIG. **10,** a self-gripping device of the invention comprising a sheet **20** and upright gripping elements **10** is shown in self-gripping engagement with a receiving layer **40** which is shown to be fibrous in nature for purposes of illustration.

In certain applications, it is desirable to utilize a receiving layer such as that shown in FIG. **10** 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. The receiving layer or material which the gripping elements have the special advantage in being able to engage and hold is fibrous in nature and may have fibers, fibrils or filaments which are loose at one end, for example, as occurs in animal and artificial fur, hair, feathers, and in fabrics such as velvet or in woven, piled, tufted and flocked carpets.

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 artifical 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 laminae which is capable of being penetrated or pieced 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. Also suitable are woven, knitted or non-woven (e.g. felted) materials shown engagement. The protective layer may have a thickness equal to or greater than the height of the gripping elements **10.** Such a protective layer can be readily utilized with any of the various embodiments of the invention such as those shown in FIGS. **3** through **5** and **11** through **13** for example.

It is also possible to use the receiving layer **40** as a component part of the device of the invention. In this instance the layer **40** 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 **10** forming what can be called a hybrid self-gripping surface. The gripping elements **10** in this embodiment can extend below to or beyond the surface of layer **40.** Thus, when the layer **40** is compressed, the elements **10** are exposed and protrude out of the layer **40** and are then capable of self-gripping engagement with a receiving layer or material or a similar hybrid self-gripping device.

The gripping element used in the device of the invention may be formed or molded from a variety of materials such as metal, glass, plastics or composites such as those having metal or glass cores and a plastic sheath with the edge molded in.

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 FIGS. **4, 5, 11** and **12,** and/or by mechanically attaching the gripping elements using adhesive, flocking, tufting and weaving (as in brush and carpet manufacturing), welding or heat sealing techniques. In FIGS. **9***a* through *c* gripping elements **10** may also be attached to base **20** in a staple-like fashion.

The embodiment shown in FIG. **11** illustrates a carpet like device wherein each line represents a tuft of a single fiber or filament which may be formed from any of the wire-like shapes shown in FIG. **2.** The device shown in FIG. **11** may be made entirely from wire-like loops such as shown in FIG. **1***e* and may also contain conventional loops or tufts made from synthetic or natural fibers as are used in carpet manufacturing.

In the embodiment shown in FIGS. **3***a* and *b* the gripping element **10** can be attached to the filament **22** which can be made of metal, plastic or glass using the above techniques, twisting between strands of wire as in a brush. The devices of FIG. **3** may also be attached further to a backing member in a parallel crosswise fashion to form a self-gripping sheet or web. The same is true in the embodiments shown in FIGS. **13***a* and *b* where a plurality of gripping elements are attached at a common point **24** forming the base of the clustered self-gripping device.

The nature of the self-gripping action by the gripping elements may be permanent or reversible depending upon the nature of the gripping elements and the receiving layers or materials which come into self-gripping engagement therewith. For example, troughs may be rigid to provide a more permanent or tenacious self-gripping action or they may be resilient to facilitate removal from a receiving layer. As noted previously, the cutting action of the troughs also facilitates removal from a receiving layer.

The gripping elements generally range in length from about 0.002 to about 0.75 inch and the flat member **11** forming the gripping element can range from about 0.001 to 0.08 inch in width. It should be noted that extremely small gripping elements can form the device of the invention and yet be invisible to the naked eye.

A further aspect of the present invention relates to a receiving material such as those shown in FIGS. **17***a–c* which is adapted to enter into self-gripping engagement with self-gripping devices in general and, in particularly, the devices of the invention and comprises at least one layer of non-woven, or knitted fibers or filaments having at least one longitudinal sharp edge which may be continuous or serrated as shown in FIG. **2** or fibers or filaments having transverse striations as shown in FIGS. **6, 7** and **15.**

FIGS. **17***a* shows such a layer which is braided or non-woven: FIG. **17***b* shows such a layer which is knitted and FIG. **17***c* illustrates a non-woven layer.

The receiving materials such as those shown in FIGS. **17***a–c* can be used alone or can be used as a component of a multi-layer structure. It should also be noted that the composite fiber or filament shown in FIG. **16** and described below can also be used in this embodiment of the invention.

The receiving materials of the invention may be constructed solely of filaments or fibers as shown in FIGS. **2, 6, 7, 15** and **16** and may be used in combination with each other or they may be used as a component of a woven, non-woven, knitted or braided structure which also includes conventional fibers or filaments.

When constructing receiving materials from fibers or filaments having a longitudinal edge as shown in FIG. **2,** the edges may be randomly oriented or they may be arranged in a predetermined pattern to achieve special self-gripping properties. FIGS. **19***a* and **19***b* illustrate, for example, cross-sectional view of the filaments shown in FIGS. **2***c* and **2***e* with the edges oriented in the same direction.

FIG. **7** provides several illustrations of fibers, indicated generally by the reference numeral **30,** having lateral protrusions. The fibers shown in FIGS. **7***a* through *d* can be characterized as having transverse striations which may also be crisscrossed or helical as shown. The transverse striations may be angular as shown in FIGS. **7***a* through *c* or they may be curved in cross-section as shown in FIG. **7***d*. The fibers **30** may be solid as shown in FIGS. **7***a* through *c* or they may be hollow as shown in FIG. **7***d*.

In FIG. **15** another type of filament **30** is shown wherein the lateral protrusions are in the form of granules or particulate materials **32** attached to the surface of the fiber in a random or uniform pattern. Such fibers are known and have been used for example to form abrasive pads. The granules **32** may be embedded in or adhesively attached to the fiber **30.**

FIG. **16** illustrates a further embodiment of a composite fiber with a high tensile narrow core **31** and a deformable outer coating **33** which is capable of being displaced or cold formed, preferably without rupturing or cutting, thereby providing a projected site or lateral protrusion for self-gripping engagement with a self-gripping device. The coating **33** in practice is displaced or cold formed upon engagement with the self-gripping device of the invention. The core **31** is generally a stiff element made of wire, glass, glass yarn or plastic such as polyacetals, polyesters, polyamides, polypropylene, and yarns or the like formed from any of these. The coating **33** can be an elastomer, a tacky or pressure-sensitive material, or soft and pliable material that is resistant to peeling and stripping. Suitable materials for coating **33** include synthetic and natural rubbers, ethylene vinyl acetate elastomers, silicon resins, urethane polymers, high-tack composition, ionomer resins and the like.

It should be noted that the fibers shown in FIGS. **7,** 15 and **16,** for example, can also be in the form of filaments which can be spun into yarn, braided, woven, knitted, felted and the like. The filaments in any of these forms may be anchored or attached to a backing member to provide a particularly desirable receiving material for use with self-gripping devices of the invention.

The fibers shown in FIGS. **7** and **15** may also be composites comprising a core and an outer coating having lateral protrusions. The fibers shown in FIG. **7,** for example, can be made using known techniques from metals such as aluminum, steel, copper and the like or from plastics including thermoplastics such as polyolefins, nylons, polyesters and the like, and thermosetting resins such as phenolics epoxy resins, melamines, ureas, and the like. The fibers can be formed using extrusion, melt spinning, solvent spinning, coldforming, printing, embossing, film slitting and similar techniques.

FIG. **14** shows fibers **30** having lateral protrusions which are attached to a base **34.** The fibers **30** generally range in length from about 0.001 to about 0.75 inch, are closely packed on base **34** and the upper ends thereof have a penetrating profile to permit entry by gripping elements. The fibers **30** are preferably spaced no greater than one filament width apart on the base **34** and the penetrating profile can be rounded, pointed, cut-off at an angle as shown in FIG. **17,** or the like.

In FIG. **14,** fibers **30** can be attached to the base **34** using conventional tufting, weaving, flocking, piling, or adhesive techniques. Smooth fibers may also be mixed in with the fibers **30.** The base **34** can be made from the same materials as the base for the gripping elements **10** and it can be in the form of a sheet as shown in FIG. **14** or a strip or patch as illustrated in FIGS. **4** and **5.** The device shown in FIG. **14** may also include other filaments which can be looped or loose at one end and may include different types of fibers having lateral protrusions which may also vary in size, including the fibers of FIG. **16** having an outer coating **33** which has a higher coefficient of friction or a pressure-sensitive force in contact.

The gripping elements used in the invention can be formed or molded using any number of fabricating techniques. For example, both the wire-like gripping elements shown in FIG. **1** or the flat elements shown in FIG. **18** can be molded using techniques such as compression molding or injection molding or they can be formed using mechanical techniques such as bending, cold-forming, stamping, cutting, punching and the like, or by using chemical techniques such as etching and like.

Several particularly desirable self-gripping connections can be formed within the context of this invention. For example, the gripping device shown in FIG. **12** is especially useful for self-gripping the structure shown in FIG. **14** described above. The fibers **30** in FIG. **14** because of their lateral protrusions are capable of entering into self-gripping engagement with the receiving materials of FIG. **17** and especially FIG. **17***c*. Additional combinations include the gripping device of FIG. **4** with the receiving material of FIG. **17***b* and the gripping device of FIG. **5** with the receiving material of FIG. **17***c*. These combinations provide highly efficient and specialized self-gripping connections and are not intended to limit the invention in any way.

The self-gripping devices and receiving layers of the invention 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, filters, decorative trim, and the like.

What is claimed is:

1. Self-gripping device comprising a multiplicity of upright gripping elements stiffly attached to a base, each of said gripping elements defining a trough having a sharp longitudinal edge along its interior surface, said gripping elements being capable of penetrating and becoming lodged in a receiving material, said gripping elements being wire-like members curved to define said trough, said wire-like members being curved to define said trough being a closed loop attached to said base.

2. Self-gripping device of claim **1** wherein said loops are attached to said base in a staple-like fashion.

3. Self-gripping device of claim **1** which includes a resilient receiving material over the gripping elements forming a hybrid self-gripping device.

4. Self-gripping device of claim **1** in self-gripping engagement with a receiving material.

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