A multi-element self-gripping device 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 are elongated members having at least one downwardly inclined integral linguiform tab and are adapted to penetrate and become lodged in a receiving material.
MULTI-ELEMENT SELF-GRIPPING DEVICES
WITH LINGUIFORM GRIPPING TABS

RELATED APPLICATIONS

This application is a continuation-in-part application of copending applications Ser. No. 171,701, and Ser. No. 171,668, both filed Aug. 13, 1971. This is a continuation, of application Ser. No. 295,637 filed Oct. 6, 1972.

BACKGROUND

This invention relates to a self-gripping device having a plurality of stiffly attached flat gripping elements having linguiform gripping tabs. The gripping elements are adapted to penetrate a receiving material and upon the application of a withdrawing force the entrances of the tabs act as a funnel which directs the receiving material under the tab resulting in a positive highly efficient self-gripping action. The device of the invention is thus 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, 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 serious hamper conventional fasteners, involving mating specific fastening sites such as a bore or hole with corresponding fastening devices such as a screw or bolt.

A self-gripping connection can be formed simply by hand without the need for special tools. Once the self-gripping connection is formed it can be pulled apart due to the reversible nature of the self-gripping connections. This provides for invisible attachment that leaves no 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 are 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 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 end 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 comprises an elongated member having at least one integral linguiform tab therein, preferably in a downwardly inclined direction. The gripping elements are adapted to penetrate or become lodged in a receiving material and especially receiving materials made up of fibers, fibrils, filaments and thinwalled cells, webs and sheaths. The gripping elements are particularly adapted for self-gripping fibers, fibrils, fascicles, filaments, braids, tufts, yarns, and especially any of these loose at one end. Such fibers and the like offer an infinite number of engaging sites and the devices of the invention are capable of gripping same along their entire length.

DESCRIPTION OF THE DRAWING

FIGS. 1 a through j are side elevational views showing a gripping element having linguiform gripping tabs which are suitable for use in the device of the invention.

FIGS. 2 a through h are cross-sectional views of elongated members suitable for the gripping elements used in the invention.

FIGS. 3 a through d are side elevational views of various shapes for the linguiform tabs in the gripping element used in the invention.

FIGS. 4, 5 and 6 are perspective views illustrating various configurations of the self-gripping device of the invention.

FIG. 7 is a side sectional view illustrating particular embodiments of the invention.

FIGS. 8 a through h are side elevational views partly in section illustrating various profiles of filaments which provide for highly efficient self-gripping engagement with the device of the invention.

FIGS. 9 and 10 are side elevational views of filaments which also provide highly efficient self-gripping engagement with the device of the invention.

FIG. 11 is a perspective view of a receiving layer comprising filaments having striations such as shown in FIGS. 8 through 10.

FIG. 12 is a perspective view illustrating a further configuration of the self-gripping device of the invention.

FIG. 13 is a perspective view of a self-gripping device utilizing the gripping element shown in FIG. 1 g.

DESCRIPTION

Referring now to the drawing and in particular to FIGS. 4, 5, 6 and 12, 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 which may be a surface such as the sheet or strip 20 shown in FIG. 4 or a patch or disc 26 shown in FIG. 12, or a linear element such as the filament 22 shown in FIG. 5 a or a common point 24 shown in FIGS. 6 a and b. Similar or dissimilar gripping elements which can vary in size may be arranged on the base in a uniform or irregular pattern and they may extend from both sides of a base such as shown in FIG. 12 or they may radiate about a line as shown in FIGS. 5a or about a common point such as the six-element arrangement shown in FIG. 6 a or the four-element tetrahedron-type arrangement shown in FIG. 11 b.

Referring now to FIG. 1, the gripping elements 10 of the device of the invention include an elongated member 12 having at least one preferably downwardly inclined integral tab 14. As shown in FIG. 1, a plurality of tabs 14 can be uniformly or randomly spaced along member 12 singly or in rows. As shown in FIG. 1 h the tabs 14 can progressively increase in size from the tip or upper end of the member 12 downward. The tabs 14 can be pointed sharply or gradually, or they can be blunt, bulbous or the like as shown for example in FIGS. 1 and 3.

The elongated member 12 can have virtually any cross-section so long as the tabs 14 can be formed therein. Thus, the elements 12 can be solid or hollow, curved, bent, round, flat, wavy, square, triangular, multi-sided and the tabs 14 formed along an edge or within the body thereof. Examples of these are shown in FIGS. 1 and 2.

The member 12 may also be curved as shown in FIG. 1 e to increase the overall stiffness of the gripping elements 10. It is also possible to use perforated, corrugated or similarly textured members for the gripping elements as well as composite members comprising a stiff generally metal core with an outer coating such as an extruded plastic sheath and the like.

As noted previously, the tabs 14 act as a funnel direct-recting receiving material tabs 14 for positive self-gripping action.

The tabs 14 are also capable of functioning as a barb, which can enhance the self-gripping ability of the device of the invention, for example, as shown in FIGS. 1 f and g. In the embodiment shown in FIGS. 1 a and b for example, there is no barb and self-gripping is accomplished by engagement of the receiving material with the tabs 14. 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 in this embodiment provides a unique self-gripping device wherein the need for barbs can be eliminated. In another embodiment, self-gripping action can be accomplished by the tabs 14 acting as a barb per se and also by engaging receiving material thereunder.

As indicated above, the self-gripping device of the invention is especially suited for self-gripping engagement with receiving materials which are fibrous in nature and is equipped to self-grip surfaces such as those wherein the fibers, tufts, yarns and the like, are loose at one end. In FIGS. 1 a, 1 e, 1 g, 1 j and 1 k, the engagement of the tabs with a filament 30 is illustrated and in FIG. 1 d a bundle of three filaments is shown being engaged by a single tab. In FIGS. 1 b, filament 30 loose at one end and attached to a base 32 on the other end is shown gripped by the uppermost tab of the element 10. Thus, the fibers 30 can be generally parallel to the member 12 and still be effectively self-gripped. This is a unique capability. It should also be understood that the linguiform tabs are capable of gripping fibers and the like oriented or held in any direction or plane. Besides filaments and fibers, the linguiform tabs are capable of engaging thin walled cells, webs and sheets.

A plurality of gripping elements 10, which may be the same or different, cooperate in engaging a receiving material to distribute the self-gripping force over a given area and thus eliminate stress concentrations.

It is evident, therefore, that the device of the invention is not only capable of unlimited freedom of self-gripping engagement over the entire surface but also throughout the depth of a receiving material. Since each fiber loose at one end in a receiving material offers an indefinite number of engaging sites along its entire length, self-gripping engagement can take place between the very end of a filament 30 and a gripping element 10 as shown for example in FIG. 1 b or it can occur at the base of a fiber 30 and a gripping element 10 or at any combination of sites therebetween.

Also, upon entry into a receiving material, fibers and filaments therein are effectively displaced by the entering linguiform tabs and because of their physical relationship to one another in a receiving material, they tend to return to their original position which greatly enhance the probability of self-gripping engagement with the tabs upon application of withdrawing force to the gripping elements.

The tabs may be bent out from the member 12 from one or both sides thereof in any desired predetermined, uniform, random or irregular pattern. Generally, the tabs 14 are bent out a sufficient distance such that the tabs are capable of accommodating one or more filaments. The angle of tabs 14 in relation to member 12 can be 90° but are preferably downwardly inclined.

The tip or upper end of the gripping elements 10 may be rounded as shown in FIGS. 1 a, 1 b, 1 c, 1 d, 1 f or 1 h for example or they may have a sharp centrally located tip as shown in FIG. 1 e or a sharp asymmetrical tip as shown in FIGS. 1 i and 1 j. The upper end of the gripping elements 10 may also be provided with a cutting edge as shown in FIG. 1 g by 12′ to facilitate initial penetration into a receiving layer or material.

Generally speaking the upper end of the gripping elements 10 are characterized by a penetrating profile or shape which may be achieved by any of the shapes shown or by an angled or straight cut across the member 12 or forming in such a way that multiple sharp points result. 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 asewed wedges. In a preferred embodiment, the receiving layer or material 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 and in fabrics such as velvet or in woven, piled, tufted and flockaded carpets.

Thus, the self-gripping device of the invention is particularly adapted for self-gripping 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 laminate 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 asheets can be a sheet with densely punched holes relatively close to each other or expanded sheets such as expanded metal.


The tabs 14 can be formed in a member 12 in such a manner that they have cutting or shearing edges. For weaker force engagement the edges can be rounded off, mechanically or by etching. This makes it possible for the tabs 14 to not only compress and/or displace or interlock with a filament but also to partially cut into the filament to obtain self-gripping. This ability to cut 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. 7, a self-gripping device of the invention comprising a base 20 and upright gripping elements 10 is shown in self-gripping engagement with a receiving layer 40 which is shown to be porous in nature for purposes of illustration.

In certain instances, the member 12 can be made from a thin resilient metal in which case the tabs 14 will have a spring-like action enabling them to flatten out when penetrating a receiving layer or material and spring-back to their original position after insertion or upon pulling the element out.

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 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 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 and 12 and/or by mechanical attaching the gripping elements using adhesive, welding or heat sealing techniques. In FIGS. 4 and 12 pairs of gripping elements may also be inter-connected in a staple-like fashion.

In the embodiment shown in FIG. 5 the gripping element 10 can be attached to the filament 22 which can be made of metal, plastic or glass using the above techniques. The same is true in the embodiments shown in FIGS. 6 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. Suitable gripping elements and attaching techniques including staple-like structures and preformed elements are disclosed in my copending applications Ser. Nos. 171,701, filed Aug. 13, 1971, Ser. No. 171,668, filed Aug. 13, 1971, Ser. No. 179,880, filed Sept. 13, 1971, Ser. No. 180,055, filed Sept. 13, 1971.

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, the lingual form tabs 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 tabs 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 width of member 12 forming the gripping element can range from about 0.001 to 0.08 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.

The self-gripping device of the present invention is especially adapted to enter into self-gripping engagement with receiving materials having a base having attached thereto in relatively thick profusion, a plurality of fibers loose at one end and having lateral protrusions.

FIG. 8 provides several illustrations of such fibers, indicated generally by the reference numeral 30, having lateral protrusions. The fibers shown in FIG. 8 a through h can be characterized as having transverse striations which may also be crisscrossed or helical as shown, for example, in FIGS. 8 e and f. The transverse striations may be angular as shown in FIGS. 8 a through
The fibers 30 may be solid as shown in FIGS. 8 a through f or they may be hollow as shown in FIGS. 8 g and h.

In FIG. 9, 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 to form abrasive pads. The granules 32 may be embedded in or adhesively attached to the fiber 30.

FIG. 10 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 the self-gripping device of the invention. The coating 33 in practice is displaced or cold formed upon engagement with a self-gripping device of the invention. The core 31 is generally a stiff element made of wire, glass, glass yarn or plastic such as polyacetal, polystyrene, polypropylene, and other forms like these. The coating 33 can be an elastomer, a tacky or pressure-sensitive material, or a soft and pliable material that is resistant to peeling and stripping. Suitable materials for coating 33 include synthetic and natural rubber, ethylene vinyl acetate elastomers, silicone resins, urethane polymers, high-tack compositions, ionomer resins and the like.

It should be noted that the fibers shown in FIGS. 8, 9 and 10, 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 in general.

The fibers shown in FIGS. 8 and 9 may also be composed of a core and an outer coating having lateral protrusions. The fibers shown in FIG. 8 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 thermoplastic resins such as phenolics and the like. The fibers can be formed using extrusion, melt spinning, solvent spinning, cold forming, printing, embossing, film slitting and similar techniques.

FIG. 11 illustrates fibers 30 having lateral protrusions that are attached to a base 50. The fibers 30 generally range in length from about 0.001 to about 0.75 inch, and are closely packed onto base 36 and upper ends thereof have a penetrating profile to permit entry by gripping elements. The fibers 30 are preferably spaced closer than one filament width apart on the base 50 and the penetrating profile can be rounded, pointed, cut-off at an angle as shown in FIG. 10, or the like.

In FIG. 11 fibers 30 can be attached to the base 50 using conventional tufting, weaving, flocking, piling, or adhesive techniques. The base 50 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. 11 or a strip or patch. The device shown in FIG. 11 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. 10 having an outer coating 33 which has a higher coefficient of friction or a pressure-sensitive force in contact.

An alternate embodiment of the invention is shown in FIG. 1g and 13. In this embodiment, the gripping element 10 is provided with tabs 14 which are bent out from the body of the member 12 so as to be parallel or nearly parallel forming a generally U-shaped opening with the body 12. If desired the tabs 14 can be inclined at an angle towards or away from the body 12. The gripping elements shown in FIG. 1g are especially suited for attachment to articles to be mounted on a vertical surface such as a wall. In contrast to the device shown in FIG. 4, the gripping elements of FIG. 1g can also be mounted lengthwise in relatively thick profusion as shown in FIG. 13 on a base 20. The base 20 can be sheet-like as shown or it can be in the form of a patch, strip or tape. The gripping elements of FIG. 1g can also be mounted or attached directly on an article to be mounted on a vertical surface such as, for example, a framed picture, mirror and the like. The gripping element of FIG. 1g is capable of entering into self-gripping engagement with receiving materials having a plurality of loops such as in a loop carpet. A plurality of fibers or filaments loose at one end or in a non-woven structure or fiber and filament in a twisted or helical pattern as in a random non-woven structure. The foregoing are illustrated in FIG. 1g from top to bottom wherein the filaments and fibers are assigned reference numeral 30 as shown in the other figures of FIG. 1.

The self-gripping device 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 or commercial users to render selected areas of articles or entire articles self-gripping such as carpets, fabrics, felts, wall cladded materials, panels, tiles, 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 and distributed in all directions over a base, each of said gripping elements comprising elongated member having a flat longitudinal face section, said flat section having a plurality of integral linguiform tabs struck out from within the periphery and spaced from the edges thereof thereby forming openings in said member, said tabs and said openings forming substantially V-shaped configurations between the edge of the tabs and the edge of the openings, said tabs being bent out so as to be downwardly inclined relative to said base, said gripping elements being adapted to penetrate and become lodged in a fibrous receiving material.

2. Self-gripping device of claim 1 wherein each tab is sharp.

3. Self-gripping device of claim 1 wherein each tab is rounded.

4. Self-gripping device of claim 1 wherein a plurality of said linguiform tabs are spaced along said member.

5. Self-gripping device of claim 4 wherein said tabs are on more than one side of said member.

6. Self-gripping device of claim 4 wherein the tabs progressively increase in size from the tip of said member downward.

7. Self-gripping device of claim 1 wherein the upper end of said elongated members are rounded.

8. Self-gripping device of claim 1 wherein the upper end of said elongated members are sharp.
9. Self-gripping device of claim 1 wherein said elongated members are curved about their longitudinal axis.

10. Self-gripping device of claim 1 wherein said base is a surface and said gripping elements extend from both sides thereof.

11. Self-gripping device of claim 10 wherein said surface is a sheet.

12. Self-gripping device of claim 10 wherein said surface is a tape.

13. Self-gripping device of claim 10 wherein said surface is a patch.

14. Self-gripping device of claim 1 having a protective layer over said gripping elements.

15. Self-gripping device of claim 1 which includes a resilient protective material over the gripping elements forming a hybrid self-gripping device.

16. Self-gripping device of claim 1 in self-gripping engagement with a fibrous receiving material.