

[54] **METHOD OF MAKING MULTI ELEMENT
SELF-GRIPPING DEVICE HAVING
COOPERATING GRIPPING ELEMENTS**

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Related U.S. Application Data

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abandoned.

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29/418; 29/428; 139/46

[51] Int. Cl. **B23p 17/00**

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29/411, 432.2, 418, 428; 24/204; 28/72 CS;
139/46

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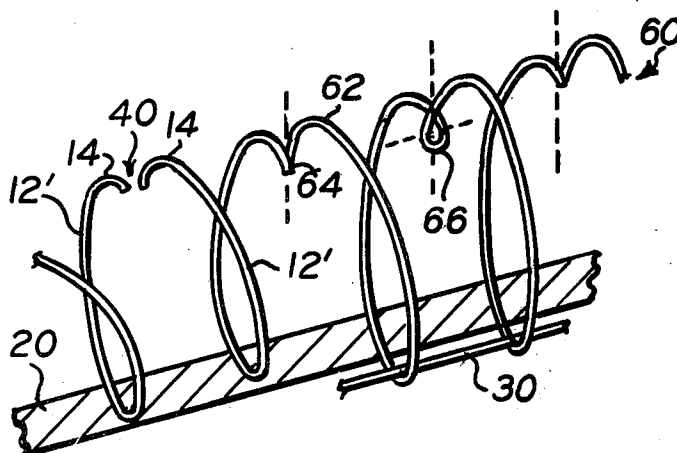
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[57] **ABSTRACT**

A self-gripping device is disclosed and includes a plurality of upright gripping elements stiffly attached to a base. The gripping elements are adapted to cooperate in groups of at least two for self-gripping engagement with a receiving material. Such gripping elements can include a stem and an upper portion having a plurality of arms which are adapted to cooperate with each other for self-gripping engagement.

3 Claims, 17 Drawing Figures



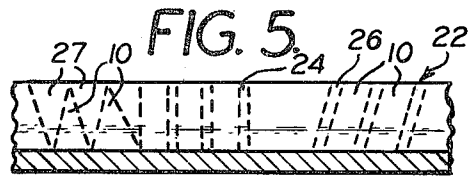
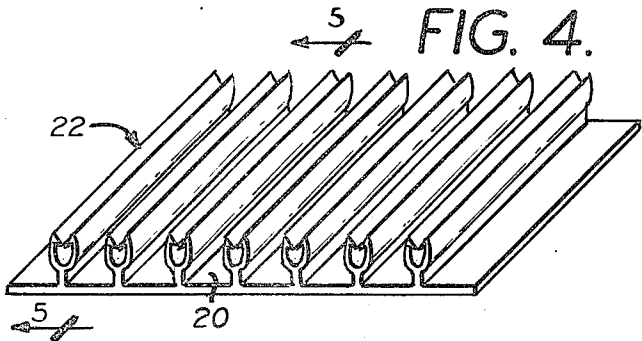
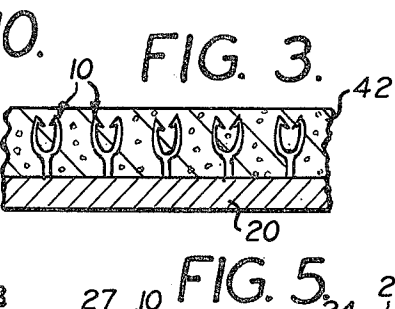
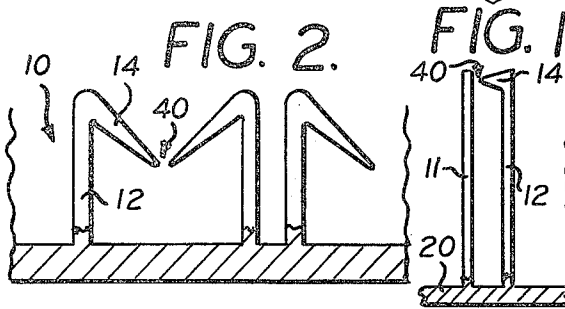
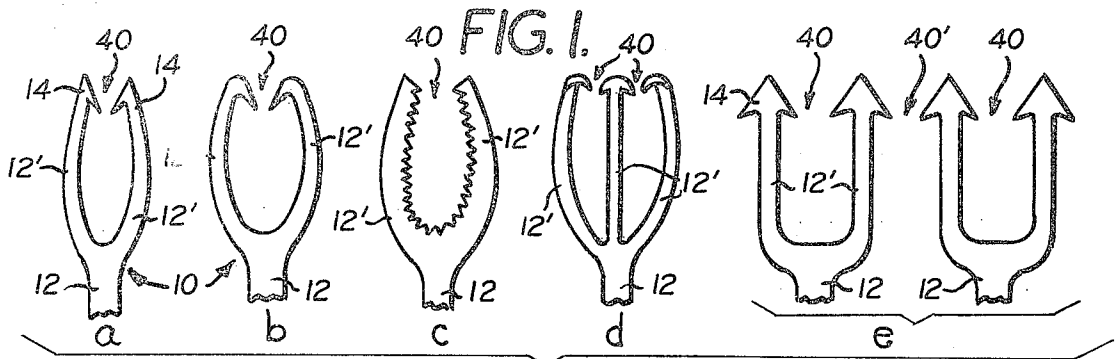
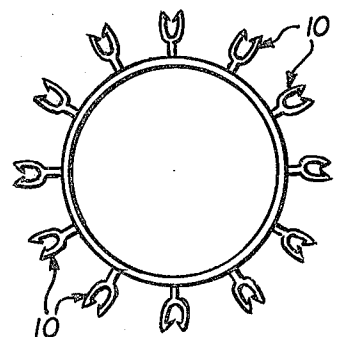
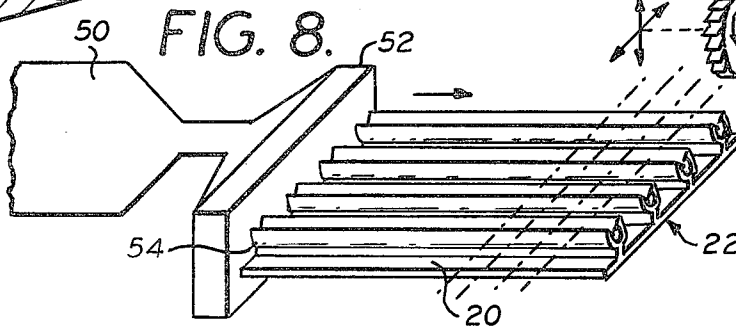
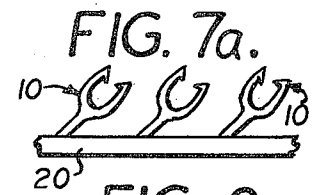
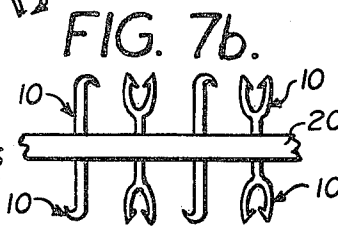
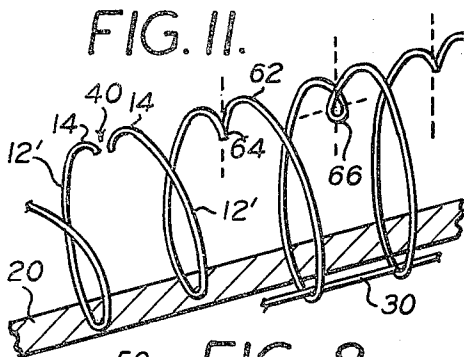
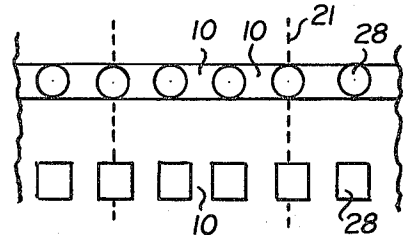


FIG. 6.



METHOD OF MAKING MULTI ELEMENT SELF-GRIPPING DEVICE HAVING COOPERATING GRIPPING ELEMENTS

This is a continuation, of application Ser. No. 298,906, filed Oct. 19, 1972, now abandoned.

BACKGROUND

This invention relates to self-gripping devices having a plurality of gripping elements which are adapted to cooperate in groups of at least two for self-gripping engagement with a receiving material.

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 seriously 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 the ever-increasing use and sophistication of self-gripping devices, the ability of self-gripping devices to form unique self-gripping connections for particular applications becomes important.

SUMMARY

The self-gripping device of the invention comprises a plurality of upright gripping elements stiffly attached to a base, said gripping element being adapted to cooperate in groups of at least two with at least one member of the group having self-gripping means oriented in the direction of the other member of the group for self-gripping engagement with a receiving material. In a preferred embodiment the gripping elements comprise a stem and an upper portion having a plurality of arms each having self-gripping means adapted to cooperate

with each other for self-gripping engagement with a receiving layer.

DESCRIPTION OF THE DRAWINGS

FIGS. 1a through 1e are side elevational views of gripping elements suitable for use in the device of the invention.

FIG. 2 is a side elevational view partially in section and partially broken away illustrating a group of gripping elements suitable for use in the device of the invention.

FIG. 3 is a cross-sectional view illustrating several embodiments of the invention.

FIG. 4 is a perspective view illustrating an integral structure from which the self-gripping device of the invention can be formed.

FIG. 5 is a cross-sectional view partly broken away taken along line 5—5 of FIG. 4.

FIG. 6 is a top plan view partly broken away illustrating several ways in which the device of the invention can be formed from the structure shown in FIG. 4.

FIGS. 7a and 7b are side elevational views partly broken away illustrating several embodiments of the device of the invention.

FIG. 8 is a perspective view of apparatus suitable for forming the structure of FIG. 4.

FIG. 9 is an end elevational view illustrating a further embodiment of the self-gripping device of the invention.

FIG. 10 is a side elevational view of an alternate embodiment of cooperating gripping elements according to the invention and

FIG. 11 is a side elevational view partly in cross-section illustrating an alternate embodiment for forming cooperating groups of gripping elements from a continuous filament such as a wire.

DESCRIPTION

Referring now to the drawings and in particular FIG. 2, the self-gripping device of the invention is shown to include a base 20 having a plurality of upright gripping element 10 stiffly attached thereto. The gripping elements 10 include an upright stem 12 and self-gripping means 14 which cooperate with similar means of adjacent gripping element 10 for self-gripping engagement at 40. Thus, adjacent gripping elements 10 can cooperate for self-gripping engagement forming what can be termed a self-gripping trap.

In FIG. 1 several embodiments are shown wherein gripping elements 10 are self-contained and include an upright stem 12 and a plurality of arms 12' forming a bifurcated portion. Each of the arms 12' terminate in gripping hooks 14 which cooperate for self-gripping engagement at 40. In FIG. 1a the gripping means 14 are shown as sharply pointed hooks and in FIG. 1b the hooks are more rounded. In FIG. 1c the arms 12' forming the bifurcated portion each have serrated edges facing each other and provide for self-gripping engagement throughout the depth of the bifurcated portion. In FIG. 1d the stem 12 is shown having three upright arms 12' forming a trifurcated position. The three arms 12' terminate in rounded hooks which cooperate for self-gripping engagement at 40. At FIG. 1e the gripping means 14 make it possible for arms 12' attached to the same stem 12 to cooperate at 40 for self-gripping engagement. It is also possible for arms 12' having gripping means 14 from adjacent gripping elements 10 to

cooperate at 40' for self-gripping engagement. Thus in FIG. 1e self-gripping cooperation at 40 can be termed an intra-element self-gripping trap and self-gripping cooperation at 40' can be termed an inter-element self-gripping trap.

Generally speaking, the upper ends of the gripping elements 10 have a penetrating profile of shape to facilitate penetration into a receiving material. This applies to the embodiments shown in FIG. 1 as well as to the embodiment shown in FIG. 2. The penetrating shape may be sharply pointed as shown in FIGS. 1a, 1c and 1d, for example, or they may be rounded as shown in FIGS. 1b, 1d and 2, for example. In those instances where skin irritation is to be avoided the upper end or ends of the gripping elements are rounded.

The gripping elements 10 may be formed or molded from a wide variety of materials such as metal, glass, plastic or composites of these but are preferably made of plastic or metal. Also the cross-sectional shape of the stem 12, the arms 12' and the gripping means 14 may be varied. For example, they may be rectangular, crescent shape polygonal and the like.

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 elements and the base. Such techniques include inserting the base of the gripping elements in or through the base with or without the use of additional techniques such as welding, heat sealing, or using adhesives. The latter techniques can also be used to attach the gripping elements without inserting same. As discussed below the gripping elements 10 can also be integrally formed with the base 20.

Referring now to FIG. 3, a self-gripping device of the invention comprising sheet 20 and upright gripping elements as shown in FIG. 1a is shown in self-gripping engagement with a receiving layer 42 which is fibrous in nature for purposes of illustration.

For certain applications, it is desirable to utilize a receiving layer such as that shown in FIG. 3 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 device without irritation to the user or premature gripping engagement. A protective layer has a thickness equal to or greater than the height of the gripping elements 10 and can be readily utilized with any various embodiments of the invention such as those shown in FIGS. 1, 2, 7 and 9, for example.

It is also possible to use the receiving layer 42 as a component part of the device of the invention. In this instance the layer 42 is made of a resilient material such as felt, carpet-like materials, sponge, plastic and can be 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 FIG. 3 can extend below, to or beyond the surface of layer 42. Thus when layer 42 is compressed, the elements 10 are exposed and protrude out of the layer 42 and are then capable of self-gripping engagement with a receiving layer of material or a similar hybrid self-gripping device.

Referring now to FIG. 4, the self-gripping device of the invention is preferably formed from an integral structure having base 20 and a plurality of substantially parallel ribs 22 which have a cross-sectional shape or profile which defines gripping elements suitable for cooperative self-gripping engagement according to the invention. The ribs 22 in FIG. 4 have a profile corresponding to the gripping element of FIG. 1a for purposes of illustration. It is also possible to position ribs 22 to produce a structure wherein adjacent elements cooperate for self-gripping engagement such as shown in FIG. 2.

The ribs 22 are cut into spaced apart gripping elements 10 by removing portions of the rib as shown in FIG. 5 wherein the rib can be cut at a 90° angle relative to the base and portions 24 removed to form perpendicular gripping elements or it can be cut at an angle and portions 26 removed to form angled gripping elements 10 also as shown in FIG. 5. In addition, angled or pointed elements 10 can be formed by cutting and removing wedged shape portions 27 from the ribs 22.

It is also possible to remove segments of the base underlying the portions of the rib to be removed between adjacent gripping elements. For example, in FIG. 6 reference numeral 28 is used to designate square and round perforations through ribs 22 and base 20 which forms spaced apart gripping elements 10 integral with the perforated base 20. The perforations 28 can be in a random or uniform pattern and can be the same or different as illustrated in FIG. 6. In addition, the base 20 can be cut or slit along dotted lines 21 to form strip or patch like self-gripping devices in contrast to the sheet like structure shown in FIG. 4.

As shown in FIG. 7a and 7b the ribs 22 can be inclined at an angle to form inclined gripping elements 10 and gripping elements can be formed on both sides of the base 20. Also shown in FIG. 7b is the use of conventional gripping elements in combination with the trap type elements of the invention.

Suitable apparatus for forming the integral structure shown in FIG. 4 is illustrated in FIG. 8 and includes an extruder 50 provided with an elongated slot type die 52 having an opening 54 which corresponds to the cross-sectional profile of the integral structure to be extruded. Extrudable material is melted and conveyed in the extruder 50 and forced out of the die in a hot plastic state. The ribs 22 may be formed straight as shown or can be formed in a way or zig zag pattern using two-part moving dies as are known in the art. It is also possible to extrude a composite structure using coaxial dies or composite extruding devices as are known in the art. Such a composite structure could include, for example, a first material for the base 20, a second material for the stem 12 and a third material for the gripping means 14. Also shown in FIG. 8 is a rotating cutting wheel 56 which is capable of moving vertically and transversely with respect to ribs 22 to remove portions thereof to form integral gripping elements 10.

Related integral structures, grips, elements formed therefrom and methods and apparatus for forming same are disclosed in my co-pending application Ser. No. 214,871, filed Jan. 3, 1972.

In FIG. 9 a circular structure is illustrated which can be readily extruded and simultaneously or sequentially slit and laid flat to form a sheet or strip like self-gripping device according to the invention.

Integral structures such as shown in FIG. 4 can be formed from materials including metals and plastics. Suitable metals include aluminum and aluminum alloys, copper, copper alloys, iron and the like. Suitable plastics include extrudable thermosetting phenolic compositions and the like and extrudable thermoplastics such as polyethylene, polypropylene, polystyrenes, polycarbonates, polysulfones, nylons and the like.

The term cut includes techniques such as slicing, slitting, stamping, punching and the like. It is also possible to chemically or electrically cut an extruded structure to form the spaced apart gripping elements using etching electric arc techniques and the like.

The self-gripping devices are adapted to penetrate and become lodged in a receiving material or layer which can be formed from a variety of materials including woven, non-woven, and knitted fabrics and fibers, carpets and carpet-like materials, foam rubber and plastics, wood, cork, sponge, leather, paper, cardboard, corrugated carboard, metal and plastic mesh, expanded and perforated sheet materials and composites and laminates including any of the foregoing. The gripping trap of the invention is especially suited for gripping fibrous materials.

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 now abandoned, and Ser. No. 154,589, filed June 18, 1971, now abandoned.

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 material that comes into self-gripping engagement with the gripping elements. For example, the gripping elements may be rigid to provide more permanent or tenacious self-gripping action or they may be resilient to facilitate removal from a receiving layer. The degree of self-gripping also depends in part upon the shape of the gripping elements.

In its simplest form the self-gripping device of the invention can include a base 20 having upright cooperating elements 11 and 12 stiffly attached thereto. The member 12 is provided with a self-gripping detent or protrusion 14 which cooperates with the generally linear element 11 for self-gripping engagement at 40. Stated differently, the self-gripping means 14 is oriented in the direction of the other member or element 11 thus making it possible to cooperatively self-grip at 40 as shown. The cooperating elements of FIG. 10 can be formed from a common stem as in FIG. 1 or they can be individually attached to a base as shown in FIG. 10. The gripping means 14 shown in FIG. 10 can have any of the configurations shown in FIGS. 1 and 2 including combinations thereto.

FIG. 11 illustrates an embodiment wherein a filament such as metal wire is stretched or otherwise inserted in or through the base 20 to form heart-shaped configurations which are cut as indicated by the dotted lines to form a gripping trap according to the invention wherein adjacent members 12' cooperate for self-gripping engagement at 40. The members 12 can be formed in pairs by bending a linear element into the heart-shaped configuration shown and inserting the lower ends thereof into the base 20 or otherwise attaching same thereto. It is also possible to utilize other configurations which when cut will form cooperating gripping elements 12'. For example, a linear element such as a wire

can be looped once or more times in place of the upper portion of the heart-shaped configuration and cut horizontally or vertically to form the cooperating gripping elements. The loop 66 when cut horizontally, or vertically provides cooperating elements which physically overlap lending a spring action to the cooperating self-gripping capability.

Thus, the self-gripping device of the invention incorporating the embodiment of FIG. 11 have groups of gripping elements 12' with gripping means 14 which cooperate for self-gripping engagement at 40. The gripping elements 12' have their origin in loops stiffly attached to the base 20 having a depression 64 or a curl 66 oriented interiorly of the loop as shown. In other words the depression 64 and the curl 66 extend downward from the upper lobe portion 62 of the respective loops towards the base 20. The loops are severed or separated horizontally or vertically at the depression 64 or the curl 66 forming the gripping elements 12'. In a preferred embodiment a plurality or series of the loops have their origin in a common linear member 60 which as previously described can be stitched into or through the base.

The cooperating groups of gripping elements shown in FIG. 11 can be made according to the invention by stiffly mounting a plurality of loops to a base in the generally upright position. Each of the loops is formed before or after mounting on the base with a depression 64 or curl 66 oriented as described above. The depressions or curls are cut vertically or horizontally as indicated by the dotted lines in FIG. 11 thereby forming groups of cooperating gripping elements 12' having gripping means 14 oriented towards each other for cooperative self-gripping engagement at 40.

The cooperating self-gripping device shown in FIG. 11 can be made from monofilament or yarn made of metal or plastic wire and installed continuously or individually as described above. A linear element can be embedded in the base or stretched through using conventional sewing techniques. The further linear element 30 can be inserted on the opposite side of the base through loops protruding therefrom as shown to prevent the cooperating gripping elements from being pulled from the base. The cooperating gripping elements shown in FIG. 11 can be fused into or onto the base and can be surface mounted using adhesive, welding, and like techniques. In this embodiment, the base 20 can be a fabric which can be rigid or flexible or made rigid after installing the linear looped arrangement as shown in FIG. 11. The base 20 can also be made of a plastic or elastomeric sheet material or it can form the outer surface or skin of an article.

The gripping elements of the self-gripping devices of the invention will generally range in height from about 0.001 to about 0.75 inch.

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 clad materials, panels, tiles, sheets, filters, decorative trim and the like.

What is claimed is:

1. Method for making a self gripping device which comprises stiffly mounting a plurality of loops to a base in generally upright position, said loops having a curl

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interiorly oriented with respect to said loop, horizontally severing said curls relative to said base thereby forming pairs of overlapping, cooperating gripping elements.

2. Process of claim 1 wherein a plurality of said loops 5

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have their origin in a common linear member.

3. Process of claim 2 wherein said linear member is stitched into or through said base.

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