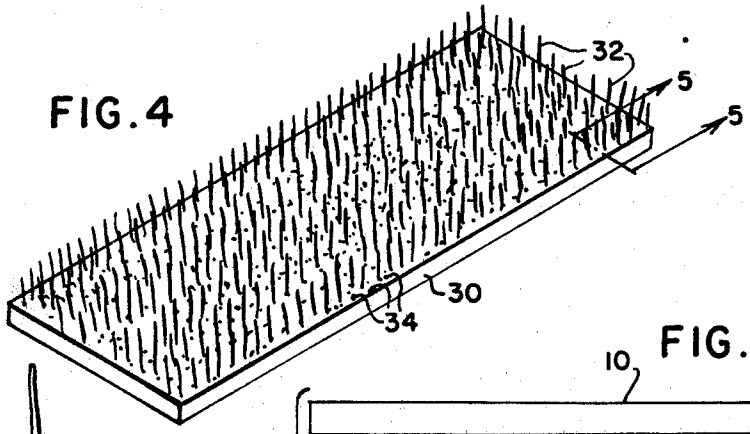
March 3, 1970 G. C. BRUMLIK 3,497,925

SELF-GRIPPING FASTENING ASSEMBLY

Filed July 31, 1967

FIG. 4



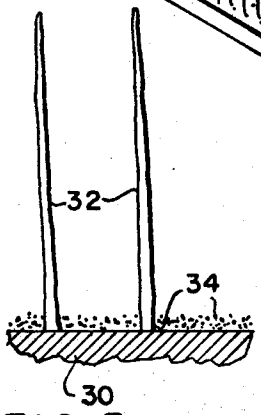


FIG. 5

FIG. 1

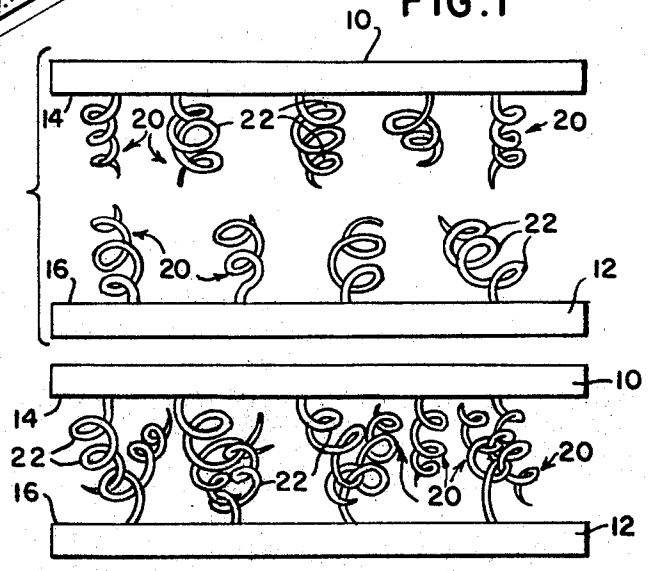


FIG. 2

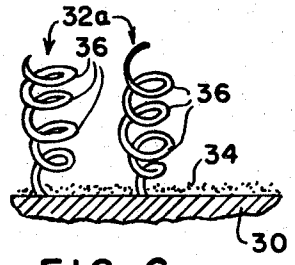


FIG. 6

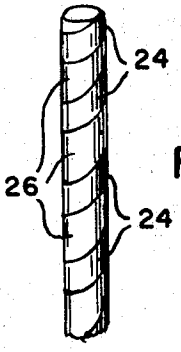


FIG. 3

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SELF-GRIPPING FASTENING ASSEMBLY

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ABSTRACT OF THE DISCLOSURE

A self-gripping fastening assembly consisting of a plurality of flexible fastening elements of helical shape secured to the surfaces of articles to be fastened together, with the fastening elements extending substantially perpendicularly from the surfaces of the articles and the helical turns thereof arranged to mesh and interlock when the surfaces of the articles are brought together. The helical fastening elements may be formed by the method of extruding filaments of two different plastics having different coefficients of expansion, blowing the filaments in straight form upon the surface of the article and thereafter treating the filaments to cause them to curl into helical form.

The present invention relates to fastening devices, and in particular to a novel and improved self-gripping fastening assembly for removably attaching a pair of articles, and to a method of forming such assembly.

A self-gripping fastening assembly is presently available on the market, and is sold under the trademark "Velcro." This product is normally used for releasably attaching fabrics to each other, and is available in the form of pairs of fabric strips which are sewn to the articles to be attached together. On one of the strips there is provided closely-spaced rows of tiny plastic loops upstanding from the strip, while on the other strip there is provided matching rows of tiny plastic hooks. When these strips are pressed together, the hooks on one strip engage and grip the loops on the other strip to secure the strips and the attached fabric tightly together.

While such "Velcro" fastening assemblies provide extremely effective gripping action, the manufacture thereof is costly and the product itself is expensive. In addition, since the gripping elements must be mounted upon fabric strips and supplied in this form, their use has been restricted essentially to fabrics since attachment of the fabric strips to solid or rigid articles, particularly to three dimensional curved surfaces, is difficult if not impossible.

It is an object of the present invention to provide a self-gripping fastening assembly which will couple a pair of articles firmly together, and which can be applied directly to the surface of any article.

Another object of the invention is the provision of a method of making a fastening assembly of the character described which includes a relatively few simple steps, providing an inexpensive manufacturing operation and a product which may be made available economically.

A further object of the invention is the provision of a fastening assembly of the character described which may be applied to solid and rigid articles as well as to fabrics or flexible sheet materials. A feature of the invention is that the fastening elements are identical on both of the article surfaces to be fastened together, so that, unlike conventional fasteners, it is not necessary to match one type of fastener element to a different type of fastener element.

In accordance with the invention there is provided self-

gripping fastening means for connecting together a pair of articles, the fastening means comprising a plurality of fastening elements secured to at least one surface of each of said pair of articles, each fastening element comprising a helically-formed filament secured at one end to a respective article surface and projecting substantially perpendicularly therefrom, each element having a plurality of helical convolutions arranged substantially parallel to the surface upon which said article is mounted and arranged to mesh and interlock with corresponding helical convolutions of a fastening element mounted on the other article when the article surfaces are brought into confronting engagement.

The invention also contemplates a method for forming the fastening elements which comprises the formation of small straight filaments, blowing the filaments upon a tacky surface area of each article, and then treating the filaments to cause each filament to curl into spiral form.

Additional objects and advantages of the invention will become apparent during the course of the following specification when taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevational view of a pair of articles mounting helical fastening elements made in accordance with the present invention, the articles being shown in separated condition;

FIG. 2 is a side elevational view similar to FIG. 1, but showing the articles fastened together;

FIG. 3 is an enlarged perspective view of a helically-extruded plastic filament used to form the fastening elements of the invention;

FIG. 4 is a perspective view of an article having secured thereto a plurality of filament lengths in straight form prior to curling treatment of the latter;

FIG. 5 is an enlarged section taken along line **5—5** of FIG. 4 and showing the filament lengths in straight form; and

FIG. 6 is an enlarged section similar to FIG. 5, but showing the filaments in helical form after treatment thereof.

Referring in detail to the drawings, there is shown in FIG. 1 a pair of articles **10** and **12** to which have been applied fastening means in accordance with the present invention. The articles **10** and **12** are intended to be releasably secured to each other with their opposed surfaces **14** and **16** in abutment. For this purpose each of the surfaces **14** and **16** are covered with a plurality of fastening elements **20**.

Each of the fastening elements **20** comprises a length of plastic, metal, glass or similar material arranged in helical form and secured at one end to the respective surface **14** and **16** with the axis of the element disposed substantially perpendicularly to said surface. The diameter of each element **20** is relatively small compared to its length, and the element is made of a material which, in such small diameter size, will be substantially flexible. In the helical form, as shown, each element **20** has one or a plurality of turns **22** which are disposed substantially parallel to the surfaces **14** and **16** on which the element is mounted.

To fasten together the articles **10** and **12**, the latter are merely brought together with their surfaces **14** and **16** facing each other until the element **20**, on each surface engage. The articles **10** and **12** are then given a slight rubbing motion in a lateral direction, causing the elements **20** on the opposed articles to mesh with each other and grip together. Since the elements **20** are substantially flexible, the turns **22** of one set of elements will interleave with the

turns 22 of the other set of elements, in the manner shown in FIG. 2, and will link or otherwise lock frictionally together.

The size of the fastening elements 20, the number of elements employed, and the spacing of the elements will be determined by the size and nature of the articles to be fastened together. In its preferred form, the fastening means is employed to couple together small articles such as three dimensional model parts, flexible or rigid sheet material and the like, in which case the fastening elements 20 are made in small, filament-like form, and a large number of these elements are closely spaced in random arrangement over the opposed surfaces of the articles to be fastened together. The articles are thus firmly locked together by the total gripping action of the large volume of tangled fastening elements.

In its preferred commercial form wherein the fastening elements 20 are made of plastic, the fastening means of the invention is made and applied in accordance with a novel method which will now be described.

Two separate plastic materials are initially employed, having different coefficients of expansion under heat, chemical, or other treatment. Such materials are well known to those skilled in the art. These materials are fed separately and kept segregated within a plastic extruding machine, and are extruded together. The extruding machine has an outlet cavity which is spiral and is arranged in the usual manner to produce a helical extrusion. In this instance, as shown in FIG. 3 the two extruded plastic materials 24 and 26 form the composite extruded helical filament 28, with the spiral turns of one material 24 alternating with the spiral turns of the other filament 26 in barber pole fashion.

The filament 28 is extruded in continuous form and, after setting, is chopped or cut into small lengths, for example lengths of ¼ inch or ½ inch. These lengths are loaded into a blowing machine and are blown by a jet of air onto the surface of the articles to be attached together, in the manner of flocking. FIGS. 4 and 5 show a flat article 30 upon which a plurality of short filament lengths 32 have been applied by air blowing. For attachment of the filament lengths, a layer of gum or adhesive 34 is first applied to the article 30 to provide a tacky surface. The short filament lengths 32 are blown toward this surface in such a manner that they will strike substantially perpendicularly, one end of each filament length becoming embedded in the tacky layer 34, as shown in FIG. 5. The filament lengths may be electrostatically deposited or flocked upon the article 30 to insure perpendicular mounting thereof, and are preferably applied at random and closely spaced from each other. The gum or adhesive is allowed to dry to secure the filament lengths 32 permanently in mounted position, secured at one end to the article 30 and upstanding therefrom.

It will be appreciated that if the article 30 is made of plastic, its surface may be heated or othewise treated to render it tacky, in which case the use of a separate gum or adhesive layer can be omitted, but the same result achieved.

After the straight filament lengths 30 are permanently set in mounted position, they are subjected to heat, preferably in the form of superheated steam. Because of the different coefficients of expansion of the two plastic materials constituting the filament lengths, each filament length 32 will curl, and take the form shown at 32*a* in FIG. 6. That is to say, each filament length will form itself into a series of helical convolutions 36. These helical turns 36 provide the gripping action between a pair of articles in the manner previously described.

By way of example, the filament 28 may be made of two types of nylon having different coefficients of thermal expansion. When the helically-extruded filament is subjected to rapid heating, i.e., by a blast of superheated steam, the filament will curl into helical form. The curl may then be set by the application of a blast of supercooled gas such as nitrogen.

The filament may also be made of plastics which will expand or contract at different rates under chemical or ultraviolet treatment. For example, the filament 30 may be made of two types of polyolefins, one fully saturated and the other containing double bonds. Under radiation of ultraviolet light, cross-linking will occur in the unsaturated material, causing an increase in density accompanied by shrinkage of the material to provide the curling effect.

The method described above may be used to cover the entire surface of an article with fastening elements, or to cover a selected portion of the article surface, depending upon the extent of the tacky layer applied. The method is particularly useful in covering a three dimensional curved surface of an object, which could not be done readily with conventional fastening means. Where the fastening elements are applied by air blowing in thick profusion, the attached articles will adhere tightly together because of the gripping action between the large number of closely-spaced fastening elements. To release the articles from locking engagement, it is necessary to peel one from the other under the application of considerable force.

It will be appreciated that the fastening means described above will have a wide range of use in providing secure and removable fastenings for rigid and solid articles such as in toy construction kits, for fabrics and flexible plastic sheeting in replacing slide fasteners, snap fasteners and the like, and in a variety of other fields. By the use of suitable gums, adhesives or other tacky substances, the looped wire lengths can be readily applied directly to any pair of objects which are to be coupled, and the looped elements can be applied either to the entire surfaces of the objects or to selected areas on the surfaces. Even inflated bodies may be treated in this manner.

A particular advantage of the fastening arrangement described above, is that the elements on each article to be attached are identical. This provides the fastening means with a greater range of utility than the "Velcro" type fastening in which one article carries loop elements and the other article carries hook elements. In securing together toy building blocks in staked relationship, for example, the blocks can be attached to adjacent blocks at all sides without the necessity for matching one type of fastening element with a different fastening element.

While preferred embodiments of the invention have been shown and described herein, it is obvious that numerous omissions, changes and additions may be made in such embodiments without departing from the spirit and scope of the invention.

What is claimed is:

1. A self-gripping fastening assembly for releasably connecting together a pair of articles, said fastening assembly comprising a plurality of flexible fastening elements secured to at least one surface of each of said articles, each fastening element comprising a single helically-formed flexible filament mounted at one end on said surface of one of said articles and projecting substantially perpendicularly therefrom, the mounting portion of each filament being substantially spaced from the mounting portion of the other filaments, each fastening element having at least one helical convolution disposed substantially parallel to the surface upon which said element is mounted and being spaced laterally from the convolutions of adjacent elements, the convolutions on each filament being spaced apart sufficiently to receive the filaments of the opposite article when the surfaces of the articles are brought into confronting engagement, the helical convolutions of the fastening elements on one article being arranged to releasably mesh and interlock with helical convolutions of the fastening elements on the other article in said confronting engagement.

2. A fastening assembly according to claim 1 in which said fastening elements are mounted at random on said article surfaces and are closely spaced from each other.

3. A fastening assembly according to claim 1 in which each of said fastening elements is made of plastic.

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U.S. Cl. X.R.

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