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 [73] Assignee **American Velcro Inc.**

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[54] **METHOD FOR MAKING FLEXIBLE STRIPS OF MATERIAL HAVING ON ONE SURFACE THEREOF A PILE OF UPSTANDING HOOKING ELEMENTS**
 5 Claims, 6 Drawing Figs.

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 [51] Int. Cl. **B32b 3/06,**
 B32b 7/06
 [50] Field of Search 156/196,
 435; 161/48, 51, 52, 63, 64, 65, 66, 67, 140;
 24/DIG. 18; 128/DIG. 15

[56] **References Cited**

UNITED STATES PATENTS

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ABSTRACT: A method is disclosed for producing the hooked surface of a hook- and loop-type fastener by treating a starting fabric material having a pile of upstanding threads. The treatment comprises impregnating the threads and pile with a liquid plastic monomer having the capability of being converted by the application thereto of a suitable form of energy to a flexible solid, applying heat or other suitable form of energy to the underside of the starting material to set the lower portion of the threads into a relatively permanent and stiffened shape and then subjecting the other side of said starting material simultaneously to a pressure and heat or other suitable form of energy to bend and set the upper portions of the threads into the form of hooking elements.

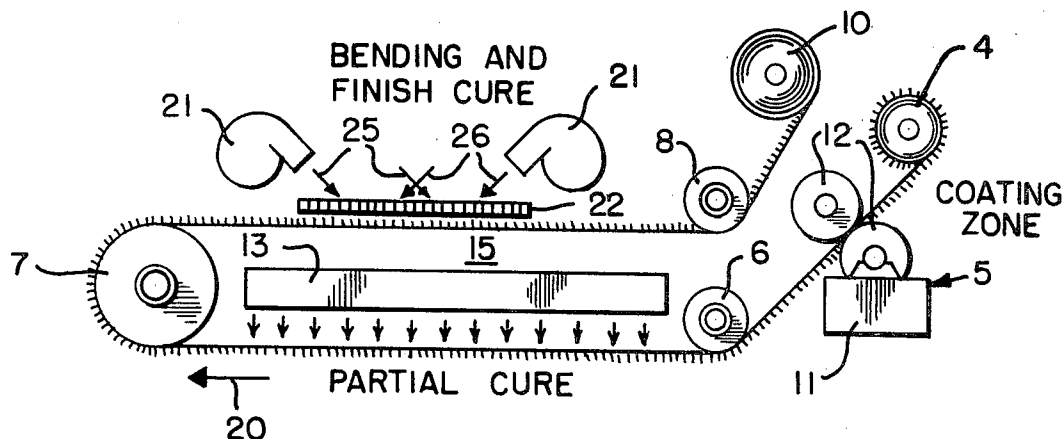


FIG. 1

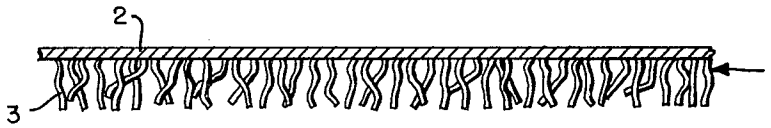
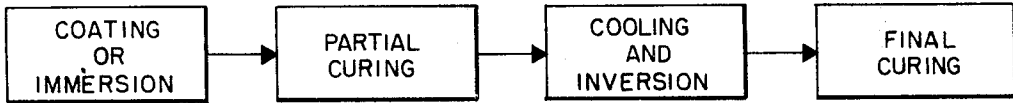


FIG. 2

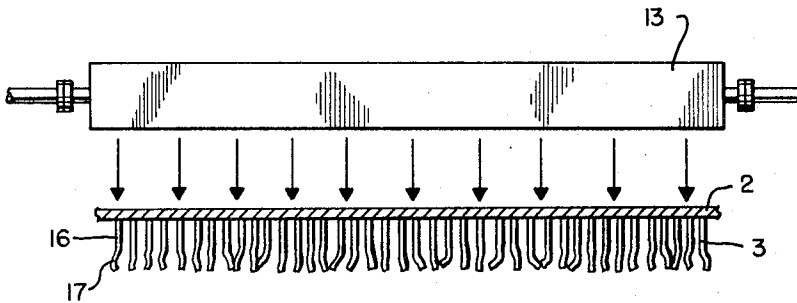


FIG. 3

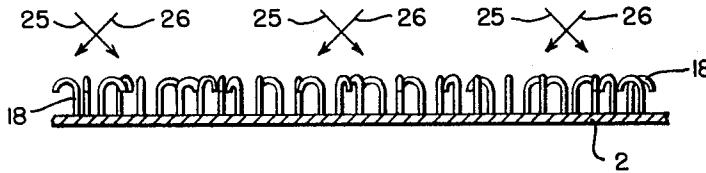


FIG. 4

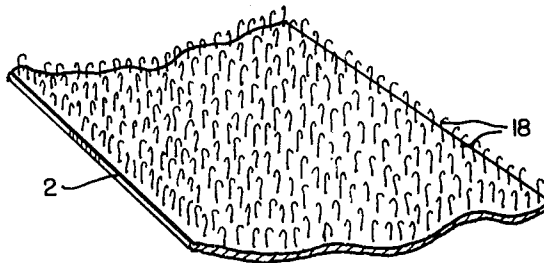
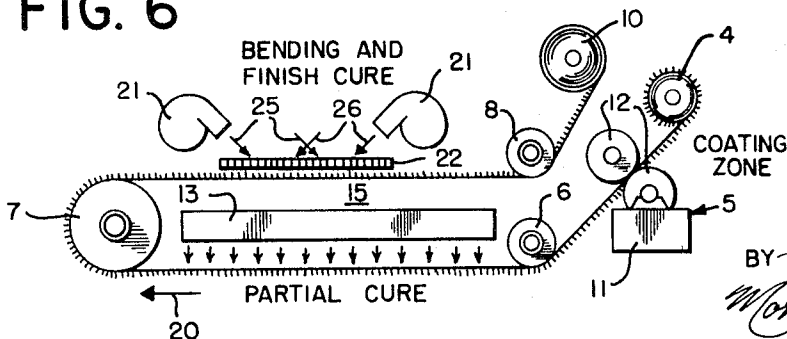


FIG. 5

FIG. 6



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METHOD FOR MAKING FLEXIBLE STRIPS OF MATERIAL HAVING ON ONE SURFACE THEREOF A PILE OF UPSTANDING HOOKING ELEMENTS

FIELD OF THE INVENTION

This invention relates to a method and apparatus for forming hooking elements from an upstanding pile of threads.

BACKGROUND OF THE INVENTION

Separable fastening devices of the prior art are generally made up of two layers of flexible material, each layer being in the form of a band or tape having on opposite faces thereof surfaces provided with a multiplicity of small interengaging means which protrude outward therefrom forming opposed pilelike fabrics. By preference, the interengaging surfaces are those incorporated in fasteners described in U.S. Pat. No. 3,009,235 wherein one surface includes a multiplicity of small outwardly projecting loops of thin filamentary material and the other surface is provided with a multiplicity of curled or hooklike resilient projections.

It will be understood that when two layers of this type are pressed into face-to-face contact, their respective hooking elements and loops interengage one with the other thereby securing said layers into locking engagement. Separation of the two layers requires a force of considerable magnitude when attempting to effect the separation of a large number of hooking elements and loops at once, but separation may be quite readily effected by progressively peeling the layers apart.

Fasteners constructed with interlocking hooking element and loop members of the type described find a wide variety of applications. For instance, they can be substituted for existing closing devices such as buttons, buckles, clasps, slidable fasteners of the type popularly termed zippers, or like attachments which are currently used in many diverse types of wearing apparel. In addition, they serve a useful function in many particular environments where it is desired to fasten one object to another in a quick and efficient manner.

The most common method until the present has been to form the hooking elements by subjecting loops to the cutting action of a device consisting of a comb of tapered needles having mounted thereon small rapidly reciprocating scissorslike cutters which clip each loop at a predetermined point thereby resulting in a hooking element and stub formation. Among hooking elements produced by existing methods uncut or partially cut loops are sometimes found intermixed with the cut loops. The presence of such uncut loop is a function of the extremely thin sectional mass and resilient nature of the loops whereby they offer little resistance and therefore can be pushed out of alignment and avoid the cutting operation.

It is a principle object of this invention to provide upstanding a multiplicity of hooking elements which are randomly oriented and which avoid many of the difficulties inherent in the product.

SUMMARY OF THE INVENTION

The method contemplated by this invention consists essentially of providing a length of flexible material with a pile of upstanding threads which are adapted to become permanently shaped upon being impregnated with a liquid plastic monomer which can be converted by heat, for example, or other forms of energy to a flexible solid. The lower portion of the pile is then heat set into a relatively rigid configuration after which the uncured upper portions of said threads are subjected simultaneously to pressure and heat to bend the threads into hooks extending randomly in all directions and heat setting the upper portions into relatively permanent hook shapes. More particularly, pressure and heat are applied by a controlled flow of gaseous or liquid material whose temperature is sufficient to accomplish heat setting.

It will be appreciated that hooking elements formed by this method assume open hook configurations without the stubs commonly found in hooking elements made by cutting loops. Also, the controlled flow of gaseous or liquid material insured

that the hooking elements will be subjected to pressure in a variety of different directions thereby resulting in ultimate hooks which extend in random directions and so have a greater probability of interengagement with mating looped elements.

Other advantages and novel features of this invention which have not been heretofore described will become apparent from a reading of the following detailed description taken in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram showing the various steps of the method herein described;

FIGS. 2, 3 and 4 are elevational views of the starting material showing in sequence the various steps of the method of this invention;

FIG. 5 is an isometric view of the finished product produced by the method of the invention; and

FIG. 6 is a composite elevational view of a suitable apparatus for carrying out the method of this invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring initially to FIG. 2, it will be seen that the starting material 1 is a length of flexible material comprising a foundation 2 in which is securely anchored a pile of upstanding threads 3 arranged in random fashion over the surface of said foundation in such a manner as to form a unitary structure with the latter. Any one of many commercially available pile fabrics of the type described may be used as the starting material. For instance, upstanding threads made of cotton or one of the synthetic textiles can be used, the choice being determined by the absorbability of the pile and by the ultimate strength desired between the hook and loop engaging surfaces of the separable fastener. In other words, the yield strength of the upstanding threads 3 and foundation 2 should be greater than the greatest possible force to which the separable fastener may be subjected thereby insuring that the pile threads 3 or foundation 2 will not break and that the threads 3 will not rupture out of their anchored position in the foundation 2.

The starting material 1 is to be supplied on a reel 4 such as that shown in FIG. 6 and is directed past an impregnating means 5 and then fed around rollers 6, 7 and 8 in the manner indicated in FIG. 6 whereby the pile threads are upstanding from that surface on the starting material which is not in contact with said rollers, and ultimately wound on takeoff spool 10.

The starting material 1 is driven in the direction of arrow 20 by any suitable means (not shown) thereby following the winding path defined by said rollers. As the starting material proceeds around said path, it will successively pass through the various processing zones in each of which a step of the method contemplated by this invention is performed. It should be noted that the apparatus shown in the drawings for accomplishing the method of this invention is not, in any way, to be construed as limited to the specific apparatus therein shown. But rather, the specific apparatus depicted in the drawings is included for purposes of illustration only, and accordingly, any other suitable apparatus may be provided without departing from the spirit of this invention.

The impregnating means 11 is shown diagrammatically as constituting a tank and squeeze rollers 12 suitable for applying liquid material to the pile threads. The liquid material should be sufficiently low in viscosity to impregnate the pile threads 3 while, at the same time, be adapted to later become rigid upon subjection to a suitable heat treatment. Suitable impregnating liquids for this purpose consist of any of the well-known thermosetting substances such as epoxy resins, melamine resins, nylon monomer, plastisol or an appropriate thermal-setting polyvinyl resin.

After impregnation with the resins the starting material continues to travel in the direction of arrow 20 around roller 6

and enters the heating zone indicated generally at 15 in which is stationed an appropriate heat source 13 positioned above the starting material. The heat source 13 can be of any suitable type which will direct a flow of heat downward into contact with that side of the foundation material opposite to the side carrying the pile threads 3. It will be understood that the invention contemplates using various forms of energy such as radiation energy, for example, to convert the liquid impregnant to a flexible solid.

The speed at which the starting material travels is such that any given portion of the starting material will be subjected to heat for a predetermined precise period of time. It will be appreciated that this arrangement will permit the heat generated by the heat source 13 to penetrate the underside of the foundation material 2 and become transmitted gradually by conduction to the pile threads 3 so as to cure only a portion at a time of each thread, starting of course with the portion of each thread located immediately adjacent to the foundation material and proceeding downward to each consecutive portion of the pile threads. Thus, as shown in FIG. 3, the lower portion 16 of each pile thread is set into a relatively straight configuration while the upper portion 17 of each pile thread remains uncured conforming to its original configuration as shown in FIG. 2.

As the starting material continues its journey in the direction of arrow 20, it will pass around roller 7 during which time it will be allowed to cool thereby setting the lower cured portion 16 of each pile thread 3 into a relatively straight permanent shape. It will be readily apparent that as the starting material proceeds, the roller 7 causes it to be gradually inverted so that the pile threads now project upward in which position they are ready to be formed into hooks.

Because of the inverted position of the starting material, the upper uncured portion 17 of some of the pile threads 3 will fall over under the influence of gravity to form substantially hook-shaped elements 18. For the most part though, the pile threads will remain in a substantially upright position and therefore in order to bend these pile threads into hooks, a controlled flow of air is directed by blowers 21 over the thread in the direction indicated by arrows 25 and 26 of FIG. 4. It will be understood, however, according to the method of the present invention that fluids generally may be used.

The blowers are strategically positioned above the pile threads 3 so that the cross currents of air are set up in a variety of different directions over the surface of the pile threads. The pressure exerted by the air flow is of sufficient magnitude to cause the upper uncured portion 17 of the pile threads 3 to bend over into hook-shaped formations 18 which are best seen in FIGS. 4 and 5. Furthermore, the air or gaseous material is heated to sufficiently high temperature to finish the cure and heat set the upper portion of each pile thread into a relatively permanent hook shape. The heating of the air can be accomplished by any suitable means, such as, for instance, a second heater shown diagrammatically at 22, which communicated with air blowers 21.

After subjection to the controlled flow of hot gaseous material, the starting material, which now has a pile of upstanding hook-shaped elements disposed over the surface thereof, is wound on takeoff spool 10 in which form it can be transported to an appropriate facility for further processing in accordance with its ultimate intended application.

Thus, in summary, it will be seen that the method of this invention produces a flexible strip of material in which are anchored a multiplicity of open, reinforced, flexible hooks 18

which extend randomly in a variety of different directions and which are particularly suitable for use as the hooked member of a separable hook or loop fastener referred to above. Since the planes of the open hooks form angles with each other which vary in accordance with the laws of statistical distribution, it will be apparent that the probability of engagement with loops of the mating member is greatly increased thereby increasing the adhesive strength of the separable fastener with which the strip is intended for use.

While a preferred specific embodiment of the invention has been heretofore described, it is to be clearly understood that various modifications can be made in the details of the invention without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. A method for producing a flexible strip of material in which are anchored a multiplicity of hooking elements from a starting material having a multiplicity of projecting threads, the method comprising impregnating said threads with a liquid plastic monomer, applying heat to that side of said starting material opposite to the side carrying said threads for a period of time sufficient to heat set the lower portion of said threads into a relatively permanent straight configuration, and subjecting the other side of said starting material to a pressure source and heat treatment source to bend the upper portions of said threads into hooks extending randomly in different directions and heat setting said upper portions into relatively permanent hook shapes.

2. A method for producing a flexible strip of material in which are anchored a multiplicity of hook-shaped elements, the method comprising providing a length of flexible material with a multiplicity of upstanding threadlike elements, impregnating said elements with a liquid plastic monomer, applying heat to the underside of said material for a period of time sufficient to heat set the portions of said threads adjacent to said fabric, inverting said material so that said threads assume an upright position and simultaneously cooling said material thereby fixing said lower portions into a relatively rigid straight-lined configuration, subjecting said threads in said upright position simultaneously to a pressure source and heat treatment source bending the upper portion of said threads into hooked shapes extending randomly in different directions and heat setting said upper portions into relatively permanent hook shapes.

3. The method according to claim 1 wherein said pressure source and said heat source is a controlled flow of hot gaseous material.

4. The method according to claim 2 wherein said pressure source and said heat source is a controlled flow of hot fluid material.

5. A method for producing a flexible strip of material in which are anchored a multiplicity of hooking elements from a starting material having a multiplicity of projecting threads, the method comprising impregnating said threads with a liquid substance having the characteristic of becoming flexibly solid upon exposure to a source of energy, exposing the side of said material opposite to the side from which said threads project to an energy source for a period of time sufficient to set the lower portion of said threads into a relatively permanent straight configuration, and subjecting the other side of said starting material to exposure to an energy source and to pressure to bend and to set the upper portion of said threads into hooks.

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