

[54] **METHOD OF SEVERING PILE LOOPS
IN THE PREPARATION OF
SEPARABLE FASTENERS**

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Related U.S. Application Data

[62] Division of Ser. No. 835,204, June 20, 1969, abandoned.
[52] U.S. Cl.**28/76 P, 26/9, 83/15**
[51] Int. Cl.**D06c 13/00**
[58] Field of Search**28/72 P, 74 P, 76 P;**
26/7, 8 R, 8 C, 9; 83/15, 170; 51/322, 323;
69/22

[56] **References Cited**

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[57]

ABSTRACT

A method for uniformly cutting loop-shaped elements upstanding from a foundation sheet by encasing a plurality of filamentary loops in a medium capable of retaining them in a relatively immovable state prior to subjecting portions thereof to a cutting action. In a particular embodiment the loops are cut or milled to form the hook member of a hook and loop type fastener.

8 Claims, 7 Drawing Figures

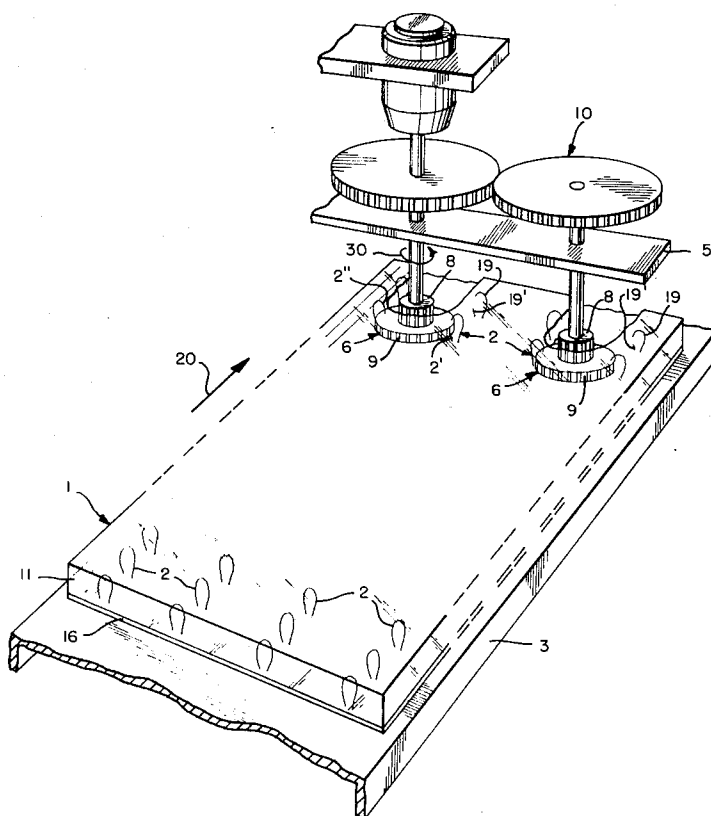


FIG. 1

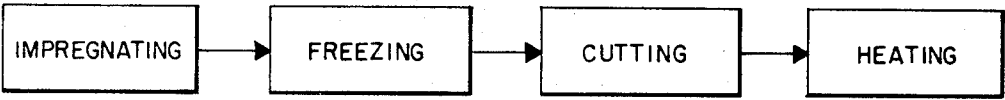


FIG. 2

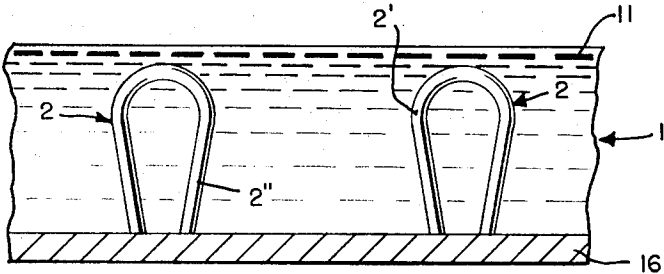


FIG. 3

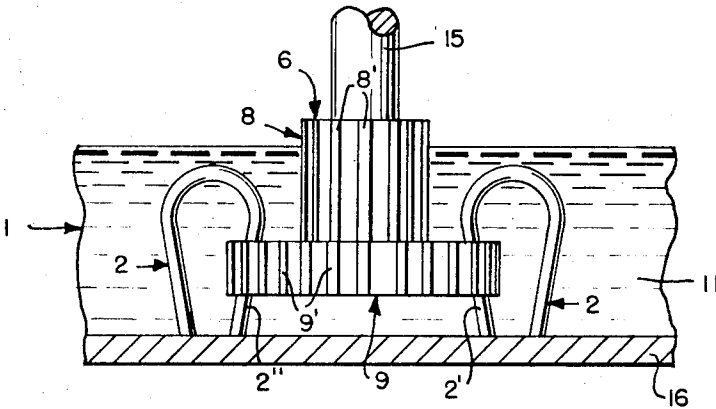
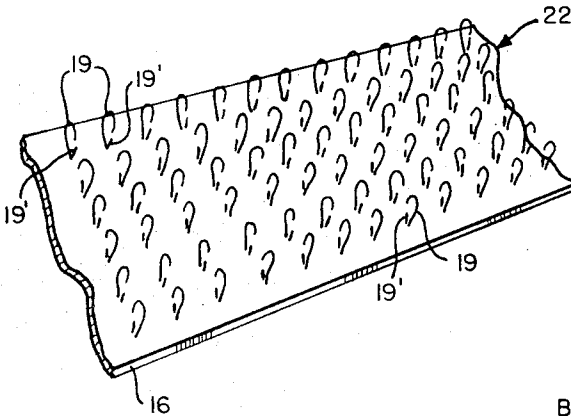


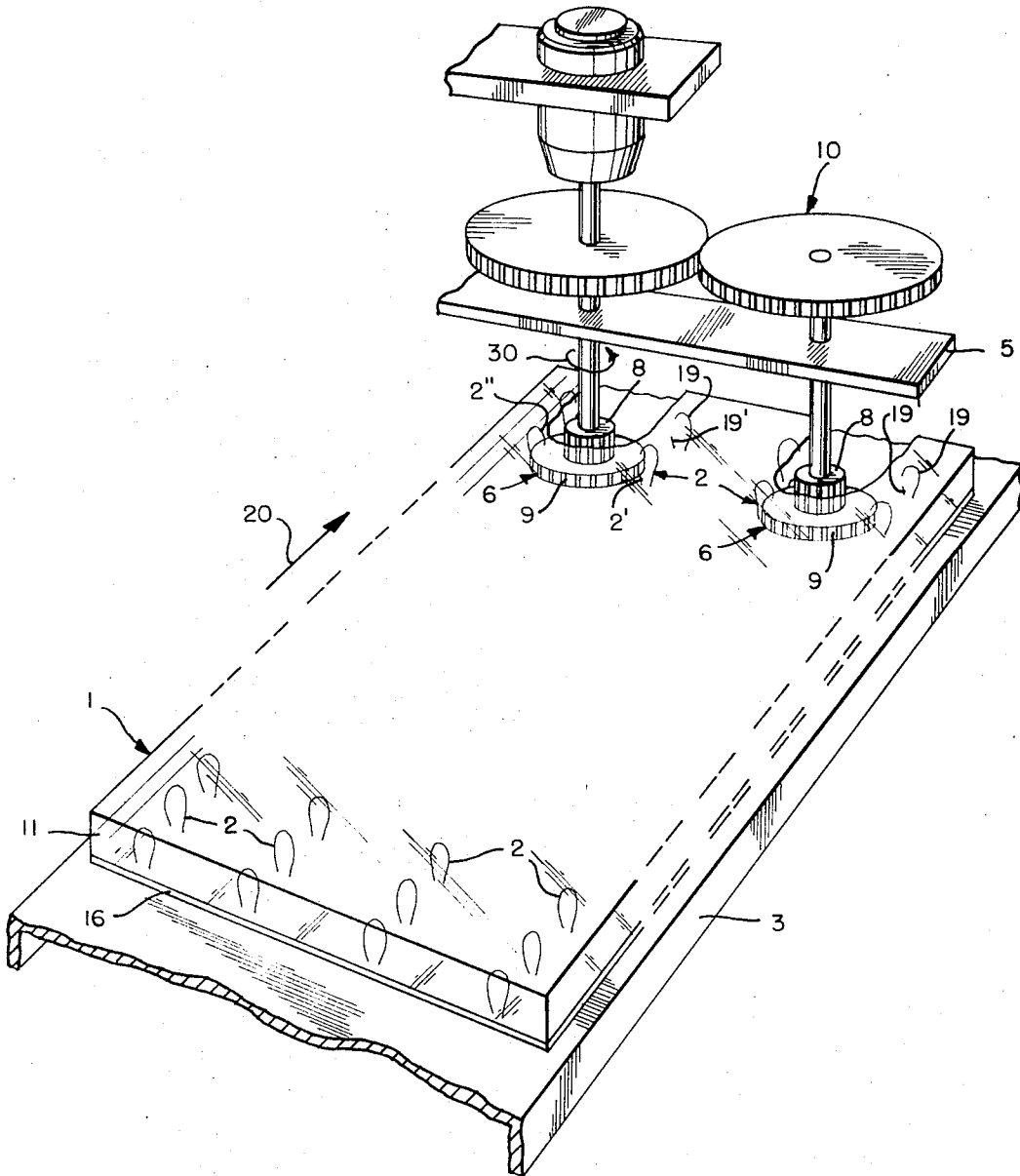
FIG. 4



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FIG. 5



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METHOD OF SEVERING PILE LOOPS IN THE PREPARATION OF SEPARABLE FASTENERS

This is a divisional application of my copending application, Ser. No. 835,204, filed June 20, 1969 and now abandoned

BACKGROUND OF THE INVENTION

Separable fastening devices of the prior art of the type concerned herein are 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 pile-like fabrics. By preference, the interengaging surfaces are those incorporated in fasteners described in U.S. Pats. Nos. 2,717,437 and 3,009,235 wherein one surface includes a multiplicity of small outwardly projecting loops of thick filamentary material and the other surface is provided with a multiplicity of small curled or hook-like projections which have been formed by cutting loops of resilient material secured to a base sheet. For ease in identification, the surface provided with loops will be referred to as the female member and the surface provided with hooks will be referred to as the male member.

It will be understood that when two layers of this type are pressed into face-to-face contact, their respective hooks and loops interengage one within 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 hooks and loops at once, but separation may be quite readily effected by progressively peeling the layers apart.

Fasteners constructed with interlocking hooks and loops of type described find a wide variety of applications. For instance, they can be substituted for existing fastening devices such as buttons, buckles, 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.

In the past, the hooked member of these fasteners has been formed, for example as described in U.S. Pat. No. 2,933,797, by subjecting a base sheet having a plurality of upstanding resilient loop members to the cutting action of a device consisting of a comb of tapered needles having mounted thereon small rapidly reciprocating scissor-like cutters which clip each loop at a predetermined point thereby resulting in a hook and stub formation which, due to the resilient nature of the loops, to a great extent resembles a snap hook configuration.

One problem in maintaining the quality in existing hook members is to make very certain that there are not a large number of uncut resilient loops found to be intermixed with the cut loops. It will be appreciated that uncut loops effectively reduce the engaging force between the hook and loop members in direct proportion to the number of such uncut loops. These uncut loops result from the fact that present cutting devices of the type described above fail to take into account that, because of the extremely thin sectional mass and resilient nature of these loops, a certain percentage of these loops tend to become misaligned thereby avoiding the cutting operation entirely, or, in some cases, re-

sulting in loops which are partially cut or hooks which are cut on a skew. It will be appreciated that the existence of these defective hooks inhibits the effectiveness of the separable fasteners to which they are intended to be applied.

It is sometimes advantageous to form the hooking element by removing a segment of one leg of each resilient loop instead of by merely cutting through the leg, thereby reducing the length of the remaining stub to such an extent that a rather wide gap is produced between the summit of the hook and the end of the stub. In such an arrangement, the probability of interengagement between the open hooks and the filamentary loops is excellent. However, by providing the resilient loops with an inherent tendency to twist, cutting of one leg of each resilient loop by a knife blade will also produce excellent results, since the newly formed hook will thereafter twist out of alignment with the stub portion.

It is a principal object of this invention to provide a method for producing the male member of the type described from any starting resilient loop material irrespective of the particular material used or the method in which the material has been made.

Another object of the invention is to replace cutting devices of the prior art with a new and useful cutting apparatus which efficiently transforms every loop into a hook and stub formation, of the type described, and wherein virtually 100 percent cutting is insured.

Although the invention is described in connection with the formation of hooks for loop fasteners, it will be understood that the invention can have broader application in the field of cutting pile materials generally, for example in the contour cutting of rugs.

SUMMARY OF THE INVENTION

The subject matter of this invention is directed in a particular embodiment thereof to an improved method and apparatus for making a flexible strip of material in which are anchored a multiplicity of small, thin outwardly projecting hooks, the strip being suitable for use as the hook member of a separable fastener which is readily engageable with the opposed face of a loop member, the surface of which is provided with a multiplicity of loops projecting outward from the surface thereof. In accordance with the invention, and a particular embodiment thereof, a length of flexible base material having a multiplicity of resilient loops in spaced apart parallel rows is first encapsulated in a solid or semi-solid material whereupon the encapsulating material surrounding each loop is subjected to the action of cutters arrayed across the path of travel of the base material thereby exposing one leg of each loop at a selective cross-section to one of the cutters. The exposed section of each loop is then cut through by the continuing action of said cutter, which due to its position between each pair of loops simultaneously cuts through the exposed section of two opposed loops. Each adjacent pair of opposed loops is at the same time subjected to similar action of another cutter. As the field of encapsulated loops passes against the cutters, each succeeding pair of loops in the rows will, in sequence, be cut in the manner indicated above thereby uniformly transforming every loop into a hook and stub. Finally, the encapsulating material is removed from the hook and stub formation leaving a composite tape consisting

of a flexible strip of material having embedded therein a multiplicity of upstanding hooks.

It will be readily apparent that encapsulating each loop-shaped element in a solid or semi-solid material virtually insures that no loop will escape the cutting action of the rotary cutters. That this is true is due to the fact that each loop is effectively prevented from being pushed aside because it is firmly held in place by the encapsulating material. Thus, it will be seen that the cutters act against a virtually solid backdrop fashioned by the encapsulation material. The filamentary material selected for encapsulation may be nylon, for example and may be stretched by expansion when encapsulated in a material such as ice. Furthermore in addition to stretching of the nylon caused by the expansion of the encapsulating ice during its formation, nylon becomes even more brittle when cold and becomes "notch-sensitive" when stretched, i.e., able to be severed very easily.

Other advantages and novel features of this invention which have not been heretofore described will in part be stated and in part become apparent in the following detailed description taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

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

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

FIG. 4 is an isometric view of a composite tape produced by the method of this invention;

FIG. 5 is a composite isometric view of a suitable apparatus for carrying out the method of this invention;

FIG. 6 is a plan view of an alternate cutter having a tapered knife edge; and

FIG. 7 is a cross-sectional view taken along lines 7-7 of FIG. 6

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A starting material 1 is best seen in FIG. 2 and comprises a foundation sheet 16 of flexible material having secured thereto a multiplicity of loops 2 arranged in parallel spaced apart rows and upstanding from one surface of said foundation sheet 16. The loops 2 are secured to the foundation sheet 16 in any suitable fashion depending on the particular type of foundation material used. The foundation material may for instance be constituted of a continuous band, film, or plate of synthetic material, the surface of which has embedded therein parallel rows of loops which may be made up of the same or different material. Alternately, the foundation material may consist of a flexible fabric having a number of firmly woven weft and warp strands, in which case the loops can be formed by supplemental warp strands which have been interwoven between the primary warp and weft strands. In the embodiment of the invention shown in the drawings, the loops are made of a monofilament material such as nylon.

It should be pointed out here that the most common form of the hook and loop members of the separable fasteners referred to above is to have the loops 2, which ultimately will form hooks 19, constituted of a thermoplastic material, which when subjected to a suitable treatment, say, a heat or chemical treatment, become

fixed into a relatively permanent shape. Such materials include among others those of the monofilament or multifilament variety or a fibrous materials which has been impregnated with a suitable heat settable resin. However, depending upon the particular sphere of use to which the separable fasteners is to be applied, the loops 2 as well as the foundation material may be constructed of other material such as metal wires, textile strands, etc., all of which may retain a relatively permanent shape wholly apart from any heat setting or chemical treatment.

In any case, irrespective of the process utilized to form the loops and irrespective of the particular material used to form either the loops 2 or foundation sheet 16, the first step of the method herein disclosed for producing the male member of a separable fastener consists of encapsulating the pile of loops 2 in a solid or semi-solid material 11. Experimentation has indicated that ordinary water frozen into ice forms a particularly effective encapsulating medium. Thus, the preferred embodiment of the invention contemplates a foundation material having a pile of upstanding loops which is buried inside a thin coating of ice. The encapsulating ice is the most advantageously formed by spraying the pile of loops with cold water in a freezing atmosphere. In this ice coated condition, the loop-shaped element are virtually solidified into a an immovable state wherein they cannot be pushed out of the path of the cutters thereby insuring that no loop will escape the cutting operation.

The particular form of the encapsulated medium is not to be considered as limited to ice and accordingly, therefore, may consist of a paste, gel, or other semi-solid material. The important characteristic of the encapsulating medium is that it be of sufficient viscosity to retain the loops in a relatively immovable state. Thus, water to which has been added a thixotropic material has been found to be particularly well suited for this purpose. Furthermore, the term encapsulation should be construed to mean the encapsulation individually of each loop as by spraying or dipping without necessarily having a plurality of loops encapsulated within a single mass.

The method and apparatus of the preferred embodiment of this invention can be best described by reference to FIG. 5 in which is depicted an isometric view of the encapsulated starting material in operative engagement with the cutting apparatus, indicated generally by reference numeral 10. The encapsulated starting material is pulled over slideway 3 at a constant speed in the direction of arrow 20 so that a pile of upstanding loops 2 is on that face of the starting material which is not gliding on the slideway 3. Positioned above the slideway 3 is a stationary support 5 to which is attached in a straight line arrangement a series of rotary cutters 6.

Each cutter 6 is provided with two abutting coaxial cylinders 8 and 9, the circumferential surface of each cylinder being provided with cutting elements 8' and 9' shown diagrammatically in FIG. 3. Alternatively, by way of further example, each rotary cutter may be provided with an appropriate abrasive surface suitable for milling away a segment of one leg of each loop 2.

The diameter of each rotary cutter is slightly greater than the separation between opposed legs 2' and 2'' of the two loops which are to have a segment removed. With this arrangement, those legs which are at any one

time subjected to the cutting action of the rotary cutters will be cut all the way through thus insuring that no loops remain uncut or partially cut. For dependability and durability it has been found that the cutters should be made of cemented carbide or similar material.

The rotary cutters are driven in the direction of arrow 30 at a speed sufficient for cutting through the encapsulated medium 11 and loops 2. The exact rotational speed of the cutters is not critical as long as that speed is sufficient to accomplish cutting of the loops as they are pulled into operative engagement with the cutters.

Hook 19 and 19' formations are formed by drawing the encapsulated pile material into contact with the rotary cutters along the slideway 3 (FIG. 5). Hereby, the encapsulating material between each pair of rows of loops is cut away so as to expose one leg of two opposed loops at selective cross-sections thereof. As the cutters proceed into the pile of encapsulated loops 2, it will be seen that due to the spacing between adjacent cutters in said line, each cutter will rotate between a separate pair of rows of loops thereby directing the cutting surface of each cutter against two loops simultaneously. In this manner, the opposed legs 2' and 2'' and the corresponding legs of each adjacent pair of loops are simultaneously subjected to the cutting action of the line of rotary cutters 6.

As the encapsulated pile material progresses, it will be seen that the leg of one of the loops being cut will be subjected to positive cutting action in the direction of travel while the leg of the other loop being cut will be subjected to positive cutting action in the opposite direction. As the cutting continues, depending on the width of the cutting surface, a segment of each loop being cut equal to said width is removed to leave a hook 19 and stub 19' in spaced apart relationship. Upon further passage of the encapsulated pile material, the next succeeding pair of opposed loops will be brought into operative engagement with the cutters, the cutting action of each cutter being thereby repeated in the manner described above and so on over and over for every succeeding pair of opposed loops. It will be appreciated that each adjacent pair of rows of loops will be subjected to similar cutting action by the other cutters in said line so that virtually the entire pile of loops is transformed into spaced apart hook and stub formations as described above.

It should be noted that when ice is used as the encapsulating medium a certain amount of water will accumulate as the cutting proceeds. This water acts as a natural lubricant and coolant for the rotary cutters thereby further enhancing the utility and dependability of the rotary cutters.

After the desired length of material having said hook and stub formations is formed, the encapsulating material is removed from said formations in any suitable manner thereby leaving the composite tape 22 shown in FIG. 4 consisting of a foundation sheet 16 having a multiplicity of open hooks 19 and stubs 19' in spaced apart relationship projecting outward from the surface thereof. Removal of the encapsulating material 11, when it is in the form of ice, can be best accomplished by exposing it to a suitable amount of heat thereby melting the ice and allowing the water to drain away. The heating can be accomplished by any suitable

means such as by passing the encapsulated pile material through a heating tunnel or oven (not shown) which is equipped with a suitable drain for removal of water formed as a result of melting the ice matrix.

While the preferred embodiment of the invention involving cutting away a portion of one leg of a loop to form a hook and stub element has been described above, it is possible to provide a tapered knife 32 shown in FIG. 6 and 7 having tapered edges 34 in place of the cutting elements 8 and 9 and thereby merely cut through opposing loop legs 2' and 2'' without removing a segment thereof.

As an alternative, a reciprocating bar cutter with either a broad or knife edge can replace the rotary cutter 6 between pairs of loops, or a row of loops can be cut independent of any other by a suitable cutter. Such a reciprocating bar cutter may comprise a tapered knife as shown in FIGS. 6 and 7 driven by a conventional reciprocating drive means. Thus, it is to be clearly understood that various modifications can be made in the details of the invention described herein without departing from the spirit of the invention and the scope of the appended claims.

I claim:

1. An improved method for uniformly cutting loop-shaped elements secured to and upstanding from a foundation sheet, the improvement comprising encapsulating said elements in a material capable of retaining them in a relatively immovable state, cutting through said encapsulating material to expose said elements at a selected cross-section, cutting through said exposed section while said elements remain fixed in said encapsulating material, and removing said encapsulating material from the cut loop-shaped elements.

2. The method of claim 1 wherein the encapsulating material is water in the form of ice.

3. The method of claim 1 wherein the encapsulating material is a semi-solid comprising water and a thixotropic material added to the water.

4. The method of claim 1 wherein the encapsulating material is a viscous material in the form of a gel.

5. The method of claim 2 wherein the cut loop-shaped elements are exposed to heat to remove the water.

6. An improved method for uniformly cutting loop-shaped elements embedded in and upstanding from a foundation material, said improvement comprising encapsulating said elements in a material capable of retaining them in a relatively immovable state, subjecting the encapsulating material surrounding each pair of loop-shaped elements to the action of a fixed line of cutters thereby exposing one leg of each loop-shaped element at selected cross-sections, cutting through the exposed leg section of each loop-shaped element by means of the continuing action of said cutters while the loop-shaped elements remain fixed in said encapsulating material, and removing said encapsulating material from the cut loop-shaped elements.

7. The method of claim 6 wherein each cutter is a rotary cutter which cuts through the exposed section of two loop-shaped elements simultaneously.

8. The method of claim 6 characterized by cutting away a segment of one leg of each loop-shaped element.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,732,604 Dated May 15, 1973
Inventor(s) George H. Erb

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

PAGE 2 of 2

7. In column 3, lines 17 through 19

"comes even more brittle when cold and becomes "notch-sensitive" when stretched, i.e., able to be severed very easily."

should read

-- comes brittle when cold and becomes even more "notch-sensitive" when stretched, i.e., able to be severed very easily.--

8. In column 4, line 3, the word "materials" should read -- material --.

9. In column 4, line 49, the word "be" should be changed to read -- by --.

Signed and sealed this 25th day of December 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,732,604 Dated May 15, 1973
Inventor(s) George H. Erb

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

PAGE 1 of 2

1. Add FIGS. 6 and 7 as is shown on the attached sheet of drawings.
2. In column 1, line 23, "case" should be changed to read -- ease --.
3. In column 1, line 37, "of type" should be changed to read -- of the type --.
4. In column 2, line 25, before the word "replace" and after the word "is", the word -- to -- should be inserted.
5. In column 2, line 31, before the word "loop" and after the word "for", the words -- hook and -- should be inserted.
6. In column 3, line 4, the word "semi-soild" should be correctly spelled -- semi-solid --.

FIG. 6

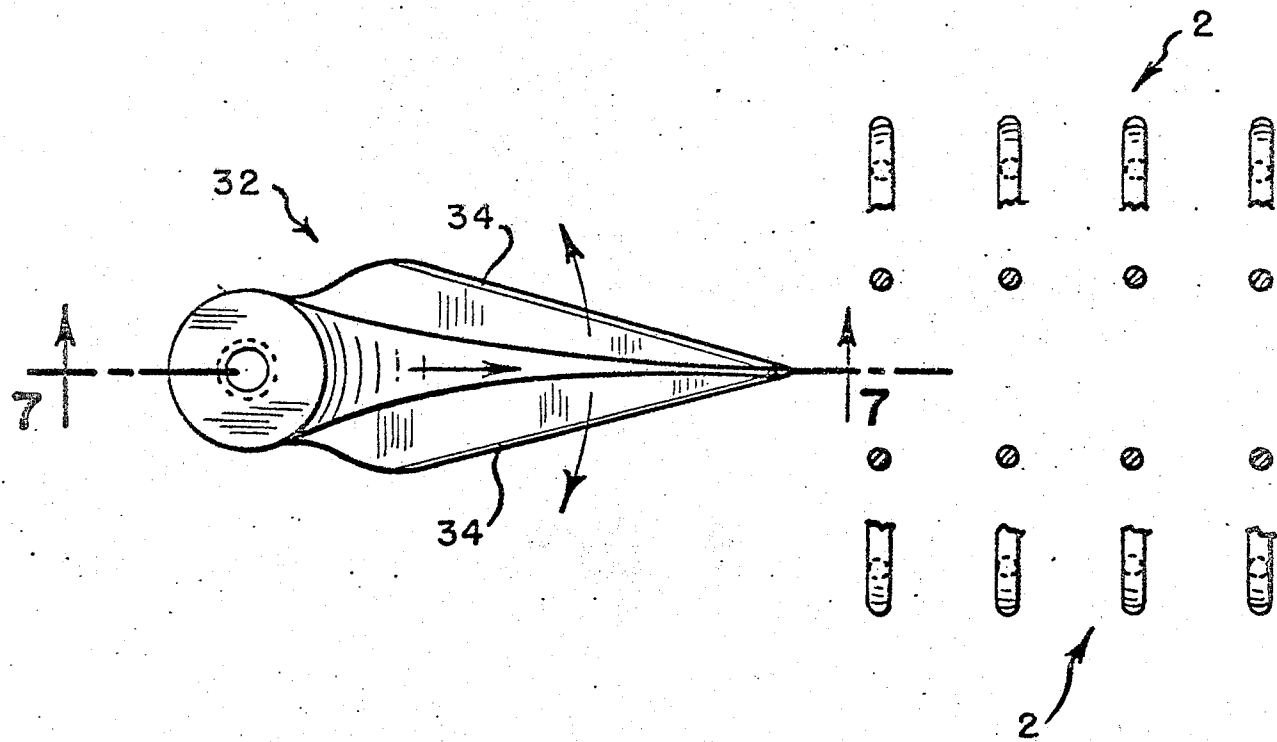


FIG. 7

