

[54] **TURF-LIKE PRODUCT AND METHOD  
OF MAKING IT**

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161/64, 161/67  
[51] Int. Cl.:.....**D04h 11/00, A46d 1/00**  
[58] Field of Search .....**161/62, 63, 64, 67; 156/72**

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[57] **ABSTRACT**

A product having a turf-like appearance and useful as a playing field surface for football, baseball, or other games can be made in a wide variety of blade patterns and textures by (a) providing a liquid layer of polymeric matrix material (e.g., a foamable polyurethane composition) which can be solidified in situ to a desired degree of resilience and toughness; (b) providing a number of flexible polymeric ribbons; (c) making numerous width-wise cuts in one edge of each ribbon so as to form numerous blades (grass-blade-like elements) which are fastened together at their base; (d) forming a composite structure in which the ribbons are closely-spaced and in embedded relation with the liquid matrix layer whereby each ribbon has its length parallel with the matrix layer, its width perpendicular thereto, its blades upstanding therefrom, and a lower portion embedded therein; and (e) causing the matrix layer to solidify in situ.

**11 Claims, 4 Drawing Figures**

**FIG. 1**

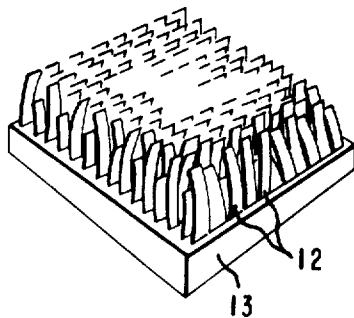


**FIG. 2**

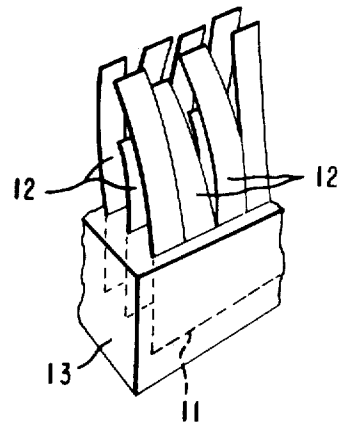


**FIG. 3**

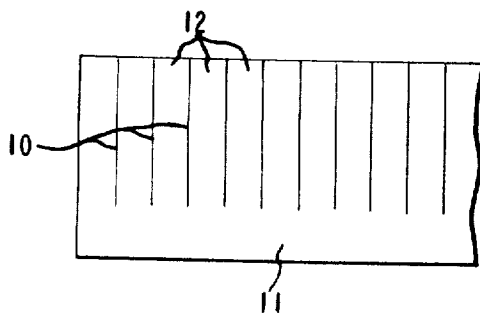
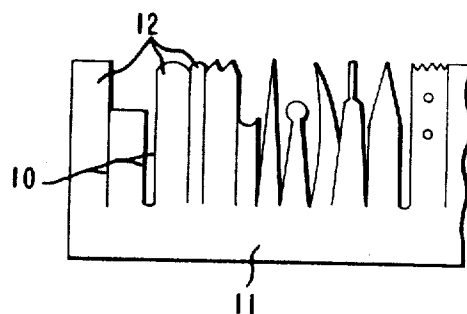


**FIG. 4**



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## TURF-LIKE PRODUCT AND METHOD OF MAKING IT

## BACKGROUND OF THE INVENTION

This invention relates to a product having a turf-like appearance; it also concerns a process for manufacturing such a product.

There is a growing demand for man-made products having a turf-like appearance and useful as a playing field surface. A natural turf playing field for football, baseball, or other games is difficult and costly to keep in useful and attractive condition, especially when subjected to bad weather conditions, or insect attacks, or when the field gets very frequent or severe use. The many drawbacks of using a turf that is in poor condition are well known in the art. It is also known that a field can have a quality of natural turf that is not unduly objectionable from the standpoint of the players, but the overall appearance of the turf as viewed by the audience leaves much to be desired. When a game is to be watched by a large television audience or by a large crowd in the stands, it is obviously desirable to have a playing field that is not only useful for the players but also attractive to the audience.

## SUMMARY OF THE INVENTION

Expressed broadly, the present invention provides a process for preparing a product having a turf-like appearance which comprises

- providing a liquid layer of polymeric matrix material which is capable of being solidified in situ,
- providing a number of flexible polymeric ribbons,
- forming one edge of each of said ribbons into numerous closely-spaced grass-blade-like elements which are fastened together at their base by providing numerous width-wise cuts of predetermined length along said edge and leaving a portion of the ribbon uncut at the base of said elements,
- placing said ribbons in closely-spaced relation with each other and in embedded relation with said liquid matrix layer so that each of said ribbons has its length substantially parallel with the matrix layer, its width substantially perpendicular to the matrix layer, its grass-blade-like elements upstanding from the matrix layer, and a lower portion embedded in the matrix layer, and
- causing the matrix layer to solidify in situ.

The invention also provides a product having a turf-like appearance and comprised of

- an in situ solidified matrix layer of polymeric material and
- numerous closely-spaced flexible polymeric blade-containing ribbons in embedded attachment with (A) and providing the upper surface of the product with a lawn-like appearance, each of said ribbons
  - having its length substantially parallel with (A) and its width substantially perpendicular to (A),
  - having as an uppermost portion numerous closely-spaced grass-blade-like elements upstanding from (A) and fastened together at their base, and
  - having a lower portion in embedded attachment with (A).

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention is illustrated in the attached drawings wherein:

FIG. 1 shows a perspective view of a sample of the turf-like product made by embedding the lower uncut portion of ribbons of the type shown in FIG. 3 in a layer of polymeric matrix material.

FIG. 2 shows an enlarged fragmentary perspective view of a sample of the product whose structure is similar to that shown in FIG. 1.

FIG. 3 shows a side view of a polymeric ribbon resting on its lower edge and having an upper portion which has been formed into numerous grass-blade-like elements.

FIG. 4 shows a similar view of a ribbon having blades of various size and shape.

## DESCRIPTION OF PREFERRED EMBODIMENTS

In Step (a) of the novel process as described above, there is provided a liquid layer of polymeric matrix material which is capable of being solidified in situ. This liquid matrix layer can be formed first as a separate component followed by insertion therein of the properly positioned ribbon components; or an assembly of the properly positioned ribbons (as required in Step d) and can be fastened in place above a suitable casting surface or mold followed by allowing the liquid matrix material to flow onto the casting surface and between the lower portions of the ribbons to be embedded therein. Either method can be carried out as a continuous process or as a batch process.

The matrix material used in Step (a) can be any known liquid polymeric composition which is capable of being solidified in situ to form a solidified matrix layer having the properties needed according to particular use intended for the product. A matrix material is used which does not undergo any harmful reaction with the ribbon components during Steps (d) and (e), and which is low enough in viscosity to undergo a suitable rate of flow into the spaces between the ribbons.

A liquid matrix composition can be converted in Step (e) of the process to a solidified matrix layer by any one of such known methods as evaporating the organic solvent of a polymer solution, drying a polymer latex, heating a plastisol or organosol, allowing a composition to cure or cross-link, for example with the aid of heat or an accelerator compound, or by combining two or more methods known to be useful for solidifying a layer of liquid polymeric composition. When a cellular matrix layer is desired, one can employ known foaming agents or other means known to be useful for preparing cellular sheets from liquid polymeric compositions.

In some of the most useful embodiments of the invention, the solidified matrix layer of the product (component A) is a flexible and resilient sheet of "nonfibrous" polymeric material; this means that the polymeric material does not have a predominantly fibrous structure as in the case of a fabric or paper, although it can contain a fibrous filler or reinforcement, and it can have a reinforcing fabric or any other useful material in attached or embedded relation with it.

Component (A) preferably has a thickness of about 0.2-1.5 inches in many applications of the product. It is also often preferred that the polymeric material of component (A) be an elastomer. The polymeric material can be noncellular or cellular, the cells being either open or closed. A closed-cell elastomer foam is preferred in some applications.

Component (A) can be a composite matrix made up of a plurality of polymeric layers of the same composition or different compositions. In some cases it is beneficial to have an upper portion of the matrix which differs from the lower portion in certain properties, for example in resilience, toughness, porosity, or resistance to degradation by sunlight.

One skilled in the art, in view of the present disclosure, will be able to select suitable polymeric materials for the preparation of matrix component (A) and ribbon component (B) according to the properties needed and the conditions under which the product is to be used. Among the most useful polymers for both components are polyurethane elastomers, neoprene, ethylene/propylene/diene elastomers, chlorosulfonated polyethylene, butadiene/styrene elastomers, natural rubber, polyamides, polypropylene, and plasticized polyvinylchloride and the like. The polymeric material used to form either component can contain one or more of such known additives as pore-forming agents, coloring agents, curing agents, fillers, fireproofing agents, inhibitors, fungicides, and plasticizers.

The invention makes it easy to construct synthetic turfs from elastomeric materials which provide good resistance of the blades and matrix to undue stiffness or brittleness at low temperatures plus good weather resistance, fire resistance, skid resistance, impact resistance, ball-bounce properties, and ability to retain a turf-like structure after prolonged and re-

peated use. The resilient and skid resistant embodiments of the product tend to reduce the frequency of player injuries.

In Step (b), flexible polymeric ribbons are provided which have the desired dimensions, toughness, weather resistance and other properties according to the intended use of the turf-like product. Also, of course, the ribbons (component B of the product) are made of a material which will not undergo any harmful reaction with the matrix material either during or after Steps (d) and (e). The use of a single ribbon as component (B) is also within the spirit of the invention since there is still obtained a product having numerous closely-spaced ribbon components along its surface when a single ribbon is used in Step (d) by such procedures as by wrapping the ribbon back and forth over a series of holding pins fastened outside the matrix area or by mounting the ribbon spirally in a suitable holding means fastened above the area to be filled with the matrix.

A ribbon thickness of about 0.005–0.1 inch is preferred in many applications of the product, with special preference for a thickness of about 0.010–0.05 inch. A ribbon width of about 0.3–2.0 inches is also usually preferred. In some embodiments, the ribbon thickness, width, stiffness, color, or other characteristics vary from one ribbon member to another, or from one portion to another portion of the same ribbon. For example, a ribbon can be used whose thickness gradually decreases from the lower edge to the top; or a bead or groove can be provided near the lower edge to enhance the strength with which the ribbon is attached to the solidified matrix. Also useful are ribbons made up of two or more layers of similar or different materials; for example, the layers can have different shrinkage properties, causing the blades of the product to curl; or the ribbon can be composed of a polymer-coated fabric.

In Step (c) of the process (see FIG. 3 of the drawings), numerous width-wise cuts 10 of predetermined length are made in the ribbon along its upper edge so that numerous grass-blade-like elements (blades 12) are formed which are fastened together at their base, the cuts terminating in an uncut portion 11 of the ribbon. A blade length of about 0.2–1.5 inches is usually preferred. The blades can be uniform or nonuniform in height, width, thickness, shape, color, or other characteristics. In the modification of FIG. 3 shown in FIG. 4 of the drawings there is an illustration of blades 12 of various size and shape formed by cuts 10 which terminate at base portion 11; all or part of the blades in all or part of the ribbons in a given product can have any one of these designs or any other design considered suitable.

By having the blades vary in any particular appearance characteristic along the length or width of the product, it is possible to enhance the attractiveness or the random appearance of the product. The blade-forming cuts can be made rapidly and economically by using cutting machines and techniques well known in the art of cutting predetermined shapes in various kinds of ribbons, tapes, and the like. In one machine, an oscillating cutting blade strikes the ribbon as it rests on an anvil while the ribbon is moved along like in a sewing machine. The Step (c) cutting operation can be completed prior to Step (d); or incomplete cuts can be made prior to Step (d) which are easily broken open after Step (e), for example, by means of wire buffing wheels. Also, Step (c) can be carried out after Step (e) by subjecting the surface of the composite structure to suitable cutting means such as cutting wheels or sharp knives.

Step (d) brings about the formation of a composite structure wherein the ribbons are in closely-spaced relation with each other and in embedded relation with the matrix layer; each ribbon member has its length (e.g., its bottom edge) completely or almost completely parallel with the matrix layer, its width completely or approximately perpendicular to the matrix layer, its blades (if cut already) upstanding from the matrix layer, and a lower portion embedded in the matrix layer. As is true with natural turf, all or part of the blades in some embodiments of the product are not straight or perpendicular to the matrix. And in some embodiments only the

lower portion of the blades extend upward from the matrix. A narrow space separates adjacent ribbon components; this space can be extremely narrow when the liquid matrix material has a relatively low viscosity under the conditions used in Step (d). Heat, vibrating means, or pressure changes can be employed to enhance the flow of matrix material.

It is a preferred embodiment of the invention to form the composite structure so that the ribbons are completely or almost completely parallel with each other. It is also preferred that the space between adjacent ribbons be about 0.05–0.5 inch; the space can be uniform or it can vary enough to enhance the random appearance of the product.

Before the properly oriented ribbons and liquid matrix material are allowed to come in contact with each other, the ribbons can be clamped together in a suitable clamping device with a removable spacer strip, for example a tape of polytetrafluoroethylene or polypropylene, interposed between the upper portion of adjacent ribbons. The above-mentioned variation in space between adjacent ribbons will result by using a predetermined variation in the thickness of spacer strips.

Synthetic turf products are obtainable according to the present invention having an attractive and durable lawn-like appearance and having beneficial utility as a surface material for areas on which sports events such as ball games or other activities are performed. The product can be made in any one of numerous predetermined patterns and textures, and degrees of resilience or toughness or other characteristics. The present process is also useful for the manufacture of such products as buffing wheels, carpets for use outside or inside, and surfaces for golf-practicing areas in which different areas have different predetermined ball-slowing characteristics.

The example which follows is given for the purpose of illustrating the invention. All quantities shown are on a weight basis unless otherwise indicated.

An attractive and durable product having a turf-like appearance and useful in many applications where natural turf is used is prepared as follows:

Two different batches of ribbons are prepared. First, a number of flexible polymeric ribbons are prepared having the appearance shown in FIG. 3 of the drawings. The ribbons are made of a tough weather-resistant elastomer material (described below) having a grass-like green color; they have a thickness of 15 mils (0.015 inch), a width of 1¼ inch, and a length of 12 inches.

Using a cutting apparatus equipped with a series of knife-like cutting dies, numerous width-wise cuts 10 are made in each ribbon along its upper edge so that numerous grass-blade-like elements or blades 12 are formed which are fastened together at their base. The cuts terminate in the uncut portion 11 of the ribbon. Each cut is three-fourths inch long and the cuts are one-eighth inch apart; so blades 12 have a length of three-fourths inch and a width of one-eighth inch, and base portion 11 is one-half inch wide (distance from the lower end of cuts 10 to the lower edge of the ribbon).

In preparing the ribbons, the elastomer material is made by mixing the ingredients of Formula 1.1 below. Ingredients 1–9 are added in the order shown to a water-cooled Model No. OOC Banbury Mixer and mixed at a speed of 85 rpm until the temperature in the mixer reaches 177° C. The resulting mixture is placed on a two-roll rubber mill, and ingredients 10–13 are added gradually in the order shown while operating the mill at a low enough temperature so that the temperature of the hot mixture stays a little below 180° C.

#### FORMULA 1.1

| Ing. No.                        | Parts |
|---------------------------------|-------|
| 1 Terpolymer 64/32/4            | 930   |
| 2 Terpolymer 72/24.5/3.5        | 248   |
| 3 Chlorosulfonated polyethylene | 62    |
| 4 Stearic acid                  | 12.4  |
| 5 Zinc oxide                    | 62    |

|                                     |      |
|-------------------------------------|------|
| 6 Silica                            | 1240 |
| 7 Oil                               | 37.2 |
| 8 Polyethylene                      | 248  |
| 9 Green pigment                     | 37.2 |
| 10 2-mercaptobenzothiazyl disulfide | 12.4 |
| 11 Tetramethylthiuram disulfide     | 8.68 |
| 12 Zinc di-n-butyl dithiocarbamate  | 24.8 |
| 13 Sulfur                           | 24.8 |

The numbered ingredients of Formula 1.1 are further described as follows: No. 1 is an elastomer terpolymer of 64 percent ethylene, 32 percent propylene, and 4 percent 1,4-hexadiene; Mooney viscosity (ML 1 + 4/121° C.) of 60. No. 2 is an elastomer terpolymer of 72 percent ethylene, 24.5 percent propylene, and 3.5 percent 1,4-hexadiene; Mooney viscosity (ML 1 + 10/121° C.) of 60. No. 3 has a chlorine content of 35 percent and a sulfur content of 1 percent; made from high-density polyethylene. No. 6 is "Silene" D from Pittsburgh Plate Glass Co., understood to be a medium reinforcing hydrated silica pigment. No. 7 is "Sunpar" 150 from Sun Oil Co., understood to be a nonstaining paraffinic oil; Sayboldt Universal Viscosity of 508 at 38° C. and of 64.3 at 99° C. No. 8 is a high-pressure type branched polyethylene; melt index of 22, density of 0.925. No. 9 is a pigment known as CI 74,260, Pigment Green 7 ("Color Index," second edition, Vol. 3). No. 13 is sulfur grade 1030 Tube from Stauffer Chemical Co.

After the composition is thoroughly mixed, the preparation of the ribbons is completed by (1) removing the composition from the mill in the form of a sheet material; (2) transferring the sheet material while still hot to a 3-roll calender whose rolls are initially at about 22° C. and calendering the hot elastomer material so that it is rapidly made into a 15 mil thick film; (3) winding the film with a cotton duck interlayer to form a roll, the roll being a cylinder which, when placed so that its axis is vertical, has a flat spiral top and bottom and a vertical side containing the outer ends of wound material; (4) sealing the roll by applying adhesive tape over said outer ends and using tape to fasten a canvas cover over said spiral top and bottom; (5) curing the roll of elastomer film in steam at 150° C. and 60 psi for 2 hours; (6) cooling the cured film to room temperature and cutting it into 1½ inch wide ribbons; and (7) cutting the ribbons as described above to provide ribbons of suitable length containing blades 12.

The cured and cooled film obtained in step (6) has the following properties:

|                                 |     |
|---------------------------------|-----|
| Hardness                        | 60  |
| Tensile strength at break, psi  | 970 |
| Modulus at 100% elongation, psi | 550 |
| Elongation at break, %          | 270 |

The harness (Shore Durometer A) is tested by ASTM Method D-2240-68. The modulus, tensile, and elongation values are obtained at room temperature by ASTM Method D-412-68.

The cured film is cut into 1½ inch wide ribbons; then the ribbons are cut as described above to provide ribbons of suitable length containing blades 12.

Next, in preparing the second batch of ribbons, a number of narrower ribbons are prepared by repeating the procedure described above except the cured film is cut into ¾ inch wide ribbons, and the ribbons are cut so that the blades 12 are three-eighths inch long and the base portion 11 is one-half inch wide.

Enough of the ribbons from the resulting two batches and 12 inch long spacer strips of polytetrafluoroethylene tape having a ¼ inch width and a ¼ inch thickness are used to form a 12 inch square assembly in a clamping device wherein the sequence of layers clamped together is (1) a ribbon from the first batch, (2) a spacer strip, (3) a ribbon from the second batch, and (4) a spacer strip. Any known type of clamp can be used which is capable of holding the layers together in the manner described. The spacer strips are interposed between the upper (blade) portion of the ribbons. The ribbon assembly is mounted in a mold into which the matrix layer will be cast.

The mold has the general shape of a box whose inside measures about 12 inches square by three-fourths inch deep. The lower edge of each of the ribbons is one-eighths inch above the bottom of the mold. The general appearance of the ribbon assembly can be visualized by turning FIG. 1 upside down and imagining that it is the uncut base of the ribbons instead of the blades which project downward.

A foamable liquid polyurethane matrix composition capable of being solidified in situ to a closed-cell cellular elastomer structure having a dirty brown color similar to that of good top soil is prepared by mixing the ingredients of Formula 1.2 shown below. Ingredients 1-5 are mixed together first; then the resulting mixture is mixed with ingredient 6 at 22° C.

#### FORMULA 1.2

| Ing. No. |                            | Parts |
|----------|----------------------------|-------|
| 20       | 1 Triol                    | 100   |
|          | 2 Diamine                  | 0.6   |
|          | 3 Water                    | 2     |
|          | 4 Diphenyl methane mixture | 5     |
| 25       | 5 Brown pigment            | 2     |
|          | 6 Diisocyanate             | 34    |

The numbered ingredients of Formula 1.2 are further described as follows: No. 1 is Product C.P. 4701 from Dow Chemical Co., understood to be a long chain polyether triol. No. 2 is "Dabco" from Air Products and Chemical Corp., understood to be a 33 percent solution of triethylenediamine in a nonvolatile diol solvent. No. 4 is a mixture of 95 percent methylene-bis-o-chloraniline and 5 percent 3-chloro-4,4'-diaminodiphenylmethane. No. 5 is a pigment shown in the "Color Index" as CI 77499, Pigment Brown 7. No. 6 is an undistilled mixture of 80 percent 2,4-toluene diisocyanate and 20 percent 2,6-toluene diisocyanate, the total isocyanate content being 43 percent.

The matrix composition is poured into the mold to a depth sufficient to provide a ½ inch thick matrix layer after it is foamed and solidified. The matrix material flows quickly into the space beneath and between the lower portions of the ribbons. Then the liquid matrix layer is exposed to air at 23° C. until it has foamed and solidified. Finally, the mold, clamping device, and spacer strips are removed from the resulting synthetic turf product. If desired, the matrix layer can be prepared so as to contain a filler or fabric made of any suitable organic or inorganic material.

There has thus been formed a product having a composite structure as shown in FIG. 1 wherein the ribbons are in closely-spaced relation with each other (one-eighth inch between the rows of blades 12 as measured at the top of the matrix layer) and in embedded strongly attached relation with the flexible and resilient matrix layer 13; each ribbon has its length (see the lower edge of base 11 in FIG. 2) parallel with the matrix layer, its width (see base 11 and blades 12 in FIG. 2) about perpendicular to the matrix layer, its blades 12 upstanding from the matrix layer, and its lower portion 11 embedded in the matrix layer.

The product is useful as a playing field surface for various kinds of ball games and the like. The product can be made in any length or width by making obvious modifications in the process described above, for example, with respect to the length of ribbons and spacer strips, the number of ribbons in the ribbon assembly, and the size of the mold and clamps. Also a plurality of pieces of the product can be fastened together by any suitable known fastening means (e.g., by stitching and/or by using an adhesive), for example when covering a football field or other large area.

I claim:

1. A process for preparing a product having a turf-like appearance which comprises

- a. providing a liquid layer of polymeric matrix material which is capable of being solidified in situ,
  - b. providing a number of flexible polymeric ribbons,
  - c. forming one edge of each of said ribbons into numerous closely-spaced grass-blade-like elements which are fastened together at their base by providing numerous width-wise cuts of predetermined length along said edge and leaving a portion of the ribbons uncut at the base of said elements,
  - d. placing said ribbons in closely-spaced relation with each other and in embedded relation with said liquid matrix layer so that each of said ribbons has its length substantially parallel with the matrix layer, its width substantially perpendicular to the matrix layer, its grass-blade-like elements upstanding from the matrix layer, and a lower portion embedded in the matrix layer, and
  - e. causing the matrix layer to solidify in situ.
2. A product having a turf-like appearance and comprised of
- A. an in situ solidified matrix layer of polymeric material and
  - B. numerous closely-spaced flexible polymeric blade-containing ribbons in embedded attachment with (A) and providing the upper surface of the product with a lawn-like appearance, each of said ribbons
    1. having its length substantially parallel with (A) and its width substantially perpendicular to (A),
    2. having as an uppermost portion numerous closely-spaced grass-blade like elements upstanding from (A)

- and fastened together at their base as the result of providing numerous width-wise cuts of predetermined length along one edge of the ribbons and leaving a portion of the ribbons uncut at the base of the elements, and
3. having the lower base portion in embedded attachment with (A).
  3. A product according to claim 2 wherein component (A) is a flexible and resilient sheet of nonfibrous polymeric material.
  4. A product according to claim 2 wherein component (A) has a thickness of about 0.2–1.5 inches.
  5. A product according to claim 3 wherein the polymeric material of component (A) is an elastomer.
  6. A product according to claim 5 wherein said elastomer has a cellular structure.
  7. A product according to claim 2 wherein said ribbons have a thickness of about 0.005–0.1 inch.
  8. A product according to claim 7 wherein said ribbons have a thickness of about 0.010–0.050 inch.
  9. A product according to claim 2 wherein said ribbons have a width of about 0.3–2.0 inches.
  10. A product according to claim 9 wherein said grass-blade-like elements have a length of about 0.2–1.5 inches.
  11. A product according to claim 2 wherein said ribbons are substantially parallel with each other and the space between adjacent ribbons is about 0.05–0.5 inch.

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