Dec. 29, 1970 E. P. CARTER ET AL 3,551,263

CUT PILE TYPE SYNTHETIC TURF SIMULATING GRASS

Filed Jan. 24, 1968

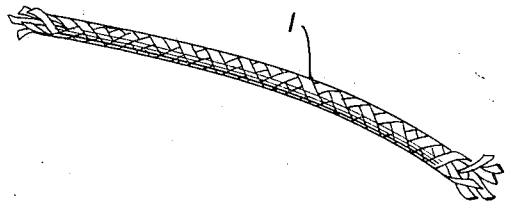

FIG. 1.

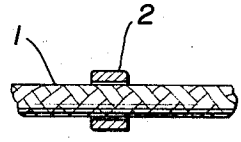

FIG. 2.

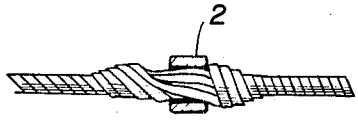

FIG. 3.

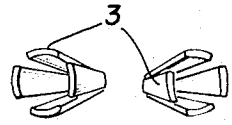

FIG. 4.

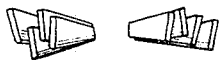

FIG. 5.

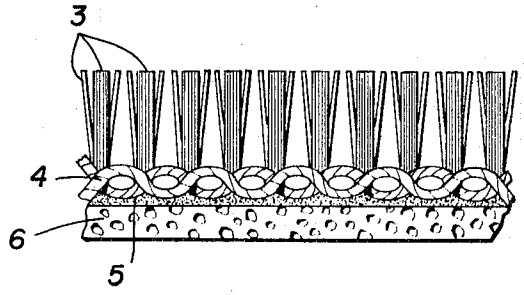

FIG. 6.

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CUT PILE TYPE SYNTHETIC TURF SIMULATING GRASS

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Int. Cl. A41g 1/00
U.S. Cl. 161—21 21 Claims

ABSTRACT OF THE DISCLOSURE

Synthetic grass products of improved quality are produced by conventional tufting of braided ribbons characterized by substantially rectangular cross sections, by conventional carpet weaving or knitting techniques, or by otherwise securing braided ribbons to a backing.

BACKGROUND OF THE INVENTION

This invention relates to an improved synthetic turf which simulates grass. More particularly, this invention relates to a grass-like turf useful both indoors and outdoors for a variety of recreational and sports activities.

Recent developments in the art of producing synthetic turf have included the discovery that a surface cover or turf consisting of a weather-resistant backing and relatively heavy denier cut pile ribbons, having substantially rectangular cross sections, secured therein with a suitable latex, closely simulates grass and is not adversely affected by exposure to all types of weather conditions and abusive wear. It was found that such turfs retain their grass-like appearance remarkably well for long periods of continued use as a cover for playgrounds. Many of the performance characteristics of such monofilament turf are comparable with those possessed by natural turf.

These flat-filament turfs were produced for the most part by conventional weaving, knitting or tufting operations employing either a single ribbon or a yarn of twisted ribbons.

Difficulties were encountered in tufting the twisted ribbon yarn. Ribbons having cross sections substantially rectangular in shape, when twisted into yarn, were unorganized and had a tendency to knot and tangle in the guide bars and needles of conventional tufting machines. Moreover, it was found that the filaments tend to line up or stack on each side of the needle during the tufting process, thereby creating in the tuft, a lined or stacked appearance in the relationship of individual fibers one to another.

It has also been found that even where the above described difficulties in using flat filament ribbons in conventional tufting machines are not involved, as where the product is produced by conventional carpet weaving or knitting techniques, or where the ribbons are secured in any other manner to the backing, the use of the braided ribbons provides a more uniform filament emergence pattern from the backing than where twisted flat filaments are employed.

SUMMARY OF THE INVENTION

It is an object of the instant invention to provide in a cut pile type synthetic turf, with filaments having substantially rectangular cross sections, a pile in which the filaments are not lined up or stacked as they emerge together from the backing, but rather open up or bloom generally in a circular manner.

It is a second object of this invention to provide a method for the production of synthetic grass-like turf of superior quality from synthetic filaments having generally rectangular cross sections.

It is still another object of this invention to provide a method of preparation of a yarn consisting of filaments having a substantially rectangular cross section, suitable for conventional cut-pile tufting in the production of synthetic turf.

Briefly, the objects of this invention are accomplished by conventional braiding of from 4 to 8 filaments having substantially rectangular cross sections, preferably characterized by widths of at least three times greater than their thickness, into a yarn, and by conventional cut-pile tufting, weaving, knitting or otherwise securing said yarn to form a structure consisting of a backing having a suitably latex formulation on the other surface of the where tufting, knitting, or weaving is employed, applying a suitably latex formulation on the othe rsurface of the backing to render the complete structure dimensionally stable. A polymeric elastomer may then be applied to the latex backing to provide a more stable and improved structure.

Other objects and advantages of the invention will be apparent from the detailed specification and the following drawing in which,

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a braided yarn suitable for use in accordance with the instant invention;

FIG. 2 is a section through the eye of a conventional tufting needle showing a braided yarn as in FIG. 1 therein;

FIG. 3 is a cross section of a conventional tufting needle with twisted yarn passing through the needle eye;

FIG. 4 is a schematic perspective view from overhead of the emergence of the free individual filaments from the braided construction which remains intact in and adjacent to the backing;

FIG. 5 is a schematic perspective view from overhead of the emergence of a twisted yarn as shown in FIG. 3; and

FIG. 6 is a cross sectional view of a synthetic turf produced by conventional methods using the braided yarn shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The grass-like pile or face material of this invention normally consists of extruded monofilaments of from about 200 to 1200 denier, and preferably of from about 300 to 500 denier, the denier decreasing as the number of braided filaments is increased from a minimum of about 4 to a practical maximum of about 8. As the number of filaments per tuft is increased, and the denier of the filament is decreased, the characteristics of the turf will vary from that of a coarser grass to that of a finer grass.

The filaments are extruded from polyamides, polyesters, and polypropylene, but preferably the polyamides which nylon 66, nylon 6, nylon 4, nylon 610, nylon 11 and their filament forming copolymers. The filaments should be generally flat and ribbon-like to simulate natural grass and possess suitable bending properties. If preferred, the filament surfaces may be delustered to reduce the sheen produced by the flat surfaces of the ribbons. One means for accomplishing this is to impart to the ribbon longitudinal striations during the extrusion process. Filaments having round, oval, arcuate, or other cross-sectional configurations can be used but are not very suitable primarily because of their stiffness and unwillingness to bend. It has been demonstrated that a ribbon-like filament extruded from a rectangular, slotted orifice dimensioned to produce monofilament ribbon having a thickness of between 0.001 and 0.003 inch, and a width of between 0.01 and 0.20 inch is preferred for the product of this invention since ribbons having these cross-sec-

tional dimensions possess good flexing and bending characteristics which promote its usefulness as a substitute for natural grass turf. If found advantageous, the ribbons may be treated with surfactants or other means for roughing the surface to facilitate fabrication thereof and prevent foot-wear slippage. The ribbon should be drawn and treated to provide the physical properties desired depending upon the polymer composition and the utilization planned for the turf. Preferably, the thermoplastic material is pigmented green to simulate the color of grass, although other colors may be used for special effects. Multifilament single strand ribbons have been utilized, but without success, because the filaments comprising the strands become separated when they are subjected to the conditions as contemplated for the produce of the present invention.

It is known that the addition of certain pigments to thermoplastic materials such as nylon and polyester may increase its resistance to degradation by ultraviolet light although many pigments, particularly inorganic materials, tend to accelerate such degradation. We have found that a mixture of about 0.50 percent of a phthalocyanine green and 1.50 percent of a cadmium yellow based on polymer weight provides good color depth and sufficient stabilization against ultraviolet light for most applications.

Phthalocyanine green refers to the well-known chlorinated copper phthalocyanine chelate compounds widely used as colorants; for examples, Monastral Green and Mapaco Green pigments made by E. I. du Pont de Nemours, Pagment Department, Wilmington, Del. Cadmium Lithopone yellow designates the common yellow inorganic pigments consisting principally of cadmium sulfide. The cadmium yellow pigments supplied by the Glidden Company, Baltimore, Md. and by Kentucky Color Company, Louisville, Ky., have proven quite satisfactory.

If desired, the nylon may be further stabilized by the incorporation of any of a number of well known UV absorbers which are compatible with the resin. These include such compounds as the aryl esters of phosphoric acid, the alkaryl phosphinates, zinc phosphates, manganous salts, chromium salts, and copper salts. For optimum weather resistance properties the nylon ribbons should be placed under the minimum tension possible.

The backing material may be formed with fibers prepared from polyesters, polyacrylonitrile, polypropylene and nylon but preferably polyesters and polyacrylonitrile. Formation of the backing may be accomplished by weaving and knitting or any of the known processes for preparing non-wovens, particularly needle punching. The backing fibers are preferably green solution dyed to add color depth to the turf and thus enhance the grass-like appearance thereof where this result is desired; however, white or conventionally dyed fibers of green or other colors may be employed. For turf which will be used outdoors the arcylic fibers are preferred because of their excellent weather-resistant properties. Turfs made for indoor installation are preferably constructed from backing formed from polyester fibers because they possess better strength properties than the acrylic fibers. Of course nylon fibers are stronger than polyester fibers, but the stretch characteristics of nylon fibers make them less desirable for most purposes.

An example of a suitable tufting medium or bocking fabric is a 5 to 10 ounces per yard nylon scrim reinforced needle punched fabric formed from acrylic staple fibers which has been treated with about 1.5 ounces per square yard of an 80/20 mixture of Hycar 1571 Resloom M–80 resin. Hycar 1571 is a water emulsion of butadiene-acrylonitrile copolymer sold by B. F. Goodrich Chemical Co., Cleveland, Ohio, and Resloom M–80 is a melamine-formaldehyde resin sold by Monsanto Co., St. Louis, Mo.

Another backing material suitable for tufting is a nylon scrim reinforced polyurethane foam carpet backing which is marketed under the trademark, Chemback, by the

Chemstrand Co., Division of Monsanto Co. Chemback is comprised of an open-mesh woven nylon scrim coated with foamed polyurethane having a density of approximately 2 lbs. per cubic foot. Chemback is produced in thickness of approximately 0.06 to 0.10 inch and in weights of 3 to 6 ounces per square yard.

Braiding of the filaments may be accomplished on any conventional braiding machine designed to accommodate from 4 to about 8 carriers. The desired flexibility of the braided yarn for conventional tufting makes it preferably that no central filament be included in the braid when it is subjected to tufting.

Any conventional tufting technique may be used with the braided filaments. When tension is applied to the braided yarn by the machine during tufting, all of the ends pull together into a tight yarn which easily passes through the machine elements.

Conventional carpet weaving and knitting techniques may also be used as may any other method of securing the face ribbon to a backing.

After weaving, knitting or tufting the face ribbon with the backing to produce a turf fabric, a solution of latex or the like is applied to the back of the fabric by padding or other acceptable means. The latex provides dimensional stability to the fabric and also serves to anchor the ribbons in the backing material. It must therefore be of a composition which has good adhesion to both the synthetic ribbon and the synthetic backing material. One such latex composition is a dispersion of Lotol 7562, Pyratex, Dow Corning Antiform, and Alcogum.

A typical latex formulation suitable for use in this invention consists of by weight:

	Parts	Percent solids
Lotol 7562	820	52
Pyratex	173	42
D.C. Antifoam	0.25	12
Alcogum	14.5	11.5

Lotol 7562 is a compounded natural rubber latex sold by the Naugatuck Chemical Division of U.S. Rubber, Naugatuck, Conn.; Pyratex is a vinyl pyridene terpolymer also sold by Naugatuck Chemical; Dow Corning Antifoam is a silicone oil sold by Dow Corning, Midland, Mich.; and Alcogum is a sodium polyacrylate viscosity control agent sold by Alco Chemical Corp., Philadephia, Pa.

The Lotol, Pyratex, and Antifoam are combined and agitated to prepare the latex composition. The Alcogum is added to the mixture until the viscosity of the solution is increased to about 2000 cp. on the Brookfield viscometer. Between about 2 and 6 ounces per square yard based on solids of the latex solution is padded or otherwise applied to the backing fabric of the turf. The latex is dried and then cured at about 325° F. for 5 minutes.

After applying and curing the latex, the turf is dimensionally stable and may be employed as a useful product without further treatment. However, it has been found that the wear properties of the turf are enhanced if a resilient foam backing is applied before use. For outdoor applications, a PVC (polyvinylchloride) closed cell foam or solid PVC is preferred because of its excellent strength and well known weather resisting properties. An open cell PVC foam is suitable for indoor uses but generally is not desirable for outdoor installation because of its propensity to absorb large amounts of moisture. However, if the turf is going to be used indoors, other elastomers such as latex foam and polyurethane also may be used with good results.

The foam may be applied by any of the conventional techniques which are well known in the art. Either mechanical, physical, or chemical foaming may be employed, and the foam sheet may be either cast and cured directly on the back of the turf, or cast separately and cemented in place. The foam may be any thickness and density de-

sired, but generally a PVC foam between 1/6 and 3/8 inch thick and having a density of 15 to 55 pounds per cubic foot is preferred. A polyurethane foam of a similar thickness having a density of 1.0 to 4.0 pounds per cubic foot and reinforced with an embedded nylon scrim is also satisfactory. It is noted however that for a preferred embodiment of this invention, a PVC plastisol containing a foam stabilizer is frothed with latex foaming equipment and cast directly upon the turf to form an open cell foam having a thickness of 1/4 inch and a density of about 35 pounds per cubic foot.

Using the above procedures, a synthetic turf is produced with a virtual absence of any lined effect such as is common in most tufted products. A randomness or lack of uniformity of the position of blades as they emerge from the backing is also achieved. Braided yarns of this type of filament not only produce a better coverage of the backing after tufting, but the cut piles open with ease completely without the effect of any setting or kinking resulting from the twist.

Referring now in detail to the drawing, FIG. 1 shows a typically braided yarn of 8 filaments each having a generally rectangular cross section characterized by a width more than 3 times greater than its thickness, which is suitable for conventional tufting, weaving or knitting in accordance with the instant invention and for the production of a synthetic grass of improved quality. FIG. 2 shows filament braid **1** in the eye of tufting needle **2**, and FIG. 3 shows the braid being under some tension as would be encountered during the conventional tufting process. FIG. 4 depicts schematically the emergence arrangement of the free unbraided pile ribbon ends of a tufted braid of 4 filaments **3** from a backing not shown. FIG. 6 shows a cross section of the completed cut pile synthetic turf product showing the emergence of filaments **3** from fiber backing **4**, the pile being anchored securely therein by bonding agent **5**. A polyvinyl chloride foam **6** has been applied on to the backing to improve the physical properties of the turf.

The invention will be more easily understood from the following examples, which are meant to be illustrative but not limited. In these examples, parts and percentages are by weight unless otherwise specified.

EXAMPLE I

Fat monofilament ribbons were produced by the conventional melt extrusion method with standard screw extruder and auxiliaries. The polypropylene polymer identified as "Escon 107," Grade CD 70, was supplied by Enjoy Chemical Company, New York, N.Y. A mixture of 1.4 percent cadmium yellow pigment and 0.6 percent phthalocyanine green pigment was incorporated in the polypropylene at the extruder inlet. The resultant grass-green filaments were 0.030 inch wide by 0.0018 inch thick. These polypropylene filaments were braided into an 8 ply braid which was tufted into a nylon scrim reinforced polyurethane foam tufting medium and sheared to 1/2" pile height. A latex adhesive was applied to the underside of a portion of the fabric and a non-woven rayon-polyolefin scrim was applied to the adhesive to form a secondary backing. Samples were found to have good random orientation of individual filaments, a minimum of lining, as well as excellent durability.

EXAMPLE II

Analogous to the procedure described in Example I, the same type of pigment composition and extrusion system was used to produce grass-green polyethylene terephthalate ribbon monofilaments 0.045 inch wide by 0.0015 inch thick. The polyester polymer was supplied by the Chemical Division of Goodyear Tire & Rubber Company, and was designated VFR 1301–A. A four ply braided yarn of polyester filaments was tufted into a nylon scrim reinforced polyurethane foam tufting medium, and the tufts were cut to 1/2" pile height. A thin layer of adhesive latex was applied to the under side to bond the fabric to a pad of foamed PVC 1/4" thick.

EXAMPLE III

A synthetic nylon turf was produced according to the procedure of Example I using 900 denier nylon filament ribbons approximately 0.002" thick by 0.066" wide which was braided into a 4 ply braid. The facing had a pile height of 5/8".

EXAMPLE IV

A synthetic nylon turf was produced by tufting a 6 ply braid of 500 denier nylon filament ribbons into a backing of 1/8" thick sheet of polyurethane foam which was reinforced by a nylon scrim. The tufts were cut to form a turf with a pile height of 3/8", and the back of the fabric was latexed to firmly anchor the nylon and prevent shedding.

It will be apparent that the product of this invention, with its random circular emergence of individual filaments of a tuft, has a physical appearance amazingly similar to that of natural grass turf, and may conveniently be employed both indoors and outdoors as a substitute for natural grass. The particular materials and their construction are combined to produce a new and novel product which is suitable for soft-shoe sports and cleated or spiked-shoe sports. Performance tests have proved that the synthetic turf of the present invention has ball-bounce characteristics somewhat similar to those of natural-grass turf.

For outdoor installations provisions must be made for adequate drainage of the synthetic turf. Depending upon local topography and type of subsurface, a slight slope may be sufficient to remove water by simple surface flow. In very flat regions one of the more permeable or perforated backing materials is preferred to aid water seepage into the subsoil. Synthetic turf according to the invention is not attacked by mildew or other fungi. Standing water in low areas should be avoided, however, since adventitious nutrient material may accumulate and support fungal growth that produces surface discolorations which are sometimes difficult to remove.

While the invention has been described for general purpose use, it is to be understood that certain modifications which will adapt the synthetic grass to meet the specific requirements demanded for individual circumstances are well within the concepts of this invention described herein and therefore the scope is not to be limited except as set forth in the appended claims.

We claim:

1. A simulated grass-like product comprised of extruded thermoplastic monofilament ribbons having substantially rectangular cross sections, said ribbons extending from and substantially perpendicular to a backing to which said ribbons are secured, from about 4 to about 8 of said ribbons being braided together at a point of emergence from the backing.

2. The product of claim **1** with said ribbons being tufted into said backing.

3. The product of claim **1** with said ribbons being woven into a warp and fill backing.

4. The product of claim **1** with said ribbons being knitted with the fibers of said backing.

5. A simulated grass-like tufted product comprised of extruded thermoplastic monofilament ribbons having substantially rectangular cross sections and having a backing and a cut-pile face of unbraided ribbons, said ribbons being secured in the backing on the side opposite the cut-pile face, from about 4 to about 8 of said ribbons being braided together where secured adjacent to and emerging from said backing.

6. The product of claim **5** having resilient material bonded to the side of the backing having an adhesive applied thereon.

7. The product of claim 5 in which the thermoplastic is nylon.

8. The product of claim 7 in which the nylon contains pigments.

9. The product of claim 5 in which the thermoplastic is polypropylene.

10. The product of claim 9 in which the polypropylene contains pigments.

11. The product of claim 5 in which the thermoplastic is polyethylene terephthalate.

12. The product of claim 5 in which the ribbons have a denier of from 300 to 900.

13. The product of claim 5 in which the braid consists of from about 4 to about 8 of said monofilament ribbons.

14. A simulated grass-like tufted product comprised of extruded thermoplastic monofilament ribbons and having a backing and a cut-pile face, said ribbons having substantially rectangular cross sections and being secured in the backing by an adhesive material applied to the backing on the side opposite the cut pile face, the segment of said ribbons being secured in said backing being braided together, the free ends of said ribbons emerging from said backing as a pile in a generally random bloom fashion.

15. The product of claim 14 having a resilient material bonded to the side of the backing having the adhesive applied thereon.

16. The product of claim 14 in which the thermoplastic is nylon.

17. The product of claim 16 in which the nylon contains pigments.

18. The product of claim 14 in which the thermoplastic is polypropylene.

19. The product of claim 18 in which the polypropylene contains pigments.

20. The product of claim 14 in which the thermoplastic is polyethylene terephthalate.

21. The product of claim 14 in which the ribbons have a denier of from 300 to 900.

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PHILIP DIER, Primary Examiner

U.S. Cl. X.R.

161—67; 156—72; 112—410; 273—176

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,551,263 Dated December 29, 1970

Inventor(s) Ernest P. Carter et al.

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

Column 2, line 13, "a suitably latex formulation on the other surface of the" should read -- a cut pile face extendin from one surface thereof and, --; line 15, "suitably" should read -- suitable --; line 55, after "which" insert -- include Column 3, line 64, "bocking" should read -- backing --. Colum 5, line 1, "1/6" should read -- 1/8 --; line 46, "Fat" should read -- Flat --.

Signed and sealed this 4th day of May 1971.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

WILLIAM E. SCHUYLER,
Commissioner of Pate